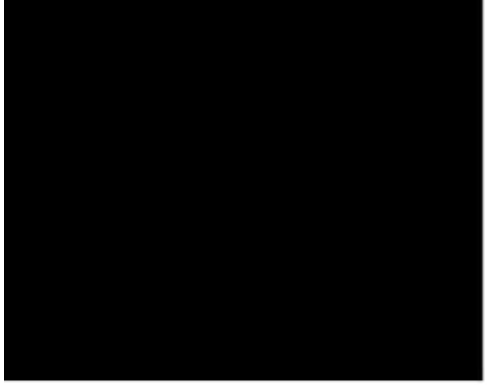

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CONTENTS

CHAPTER 1

NUMBER SYSTEM

NUMBER SYSTEM

A number system relates quantities and symbols. The base or radix of a number system represents the number of digits or basic symbols in that particular number system.

Decimal is a base (or radix) 10 numeral system. This means that the system has ten symbols or numerals to represent any quantity. These symbols are called Digits. The ten symbols are 1, 2, 3, 4, 5, 6, 7, 8, 9 and 0.

Types of Numbers :

Real numbers: Real numbers comprise the full spectrum of numbers. They can take on any form – fractions or whole numbers, decimal points or no decimal points. The full range of real numbers includes decimals that can go on forever and ever without end.

For Example: $8, 6, 2+\sqrt{3}, \frac{3}{5}$ etc.

Natural numbers: A natural number is a number that comes naturally. Natural Numbers are counting numbers from 1, 2, 3, 4, 5, ...

Whole numbers: Whole numbers are just all the natural numbers plus zero.

For Example: 0, 1, 2, 3, 4, 5, and so on upto infinity.

Integers: Integers incorporate all the qualities of whole numbers and their opposites (or additive inverses of the whole numbers). Integers can be described as being positive and negative whole numbers.

For Example: $\ldots -3, -2, -1, 0, 1, 2, 3, \ldots$

Rational numbers: All numbers of the form $\frac{p}{q}$ where p and q are integers ($q \neq 0$) are called Rational numbers.

For Example: $4, \frac{3}{4}, 0, \ldots.$

Irrational numbers: Irrational numbers are the opposite of rational numbers. An irrational number cannot be written as a fraction, and decimal values for irrational numbers never end and do not have a repeating pattern in them. *'pi'* with its never-ending decimal places, is irrational.

For Example: $\sqrt{7}, \sqrt{5}, 2+\sqrt{2}, \pi, \ldots..$

Even numbers: An even number is one that can be divided evenly by two leaving no remainder, such as 2, 4, 6, and 8.

Odd numbers: An odd number is one that does not divide evenly by two, such as 1, 3, 5, and 7.

Prime numbers: A prime number is a number which can be divided only by 1 and itself. The prime number has only two factors, 1 and itself.

For example: 2, 3, 5, 7, 11, 13, 17, ... are prime numbers.

Composite Number: A Composite Number is a number which can be divided into a number of factors other than 1 and itself . Any composite number has additional factors than 1 and itself.

For example: 4, 6, 8, 9, 10 .....

Co-primes or Relatively prime numbers: A pair of numbers not having any common factors other than 1 or –1. (Or alternatively their greatest common factor is 1 or –1)

For Example: 15 and 28 are co-prime, because the factors of 15 (1,3,5,15), and the factors of 28 (1,2,4,7,14,28) are not in common (except for 1).

Twin Primes: A pair of prime numbers that differ by 2 (successive odd numbers that are both Prime numbers).

For Example: (3,5), (5,7), (11,13), ...

Numbers at a glance

Example	Number type
0.45	rational, real
3.1415926535....	irrational, real
3.14159	rational, real
0	whole, integer, rational, real
$\frac{5}{3}$	rational, real
$1\frac{2}{3}=\frac{5}{3}$	rational, real
$\sqrt{2}=1.41421356$	irrational, real
$-\sqrt{81}=-9$	integer, rational, real
-3	rational, real
$\sqrt{25}=5$	natural, whole, integer, rational, real
9/3 = 3	natural, whole, integer, rational, real
–0.75	rational, real
π = 3.1428571…	irrational, real
3.144444.....	rational, real (since it is a repeating decimal)
$\sqrt{-9}$	Imaginary

PLACE VALUE AND FACE VALUE

In decimal number system, the value of a digit depends on its place or position in the number. Each place has a value of 10 times the place to its right.

Place value : Place value is a positional system of notation in which the position of a number with respect to a point determines its value. In the decimal system, the value of the digits is based on the number ten.

Each position in a decimal number has a value that is a power of 10. A decimal point separates the non-negative powers of 10, $(10)^0=1$, $(10)^1=10$, $(10)^2=100$, $(10)^3=1000$, etc.) on the left from the negative powers of 10, $(10)^{-1}=\frac{1}{10}$, $(10)^{-2}=\frac{1}{100}$, $(10)^{-3}=\frac{1}{1000}$, etc.) on the right.

Face value : The face value of a number is the value of the number without regard to where it is in another number. So 4 7 always has a face value of 7. However the place value includes the position of the number in another number. So in the number 4,732, the 7 has a place value of 700, but has a face value of just 7.

***Example*: Place and face values of the digits in the number 495, 784:**

Number	Digit	Place value	Face value
495,784	4	400000	4
	9	90000	9
	5	5000	5
	7	700	7
	8	80	8
	4	4	4

NAMES OF DIGITS ACCORDING TO THEIR PLACE VALUE.

Indian Method	International Method		
Unit	Unit	**1**	**1**
Ten	Ten	**10**	$\mathbf{10^1}$
Hundred	Hundred	**100**	$\mathbf{10^2}$
Thousand	Thousand	**1000**	$\mathbf{10^3}$
Ten thousand	Ten thousand	**10000**	$\mathbf{10^4}$
Lakh	Hundred thousand	**100000**	$\mathbf{10^5}$
Ten lakh	One million	**1000000**	$\mathbf{10^6}$
Crore	Ten million	**10000000**	$\mathbf{10^7}$
Ten crore	Hundred million	**100000000**	$\mathbf{10^8}$
Arab	Billion	**1000000000**	$\mathbf{10^9}$

FRACTIONS

A fraction is known as a rational number and written in the form of $\frac{p}{q}$ where p and q are integers and $q \neq 0$. The lower number 'q' is known as denominator and the upper number 'p' is known as numerator.

Type of Fractions :

Proper Fraction: The fraction in which numerator is less than the denominator is called a proper fraction.

For Example: $\frac{2}{3}, \frac{5}{6}, \frac{10}{11}$ etc.

Improper fraction : The fraction in which numerator is greater than the denominator is called improper fraction.

For Example : $\frac{3}{2}, \frac{6}{5}, \frac{8}{7}$, etc

Mixed fraction : Mixed fraction is a composite of a fraction and a whole number.

For example: $2\frac{1}{2}, 3\frac{3}{4}, 5\frac{6}{7}$ etc.

Complex fraction: A complex fraction is that fraction in which numerator or denominator or both are fractions.

For Example: $\frac{\frac{2}{3}}{4}, \frac{\frac{2}{5}}{\frac{6}{7}}, \frac{\frac{3}{7}}{\frac{5}{6}}$, etc.

Decimal fraction: The fraction whose denominator is 10 or its higher power, is called a decimal fraction.

For Example: $\frac{7}{10}, \frac{11}{100}, \frac{12}{1000}$

Continued fraction: Fractions which contain addition or subtraction of fractions or a series of fractions generally in denominator (sometimes in numerator also) are called continued fractions.

These are It is also defined as fractions whose numerator is an integer and whose denominator is an integer plus a fraction.

For Example: $2 - \cfrac{\frac{2}{2}}{2 + \frac{3}{4}}$

Comparison of Fractions :

- **If the denominators of all the given fractions are equal then the fraction with greater numerator will be the greater fraction.**

  For Example: $\frac{4}{7}, \frac{2}{7}, \frac{8}{7}, \frac{9}{7}$

  then, $\frac{9}{7} > \frac{8}{7} > \frac{4}{7} > \frac{2}{7}$

- **If the numerators of all the given fractions are equal then the fraction with smaller denominator will be greater fraction.**

  For Example: $\frac{7}{4}, \frac{7}{2}, \frac{7}{8}, \frac{7}{9}$ then, $\frac{7}{2} > \frac{7}{4} > \frac{7}{8} > \frac{7}{9}$

- **When numerator is greater than denominator and the differences of numerator and denominator are equal, then the fraction with smaller numerator will be the greater faction.**

  For Example: $\frac{5}{2}, \frac{7}{4}, \frac{11}{8}, \frac{8}{5}$

  then, $\frac{5}{2} > \frac{7}{4} > \frac{8}{5} > \frac{11}{8}$

Quicker Method (Cross Multiplication) :

This is a shortcut method to compare fractions. Using this method we can compare all types of fractions.

$$\frac{5}{9} \; ? \; \frac{4}{7}$$

$5 \times 7 = 35$ $\qquad$ $9 \times 4 = 36$

The fraction whose numerator is in the greater product is greater.

Since 36 is greater than 35, hence, $\frac{4}{7} > \frac{5}{9}$

LCM AND HCF

Factors and Multiples : If a number x divides another number y exactly, we say that x is a factor of y. Also y is called a multiple of x.

Highest Common Factor (HCF) :

The H.C.F. of two or more than two numbers is the greatest number that divides each one of them exactly. There are two methods for determining H.C.F.:

1. **Prime factorization method :** We can determine the H.C.F. of 144, 180 and 108 from following process.

   $144 = \underline{2 \times 2} \times 2 \times 2 \times \underline{3 \times 3}$

   $108 = \underline{2 \times 2} \times \underline{3 \times 3} \times 3$

   $180 = \underline{2 \times 2} \times \underline{3 \times 3} \times 5$

   In prime factoriation of the above mentioned three numbers, the common factorization is $2 \times 2 \times 3 \times 3 = 36$.
   Thus, required H.C.F. of 144, 180 and 108 is 36.

2. **Division Method:** We can determine the H.C.F. of above mentioned numbers from the following process :

   $$144\,)\,180\,(\,1$$
   $$\underline{144}$$
   $$36\,)\,144\,(\,4$$
   $$\underline{144}$$
   $$\times\times\times$$

   Thus, the H.C.F of 144 and 180 is 36.
   Now, we find the H.C.F of 36 and 108.

   $$36\,)\,108\,(\,3$$
   $$\underline{108}$$
   $$\times\times\times$$

   So, required H.C.F is 36.

Lowest Common Multiple (LCM) :

The L.C.M. of two or more than two numbers is the least number which is exactly divisible by each one of the given numbers.

❖ **Formula**: Product of two numbers
= (their H.C.F.) × (their L.C.M.).

We can determine L.C.M. of two given numbers by the following two methods:

1. **Prime Factorization method:** Suppose we have to find the L.C.M. of 12, 16 and 30, then

   $12 = 2 \times 2 \times 3$

   $16 = 2 \times 2 \times 2 \times 2$

   $30 = 2 \times 3 \times 5$

   Thus, required L.C.M. of the given numbers
   $= \underline{2 \times 2 \times 2 \times 2 \times 2} \times \underline{3} \times \underline{5} = 240$

2. **Division method:** We can determine the L.C.M. of above mentioned numbers from the following process :

2	12, 16, 30
2	6, 8, 15
3	3, 4, 15
	1, 4, 5

   Thus, required L.C.M. of the given number
   $= 2 \times 2 \times 3 \times 1 \times 4 \times 5 = 240$

H.C.F. and L.C.M. of Fractions:

❖ H.C.F. of factions $= \dfrac{\text{H.C.F. of Numerators}}{\text{L.C.M. of Denominators}}$

For Example, we have to find the H.C.F. of $\frac{1}{2}$ and $\frac{3}{4}$.

Then, H.C.F. of $\frac{1}{2}$ and $\frac{3}{4} = \dfrac{\text{H.C.F. of 1 and 3}}{\text{L.C.M. of 2 and 4}} = \dfrac{1}{4}$

❖. L.C.M of fractions $= \dfrac{\text{L.C.M. of Numerators}}{\text{H.C.F. Denominators}}$

For Example, we have to find the L.C.M. of $\frac{1}{2}$ and $\frac{3}{4}$.

Then, L.C.M. of $\frac{1}{2}$ and $\frac{3}{4} = \dfrac{\text{L.C.M. of 1 and 3}}{\text{H.C.F. of 2 and 4}} = \dfrac{3}{2}$

Formulae to Remember

❖ The product of two numbers = (HCF of the numbers) × (LCM of the numbers)

❖ Sum of first n natural numbers $= \dfrac{n(n+1)}{2}$

❖ Sum of first n even numbers $= \dfrac{\text{Last even number (last even number + 2)}}{4}$

❖ Sum of first n odd numbers $= \left(\dfrac{\text{last odd number} + 1}{2}\right)^2$

In the sequence, A, A + D, A + 2D, A + 3D .... Nth term = A + (N – 1) D

and sum of N terms $= \dfrac{N}{2}\left[2A + (N-1)D\right]$

Rules of Divisibility

These rules let you test if one number can be evenly divided by another, without having to do too much calculation!

(Divisibility Conditions)		
A number is divisible by	**If**	**Example**
2	The last digit is even (0, 2, 4, 6, 8 …..)	12**8** is 129 is not
3	The sum of the digits is evenly/ completely divisible by 3	381 (3 + 8 + 1 = 12, and 12 ÷ 3 = 4) **Yes**
		217 (2 + 1 + 7 = 10, and 10 ÷ 3 = $3\ ^{1}/_{3}$) **No**
4	The last 2 digits are evenly/ completelydivisible by 4	13**12,** (12 ÷ 4 = 3) is 70**19** is not
5	The last digit is 0 or 5	17**5** is 809 is not
6	The number is evenly / completely divisible by both 2 and 3	114 (it is even and 1 + 1 + 4 = 6 and 6 ÷ 3 = 2) Yes 308 (it is even but 3 + 0 + 8 = 11 and 11 ÷ 3 = $3\frac{2}{3}$) **No**
7	If you double the last digit and subtract it from the rest of the number and the answer is : **0 or divisible by 7** (Note : for bigger numbers you can apply this rule to the answer again if you want)	672 (Double 2 is 4, 67 - 4 = 63, and 63 ÷ 7 = 9) **Yes** 905 (Double 5 is 10 , 90 - 10 = 80, and 80 ÷ 7 = 11 3/7) No
8	The last three digits are divisible by 8	109**816** (816 ÷ 8 = 102) **Yes** 216**302** (302 ÷ 8 = 37 3/4) **No**
9	The sum of the digits is divisible by 9 (Note : for bigger numbers you can apply this rule to the answer again if you want)	1629 (1 + 6 + 2 + 9 = 18, and again, 1 + 8 = 9) **Yes** 2013 (2 + 0 + 1 + 3 = 6) **No**
10	The number ends in 0	22**0** is 221 is not
11	If the difference of the sum of the digits at odd places and the sum of the digits at even places is **0 or divisible by 11**	1**3**6**4** ((3 + 4) – (1 + 6) = **0**) **Yes** 2**5**176 ((5 + 7) – (2 + 1 + 6) = **3**) **No**
12	(i) The number is divisible by 3 and 4 both, or (ii) If you subtract the last digit from twice the rest of the number and the answer is : **0 or divisible by 12** (Note : for bigger numbers this can be applied repeatedly)	648 (6 + 4 + 8 = 18 and 18 ÷ 3 = 6, and 48 ÷ 4 = 12) **Yes** 916 (9 + 1 + 6 = 16, 16 ÷ 3 = $5\frac{1}{3}$) **No**

SOLVED EXAMPLES

EXAMPLE ▶ 1 : If an amount of ₹ 198011 is distributed equally amongst 47 persons, how much amount would each person get ?

(a) ₹4123 (b) ₹4231
(c) ₹4213 (d) ₹4132
(e) None of these

Sol. (c) Sum received by each person $= ₹\left(\frac{198011}{47}\right) = ₹4213$

EXAMPLE ▶ 2 : A company canteen requires 798 bananas per week. Totally how many bananas will it require for the months of January, February and March, 2008 if the number of employees did not change during this period ?

(a) 10480 (b) 10277
(c) 10586 (d) 10374
(e) None of these

Sol. (d) Number of days in the months of January, February and March in 2008

$= 31 + 29 + 31 = 91$ days $= 91 \div 7$ weeks $= 13$ weeks

$\because$ Consumption of bananas in 1 week = 798

$\therefore$ Consumption of bananas in 13 weeks

$= 13 \times 798 = 10374$

EXAMPLE ▶ 3 : The cost of 2 rings and 4 bangles is ₹ 46854. What is the cost of 5 rings and 10 bangles ?

(a) ₹ 115345 (b) ₹ 117135
(c) ₹ 116675 (d) Cannot be determined
(e) None of these

Sol. (b) Let the CP of 1 ring and 1 bangle be ₹ x and ₹ y respectively.

$2x + 4y = 46854$

$\Rightarrow 2.5(2x + 4y) = 2.5 \times 46854$

$\Rightarrow 5x + 10y = ₹117135$

EXAMPLE ▶ 4 : If the sum of four consecutive even numbers is 228, which is the smallest of the numbers ?

(a) 52 (b) 54
(c) 56 (d) 48
(e) None of these

Sol. (b) According to the question,

$x + x + 2 + x + 4 + x + 6 = 228$

$\Rightarrow 4x + 12 = 228$

$\Rightarrow 4x = 228 - 12 = 216$

$\therefore x = \frac{216}{4} = 54$

$\therefore$ The smallest even number = 54

EXAMPLE ▶ 5 : The difference between a two-digit number and the number obtained after interchanging the two digits of the two- digit number is 27. The sum of the two digits of the two-digit number is 15. What is the two-digit number ?

(a) 87 (b) 96
(c) 69 (d) Cannot be determined
(e) None of these

Sol. (d) Let the two digit nubmer be $10x + y$, where x is the first digit and y the second digit.

$\therefore (10x + y) - (10y + x) = 27$

$9x - 9y = 27$

$x - y = 3$ ....(a)

also $x + y = 15$ ....(b)

$\therefore x = 9$ and $y = 6$

$\therefore$ Required number is 96 or 69

EXAMPLE ▶ 6 : Five bells begin to toll together at intervals of 9 seconds, 6 seconds, 4 seconds, 10 seconds and 8 seconds respectively. How many times will they toll together in the span of one hour (excluding the toll at the start)?

(a) 5 (b) 8
(c) 10 (d) Cannot be determined
(e) None of these

Sol. (c)

2	9, 6, 4, 10, 8
2	9, 3, 2, 5, 4
3	9, 3, 1, 5, 2
	3, 1, 1, 5, 2

$\therefore$ LCM $= 2 \times 2 \times 2 \times 3 \times 3 \times 5 = 360$ sec.

$= \frac{1}{10}$ Hour.

The bells will toll together after an interval of $\frac{1}{10}$ hour.

$\therefore$ they will toll together 10 times in $\frac{1}{10}$ hour.

EXAMPLE ▶ 7 : Samantha, Jessica and Roseline begin to jog around a circular stadium. They complete their one lap around the stadium in 84 seconds, 56 seconds and 63 seconds respectively. After how many seconds will they be together at the starting point?

(a) 336 (b) 504
(c) 252 (d) Cannot be determined
(e) None of these

Sol. (b) LCM of 84, 56, 63

2	84, 56, 63,
2	42, 28, 63,
7	21, 14, 63,
3	3, 2 9
	1, 2, 3,

$\therefore 2 \times 2 \times 7 \times 3 \times 2 \times 3 = 504$

Hence, all three persons will be together at the starting point after 504 seconds.

EXAMPLE ▶ 8 : If the fractions $\frac{2}{5}, \frac{3}{8}, \frac{4}{9}, \frac{5}{13}$ and $\frac{6}{11}$ are arranged in ascending order of their values, which one will be the fourth?

(a) $\frac{4}{9}$ **(b)** $\frac{5}{13}$

(c) $\frac{3}{8}$ **(d)** $\frac{2}{5}$

(e) None of these

Sol. (a) $\frac{2}{5} = 0.4, \quad \frac{3}{8} = 0.375,$

$\frac{4}{9} = 0.44, \quad \frac{5}{13} = 0.38,$

$\frac{6}{11} = 0.54$

$\therefore$ Ascending order is

$= \frac{3}{8}, \frac{5}{13}, \frac{2}{5}, \frac{4}{9}, \frac{6}{11}$

So the fourth one will be $\frac{4}{9}$.

EXAMPLE ▶ 9 : Bhuvan has some hens and some cows. If the total number of animal-heads are 71 and the total number of feet are 228, how many hens does Bhuvan have ?

(a) 43 **(b) 32**

(c) 24

(d) Cannot be determined

(e) None of these

Sol. (e) Let Bhuwan have x hens and y cows

According to the question,

$x + y = 71$ ...(i)

$2x + 4y = 228$ ...(ii)

Multiply equation (i) by 4 and subtract equation (ii) from it :

$4x + 4y - 2x - 4y = 284 - 228$

or, $2x = 56$

or, $x = \frac{56}{2} = 28$

$\therefore$ Number of hens = 28

EXAMPLE ▶ 10 : $\frac{1}{4}$th of $\frac{2}{5}$th of a number is 82. What is the number?

(a) 410 **(b) 820**

(c) 420 **(d) 220**

(e) None of these

Sol. (b) Let the number be = x

According to the question,

$x \times \frac{2}{5} \times \frac{1}{4} = 82$

or, $x = \frac{82 \times 5 \times 4}{2} = 820$

EXERCISE

1. What is 456 times 121?
   (a) 56453 (b) 54167
   (c) 55176 (d) 54155
   (e) None of these
2. The product of two consecutive even numbers is 12768. What is the greater number ?
   (a) 110 (b) 108
   (c) 114 (d) 112
   (e) None of these
3. An amount of ₹ 50176 is distributed equally amongst 32 persons. How much amount would each person get?
   (a) ₹1,555 (b) ₹1,478
   (c) ₹1,460 (d) ₹1,568
   (e) None of these
4. If an amount of ₹ 1,72,850 is equally distributed amongst 25 people, how much amount would each person get ?
   (a) ₹8912.50 (b) ₹8642.50
   (c) ₹7130 (d) ₹6914
   (e) None of these
5. The sum of four consecutive even numbers. A, B, C, and D is 180. What is the sum of the set of next four consecutive even numbers ?
   (a) 214 (b) 212
   (c) 196 (d) 204
   (e) None of these
6. What is 786 times 964 ?
   (a) 759276 (b) 749844
   (c) 75416 (d) 757704
   (e) None of these
7. The difference between a two-digit number and the number obtained by interchanging the two digits of the number is 18. The sum of the two digits of the number is 12. What is the product of the two digits of the two digits number ?
   (a) 35 (b) 27
   (c) 32 (d) Cannot be determined
   (e) None of these
8. What is 783 times 869?
   (a) 678689 (b) 678861
   (c) 680427 (d) 681993
   (e) None of these
9. There are 15 dozen candles in a box. If there are 39 such boxes. How many candles are there in all the boxes together?
   (a) 7020 (b) 6660
   (c) 6552 (d) 3510
   (e) None of these
10. Monica, Veronica and Rachael begin to jog around a circular stadium. They complete their one lap in 48 seconds, 64 seconds and 72 seconds respectively. After how many seconds will they be together at the starting point ?
    (a) 336 (b) 252
    (c) 576 (d) Cannot be determined
    (e) None of these
11. The product of two consecutive odd numbers is 19043. Which is the smaller number?
    (a) 137 (b) 131
    (c) 133 (d) 129
    (e) None of these
12. What is 131 times 333 ?
    (a) 46323 (b) 43623
    (c) 43290 (d) 44955
    (e) None of these
13. The product of two successive numbers is 8556. What is the smaller number?
    (a) 89 (b) 94
    (c) 90 (d) 92
    (e) None of these
14. A canteen requires 112 kgs of wheat for one week. How many kgs of wheat will it require for 69 days?
    (a) 1,204kgs (b) 1,401kgs
    (c) 1,104kgs (d) 1,014kgs
    (e) None of these
15. If an amount of Rs 41,910 is distributed equally amongst 22 persons, how much amount would each person get ?
    (a) ₹1905 (b) ₹2000
    (c) ₹745 (d) ₹765
    (e) None of these
16. The product of two consecutive even numbers is 4488. Which is the smaller number?
    (a) 62 (b) 71
    (c) 66 (d) 65
    (e) None of these
17. A canteen requires 21 dozen bananas for one week. How many dozen bananas will it require for 54 days?
    (a) 162 (b) 1944
    (c) 165 (d) 2052
    (e) None of these

18. If an amount of ₹ 72,128 is distributed equally amongst 46 persons how much amount would each person get?
(a) ₹1555 (b) ₹1478
(c) ₹1460 (d) ₹1568
(e) None of these

19. What is 234 times 167 ?
(a) 42768 (b) 41184
(c) 40581 (d) 39078
(e) None of these

20. What is the least number to be added to 1500 to make it a perfect square?
(a) 20 (b) 21
(c) 22 (d) 23
(e) None of these

21. The sum of three consecutive integers is 39. Which of the following is the largest among the three?
(a) 12 (b) 15
(c) 13 (d) 16
(e) None of these

22. How many pieces of 8.6 metres length cloth can be cut out of a length of 455.8 metres cloth?
(a) 43 (b) 48
(c) 55 (d) 53
(e) 62

23. The product of two successive numbers is 3192. What is the smaller number?
(a) 59 (b) 58
(c) 57 (d) 56
(e) None of these

24. What is 184 times 156?
(a) 28704 (b) 29704
(c) 30604 (d) 27604
(e) None of these

25. If an amount of ₹ 15,487 is divided equally among 76 students, approximately how much amount will each student get?
(a) ₹206 (b) ₹210
(c) ₹204 (d) ₹218
(e) ₹212

26. The product of two consecutive even numbers is 16128. Which is the larger number?
(a) 132 (b) 128
(c) 124 (d) 126
(e) None of these

27. There are 12 dozen mangoes in a box. If there are 43 such boxes, how many mangoes are there in all the boxes together?
(a) 516 (b) 3096
(c) 6192 (d) 628
(e) None of these

28. What is 768 times 859?
(a) 656276 (b) 661248
(c) 658176 (d) 659712
(e) None of these

29. A canteen requires 13 dozen bananas per day. How many bananas will it require for 9 weeks?
(a) 728 (b) 9828
(c) 1404 (d) 9882
(e) None of these

30. The cost of 3 chairs and 10 tables is ₹ 9856. What is the cost of 6 chairs and 20 tables?
(a) ₹17227 (b) ₹18712
(c) ₹19172 (d) Cannot be determined
(e) None of these

31. An amount of ₹123098 is distributed equally amongst 61 persons. How much amount would each person get?
(a) ₹2018 (b) ₹2108
(c) ₹2258 (d) ₹2388
(e) None of these

32. The sum of a set of five consecutive even numbers is 140. What is the sum of the next set of five consecutive even numbers?
(a) 190 (b) 180
(c) 200 (d) 160
(e) None of these

33. What is 963 times 788 ?
(a) 757268 (b) 759632
(c) 758056 (d) 758844
(e) None of these

34. The cost of 5 tables and 6 chairs is ₹ 2,884. What is the cost of 15 tables and 18 chairs?
(a) ₹3300 (b) ₹7332
(c) ₹5600 (d) ₹8652
(e) None of these

35. $\frac{3}{5}$ of a number is 250 more than 40% of the same number. What is the number?
(a) 1250 (b) 1180
(c) 1200 (d) 1220
(e) none of these

36. The product of two consecutive odd numbers is 1763. What is the larger number?
(a) 43 (b) 39
(c) 41 (d) 37
(e) None of these

37. A canteen requires 4,560 kgs of rice for 30 days. How many kgs, of rice does the canteen require for one week?
(a) 1078 kgs (b) 944 kgs
(c) 1054kgs (d) 1068 kgs
(e) None of these

38. If an amount of ₹ 13,957 is divided equally among 45 people, how much approximate amount will each person get?
(a) ₹330 (b) ₹250
(c) ₹275 (d) ₹310
(e) None of these

39. The product of two consecutive even numbers is 5328. What is the smaller number?
(a) 70 (b) 68
(c) 74 (d) 72
(e) None of these

40. Three girls start jogging from the same point around a circular track and they complete one round in 24 seconds, 36 seconds and 48 seconds respectively. After how much time will they meet at one point?
(a) 2 minutes, 20 seconds
(b) 2 minutes, 24 seconds
(c) 4 minutes 12 seconds
(d) 3 minutes 36 seconds
(e) None of these

41. The average of four consecutive even numbers is 27. What is the highest number?
(a) 32 (b) 28
(c) 30 (d) 34
(e) None of these

42. Three friends A, B and C start running around a circular stadium and complete a single round in 24, 36 and 30 seconds respectively. After how many minutes will they meet again at the starting point?
(a) 12 (b) 6
(c) 8 (d) 15
(e) 18

43. If the fractions $\frac{1}{2}, \frac{2}{3}, \frac{5}{9}, \frac{6}{13}$, and $\frac{7}{9}$ are arranged in ascending order of their values, which one will be the fourth ?
(a) $\frac{2}{3}$ (b) $\frac{6}{13}$
(c) $\frac{5}{9}$ (d) $\frac{7}{9}$
(e) None of these

44. If the following fractions $\frac{7}{8}, \frac{4}{5}, \frac{8}{14}, \frac{3}{5}$ and $\frac{5}{6}$ are arranged in descending order which will be the last in the series?
(a) $\frac{8}{14}$ (b) $\frac{7}{8}$
(c) $\frac{4}{5}$ (d) $\frac{3}{5}$
(e) $\frac{5}{6}$

45. If the fractions $\frac{2}{5}, \frac{3}{4}, \frac{4}{5}, \frac{5}{7}$ and $\frac{6}{11}$ are arranged in ascending order of their values, which one will be the fourth ?
(a) $\frac{2}{5}$ (b) $\frac{3}{4}$
(c) $\frac{4}{5}$ (d) $\frac{6}{11}$
(e) $\frac{5}{7}$

46. The difference between two numbers is 3 and the difference between their squares is 63. Which is the larger number?
(a) 12 (b) 9
(c) 15
(d) Cannot be determined
(e) None of these

47. If the difference between a number and two fifths of the number is 30, find the number.
(a) 50 (b) 75
(c) 57 (d) 60
(e) None of these

48. If among 54 students each contributes ₹ 60, the amount to buy new books for the library can be collected . If 9 students drop out how much additional amount does each student have to pay ?
(a) ₹ 18 (b) ₹ 10
(c) ₹ 12 (d) Cannot be determined
(e) None of these

49. If $(12)^3$ is subtracted from the square of a number the answer so obtained is 976. What is the number?
(a) 58 (b) 56
(c) 54 (d) 52
(e) None of these

50. The cost of 5 chairs and 8 tables is ₹ 6,574. What is the cost of 10 chairs and 16 tables?
(a) ₹15674 (b) ₹16435
(c) ₹13148 (d) Cannot be determined
(e) None of these

51. If $(56)^2$ is added to the square of a number, the answer so obtained is 4985. What is the number?
(a) 52 (b) 43
(c) 65 (d) 39
(e) None of these

52. The difference between a number and one fifth of it is 84. What is the number?
(a) 95 (b) 100
(c) 105 (d) 108
(e) 112

53. Kishan has some hens and some cows. If the total number of animal heads are 59 and the total number of feet are 190, how many cows does Kishan have ?
(a) 36 (b) 32
(c) 23 (d) Cannot be determined
(e) None of these

54. Gopal has some hens and some goats. If the total number of animal heads are 43 and total number of feet are 142, how many hens does Gopal have?
(a) 28 (b) 21
(c) 15 (d) Cannot be determined
(e) None of these

55. The difference between a two-digit number and the number obtained by interchanging the two digits of the number is 9. The sum of the digits of the number is 15. What is the product of the two digits of the two-digit number?
(a) 54 (b) 72
(c) 56 (d) Cannot be determined
(e) None of these

56. The number obtained by interchanging the two digits of a two-digit number is less than the original number by 18. The sum of the two digits of the number is 16. What is the original number?
(a) 97 (b) 87
(c) 79 (d) Cannot be determined
(e) None of these

57. If all the fractions $\frac{3}{5}, \frac{1}{8}, \frac{8}{11}, \frac{4}{9}, \frac{2}{7}, \frac{5}{7}$ and $\frac{5}{12}$ are arranged in the descending order of their values, which one will be the third?
(a) $\frac{1}{8}$ (b) $\frac{4}{9}$
(c) $\frac{5}{12}$ (d) $\frac{8}{11}$
(e) None of these

58. Farah got married 8 years ago. Today her age is $1\frac{2}{7}$ times her age at the time of her marriage. At present her daughter's age is one-sixth of her age. What was her daughter's age 3 years ago?
(a) 6 years (b) 2 years
(c) 3 years (d) Cannot be determined
(e) None of these

59. Swapnil, Aakash and Vinay begin to jog around a circular stadium. They complete one lap in 36 seconds, 48 seconds and 42 seconds respectively. After how many seconds will they be together at the starting point?s \
(a) 504 seconds (b) 940 seconds
(c) 1008 seconds (d) 470 seconds
(e) None of these

60. A, B, C, D and E are five consecutive odd numbers The sum of A and C is 146. What is the value of E?
(a) 75 (b) 81
(c) 71 (d) 79
(e) None of these

61. The product of two consecutive even numbers is 582168. Which is the smaller number?
(a) 760 (b) 762
(c) 764 (d) 766
(e) 756

62. Seema's present age is four times her son's present age and four-seventh of her father's present age. The average of the present ages of all three of them is 32 years. What is the difference between the Seema's son's present age and Seema's father's present age ?
(a) 44 years (b) 48 years
(c) 46 years (d) Cannot be determined
(e) None of these

63. The sum of five consecutive even numbers of set A is 280. What is the sum of a different set B of five consecutive numbers whose lowest number is 71 less than double the lowest number of set A ?
(a) 182 (b) 165
(c) 172 (d) 175
(e) None of these

64. Deepak has some hens and some goats. If the total number of animal heads is 90 and the total number of animal feet is 248, what is the total number of goats Deepak has ?
(a) 32 (b) 36
(c) 34
(d) Cannot be determined
(e) None of these

65. The sum of the two digits of a two digit number is 15 and the difference between the two digits of the two digit number is 3. What is the product of the two digits of the two-digit number ?
(a) 56 (b) 63
(c) 42
(d) Cannot be determined
(e) None of these

66. The sum of the squares of two consecutive even numbers is 6500. Which is the smaller number?
(a) 54 (b) 52
(c) 48 (d) 56
(e) None of these

Answer Key

1	**(c)**	14	**(c)**	27	**(c)**	40	**(b)**	53	**(a)**
2	**(c)**	15	**(a)**	28	**(d)**	41	**(c)**	54	**(c)**
3	**(d)**	16	**(c)**	29	**(b)**	42	**(b)**	55	**(c)**
4	**(d)**	17	**(a)**	30	**(e)**	43	**(a)**	56	**(a)**
5	**(b)**	18	**(d)**	31	**(a)**	44	**(a)**	57	**(e)**
6	**(d)**	19	**(d)**	32	**(a)**	45	**(b)**	58	**(c)**
7	**(a)**	20	**(b)**	33	**(d)**	46	**(a)**	59	**(c)**
8	**(c)**	21	**(e)**	34	**(d)**	47	**(a)**	60	**(d)**
9	**(a)**	22	**(d)**	35	**(a)**	48	**(c)**	61	**(b)**
10	**(c)**	23	**(d)**	36	**(a)**	49	**(d)**	62	**(b)**
11	**(a)**	24	**(a)**	37	**(e)**	50	**(c)**	63	**(d)**
12	**(b)**	25	**(c)**	38	**(d)**	51	**(b)**	64	**(c)**
13	**(d)**	26	**(b)**	39	**(d)**	52	**(c)**	65	**(e)**
								66	**(d)**

ANSWERS & EXPLANATIONS

1. (c) $456 \times 121 = 55176$
2. (c) From the given alternatives,
   $112 \times 114 = 12768$
   $\therefore$ Larger number = 114
3. (d) Amount received by each person
   $= ₹ \frac{50176}{32} = 1568$
4. (d) Amount received by each person
   $= \frac{172850}{25} = ₹ 6914$
5. (b) $A + A + 2 + A + 4 + A + 6 = 180$
   $4A + 12 = 180$
   $A = 42.$
   $\therefore$ Next four consecutive even numbers are
   $50 + 52 + 54 + 56 = 212$
6. (d) $786 \times 964 = 757704.$
7. (a) Let the two-digit number be $= 10x + y$, where $x > y$
   According to the question,
   $10x + y - 10y - x = 18$
   or, $9x - 9y = 18$
   or, $9(x - y) = 18$
   or, $x - y = \frac{18}{9} = 2$ ...(i)
   and, $x + y = 12$ ...(ii)
   From equations (i) and (ii)
   $2x = 14 \Rightarrow x = \frac{14}{2} = 7$
   From equation (i)
   $y = 7 - 2 = 5$
   $\therefore$ Required product $= xy = 7 \times 5 = 35$
8. (c) $783 \times 869 = 680427$
9. (a) Total number of candles $= 15 \times 12 \times 39 = 7020$
10. (c) Required time = LCM of 48, 64 and 72

2	48,	64,	72
2	24,	32,	36
2	12,	16,	18
2	6,	8,	9
3	3,	4,	9
	1,	4,	3

   LCM $= 2 \times 2 \times 2 \times 2 \times 3 \times 4 \times 3 = 576$ seconds.
11. (a) Out of the given alternatives,
   $137 \times 139 = 19043$
   $\therefore$ Required smaller number = 137
12. (b) $? = 333 \times 131 = 43623$
13. (d) Let the numbers be x and $(x + 1)$,
   $\therefore$ $x(x + 1) = 8556$
   or, $x^2 + x - 8556 = 0$
   or, $x^2 + 93x - 92x - 8556 = 0$
   or, $(x^2 + 93)(x - 92) = 0$
   $\therefore$ $x = 92$

14. (c) Quantity of wheat for 7 days = 112 kg

$\therefore$ Quantity of wheat for 1 day $= \frac{112}{7}$ kg

$\therefore$ Quantity of wheat for 69 days

$= \frac{112}{7} \times 69 = 1104$ kg

15. (a) Required amount $= \frac{41910}{22} = ₹1905$

16. (c) Let the smaller number be x

$\because \quad x \times (x+2) = 4488$

$\Rightarrow \quad x^2 + 2x - 4488 = 0$

$\Rightarrow \quad (x+68)(x-66) = 0$

$\therefore \quad x = 66$

17. (a) Required number of bananas

$= \frac{21}{7} \times 54 = 162$ dozen

18. (d) Amount received by each person

$= \frac{72128}{46} = ₹1568$

19. (d) $234 \times 167 = 39078$

20. (b) $38^2 = 1444$

$39^2 = 1521$

$\therefore$ Required number $= 1521 - 1500 = 21$

21. (e) Let the three consecutive integers be x, x + 1 and x + 2

According to the question,

$x + x + 1 + x + 2 = 39$

or, $3x + 3 = 39$

or, $3x = 39 - 3 = 36$

or, $x = \frac{36}{3} = 12$

$\therefore$ Required largest number $= x + 2 = 12 + 2 = 14$

22. (d) Number of pieces $= \frac{455.8}{8.6} = 53$

23. (d) Out of the given alternatives,

$56 \times 57 = 3192$

24. (a) Required product $= 184 \times 156 = 28704$

25. (c) Amount received by each student

$= \frac{15487}{76} = \approx ₹204$

26. (b) Quicker Approach:

The unit's digit of the number 16128 is 8,

From the given answer choices, $126 \times 128 = 16128$

$\therefore$ Required larger number = 128

27. (c) Number of mangoes = 12 dozens

$= 12 \times 12 = 144$

$\therefore$ Number of mangoes in 43 boxes

$= 43 \times 144 = 6192$

28. (d) Required product $= 768 \times 859 = 659712$

29. (b) Requirement of bananas for 1 day in the canteen = 13 dozens

$\therefore$ Requirement of bananas for 9 weeks i.e. 63 days

$= 63 \times 13$ dozens

$= 63 \times 13 \times 12 = 9828.$

30. (e) Let the cost of one chair be ₹ x and that of a table be = ₹y

According to the question,

$3x + 10y = ₹9856$

or, $2 \times (3x + 10y) = 2 \times 9856$

$\therefore \quad 6x + 20y = ₹19712$

31. (a) Amount received by each person

$= \frac{123098}{61} = ₹2018$

32. (a) According to the question,

$x + x + 2 + x + 4 + x + 6 + x + 8 = 140$

or, $5x + 20 = 140$

or, $5x = 120$

$\therefore \quad x = \frac{120}{5} = 24$

$\therefore \quad x + 8 = 24 + 8 = 32$

The next set of five consecutive even number will start with = 34

$\therefore$ Required sum $= 34 + 36 + 38 + 40 + 42 = 190$

33. (d) $963 \times 788 = 758844$

34. (d) Let the cost of a table be = ₹x and that chair be = ₹y

According to the question,

$5x + 6y = ₹2884$

$\therefore \quad 3 \times 5x + 3 \times 6y = 3 \times ₹2884$

or, $15x + 18y = ₹8652$

35. (a) Let the number be x

Then $\frac{3x}{5} - \frac{2x}{5} = 250$

$\Rightarrow \quad x = 250 \times 5$

$= 1250$

36. (a) From the given alternatives,
$1763 = 43 \times 41$

37. (e) Required quantity of rice $= \frac{4560 \times 7}{30}$ kg $= 1064$ kg

38. (d) amount received by each person

$= \frac{13957}{45} = ₹310.15 \approx ₹310$

39. (d) Let the smaller number be x
$\because \quad x(x+2) = 5358$
$\Rightarrow \quad x^2 + 2x - 5328 = 0$
$\Rightarrow \quad (x+74)(x-42) = 0$
$\therefore \quad x = 72$

40. (b) Required time
= L.C.M of 24, 36 and 48
= 144 seconds
= 2 minutes 24 seconds

41. (c) $\frac{x + x + 2 + x + 4 + x + 6}{4} = 27$

$\Rightarrow \quad x = \frac{27 \times 4 - 12}{4}$

$= \frac{96}{4} = 24$

$\therefore$ Highest number $= 24 + 6 = 30$

42. (b) Required time = L.C.M of 24, 36 and 30
= 360 seconds = 6 minutes

43. (a) The given fractions are $\frac{1}{2}, \frac{2}{3}, \frac{5}{9}, \frac{6}{13}$ and $\frac{7}{9}$

LCM of their denominators is 234

$\therefore \quad \frac{117, 78, 26, 18, 26}{234}$

$\frac{117, 2 \times 78, 5 \times 26, 6 \times 18, 7 \times 26}{234}$

$\frac{117, 156, 130, 108, 182}{234}$

On arranging the numerators in ascending order
108, 117, 130, 156, 182.
$\therefore$ Ascending order of the fraction is

$\frac{6}{13} < \frac{1}{2} < \frac{5}{9} < \frac{2}{3} < \frac{7}{9}$

44. (a) Decimal equivalents of fractions

$\frac{7}{8} = 0.875, \quad \frac{4}{5} = 0.8$

$\frac{8}{14} = 0.57, \quad \frac{3}{5} = 0.6$

$\frac{5}{6} = 0.83$

$\therefore \quad 0.875 > 0.83 > 0.8 > 0.6 > 0.57$

$\therefore \quad \frac{7}{8} > \frac{5}{6} > \frac{4}{5} > \frac{3}{5} > \frac{8}{14}$

45. (b) Decimal equivalent of given fractions:

$\frac{2}{5} = 0.4; \quad \frac{3}{4} = 0.75; \quad \frac{4}{5} = 0.8;$

$\frac{5}{7} = 0.714; \quad \frac{6}{11} = 0.545$

Clearly, $0.4 < 0.545 < 0.714 < 0.75 < 0.8$

$\therefore \quad \frac{2}{5} < \frac{6}{11} < \frac{5}{7} < \frac{3}{4} < \frac{4}{5}$

46. (a) Let the larger and smaller numbers be x and y respectively.
Then, $x - y = 3$ ...(i)
and, $x^2 - y^2 = 63$
$\Rightarrow \quad (x+y)(x-y) = 63$

$\Rightarrow \quad (x+y) = \frac{63}{3} = 21$ ...(ii)

From equation (i) and (ii),
$x = 12$

47. (a) Let the number be = x
According to the question,

$x - \frac{2x}{5} = 30$

$\Rightarrow \quad \frac{3x}{5} = 30$

$\Rightarrow \quad x = \frac{30 \times 5}{3} = 50$

48. (c) Sum to be collected from 54 students $= 60 \times 54 = 3240$ ₹
Sum collected from 45 students $= 60 \times 45 = 2700$ ₹
Difference $= 3240 - 2700 = 540$ ₹
$\therefore$ Additional amount to be paid by each student

$= \frac{540}{45} = ₹12$

49. (d) Let the number be x.
$\because \quad x^2 - (12)^3 = 976$
$\therefore \quad x^2 = 976 + 1728 = 2704$
$\therefore \quad x = \sqrt{2704} = 52$

50. (c) $\because$ 5 chairs + 8 tables = ₹6574
$\therefore$ 10 chairs + 16 tables $= 6574 \times 2 =$ ₹ 13148

51. (b) Let the number be x.
$\because \quad x^2 + (56)^2 = 4985$
$\Rightarrow \quad x^2 = 4985 - 3136 = 1849$
$\therefore \quad x = \sqrt{1849} = 43$

52. (c) $\left(1-\frac{1}{5}\right)$ of the number = 84

$\therefore$ number $= \left(\frac{84\times 5}{4}\right) = 105$

53. (a) A hen has two legs whereas a cow has four legs.
But both of them have one head each.
Let Kishan have x cows
$\therefore$ Number of hens = 59 – x.
According to the question,
$4 \times x + (59 - x) \times 2 = 190$
or, $4x + 118 - 2x = 190$
or, $2x = 190 - 118 = 72$

$\therefore$ $x = \frac{72}{2} = 36$

Number of cows = 36

54. (c) Let the number of hens = x
$\therefore$ Number of goats = 43 – x
According to the question,
$x \times 2 + (43 - x) \times 4 = 142$
or, $2x + 172 - 4x = 142$
or, $2x = 172 - 142$

$\therefore$ $x = \frac{30}{2} = 15$

$\therefore$ Number of hens = 15

55. (c) Let the two-digit number be
= 10 x + y, where x < y.
Number obtained after interchanging the digits
= 10 y + x
According to the question,
$10y + x - 10x - y = 9$
or, $9y - 9x = 9$
or, $9(y - x) = 9$
or, $y - x = 1$ ...(i)
and $x + y = 15$ ...(ii)
From equations (i) and (ii),
y = 8 and x = 7
$\therefore$ Required product = $8 \times 7 = 56$

56. (a) Let the number be (10x + y)
Then, $(10x + y) - (10y + x) = 18$
$\Rightarrow$ $9x - 9y = 18$
$\Rightarrow$ $x - y = 2$ ...(i)
and, $x + y = 16$ ...(ii)
x = 9, y = 7
From equations (i) and (ii),
So, the number is $(10 \times 9 + 7) = 97$

57. (e) $\frac{3}{5} = 0.6, \frac{1}{8} = 0.125,$

$\frac{8}{11} = 0.727, \frac{4}{9} = 0.44,$

$\frac{2}{7} = 0.285, \frac{5}{7} = 0.714,$

$\frac{5}{12} = 0.416$

Descending order :

$\frac{8}{11}, \frac{5}{7}, \frac{3}{5}, \frac{4}{9}, \frac{5}{12}, \frac{2}{7}, \frac{1}{8}$

So, $\frac{3}{5}$ is the third.

58. (c) Let Farah's age at the time of her marriage be x.

Then, $(x + 8) = x \times \frac{9}{7}$

$\Rightarrow \frac{9x}{7} - x = 8$

$\Rightarrow x = \frac{8\times 7}{2} = 28$ years

$\therefore$ Farah's present age = 28 + 8 = 36 years

$\therefore$ Daughter's age 3 years ago = $36 \times \frac{1}{6} - 3$

= 3 years

59. (c) They will be together at the starting point after the L.C.M of 36, 48 and 42
L.C.M. of 36, 48, 42 = 1008 seconds

60. (d) A + C = 146
or A + A + 4 = 146

or A $= \frac{146 - 4}{2} = 71$

$\therefore$ E = A + 8 = 71 + 8 = 79

61. (b) Let the numbers be x and $(x + 2)$
Then, $x \times (x + 2) = 582168$
$\Rightarrow$ $x^2 + 2x - 582168 = 0$
$\Rightarrow$ $x^2 + 764x - 762x - 582168 = 0$
$\Rightarrow$ $(x + 764)(x - 762) = 0$
$\Rightarrow$ x = 762

62. (b) Let Seema's present age be x years.

Then, Seema's son's present age = $\frac{x}{4}$ years

Seema's father's present age = $\frac{7x}{4}$ years.

Then, $x + \frac{x}{4} + \frac{7x}{4} = 32 \times 3$

$\Rightarrow \quad 12x = 96 \times 4$

$\Rightarrow \quad x = \dfrac{96 \times 4}{12} = 32$

$\therefore$ Required difference $= \dfrac{7 \times 32}{4} - \dfrac{32}{4}$

$= 56 - 8 = 48$ years

63. (d) Lowest number of set A $= \dfrac{280}{5} - 4 = 52$

Lowest number of other set $= 52 \times 2 - 71 = 33$

$\therefore$ Required sum $= 33 + 34 + 35 + 36 + 37 = 175$

64. (c) Let total number of goats be x.

Then, total number of hens $= (90 - x)$

So, $x \times 4 + (90 - x) \times 2 = 248$

$\Rightarrow \quad 4x - 2x = 248 - 180$

$x = \dfrac{68}{2} = 34$

65. (e) Let the two digits be x and y.

Then, $x + y = 15$ ... (i)

$x - y = 3$ ... (ii)

from equation (i) and (ii), $x = 9, y = 6$

$\therefore$ Product $= 9 \times 6 = 54$

66. (d) Let the two numbers be x and $(x + 2)$.

Then, $x^2 + (x + 2)^2 = 6500$

$\Rightarrow \quad x^2 + x^2 + 4x + 4 = 6500$

$\Rightarrow \quad 2x^2 + 4x - 6496 = 0$

$\Rightarrow \quad x^2 + 2x - 3248 = 0$

$\Rightarrow \quad x^2 + 58x - 56x - 3248 = 0$

$\Rightarrow \quad (x + 58)(x - 56) = 0$

$\Rightarrow \quad x = 56$

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CHAPTER

2

SIMPLIFICATION

SIMPLIFICATION

Algebraic expressions contain alphabetic symbols as well as numbers. When an algebraic expression is simplified, an equivalent expression is found that is simpler than the original. This usually means that the simplified expression is smaller than the original.

BODMAS RULE :

This rule depicts the correct sequence in which the operations are to be executed, so as to find out the value of a given expression. Here, 'B' stands for 'Bracket', ' O' for 'of', ' D' for 'Division, ' M' for 'Multiplication', ' A' for 'Addition', ' S' for 'Subtraction'.

When an expression contains a vinculum (a horizontal line above an expression), before applying the 'BODMAS' rule, we simplify the expression under the vinculum.

The next step is to evaluate all the expressions in the brackets.

After removing the brackets, we must use the following operations strictly in the following order:

1. of
2. Division, Multiplication
3. Addtition, Subtraction

So, the order of precedence is:

V Vinculum first
B Brackets
O Of, Orders (i.e. Powers and Square Roots, etc.)
DM Division and Multiplication (left-to-right)
AS Addition and Subtraction (left-to-right)

LAWS OF SURDS AND INDICES

LAWS OF SURDS:

- $\left(a^{\frac{1}{n}}\right)^n = a$
- $a^{\frac{1}{n}} b^{\frac{1}{n}} = (ab)^{\frac{1}{n}}$
- $\left(a^{\frac{1}{n}}\right)^{\frac{1}{m}} = a^{\frac{1}{mn}}$

All these laws follow from the laws of indices.

TYPES OF SURDS :

Mixed surds: If one factor of a surd is a rational number and the other factor is an irrational number, then the surd is called a mixed surd.

Example: $2\sqrt{5}, -2\sqrt{3}$

Pure surds: If a surd has unity as its only rational factor, the other factor being an irrational number, then it is called a pure surd.

Examples: $\sqrt{3}, \sqrt{a}$

Since surds are irrational numbers, they can be added or subtracted as real numbers. Also a rational number can be added or subtracted from a surd. The result will be a real number.

Examples: $\sqrt{5}+3;\ 2-\sqrt{7};\ \sqrt{3}-2$

ADDITION AND SUBTRACTION OF SURDS :

Example: $5\sqrt{2}+20\sqrt{2}-3\sqrt{2}=22\sqrt{2}$

Example: $\sqrt{45}-3\sqrt{20}+4\sqrt{5}=3\sqrt{5}-6\sqrt{5}+4\sqrt{5}=\sqrt{5}$

Multiplying and Dividing Surds :

Surds can be multiplied by using the laws of surds. To multiply or divide Surds they have to first be made of the same order.

Examples: $\sqrt{4}\times\sqrt{22}=\sqrt{88}$, $\sqrt{162}/\sqrt{9}=3\sqrt{2}$

LAWS OF INDICES :

- $a^m \times a^n = a^{m+n}$
- $a^m \div a^n = a^{m-n}$
- $(a^m)^n = a^{mn}$
- $a^{\frac{1}{m}} = \sqrt[m]{a}$
- $a^{-m} = \frac{1}{a^m}$
- $a^{m/n} = \sqrt[n]{a^m}$
- $a^0 = 1$

Examples:

$\sqrt[5]{4^3} = (4^3)^{\frac{1}{5}} = (4^{\frac{3}{5}})$

$5^3 \times 5^4 = 5^7$

$\frac{5^5}{5^2} = 5^3$

Other Important Formulae

$(a+b)^2 = a^2 + 2ab + b^2$

$(a-b)^2 = a^2 - 2ab + b^2$

$(a^2 - b^2) = (a-b)(a+b)$

$(a+b)^2 + (a-b)^2 = 2(a^2 + b^2)$

$(a+b)^2 = (a-b)^2 + 4ab$

$(a+b)^3 = a^3 + b^3 + 3ab(a+b)$

$(a-b)^3 = a^3 - b^3 - 3ab(a-b)$

$a^3 + b^3 = (a+b)(a^2 - ab + b^2)$

$a^3 - b^3 = (a-b)(a^2 + ab + b^2)$

$a^3 + b^3 + c^3 - 3abc = (a+b+c)(a^2 + b^2 + c^2 - ab - bc - ac)$

$(a+b+c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

$$x^2 + \frac{1}{x^2} = \left(x + \frac{1}{x}\right)^2 - 2 = \left(x - \frac{1}{x}\right)^2 + 2$$

$$x^3 + \frac{1}{x^3} = \left(x + \frac{1}{x}\right)^3 - 3\left(x + \frac{1}{x}\right)$$

If $a + b + c = 0$, then $a^3 + b^3 + c^3 = 3abc$

SOLVED EXAMPLES

EXAMPLE ▶ 1 : What value should come in place of the question mark (?) in the following question ?

$432 \times 66 - 1562 = ?$

(a) 23450 **(b) 24360**
(c) 25890 **(d) 26950**
(e) None of these

Sol. (d) $? = 432 \times 66 - 1562$
$= 28512 - 1562 = 26950$

EXAMPLE ▶ 2 : What value should come in place of the question mark (?) in the following question ?

$44^3 \times 16^3 - 18678^2 = ?$

(a) 45980 **(b) 44890**
(c) 43780 **(d) 42670**
(e) None of these

Sol. (a) $? = 44^3 \times 16^3 - 18678^2$
$= 348913664 - 348867684$
$= 45980$

EXAMPLE ▶ 3 : What value should come in place of the question mark (?) in the following question ?

$$6\frac{2}{3} \div 4\frac{4}{5} = ?$$

(a) $1\frac{1}{3}$ **(b)** $1\frac{7}{18}$

(c) $1\frac{12}{19}$ **(d)** $1\frac{5}{8}$

(e) None of these

Sol. (b)

$$? = \frac{20}{3} \div \frac{24}{5}$$

$$= \frac{20}{3} \times \frac{5}{24} = \frac{25}{18} = 1\frac{7}{18}$$

EXAMPLE ▶ 4 : What value should come in place of the question mark (?) in the following question ?

$$\frac{3}{8} \text{ of } \frac{5}{7} \text{ of } \frac{2}{5} \text{ of } 1680 = ?$$

(a) 150 **(b) 180**
(c) 210 **(d) 240**
(e) None of these

Sol. (b) $? = 1680 \times \frac{2}{5} \times \frac{5}{7} \times \frac{3}{8} = 180$

EXAMPLE ▶ 5 : If $(28)^3$ is subtracted from the square of a number, the answer so obtained is 1457. What is the number?

(a) 127 **(b) 136**
(c) 142 **(d) 153**
(e) None of these

Sol. (d) Let the number be x.
According to the question,
$x^2 - (28)^3 = 1457$
$\Rightarrow x^2 - 21952 = 1457$
$\Rightarrow x^2 - 21952 - 1457 = 0$
$\Rightarrow x^2 = 23409$
$\Rightarrow x = \sqrt{23409} = 153$

EXAMPLE ▶ 6 : If $(89)^2$ is added to the square of a number, the answer so obtained is 16202. What is the number?

(a) 91 **(b) 8281**
(c) 8649 **(d) 93**
(e) None of these

Sol. (a) Let the number be x.
According to the question,
$x^2 + (89)^2 = 16202$

$\Rightarrow x^2 + 7921 = 16202$
$\Rightarrow x^2 = 16202 - 7921 = 8281$
$\Rightarrow x = \sqrt{8281} = 91$

EXAMPLE ▶ 7 : $\frac{4\times2+6}{5\times16-2} = ?$

(a) 5 **(b)** $\frac{16}{35}$

(c) $\frac{1}{5}$ **(d)** $\frac{16}{39}$

(e) None of these

Sol. (e) $? = \frac{4\times2+6}{5\times16-2} = \frac{8+6}{80-2} = \frac{14}{78} = \frac{7}{39}$

EXAMPLE ▶ 8 : If $(41)^2$ is added to the square of a number, the answer so obtained is 7457. What is the number ?

(a) 76 **(b) 63**
(c) 81 **(d) 82**
(e) None of these

Sol. (a) Required number
$= \sqrt{7457 - (41)^2}$
$= \sqrt{7457 - 1681}$
$= \sqrt{5776} = 76$

EXAMPLE ▶ 9 : What approximate value should come in place of question mark (?) in the following questions?
(you are not expected to calculate the exact value)
$(935.82)^2 = ?$

(a) 870000 **(b) 867500**
(c) 888800 **(d) 875800**
(e) 899800

Sol. (d) $? = (935.82)^2 \approx (936)^2$
$\approx 936 \times 936 = 876096 \approx 875800$

EXAMPLE ▶ 10 : What approximate value should come in place of the question mark (?) in the following question?
$4444 \div 56 \times (23)^2 + 63 = ?$

(a) 45670 **(b) 46290**
(c) 44630 **(d) 43530**
(e) 42050

Sol. (e) $? = \left(\frac{4444\times23\times23}{56}\right) + 63$

$\approx \left(\frac{4450\times23\times23}{56}\right) + 63$

$\approx 42037 + 63 = 42100 \approx 42050$

EXERCISE

Directions: In the following find the value of '?'

1. $56.6 \times 16.6 \times 6.6 = ?$
   (a) 6102.196 (b) 6021.196
   (c) 6210.196 (d) 6012.196
   (e) None of these
2. $? \div 46 \times 16 = 368$
   (a) 1124 (b) 1236
   (c) 1058 (d) 966
   (e) None of these
3. $999.99 + 99.99 + 9.99 = ?$
   (a) 1109.99 (b) 1019.89
   (c) 1108.99 (d) 1099.88
   (e) none of these
4. $11.6 \times ? = 899$
   (a) 77.5 (b) 78.5
   (c) 79.5 (d) 81.5
   (e) none of these
5. $85332 - 11638 - 60994 = ?$
   (a) 12700 (b) 12600
   (c) 12800 (d) 12500
   (e) None of these
6. ? of 57.75 of 0.8 = 3187.8
   (a) 45 (b) 27
   (c) 64 (d) 69
   (e) None of these
7. $(?)^2 - (12)^3 = 976$
   (a) 58 (b) 56
   (c) 54 (d) 52
   (e) None of these
8. $351 \div 6 \div 0.5 = ?$
   (a) 117 (b) 119
   (c) 121 (d) 123
   (e) None of these

9. $18 \times ? = 7776 \div 12$
(a) 32 (b) 42
(c) 160 (d) 36
(e) None of these

10. $11 \times 55 \div 5 + 9 = ?$
(a) 120 (b) 140
(c) 48 (d) 180
(e) None of these

11. $85333 - 11638 - 60994 = ?$
(a) 12701 (b) 12600
(c) 12800 (d) 12500
(e) None of these

12. $8^4 - 8^2 = ?$
(a) 64 (b) 512
(c) 4032 (d) 4096
(e) None of these

13. $6.3 \times 12.8 \times 9.9 - 69.996 = ?$
(a) 738.54 (b) 758.94
(c) 728.34 (d) 748.74
(e) None of these

14. $8 + 18 \times 368 \div 16 = ?$
(a) 598 (b) 356
(c) 648 (d) 422
(e) None of these

15. $11059 + 8889 - 908 = ? \times 85$
(a) 236 (b) 212
(c) 248 (d) 272
(e) None of these

16. $66606 + 40998 = ? - 24848$
(a) 132452 (b) 132242
(c) 132425 (d) 132254
(e) None of these

17. $894.65 - 388.24 + 100.99 = ?$
(a) 617.4 (b) 607.4
(c) 597.4 (d) 587.4
(e) None of these

18. $1181 + 1520 = (26)^2 + (?)^2$
(a) 49 (b) 43
(c) 47 (d) 45
(e) None of these

19. $59475 \div \sqrt{?} = 195 \times 5$
(a) 3969 (b) 3481
(c) 4225 (d) 3249
(e) None of these

20. $\sqrt{?} + 29 = \sqrt{2704}$
(a) 23 (b) 529
(c) 441 (d) 21
(e) None of these

21. What is the least number to be added to 1500 to make it a perfect square ?
(a) 21 (b) 35
(c) 43 (d) 59
(e) None of these

22. $-\frac{4}{5}$ of $1150 + \frac{5}{6}$ of $1248 = ?$
(a) 140 (b) 115
(c) 125 (d) 120
(e) None of these

23. $235 + 75 \times 8 = ?$
(a) 2480 (b) 835
(c) 1955 (d) 2840
(e) none of these

24. $5986 - 2340 = 1496 + ?$
(a) 2150 (b) 1150
(c) 2140 (d) 1970
(e) none of these

25. $7^{\frac{1}{4}} \times (343)^{0.25} = ?$
(a) $\sqrt{7}$ (b) 49
(c) 7 (d) $7\sqrt{7}$
(e) None of these

26. $57.63 - 37.26 = 39.27 - ?$
(a) 18.90 (b) 18.54
(c) 19.73 (d) 19.54
(e) None of these

27. $\sqrt{1089} + \sqrt{289} = \sqrt{?}$
(a) 625 (b) 50
(c) 25 (d) 1378
(e) None of these

28. $12.8 \times 2.5 + 8.6 = ?$
(a) 41.3 (b) 39.6
(c) 40.6 (d) 142.08
(e) None of these

29. $(14^2 - 13^2) \div 3 = ?^2$
(a) 9 (b) 3
(c) 27 (d) 6
(e) None of these

30. $(19)^{12} \times (19)^8 \div (19)^4 = (19)^?$
(a) 24 (b) 8
(c) 6 (d) 12
(e) None of these

31. $70.56 \div 11.2 = ?$
(a) 63 (b) 6.3
(c) 7.72 (d) 0.53
(e) None of these

32. If $x + y = 23$ and $xy = 126$; then $(x)^2 + (y)^2 = ?$
(a) 250 (b) 317
(c) 340 (d) Cannot be determined
(e) None of these

33. $986.23 + 7.952 + 8176.158 = ?$
(a) 9170.340 (b) 9169.230
(c) 9241.908 (d) 9170.762
(e) None of these

34. $\sqrt{1296} \div \sqrt{36} = ?$
(a) 1 (b) 36
(c) 6 (d) 18
(e) None of these

35. $112 \div 7 \div 4 = 8 \times ?$
(a) 0.25 (b) 0.05
(c) 0.5 (d) 8
(e) None of these

36. $\frac{1}{2}$ of $\frac{2}{3}$ of $\frac{4}{8}$ of $3750 = ?$
(a) 625 (b) 312.5
(c) 125 (d) 250
(e) None of these

37. $\frac{3 \times 8 + 4}{9 \times 15 - 9} = ?$
(a) $\frac{16}{9}$ (b) $\frac{2}{3}$
(c) $\frac{4}{9}$ (d) $\frac{3}{2}$
(e) None of these

38. $(87324 - 79576) \times 1.5 = ?$
(a) 1162.2 (b) 11622
(c) 1372.2 (d) 1163.7
(e) None of these

39. $(331 + 19) \times (15 - 11) \times (37 + 13) = ?$
(a) 70000 (b) 4131
(c) 30250 (d) 20350
(e) None of these

40. $11.88 \times \frac{250}{18} = ?$
(a) 16.50 (b) 4131
(c) 30250 (d) 20350
(e) None of these

41. $\frac{1}{2} \times \frac{3}{4} \div \left(\frac{9}{2} \times \frac{5}{8}\right) = ?$
(a) $\frac{5}{96}$ (b) $\frac{15}{8}$
(c) $\frac{5}{108}$ (d) $\frac{12}{5}$
(e) None of these

42. $\frac{18 + 17 \times 3 - 1}{8 - 15 \div 3 - 1} = ?$
(a) 17 (b) 26
(c) 13 (d) 34
(e) None of these

43. $1\frac{1}{2} + 1\frac{2}{3} \div \left(\frac{6}{7} - \frac{5}{6}\right) = ?$
(a) 71.5 (b) 133
(c) $\frac{19}{252}$ (d) $\frac{19}{180}$
(e) None of these

44. $\sqrt{?} - 63 = 9^2$
(a) 12 (b) 144
(c) 324 (d) 128
(e) None of these

45. $916.28 - 72.4 = 728.2 + ?$
(a) 115.86 (b) 125.68
(c) 215.68 (d) 216.04
(e) None of these

46. $7776 \div 18 \times 3 = ?$
(a) 144 (b) 1926
(c) 1296 (d) 1266
(e) None of these

47. $8994 - 4178 - 2094 = ?$
(a) 2720 (b) 2726
(c) 2730 (d) 2734
(e) None of these

48. $315 \times 114 - 1565 = ?$
(a) 34534 (b) 34435
(c) 34345 (d) 33445
(e) None of these

49. $1256 \div (32 \times 0.25) = ?$
(a) 160 (b) 154
(c) 165 (d) 157
(e) None of these

50. $69.2 \times 18.4 \times 4.5 = ?$
(a) 5729.76 (b) 5972.76
(c) 5279.76 (d) 5792.76
(e) None of these

51. $3.2 \times 6.8 \times 9.5 = ?$
(a) 207.62 (b) 202.67
(c) 206.27 (d) 207.72
(e) None of these

52. $15^3 \times 9^3 - 1555^2 = ?$
(a) 41250 (b) 43250
(c) 42350 (d) 44250
(e) None of these

53. $8\frac{2}{5} \div 10\frac{2}{25} = ?$
(a) $\frac{5}{6}$ (b) $\frac{7}{8}$
(c) $\frac{4}{5}$ (d) $\frac{3}{4}$
(e) None of these

54. $\frac{3}{5}$ of $\frac{3}{4}$ of $\frac{5}{6}$ of $992 = ?$
(a) 388 (b) 390
(c) 372 (d) 376
(e) None of these

55. $\sqrt{?} + 17 = \sqrt{961}$
(a) 169 (b) 256
(c) 225 (d) 196
(e) None of these

56. $123 \div 6 \div 0.8 = ?$
(a) 25.625 (b) 23.545
(c) 27.455 (d) 21.365
(e) None of these

Choose the correct option.

57. What is the least number to be added to 3986 to make it a perfect square ?
(a) 118 (b) 95
(c) 110 (d) 100
(e) None of these

58. $\sqrt{3781} \times 5.36 \approx ?$
(a) 350 (b) 330
(c) 240 (d) 280
(e) 410

59. If $(26)^2$ is subtracted from square of a number, the answer so obtained is 549. What is the number?
(a) 35 (b) 33
(c) 29 (d) 41
(e) None of these

60. $[(4)^3 \times (5)^4] \div (4)^5 = ?$
(a) 30.0925 (b) 39.0625
(c) 35.6015 (d) 29.0825
(e) None of these

61. $\frac{1.6 \times 3.2}{0.08} = ?$
(a) 6.4 (b) 8
(c) 64 (d) 0.8
(e) None of these

62. $(7857 + 3596 + 4123) \div 96 = ?$
(a) 155.06 (b) 162.25
(c) 151.83 (d) 165.70
(e) None of these

63. $5321 \div 305 \times (19)^2 \simeq ?$
(a) 6150 (b) 6425
(c) 6380 (d) 6355
(e) 6300

64. If $(61)^2$ is added to the square of a number, the answer so obtained is 5242. What is the number?
(a) 40 (b) 39
(c) 37 (d) 43
(e) None of these

65. What is the least number to be added to 4400 to make it a perfect square?
(a) 87 (b) 91
(c) 93 (d) 89
(e) None of these

66. The difference between two numbers is 3 and the difference of their squares is 63. Find the greater number.
(a) 12 (b) 9
(c) 15 (d) Cannot be determined
(e) None of these

67. How much less is $\frac{4}{5}$ of 1150 from $\frac{5}{6}$ of 1248 ?
(a) 140 (b) 115
(c) 125 (d) 120
(e) None of these

68. If $(74)^2$ is subtracted from the square of a number, the answer so obtained is 5340. What is the number?
(a) 98 (b) 102
(c) 104 (d) 110
(e) None of these

69. If $2x + 3y = 78$ and $3x + 2y = 72$, what is the value of $x + y$?
(a) 36 (b) 32
(c) 30 (d) Cannot be determined
(e) None of these

70. $741560 + 935416 + 1143 + 17364 = ?$
(a) 1694583 (b) 1695438
(c) 1695483 (d) 1659483
(e) None of these

71. $(84)^2 \div \sqrt{?} = 168$
(a) 1936 (b) 1521
(c) 1681 (d) 1764
(e) None of these

72. $514789 - 317463 - 87695 - 11207 = ?$
(a) 96584 (b) 98242
(c) 96845 (d) 98424
(e) None of these

73. $\sqrt[3]{50653} = ?$
(a) 39 (b) 43
(c) 33 (d) 41
(e) None of these

74. $(17891 + 16239 - 26352) \times ? = 93336$
(a) 12 (b) 15
(c) 18 (d) 8
(e) None of these

75. $\frac{1}{4} \times 6624 \times \frac{1}{6} \times 12 = ?$
(a) 3312 (b) 3864
(c) 2208 (d) 4416
(e) None of these

76. $\frac{18 \times 15 - 50}{(40 \times 80) \div 160} = ?$
(a) 20 (b) 8.5
(c) 11.5 (d) 22
(e) None of these

77. $\sqrt{?} \times \sqrt{1681} = 2296$
(a) 2196 (b) 3364
(c) 2809 (d) 3025
(e) None of these

78. If $(74)^2$ is subtracted from the square of a number, the answer so obtained is 3740. What is the number?
(a) 9216 (b) 98
(c) 9604 (d) 96
(e) None of these

79. $93 \times 45 \div 25 = ?$
(a) 167.4 (b) 837
(c) 279 (d) 130.2
(e) None of these

80. $0.08 \times ? \times 1.6 = 0.2944$
(a) 1.3 (b) 0.4
(c) 0.2 (d) 2.3
(e) None of these

81. $6 \times 66 \times 666 = ?$
(a) 263736 (b) 267336
(c) 263763 (d) 263376
(e) None of these

82. $5\frac{1}{7} \times 8\frac{1}{6} \div 7\frac{7}{8} = ?$
(a) $1\frac{7}{9}$ (b) $1\frac{7}{8}$
(c) $5\frac{1}{3}$ (d) $5\frac{2}{3}$
(e) None of these

83. $(7)^3 \div \sqrt{?} + 7 = 14$
(a) 49 (b) 1764
(c) 441 (d) 3136
(e) None of these

84. $\sqrt[3]{12167} \times ? = 1035$
(a) 35 (b) 25
(c) 55 (d) 15
(e) None of these

85. $1256 \times 3892 = ?$
(a) 4883582 (b) 4888352
(c) 4888532 (d) 4883852
(e) None of these

86. $0.08 \times 0.5 + 0.9 = ?$
(a) 1.3 (b) 0.94
(c) 0.112 (d) 1.5
(e) None of these

87. $8195 \div 745 + ? \times 12 = 7847$
(a) 648 (b) 593
(c) 601 (d) 653
(e) None of these

88. $4123 \div (2.3)^2 - 446 = ?$
(a) 401 (b) 441
(c) 301 (d) 333
(e) 386

89. If $x + y = 18$ and $xy = 72$, what is the value of $(x)^2 + (y)^2$?
(a) 120 (b) 90
(c) 180 (d) Cannot be determined
(e) None of these

90. Which least number should be added to 8115 to make it a perfect square?
(a) 349 (b) 166
(c) 144 (d) 194
(e) None of these

91. If $(46)^2$ is subtracted from the square of a number, the answer so obtained is 485. What is the number ?
(a) 4 (b) 51
(c) 56 (d) 53
(e) None of these

92. $666 \div (2.4 \times ?) = 185$
(a) 1.5 (b) 2.5
(c) 0.5 (d) 5
(e) None of these

93. $956 \times 753 = ?$
(a) 723692 (b) 727398
(c) 710308 (d) 719868
(e) None of these

94. $\frac{3}{8} \times \frac{4}{7} \times ? = 5376$
(a) 30912 (b) 25144
(c) 24808 (d) 25088
(e) None of these

95. $[(9)^3 \times (?)^2] \div 21 = 1701$
(a) 6 (b) 3
(c) 11 (d) 4
(e) None of these

96. $897214 - 336 - 46521 - 1249 - 632176 = ?$
(a) 217832 (b) 216725
(c) 216932 (d) 315950
(e) None of these

97. $\sqrt{11881} \times \sqrt{?} = 10137$
(a) 8649 (b) 9216
(c) 8281 (d) 9409
(e) None of these

98. $3.5 \times 2.4 \times ? = 42$
(a) 1.5 (b) 0.2
(c) 0.8 (d) 1.2
(e) None of these

99. $\sqrt[3]{804357} = ?$
(a) 98 (b) 89
(c) 96 (d) 93
(e) None of these

100. $\sqrt{?} \div 16 \times 24 = 186$
(a) 14884 (b) 13924
(c) 15376 (d) 15876
(e) None of these

101. $(?)^2 \div (0.04)^2 \times 5.6 = 117740$
(a) 33.64 (b) 6.2
(c) 38.44 (d) 5.4
(e) None of these

102. $9418 - ? + 1436 + 2156 = 5658$
(a) 7523 (b) 7352
(c) 7232 (d) 7325
(e) None of these

103. $9865 + ? + 3174 + 2257 = 19425$
(a) 4047 (b) 4136
(c) 4129 (d) 4092
(e) None of these

104. $\frac{9}{?} \times 33824 = 63$
(a) 4228 (b) 4832
(c) 2416 (d) 8456
(e) None of these

105. $(99)^2 - (?)^2 + (38)^2 = 8436$
(a) 57 (b) 53
(c) 49 (d) 61
(e) None of these

106. $12.36 \times 18.15 + 21.52 = ?$
(a) 250.3036 (b) 209.1448
(c) 249.454 (d) 245.854
(e) None of these

107. $(98764 + 89881 + 99763 + 66342) \div (1186 + ? + 1040 + 1870) = 55$
(a) 2354 (b) 2368
(c) 2254 (d) 2404
(e) None of these

108. $(64)^2 \div \sqrt[3]{32768} = ?$
(a) 128 (b) 132
(c) 142 (d) 104
(e) None of these

109. $\frac{21 \times 14 - 34}{12.4 + 5.6 - 15.5} = ?$
(a) 95 (b) 100
(c) 110 (d) 106
(e) None of these

110. $0.09 \times 6.8 \times ? = 2.142$
(a) 2.5 (b) 4.4
(c) 3.5 (d) 2.4
(e) None of these

111. $11\frac{1}{7} + 2\frac{5}{8} = ?$
(a) $110\frac{1}{7}$ (b) $13\frac{45}{56}$
(c) $96\frac{3}{8}$ (d) $13\frac{43}{56}$
(e) None of these

112. $894 \div 28 \times \sqrt{589} \approx ?$
(a) 700 (b) 686
(c) 796 (d) 775
(e) 754

113. If $(57)^2$ is added to the square of a number, the answer so obtained is 8010. What is the number?
(a) 61 (b) 63
(c) 67 (d) 59
(e) None of these

114. $7275.84 - 889.4 + 124.518 = ?$
(a) 6550.202 (b) 6560.598
(c) 6550.958 (d) 6510.958
(e) None of these

115. $\frac{12^2 - 4^2}{9^2 - 3^2} = ?$
(a) $1\frac{7}{9}$ (b) $1\frac{8}{9}$
(c) $1\frac{1}{3}$ (d) 9
(e) None of these

116. $18800 \div 470 \div 20 = ?$
(a) 800 (b) 2
(c) 23.5 (d) 0.10
(e) None of these

117. $\sqrt{?} + 136 = 320$ of $\frac{5}{8}$
(a) 1936 (b) 4624
(c) 4196 (d) 4096
(e) None of these

118. $777.07 + 77.77 + 0.77 + 7.07 + 7 + 77 = ?$
(a) 946.78 (b) 946.68
(c) 964.68 (d) 946.86
(e) None of these

119. $0.4 \times ? = 0.000016$
(a) 4 (b) 0.04
(c) 0.0004 (d) 400
(e) None of these

120. $4^7 \div 16^4 \times \sqrt{16} = ?$
(a) $\frac{1}{16}$ (b) $\frac{1}{4}$
(c) 4 (d) 1
(e) None of these

121. $0.99 \times 1000 \times 14 \div 11 \div 0.7 = ?$
(a) 18 (b) 180
(c) 1.8 (d) 1800
(e) None of these

122. $95^{3.7} \div 95^{0.9989} \approx 95^{?}$
(a) 1.9 (b) 3
(c) 2.99 (d) 3.6
(e) 2.7

123. $\sqrt{10000} + 1891.992$ of $\frac{3.001}{4.987} \approx ?$
(a) 2500 (b) 1230
(c) 1640 (d) 1525
(e) 2130

124. $0.0004 \div 0.0001 \times 36.000009 \approx ?$
(a) 0.10 (b) 1.45
(c) 145 (d) 14.5
(e) 1450

125. $3739 + 164 \times 27 \approx ?$
(a) 1054000 (b) 4000
(c) 8200 (d) 690
(e) 6300

126. $9876 \div 24.96 + 215.005 - ? \approx 309.99$
(a) 395 (b) 395
(c) 300 (d) 315
(e) 310

127. $[(135)^2 \div 15 \times 32] \div ? = 45 \times 24$
(a) 18 (b) 24
(c) 36 (d) 44
(e) None of these

128. $(96)^2 + (63)^2 = (?)^2 - (111)^2 - 8350$
(a) 33856 (b) 30276
(c) 174 (d) 184
(e) None of these

129. $4368 + 2158 - 596 - ? = 3421 + 1262$
(a) 1066 (b) 1174
(c) 1247 (d) 1387
(e) None of these

130. $2172 \div ? = 1832 - 956 - 514$
(a) 6 (b) 8
(c) 10 (d) 12
(e) None of these

131. $666.06 + 66.60 + 0.66 + 6.06 + 6 + 60 = ?$
(a) 819.56 (b) 805.38
(c) 826.44 (d) 798.62
(e) None of these

132. $205 \times ? \times 13 = 33625 + 25005$
(a) 22 (b) 27
(c) 33 (d) 39
(e) None of these

133. $(10)^{24} \times (10)^{-21} = ?$
(a) 3 (b) 10
(c) 100 (d) 1000
(e) None of these

134. What is the least number to be added to 4321 to make it a perfect square?
(a) 32 (b) 34
(c) 36 (d) 38
(e) None of these

135. $628.306 + 6.1325 \times 44.0268 \approx ?$
(a) 820 (b) 970
(c) 1050 (d) 1175
(e) 900

136. $1896 \div 29 + 445 \approx ?$
(a) 485 (b) 510
(c) 528 (d) 493
(e) 536

137. $(9795 + 7621 + 938) \div (541 + 831 + 496) \approx ?$
(a) 9 (b) 13
(c) 17 (d) 23
(e) 29

138. $814296 \times 36 \approx ? \times 96324$
(a) 326 (b) 272
(c) 304 (d) 358
(e) 260

139. $78 \div 5 \div 0.5 = ?$
(a) 15.6 (b) 31.2
(c) 7.8 (d) 0.4
(e) None of these

140. $12.22 + 22.21 + 221.12 = ?$
(a) 250.55 (b) 255.50
(c) 250.05 (d) 255.05
(e) None of these

141. $12^4 \times 12^{13} = ?$
(a) 12^7 (b) 12^{39}
(c) 12^{17} (d) 12^{-7}
(e) None of these

142. $464 \div (16 \times 2.32) = ?$
(a) 12.5 (b) 14.5
(c) 10.5 (d) 8.5
(e) None of these

143. If $(9)^3$ is subtracted from the square of a number, the answer so obtained is 567. What is the number?
(a) 36 (b) 28
(c) 42 (d) 48
(e) None of these

144. If $(78)^2$ is subtracted from the square of a number, the answer so obtained is 6,460. What is the number?
(a) 109 (b) 111
(c) 113 (d) 115
(e) None of these

145. $4275 \div 496 \times (21)^2 \approx ?$
(a) 3795 (b) 3800
(c) 3810 (d) 3875
(e) 3995

146. $14^{13} \times 14^3 = ?$
(a) 14^{39} (b) 14^7
(c) 14^{16} (d) 14^{10}
(e) None of these

147. What is the least number to be added to 4700 to make it a perfect square?
(a) 74 (b) 69
(c) 76 (d) 61
(e) None of these

148. $21.25 + 22.52 \times 212.22 = ?$
(a) 256.99 (b) 245.99
(c) 252.99 (d) 258.99
(e) None of these

149. $\frac{3}{5}$ of $\frac{3}{4}$ of $\frac{5}{6}$ of $992 = ?$
(a) 388 (b) 390
(c) 372 (d) 376
(e) None of these

150. $6.4 \times ? = 361.6$
(a) 63.5 (b) 52.5
(c) 66.5 (d) 56.5
(e) None of these

151. $2412 + 1139 + 5498 = ?$
(a) 8949 (b) 9049
(c) 8749 (d) 9249
(e) None of these

152. $3.2 \times 6.8 \times 9.5 = ?$
(a) 207.62 (b) 202.67
(c) 206.27 (d) 207.72
(e) None of these

153. $8994 - 4178 - 2094 = ?$
(a) 2720 (b) 2726
(c) 2730 (d) 2734
(e) None of these

154. $\sqrt{?} + 17 = \sqrt{961}$
(a) 169 (b) 256
(c) 225 (d) 196
(e) None of these

155. $9441 + 3991 - 606 = ? \times 53$
(a) 236 (b) 238
(c) 230 (d) 234
(e) None of these

156. $1719 \div 18 = ?$
(a) 95.5 (b) 96
(c) 97.5 (d) 99
(e) None of these

157. $58369 + 69521 = ? + 31972$
(a) 95998 (b) 95189 (c) 95918 (d) 95981 (e) None of these

158. $5470 \div 378 \times (19)^2 \approx ?$
(a) 5236 (b) 5265
(c) 5204 (d) 5250
(e) None of these

159. What is the least number to be added to 3986 to make it a perfect square?
(a) 188 (b) 95
(c) 110 (d) 100
(e) 5224

160. $832.456 - 539.982 - 123.321 = ?$
(a) 196.153 (b) 149.153
(c) 169.153 (d) 176.135
(e) None of these

161. $236.69 + 356.74 = 393.39 + ?$
(a) 200.04 (b) 201.04
(c) 200.14 (d) 202.14
(e) 203.04

162. $\frac{35 \times 15 \times 10}{25 \times 2} = ?$
(a) 105 (b) 115
(c) 70 (d) 35
(e) None of these

163. $859.05 + 427.89 + 663.17 = ?$
(a) 1585.91 (b) 1286.94
(c) 1950.02 (d) 1950.11
(e) 1951.01

164. $7 \times ? = 29.05$
(a) 4.05 (b) 4.15
(c) 3.95 (d) 4.25
(e) None of these

165. $\frac{558 \times 45}{18 \times 4.5} = ?$
(a) 314 (b) 313
(c) 312 (d) 311
(e) None of these

166. $559 + 965 = ? \times 16$
(a) 92.05 (b) 95.25
(c) 93.15 (d) 94.35
(e) None of these

167. $7\frac{3}{4} + 5\frac{1}{4} + 8\frac{1}{2} = ?$
(a) $20\frac{1}{4}$ (b) $21\frac{1}{2}$
(c) $21\frac{3}{4}$ (d) $21\frac{3}{4}$
(e) $20\frac{3}{4}$

168. $9.1 \times 7.5 \times 6.2 = ?$
(a) 423.15 (b) 68.25
(c) 593.775 (d) 472.5
(e) None of these

169. $49 + \sqrt{?} = 87$
(a) 1444 (b) 1442
(c) 1448 (d) 1456
(e) 1460

170. $\sqrt{?} - 17 = 22$
(a) 1511 (b) 1531
(c) 1515 (d) 1553
(e) 1521

171. $5989 \div 48 \times 11 \approx ?$
(a) 1375 (b) 1370
(c) 1372 (d) 1368
(e) 1365

172. If $3x + 5y = 44$ and $10x - 2y = 16$, what is the value of x?
(a) 7 (b) 3
(c) 5.5 (d) 6.5
(e) None of these

173. If $x + y = 20$ and $xy = 84$, then $(x)^2 + (y)^2 = ?$
(a) 232 (b) 400
(c) 128 (d) Cannot be determined
(e) None of these

174. $\sqrt{876} \times 20.6 + 165.34 \approx ?$
(a) 700 (b) 686
(c) 775 (d) 846
(e) 745

Answer Key

1	(e)	36	(a)	71	(d)	106	(d)	141	(c)
2	(c)	37	(e)	72	(d)	107	(a)	142	(a)
3	(e)	38	(b)	73	(e)	108	(a)	143	(a)
4	(a)	39	(a)	74	(a)	109	(e)	144	(e)
5	(a)	40	(e)	75	(a)	110	(c)	145	(b)
6	(d)	41	(e)	76	(e)	111	(d)	146	(c)
7	(d)	42	(d)	77	(e)	112	(d)	147	(d)
8	(a)	43	(a)	78	(d)	113	(e)	148	(e)
9	(d)	44	(e)	79	(a)	114	(d)	149	(c)
10	(e)	45	(e)	80	(d)	115	(a)	150	(d)
11	(a)	46	(c)	81	(a)	116	(b)	151	(b)
12	(c)	47	(e)	82	(c)	117	(d)	152	(e)
13	(c)	48	(c)	83	(e)	118	(b)	153	(e)
14	(d)	49	(d)	84	(e)	119	(c)	154	(d)
15	(e)	50	(a)	85	(b)	120	(d)	155	(e)
16	(a)	51	(e)	86	(b)	121	(d)	156	(a)
17	(b)	52	(c)	87	(d)	122	(e)	157	(c)
18	(d)	53	(a)	88	(d)	123	(b)	158	(e)
19	(e)	54	(c)	89	(c)	124	(c)	159	(c)
20	(b)	55	(d)	90	(b)	125	(c)	160	(c)
21	(a)	56	(a)	91	(b)	126	(c)	161	(a)
22	(d)	57	(c)	92	(a)	127	(c)	162	(a)
23	(b)	58	(b)	93	(d)	128	(d)	163	(d)
24	(a)	59	(a)	94	(d)	129	(c)	164	(b)
25	(c)	60	(b)	95	(e)	130	(a)	165	(e)
26	(a)	61	(c)	96	(c)	131	(b)	166	(b)
27	(e)	62	(b)	97	(a)	132	(a)	167	(b)
28	(c)	63	(e)	98	(e)	133	(d)	168	(a)
29	(b)	64	(b)	99	(d)	134	(e)	169	(a)
30	(e)	65	(d)	100	(c)	135	(e)	170	(e)
31	(b)	66	(a)	101	(e)	136	(b)	171	(c)
32	(e)	67	(d)	102	(b)	137	(a)	172	(b)
33	(a)	68	(c)	103	(c)	138	(c)	173	(a)
34	(c)	69	(c)	104	(b)	139	(b)	174	(c)
35	(c)	70	(c)	105	(b)	140	(e)		

ANSWERS & EXPLANATIONS

1. (e) $? = 56.6 \times 16.6 \times 6.6$
$= 6201.096$

2. (c) $\frac{?}{46} \times 16 = 368$

$\Rightarrow ? = \frac{368 \times 46}{16} = 1058$

3. (e) $? = 999.99 + 99.99 + 9.99 = 1109.97$

4. (a) $? = \frac{899}{11.6} = 77.5$

5. (a) $? = 85332 - 11638 - 60994$
$? = 85332 - 72632$
$\therefore ? = 12700$

6. (d) $? = \frac{3187.8}{57.75 \times 0.8} = 69$

7. (d) Let the required number be = x
According to the question,
$x^2 - (12)^3 = 976$
or, $x^2 - 1728 = 976$
or, $x^2 = 1728 + 976 = 2704$
or, $x = \sqrt{2704} = 52$

8. (a) $? = \frac{351}{6 \times 0.5} = 117$

9. (d) $18 \times ? = \frac{7776}{12}$
$\Rightarrow ? = \frac{7776}{12 \times 18} = 36$

10. (e) $? = \frac{11 \times 55}{5} + 9$
$= 121 + 9 = 130$

11. (a) $? = 85333 - 11638 - 60994$
$? = 85333 - 72632$
$\therefore ? = 12701$

12. (c) $? = 8^4 - 8^2$
$= 8^2 (8^2 - 1) = 64 (64 - 1)$
$= 64 \times 63 = 4032$

13. (c) $? = 6.3 \times 12.8 \times 9.9 - 69.996$
$= 798.336 - 69.996 = 728.34$

14. (d) $? = 8 + \left(\frac{18 \times 368}{16}\right)$
$= 8 + 414 = 422$

15. (e) $? \times 85 = 11059 + 8889 - 908$
$\Rightarrow ? \times 85 = 19040$
$\Rightarrow ? = \frac{19040}{85} = 224$

16. (a) $? - 24848 = 107604$
$\Rightarrow ? = 107604 + 24848 = 132452$

17. (b) $? = 894.65 + 100.99 - 388.24$
$= 995.64 - 388.24 = 607.4$

18. (d) $(?)^2 + (26)^2 = 1181 + 1520$
$\Rightarrow ?^2 + 676 = 2701$
$\Rightarrow ?^2 = 2701 - 676 = 2025$
$\Rightarrow ? = \sqrt{2025} = 45$

19. (e) $\frac{59475}{\sqrt{?}} = 195 \times 5$
$\Rightarrow \sqrt{?} = \frac{59475}{195 \times 5} = 61$
$\Rightarrow 61 \times 61 = 3721$

20. (b) $\sqrt{?} + 29 = \sqrt{2704}$
$\Rightarrow \sqrt{?} + 29 = 52$
$\Rightarrow \sqrt{?} = 52 - 29 = 23$
$\therefore ? = 23 \times 23 = 529$

21. (a) $39^2 = 1521$; $38^2 = 1444$
$38^2 < 1500 < 39^2$
$\therefore$ To make1500 a perfect square, 21 should be added to it.

22. (d) $1248 \times \frac{5}{6} - 1150 \times \frac{4}{5}$
$= 1040 - 920 = 120$

23. (b) $? = 235 + 75 \times 8$
$= 235 + 600 = 835$

24. (a) $5986 - 2340 = 1496 + ?$
$\Rightarrow 3646 = 1496 + ?$
$\Rightarrow ? = 3646 - 1496 = 2150$

25. (c) $(7)^{1/4} \times (343)^{0.25} = (7)^{1/4} \times (7^3)^{1/4} = (7^4)^{1/4} = 7$

26. (a) $57.63 - 37.26 = 39.27 - ?$
$\Rightarrow 20.37 = 39.27 - ?$
$\Rightarrow ? = 39.27 - 20.37 = 18.9$

27. (e) $\sqrt{?} = \sqrt{1089} + \sqrt{289}$
$= 33 + 17 = 50$
$? = (50)^2 = 2500$

28. (c) $? = 12.8 \times 2.5 + 8.6$
$= 32 + 8.6 = 40.6$

29. (b) $?^2 = (14^2 - 13^2) \div 3$
$= (14 + 13)(14 - 13) \div 3$
$= 27 \times \frac{1}{3} = 9$
$\therefore ? = \sqrt{9} = 3$

30. (e) $(19)^? = \frac{(19)^{12} \times (19)^8}{(19)^4}$
or $(19)^? = \frac{(19)^{20}}{(19)^4}$
or $(19)^? = (19)^{20-4} = (19)^{16}$
or $? = 16$

31. (b) $? = \frac{70.56}{11.2} = 6.3$

32. (e) $x + y = 23$ and $xy = 126$
Now $x^2 + y^2 = (x + y)^2 - 2xy$
$(23)^2 - 2 \times 126$
$529 - 252$
$\Rightarrow x^2 + y^2 = 277$

33. (a) $? = 986.23 + 7.952 + 8176.158 = 9170.340$

34. (c) $? = \sqrt{1296} \div \sqrt{36}$
$= 36 \div 6 = 6$

35. (c) $112 \div 7 \div 4 = 8 \times ?$
$\Rightarrow 8 \times ? = \frac{112}{7 \times 4}$
$\Rightarrow ? = \frac{4}{8} = \frac{1}{2} = 0.5$

36. (a) $? = 3750 \times \frac{4}{8} \times \frac{2}{3} \times \frac{1}{2} = 625$

37. (e) $? = \frac{24 + 4}{135 - 9} = \frac{28}{126} = \frac{2}{9}$

38. (b) $? = (87324 - 79576) \times 1.5$
$= 7748 \times 1.5 = 11622$

39. (a) $? = 350 \times 4 \times 50 = 70000$

40. (e) $? = 11.88 \times \frac{250}{18} = 165$

41. (e) $? = \frac{1}{2} \times \frac{3}{4} \div \left(\frac{9}{2} \times \frac{5}{8}\right)$

$= \frac{1}{2} \times \frac{3}{4} \div \frac{45}{16}$

$= \frac{1}{2} \times \frac{3}{4} \times \frac{16}{45} = \frac{2}{15}$

42. (d) $? = \frac{18 + 17 \times 3 - 1}{8 - 15 \div 3 - 1}$

$= \frac{18 + 51 - 1}{8 - 5 - 1} = \frac{68}{2} = 34$

43. (a) $? = \frac{3}{2} + \frac{5}{3} \div \left(\frac{6}{7} - \frac{5}{6}\right)$

$= \frac{3}{2} + \frac{5}{3} \div \left(\frac{36 - 35}{42}\right)$

$= \frac{3}{2} + \frac{5}{3} \div \frac{1}{42} = \frac{3}{2} + \frac{5}{3} \times 42$

$= \frac{3}{2} + 70 = \frac{3 + 140}{2} = \frac{143}{2}$

$= 71.5$

44. (e) $\sqrt{?} - 63 = 9^2$

$\Rightarrow \sqrt{?} = 81 + 63 = 144$

$\Rightarrow ? = (144)^2 = 20736$

45. (e) $916.28 - 72.4 = 728.2 + ?$

$\Rightarrow 843.88 = 728.2 + ?$

$\Rightarrow ? = 843.88 - 728.2 = 115.68$

46. (c) $? = 7776 \times \frac{1}{18} \times 3 = 1296$

47. (e) $? = 8994 - 4178 - 2094$

$= 8994 - 6272 = 2722$

48. (c) $? = 315 \times 114 - 1565$

$= 35910 - 1565 = 34345$

49. (d) $? = 1256 \div (32 \times 0.25)$

$= 1256 \div 8 = 157$

50. (a) $? = 69.2 \times 18.4 \times 4.5 = 5729.76$

51. (e) $? = 3.2 \times 6.8 \times 9.5 = 206.72$

52. (c) $? = 15^3 \times 9^3 - (1555)^2$

$= 3375 \times 729 - 2418025 = 42350$

53. (a) $? = 8\frac{2}{5} \div 10\frac{2}{25}$

$= \frac{42}{5} \div \frac{252}{25}$

$= \frac{42}{5} \times \frac{25}{252} = \frac{5}{6}$

54. (c) $? = 992 \times \frac{5}{6} \times \frac{3}{4} \times \frac{3}{5} = 372$

55. (d) $\sqrt{?} + 17 = \sqrt{961}$

or $\sqrt{?} + 17 = 31$

or $\sqrt{?} = 31 - 17$

or $\sqrt{?} = 14$

or $? = 14 \times 14 = 196$

56. (a) $? = \frac{123}{6 \times 0.8} = 25.625$

57. (c)

6	3986	63
6	36	
123	386	
3	369	
126	17	

$\because$ Clearly, $63^2 < 3986 < 64^2$

$\because$ $64^2 = 4096$

$\because$ Required number $= 4096 - 3986 =$ ₹ 110

58. (b) $? = \sqrt{3781} \times 5.36$

$\approx 61.5 \times 5.36 \approx 329.64 \approx 330$

59. (a) Let the the number be $= x$

According o the question,

$x^2 - 26^2 = 549$

or, $x^2 - 676 = 549$

or, $x^2 = 549 + 676 = 1225$

or, $x = \sqrt{1225} = 35$

60. (b) $? = [(4)^3 \times (5)^4] \div (4)^5$

$= \frac{4^3 \times 5^4}{4^5} = \frac{5^4}{4^2}$

$= \frac{5 \times 5 \times 5 \times 5}{4 \times 4} = 39.0625$

61. (c) $? = \frac{1.6 \times 3.2}{0.08} = 64$

62. (b) $? = \frac{7857 + 3596 + 4123}{96}$

$= \frac{15576}{96} = 162.25$

63. (e) $? = \frac{5321}{305} \times (19)^2 = 6297.97 \approx 6300$ (approx)

64. (b) Let the number be x.

$\because$ $x^2 + 61^2 = 5242$

$\Rightarrow x^2 = 5242 - 3721$

$= 1521$

$\therefore$ $x = 39$

65. (d) $\because \sqrt{4400} \simeq 66.33$
$\therefore$ Required number $= 67^2 - 4400$
$= 4489 - 4400$
$= 89$

66. (a) Let the larger and smaller numbers be x and y respectively.
Then, $x - y = 3$ ...(i)
and, $x^2 - y^2 = 63$
$\Rightarrow (x + y)(x - y) = 63$
$\Rightarrow (x + y) = \frac{63}{3} = 21$ ...(ii)
From equation (i) and (ii), $x = 12$

67. (d) $1248 \times \frac{5}{6} - 1150 \times \frac{4}{5}$
$= 1040 - 920 = 120$

68. (c) Let the number be x.
Then,
$x^2 - (74)^2 = 5340$
$\Rightarrow x^2 = 5340 + 5476$
$= 10816$
$\Rightarrow x = \sqrt{10816} = 104$

69. (c) $2x + 3y = 78$ ... (i)
$3x + 2y = 72$ ...(ii)
From equations (i) and (ii),
$x = 12, y = 18$
$\therefore x + y = 12 + 18 = 30$

70. (c) $? = 741560 + 935416 + 1143 + 17364 = 1695483$

71. (d) $\frac{(84)^2}{\sqrt{?}} = 168$
$\sqrt{?} = \frac{84 \times 84}{168} = 42$
$\Rightarrow ? = (42)^2 = 1764$

72. (d) $? = 514789 - 317463 - 87695 - 11207 = 98424$

73. (e) $? = \sqrt[3]{50623} = \sqrt[3]{(37)^3} = 37$

74. (a) $? = \frac{93336}{17891 + 16239 - 26352} = \frac{93336}{7778} = 12$

75. (a) $? = \frac{1}{4} \times 6624 \times \frac{1}{6} \times 12 = 3312$

76. (e) $? = \frac{18 \times 15 - 50}{(40 \times 80) \div 160} = \frac{220}{20} = 11$

77. (e) $\sqrt{?} = \frac{2296}{\sqrt{1681}} = \frac{2296}{41} = 56$
$? = (56)^2 = 3136$

78. (d) Let the number be = x
According to the question,
$x^2 - (74)^2 = 3740$
or $x^2 = 3740 + 5476 = 9216$
$\therefore x = \sqrt{9216} = 96$

79. (a) $? = 93 \times 45 \div 25$
$= \frac{93 \times 45}{25} = 167.4$

80. (d) $? = \frac{0.2944}{0.08 \times 1.6} = 2.3$

81. (a) $? = 6 \times 66 \times 666 = 263736$

82. (c) $? = \frac{36}{7} \times \frac{49}{6} \times \frac{8}{63}$
$= \frac{16}{3} = 5\frac{1}{3}$

83. (e) $\frac{(7)^3}{\sqrt{?}} = 14 - 7 = 7$
$\Rightarrow \sqrt{?} = \frac{7^3}{7} = 49$
$\Rightarrow ? = 49^2 = 2401$

84. (e) $? = \frac{1035}{\sqrt[3]{12167}} = \frac{1035}{23} = 45$

85. (b) $? = 1256 \times 3892 = 4888352$

86. (b) $? = 0.08 \times 0.5 + 0.9$
$= 0.04 + 0.9 = 0.94$

87. (d) $? \times 12 = 7847 - \frac{8195}{745}$
$\Rightarrow ? \times 12 = 7847 - 11 = 7836$
$\Rightarrow ? = 653$

88. (d) $? = 4123 \div (2.3)^2 - 446$
$= \frac{4123}{2.3 \times 2.3} - 446$
$\approx 779 - 446 = 333$ (approx)

89. (c) $x + y = 18$
$\Rightarrow (x + y)^2 = 18^2 = 324$
$\Rightarrow x^2 + y^2 + 2xy = 324$
$\Rightarrow x^2 + y^2 = 324 - 2xy$
$\Rightarrow x^2 + y^2 = 324 - 2(72)$
$\Rightarrow x^2 + y^2 = 324 - 144 = 180$

90. (b)
$$\begin{array}{r|l} & 90 \\ 9 & 8115 \\ & 81 \\ \hline 180 & 15 \end{array}$$
$\therefore$ required number $= 91 \times 91 - 8115 = 166$

91. (b) Let the number be x
$\therefore x^2 - (46)^2 = 485$
$\Rightarrow x^2 = 485 + (46)^2 = 2601$
$\therefore x = \sqrt{2601} = 51$

92. (a) $666 \div (2.4 \times ?) = 185$
or $\frac{666}{2.4 \times ?} = 185$
or $? = \frac{666}{2.4 \times 185} = 1.5$

93. (d) $? = 956 \times 753 = 719868$

94. (d) $\frac{3}{8} \times \frac{4}{7} \times ? = 5376$

or $? \times \frac{3}{14} = 5376$

or $? = \frac{5376 \times 14}{3} = 25088$

95. (e) $[9^3 \times (?)^2] \div 21 = 1701$

or $\frac{9^3 \times (?)^2}{21} = 1701$

or $?^2 = \frac{1701 \times 21}{9 \times 9 \times 9} = 49$

$\therefore ? = \sqrt{49} = 7$

96. (c) $? = 897214 - (336 + 46521 + 1249 + 632176)$
$= 897214 - 680282 = 216932$

97. (a) $\sqrt{11881} \times \sqrt{?} = 10137$

or $109 \times \sqrt{?} = 10137$

or $\sqrt{?} = \frac{10137}{109} = 93$

or $? = 93 \times 93 = 8649$

98. (e) $3.5 \times 2.4 \times ? = 42$

or $? = \frac{42}{3.5 \times 2.4} = 5$

99. (d) $? = \sqrt[3]{804357}$
$= \sqrt[3]{93 \times 93 \times 93}$
[from given options]
$= 93$

100. (c) $\sqrt{?} \div 16 \times 24 = 186$

or $? = \frac{\sqrt{?}}{16} \times 24 = 186$

or $\sqrt{?} = \frac{186 \times 16}{24} = 124$

$\therefore ? = 124 \times 124 = 15376$

101. (e) $\frac{?^2}{(0.04)^2} \times 5.6 = 117740$

or $(?)^2 = \frac{117740 \times 0.04 \times 0.04}{5.6} = 33.64$

or $? = \sqrt{33.64} = 5.8$

102. (b) $9418 - ? + 1436 + 2156 = 5658$
or $13010 - ? = 5658$
or $? = 13010 - 5658 = 7352$

103. (c) $9865 + ? + 3174 + 2257 = 19425$
or $? + 15296 = 19425$
or $? = 19425 - 15296 = 4129$

104. (b) $\frac{9}{?} \times 33824 = 63$

or $? = \frac{9 \times 33824}{63} = 4832$

105. (b) $(99)^2 - (?)^2 + (38)^2 = 8436$
or $9801 - (?)^2 + 1444 = 8436$
or $11245 - (?)^2 = 8436$
or $(?)^2 = 11245 - 8436 = 2809$
or $? = \sqrt{2809} = 53$

106. (d) $? = 12.36 \times 18.15 + 21.52$
$= 224.334 + 21.52$
$= 245.854$

107. (a) $(98764 + 89881 + 99763 + 66342) \div (1186 + ? + 1040 + 1870) = 55$
or $354750 \div (? + 4096) = 55$

or $\frac{354750}{?+4096} = 55$

or $? + 4096 = \frac{354750}{55}$

or $? + 4096 = 6450$
or $? = 6450 - 4096 = 2354$

108. (a) $? = (64)^2 \div \sqrt[3]{32 \times 32 \times 32}$

or $? = \frac{64 \times 64}{32} = 128$

109. (e) $? = \frac{21 \times 14 - 34}{12.4 + 5.6 - 15.5}$

$= \frac{294 - 34}{18 - 15.5} = \frac{260}{2.5} = 104$

110. (c) $0.09 \times 6.8 \times ? = 2.142$

or $? = \frac{2.142}{0.09 \times 6.8} = 3.5$

111. (d) $? = 11 + \frac{1}{7} + 2 + \frac{5}{8}$

$= (11+2) + \left(\frac{1}{7} + \frac{5}{8}\right) = 13 + \left(\frac{8+35}{56}\right)$

$= 13 + \frac{43}{56} = 13\frac{43}{56}$

112. (d) $894 \div 28 \times \sqrt{589} = ?$

or $? = \frac{894}{28} \times 24.3 \approx 775.86$

≈ 775

113. (e) Let the number be = x
According to the question,
$x^2 + 57^2 = 8010$
or, $x^2 + 3249 = 8010$
or, $x^2 = 8010 - 3249 = 4761$
or, $x = \sqrt{4761} = 69$

114. (d) $? = 7275.84 + 124.518 - 889.4$
$= 7400.358 - 889.4 = 6510.958$

115. (a) $? = \frac{(12+4)(12-4)}{(9+3)(9-3)} = \frac{16\times 8}{12\times 6} = \frac{16}{9} = 1\frac{7}{9}$

116. (b) $? = \frac{18800}{470} \div 20 = 40 \div 20 = 2$

117. (d) $\sqrt{?} + 136 = 320 \times \frac{5}{8}$

or $\sqrt{?} + 136 = 200$

or $\sqrt{?} = 200 - 136 = 64$

or $? = 64 \times 64 = 4096$

118. (b) 946.68

119. (c) $? = \frac{0.000016}{0.04} = 0.0004$

120. (d) $? = 4^7 \div (4^2)^4 \times 4 = 4^8 \div 4^8 = 1$

121. (d) $\frac{0.99\times 1000\times 14}{11\times 0.7} = ?$

$\Rightarrow ? = \frac{990\times 14}{7.7}$

$= 1800$

122. (e) $95^{3.7} \div 95^{0.9989} = 95^?$

or $95^{(3.7 - 0.9989)} = 95^?$

or $95^{2.7011} = 95^?$

or $? = 2.7011 \approx 2.7$

123. (b) $\sqrt{10000} + 1891.992$ of $\frac{3.001}{4.987}$

$= 100 + 1892 \times \frac{3}{5} = 100 + 1135.2$

$= 1235.2 = 1230$

124. (c) $0.0004 \div 0.0001 \times 36.000009$
$= 4 \div 1 \times 36 = 144 \approx 145$

126. (c) $? = \frac{9876\times 14}{24.96} + 215.005 - 309.99$

$= 395.673 - 94.985 \simeq 300$

125. (c) $3739 + 164 \times 27 = 3739 + 4428 = 8167 \approx 8200$

127. (c) $[(135)^2 \div 15 \times 32] \div ? = 45 \times 24$

or $\left[\frac{135\times 135\times 32}{15}\right] \div ? = 45\times 24$

or $38880 \div ? = 45 \times 24$

or $? = \frac{388880}{45\times 24} = 36$

128. (d) $(96)^2 + (63)^2 = (?)^2 - (111)^2 - 8350$
or $9216 + 3969 = (?)^2 - 12321 - 8350$
or $13185 = ?^2 - 20671$
or $?^2 = 33856$
or $? = \sqrt{33856} = 184$

129. (c) $4368 - 2158 - 596 - ? = 3421 + 1262$
or $6526 - 596 - ? = 4683$
or $? = 5930 - 4683 = 1247$

130. (a) $2172 \div ? = 1832 - 956 - 514$
or $= \frac{2172}{?} = 362$
or $? = \frac{2172}{362} = 6$

131. (b) $? = 666.06 + 66.60 + 0.66 + 6.06 + 6 + 60$
$= 805.38$

132. (a) $205 \times ? \times 13 = 33625 + 25005$
or $205 \times ? \times 13 = 58630$
or $? = \frac{58630}{205\times 13} = 22$

133. (d) $? = (10)^{24} \times (10)^{-21}$
$= (10)^{24-21} = 10^3 = 1000$

134. (e)

$$\begin{array}{r|l} & 66 \\ 6 & 4321 \\ 6 & 36 \\ \hline & 721 \\ 126 & 756 \\ \hline & -35 \end{array}$$

$\therefore \quad = (66)^2 - 4321$
$= 4356 - 4321 = 35$

135. (e) $? = 628.306 + 6.1325 \times 44.0268$
$? \approx 628 + 6 \times 44$
$\approx 628 + 264 = 892 \approx 900$

136. (b) $? = 1896 \div 29 + 445$

$= \frac{1896}{29} + 445$

$= 65.4 + 445 = 510.4$

≈ 510

137. (a) $? = (9795 + 7621 + 938) \div (541 + 831 + 496)$
$= 18354 \div 1868 \approx 9.8 \approx 9$

138. (c) $814296 \times 36 = ? \times 96324$
or $? = \frac{814296\times 36}{96324} \approx 304$

139. (b) $? = 78 \div 5 \div 0.5$
$= \frac{78}{5\times 0.5} = 31.2$

140. (e) $? = 12.22 + 22.21 + 221.12$
$= 255.55$

141. (c) $? = 12^4 \times 12^{13} = 12^{4+13} = 12^{17}$

142. (a) $? = 464 \div (16 \times 2.32)$

$= \frac{464}{16\times 2.32} = 12.5$

143. (a) Let the required number be x
$\therefore \quad x^2 - (9)^3 = 567$
$x^2 = 567 + 729 = 1296$

$\therefore \quad x = \sqrt{1296} = \sqrt{(36)^2} = 36$

144. (e) Let the number be x.
According to the question,
$x^2 - 78^2 = 6460$
or, $x^2 = 6460 + 6084$
or, $x^2 = 12544$
or, $x = \sqrt{12544} = 112$

145. (c) $? = 4275 \div 496 \times 21^2$
$= \frac{4275 \times (21)^2}{496} \approx \frac{4275 \times 441}{495} \approx 3808 \approx 3810$

146. (c) $? = 14^{13} \times 14^3 = 14^{13+3} = 14^{16}$

147. (d) $69 \times 69 = 4761$
$68 \times 68 = 4624$
Clearly, $4624 < 4700 < 4761$
$\therefore$ Hence, 61 should be added to 4700 to make it a perfect square.

148. (e) $? = 21.25 + 47779.1944$
$= 4800.4444$

149. (c) $? = \frac{3}{5} \times \frac{3}{4} \times \frac{5}{6} \times 992$
$= \frac{3}{8} \times 992 = 372$

150. (d) $\frac{361.6}{6.4} = 56.5$

151. (b) 9049

152. (e) 206.72

153. (e) 2722

154. (d) $\sqrt{?} = 31 - 17 = 14 = \sqrt{196}$

155. (e) $? = \frac{9441 + 3991 - 606}{53} = \frac{12826}{53} = 242$

156. (a) 95.5

157. (c) $58369 + 69521 - 31972 = ? = 95918$

158. (e) $? = 5470 \div 378 \times 19^2$
$= \frac{5470}{378} \times 361$
$= 5223.996$
$= 5224$ (approx)

159. (c) $\because \sqrt{3986} = 63.13$
The next higher square is $(64)^2 = 4096$
$\therefore$ number to be added $= 4096 - 3986 = 110$

160. (c) $? = 832.456 - (539.982 + 123.321)$
$= 832.456 - 663.303 = 169.153$

161. (a) $236.69 + 356.74 = 393.39 + ?$
or $593.43 = 393.39 + ?$
or $? = 593.43 - 393.39 = 200.04$

162. (a) $? = \frac{35 \times 15 \times 10}{25 \times 2} = 105$

163. (d) $? = 859.05 + 427.89 + 663.17 = 1950.11$

164. (b) $? = \frac{29.05}{7} = 4.15$

165. (e) $? = \frac{558 \times 45}{18 \times 4.5} = 310$

166. (b) $559 + 965 = ? \times 16$
or $1524 = ? \times 16$
or $\Rightarrow ? = \frac{1524}{16} = 95.25$

167. (b) $? = 7 + \frac{3}{4} + 5 + \frac{1}{4} + 8 + \frac{1}{2}$
$= (7 + 5 + 8) + \left(\frac{3}{4} + \frac{1}{4} + \frac{1}{2}\right)$
$= 20 + \left(\frac{3+1+2}{4}\right)$
$= 20 + \frac{3}{2} = 20 + 1 + \frac{1}{2} = 21\frac{1}{2}$

168. (a) $? = 9.1 \times 7.5 \times 6.2$
$= 423.15$

169. (a) $49 + \sqrt{?} = 87$
or $= 87 - 49 = 38$
or $? = (38)^2 = 1444$

170. (e) $\sqrt{?} = 17 + 22 = 39$
$\Rightarrow ? = 39 \times 39$
$= 1521$

171. (c) $? = \frac{5989}{48} \times 11 \approx 124.8 \times 11 \approx 1372$

172. (b) $3x + 5y = 44$ ...(i)
$10x - 2y = 16$ ...(ii)
By equation (i) $\times$ 2 + equation (ii) $\times$ 5 we have
$6x + 10y + 50x - 10y = 88 + 80$
or, $56x = 168$
$\therefore x = \frac{168}{56} = 3$

173. (a) Given, $x + y = 20$ and $xy = 84$
$\therefore x^2 + y^2 = (x + y)^2 - 2xy$
$= (20)^2 - 2 \times 84$
$= 400 - 168 = 232$

174. (c) $? = \sqrt{876} \times 20.6 + 165.34$
$\simeq 29 \times 21 + 165$
$= 609 + 165 = 774 \approx 775$

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CHAPTER

3

PERCENTAGE

PERCENTAGE

In mathematics, percentage is a way of expressing a number as a fraction of 100 (per cent meaning per hundred). It is often denoted using the percent sign, "%".
For example, 45% (read as "forty-five percent") is equal to

$$45\% = \frac{45}{100} = 0.45$$

Quicker Methods to Solve the Problems of Percent

❖ **For converting a fraction or a decimal to a Percentage, multiply it by hundred.**

ILLUSTRATION 1: Convert the fraction $\frac{3}{5}$ into percent fraction.

Sol. $\frac{3}{5} = \left(\frac{3}{5} \times 100\right)\% = 60\%$

ILLUSTRATION 2 : Convert the fraction $\frac{3.5}{100}$ into percent fraction

Sol. $\frac{3.5}{100} = \left(\frac{3.5 \times 100}{100}\right)\% = 3.5\%$

❖ **For converting a percentage to a fraction or decimal, divide by hundred.**

ILLUSTRATION 3: Convert 60% in a fraction.

Sol. $60\% = \frac{60}{100} = \frac{3}{5}$

❖ **For converting a percentage into a decimal.**

ILLUSTRATION 4: Convert 60% into a decimal number.

Sol. $60\% = \frac{60}{100} = 0.60$

❖ **If price of a commodity is decreased by x %, the consumption should be reduced, so that the expense remains the same, by**

$$\frac{x}{(100+x)} \times 100\%$$

ILLUSTRATION 5: If the price of sugar is increased by 25%, find how much percent a family must reduce their consum- ption of sugar so as not to increase the expenditure of the family?
Sol. Reduction in consumption of sugar

$$= \left(\frac{25}{100+25} \times 100\right)\% = \left(\frac{25 \times 100}{125}\right)\% = 20\%$$

ILLUSTRATION 6 : If the price of Kerosene oil falls by 10%, find how much percent can a householder increase its consumption, so as not to decrease expenditure on this item?
Sol. Increase in consumption of Kerosene oil

$$= \left[\frac{10}{100-10} \times 100\right]\%$$

$$\left(\frac{10}{90} \times 100\right)\% = 11.11\%$$

❖ **If A is x% greater than B, then B will be**

$$\left(\frac{x}{100+x} \times 100\right)\%$$ **lesser than A.**

❖ **If A is x% lesser than B, then B will be**

$$\left(\frac{x}{100-x} \times 100\right)\%$$ **lesser than A.**

ILLUSTRATION 7 : If income of Rekha is 30% less than that of Vina, then how much percent is Vina's income more than that of Rekha?
Sol. Vina's income is more than that of Rekha by

$$= \left[\frac{30}{100-30} \times 100\right]\% = \left[\frac{30}{70} \times 100\right]\% = 42\frac{6}{7}\%$$

ILLUSTRATION 6: If Ravi's salary is 50% more than that of Gopal's, then how much percent is Gopal's salary less than that of Ravi's salary?
Sol. Gopal's salary is less than that of Ravi's by

$$= \left[\frac{50}{100+50} \times 100\right]\% = 33\frac{1}{3}\%$$

❖ **If price of a commodity is decreased by x %, the consumption can be increased, so that the expense remains the same,**

$$\text{by } \frac{x}{100+x}\times 100\ \%$$

❖ **To find percentage increase ordecrease in consumption, due to increase/decrease in price, followed by an increase/ decrease in consumption**

% increase/decrease in price (a) + % increase/decrease in consumption (b) $=\frac{a\times b}{100}=\%$ increase decrease in expenditure.

ILLUSTRATION ▶ 9: The price of sugar is increased by 20%. But expenses increased only by 10%. What is the percentage increase or decrease in consumption ?

Sol. Keeping the above formula in mind, we get–

$$20+b+\frac{20b}{100}=10,\quad \frac{120b}{100}=-10$$

$$b=\frac{-10\times 100}{120}=-8.33$$

which means that consumption decrease by 8.33%

❖ **To find given income, when percentage expenditure on different items and balance income is given, following formula can be used**

$$\left[-x_i\left(\frac{q_0\ \text{expenditure}}{100}\right)\right]\times\left[1-\frac{q_0\ \text{expenditure of the balance}}{100}\right]$$

= Remaining amount

ILLUSTRATION ▶ 10: Arvind spends 25% of his income on foods; 15% on education of his children and 20% on rent. 20% of the balance, he spends on clothes. After all this expenditure, he is left with ₹10,000. Find his total amount.

Sol. Keeping in mind, the above formula, we get –

$$\left[x-\frac{(25+1.5+20)x}{100}\right]\left(1-\frac{20}{100}\right)=10,000$$

$$=\left(x-\frac{60x}{100}\right)\left(\frac{80}{100}\right)=10,000$$

$$=\frac{40x}{100}\times\frac{80}{100}=10,000$$

$$x=\frac{10,000\times 100\times 100}{40\times 80}=31,250$$

❖ **To find population of a country, when different increase percentages are given, across a number of years, following formulas can be used–**

ILLUSTRATION ▶ 10: The present population of Agra is 15,00,000 population during 2015 grows at a rate of 10%, and that during 2016 grows ata rate of 8%. Find the population at the end of 2016.

Sol. According to the formula given above–

$$P_N=15,00,000\left(1+\frac{10}{100}\right)\left(1+\frac{8}{100}\right)=1782000$$

Students should remember that commutative property is applicable in percentage also.

So, x% of y = y% of x.

So, if you are required to 12% of 50, then it would be easier to find 50% of 12, which is '6'.

Facts to Remember

Fractional Equivalents of Important Percentages

$1\%=\frac{1}{100}$	$2\%=\frac{1}{50}$	$4\%=\frac{1}{25}$	$8\%=\frac{2}{25}$	$16\%=\frac{4}{25}$	$64\%=\frac{16}{25}$	$96\%=\frac{24}{25}$
$5\%=\frac{1}{20}$	$10\%=\frac{1}{10}$	$20\%=\frac{1}{5}$	$40\%=\frac{2}{5}$	$60\%=\frac{3}{5}$	$80\%=\frac{4}{5}$	$120\%=\frac{6}{5}$
$6\frac{1}{4}\%=\frac{1}{16}$	$12\frac{1}{2}\%=\frac{1}{8}$	$25\%=\frac{1}{4}$	$37\frac{1}{2}\%=\frac{3}{8}$	$50\%=\frac{1}{2}$	$87\frac{1}{2}\%=\frac{7}{8}$	$100\%=1$
$8\frac{1}{3}\%=\frac{1}{12}$	$16\frac{2}{3}\%=\frac{1}{6}$	$33\frac{1}{3}\%=\frac{1}{3}$	$66\frac{2}{3}\%=\frac{2}{3}$	$83\frac{1}{3}\%=\frac{5}{6}$	$133\frac{1}{3}\%=\frac{4}{3}$	$166\frac{2}{3}\%=\frac{5}{3}$

SOLVED EXAMPLES

EXAMPLE ▶ 1: 88% of 900 – $(?)^2$ = 623

(a) 69 **(b) 121**
(c) 13 **(d) 169**
(e) None of these

Sol. (c) $(?)^2 = \frac{900 \times 88}{100} - 623$

$= 792 - 623 = 169$

$\Rightarrow ? = \sqrt{169} = 13$

EXAMPLE ▶ 2 : In an annual examination Harish scores a total of 421 marks out of 675. What is his approximate percentage in the annual examination ?

(a) 56 **(b) 72**
(c) 92 **(d) 88**
(e) 62

Sol. (e) Percentage of marks obtained by Harish

$= \frac{421}{675} \times 100 \simeq 62.4 \approx 62$

ILLUSTRATION ▶ 3 : In an examination it is required to get 270 of the aggregate marks to pass. A student gets 216 marks and is declared failed by 8% marks. What are the maximum aggregate marks a student can get ?

(a) 825 **(b) 675**
(c) 750 **(d) Cannot be determined**
(e) None of these

Sol. (b) Difference = 270 - 216 = 54

According to the question,

8% of total aggregate marks = 54

$\Rightarrow$ Total aggregate marks = $\frac{54 \times 100}{8} = 675$

Alternatively,

Total aggregate marks

$= \frac{\text{Difference in marks} \times 100}{\text{\% by which the candidate scores less / more}}$

$= \frac{54 \times 100}{8} = 675$

EXAMPLE ▶ 4 : 56% of a number is 1064. What is 38% of that number ?

(a) 666 **(b) 722**
(c) 856 **(d) 912**
(e) None of these

Sol. (b) 38% of $1900 = \frac{1900 \times 38}{100} = 722$

EXAMPLE ▶ 5 : Nupur invests ₹ 89856, which is 26% of her annual income, in mutual funds. What is her monthly income ?

(a) ₹ 33606.25 **(b) ₹ 28990**
(c) ₹ 28800 **(d) ₹ 23980.50**
(e) None of these

Sol. (c) Annual income of Nupur = $\frac{89856 \times 100}{26}$ = ₹345600

$\therefore$ Nupur's monthly income = ₹$\left(\frac{345600}{12}\right)$ = ₹ 28800

EXAMPLE ▶ 6 : Two candidates contested an election. If one got 520 votes which was 65% of votes, what was the total number of votes?

(a) 858 **(b) 702**
(c) 780 **(d) 754**
(e) None of these

Sol. (e) According to the question,

$\frac{65}{100} \times$ Total votes = 520

$\therefore$ Total votes = $\frac{520 \times 100}{65} = 800$

EXAMPLE ▶ 7 : Surjeet Singh's salary is 80% of Ranjeet's salary. What is Surjeet Singh's salary if Ranjeet's salary is ₹ 15000?

(a) ₹ 10,000 **(b) ₹ 18,000**
(c) ₹ 12,500 **(d) ₹ 12,000**
(e) None of these

Sol. (d) Surjeet's salary = 80% of 15000

$= 15000 \times \frac{80}{100} =$ ₹ 12000

EXAMPLE ▶ 8 : The population of a town is 189000. It decreases by 8% in the 1st year and increases by 5% in the 2nd year. What is the population in the town at the end of 2 years ?

(a) 193914 **(b) 185472**
(c) 182574 **(d) 191394**
(e) None of these

Sol. (c) After 2 years, the required population of the town

$= 189000\left(1 - \frac{8}{100}\right)\left(1 + \frac{5}{100}\right)$

$= \left[\frac{92}{100}\right]\left[\frac{105}{100}\right] = 182574$

EXAMPLE ▶ 9 : If the numerator of a fraction is increased by 400% and the denominator is increased by 500%, the resultant fraction is $\frac{10}{21}$. What was the original fraction?

(a) $\frac{5}{12}$ (b) $\frac{8}{13}$

(c) $\frac{17}{14}$ (d) $\frac{4}{7}$

(e) **None of these**

Sol. (d) Let the original fraction be $= \frac{x}{y}$

According to the question,

$$\frac{x + 400\% \text{ of } x}{y + 500\% \text{ of } y} = \frac{10}{21}$$

or $$\frac{x \times \frac{500}{100}}{y \times \frac{600}{100}} = \frac{10}{21}$$

or $$\frac{5x}{6y} = \frac{10}{21}$$

or $$\frac{x}{y} = \frac{10}{21} \times \frac{6}{5} = \frac{4}{7}$$

EXERCISE

1. There are 1225 employees in an organization, out of which 40% got transferred to different places. How many such employees got transferred ?
   (a) 540 (b) 490
   (c) 630 (d) 710
   (e) None of these
2. If the numerator of a fraction is increased by 500% and the denominator is increased by 300%, the resultant fraction is $2\frac{4}{7}$. What was the original fraction?
   (a) $\frac{4}{7}$ (b) $\frac{12}{7}$
   (c) $\frac{15}{4}$ (d) $\frac{6}{5}$
   (e) None of these
3. What is 25% of 50% of $\frac{2}{3}$ rd of 630?
   (a) 36.5 (b) 52.5
   (c) 45.5 (d) 68.5
   (e) None of these
4. Shilpa spent 8% on school fees, 25% on rent and 17% on furniture. 25% of the remaining amount was spent on medical bills and the remaining ₹ 6,000 was set aside for investment. How much money did she spend on rent ?
   (a) ₹3,750 (b) ₹6,000
   (c) ₹4,000 (d) ₹3,250
   (e) None of these
5. The difference between 89% of a number and 73% of the same number is 448. What is 49% of that number ?
   (a) 1426 (b) 1372
   (c) 1218 (d) 1124
   (e) None of these
6. 75% of 740 of $\frac{3}{5} = ?$
   (a) 121 (b) 91
   (c) 555 (d) 333
   (e) None of these
7. If the production of a factory grows at a 8% p.a., what will be its production for the year 2006 if its production in 2004 was 70 lakh tonnes?
   (a) 63.48 lakh tonnes (b) 81.68 lakh tonnes
   (c) 81 lakh tonnes (d) 80.68 lakh tonnes
   (e) None of these
8. The difference between 58% of a number and 39% of the same number is 247. What is 62% of that number ?
   (a) 1,300 (b) 806
   (c) 754 (d) 1,170
   (e) None of these
9. What is 240 per cent of 700?
   (a) 1650 (b) 1780
   (c) 1560 (d) 1710
   (e) None of these
10. 15% of 6500 = ? % of 12500
    (a) 8.2 (b) 7.5
    (c) 6.3 (d) 7.8
    (e) None of these
11. The population of a town is 126800. It increases by 15% in the 1st year and decreases by 20% in the 2nd year. What is the population of the town at the end of 2 years?
    (a) 174984 (b) 135996
    (c) 116656 (d) 145820
    (e) None of these
12. 8926 – ? % of 650 = 8848
    (a) 15 (b) 8
    (c) 12 (d) 10
    (e) None of these

13. 52% of 666 + ? = 500
(a) 138.53 (b) 168.46
(c) 144.54 (d) 153.68
(e) None of these

14. The difference between 75% of a number and 20% of the same number is 378.4. What is 40% of that number ?
(a) 275.2 (b) 274
(c) 267.2 (d) 266
(e) None of these

15. If the numerator of a fraction is increased by 200% and the denominator of the fraction is increased by 150%, the resultant fraction is $\frac{9}{35}$. What is the original fraction?
(a) $\frac{3}{10}$ (b) $\frac{2}{15}$
(c) $\frac{3}{16}$ (d) $\frac{2}{7}$
(e) None of these

16. 40% of 15% of 3/4th of a number is 153. What is the number?
(a) 3400 (b) 3650
(c) 3600 (d) 3200
(e) None of these

17. 680% of (?) = 290360
(a) 43800 (b) 42700
(c) 41900 (d) 42500
(e) None of these

18. 920 × ? % of 7.5 = 2898
(a) 42 (b) 36
(c) 45 (d) 48
(e) None of these

19. The difference between 42% of a number and 35% of the same number is 110.6. What is 60% of that number?
(a) 936 (b) 948
(c) 790 (d) 1106
(e) None of these

20. If the numerator of a fraction is increased by 250% and the denominator is increased by 300%, the resultant fraction is $\frac{7}{9}$. What is the original fraction ?
(a) $\frac{8}{11}$ (b) $\frac{7}{8}$
(c) $\frac{8}{9}$ (d) $\frac{7}{11}$
(e) None of these

21. The wheat sold by a grocer contained 10% low quality wheat. What quantity of good quality wheat should be added to 150 kgs of wheat so that the percentage of low quality wheat becomes 5%?
(a) ₹150kg (b) ₹135kg
(c) ₹50kg (d) ₹85kg
(e) None of these

22. What is 26% of 55% of $\frac{10}{13}$ th of 6100?
(a) 617 (b) 681
(c) 706 (d) 734
(e) None of these

23. One-eighth of a number is 17.25. What will 73% of the number be ?
(a) 100.74 (b) 138.00
(c) 96.42 (d) 82.66
(e) None of these

24. 45% of a number is 255.6. What is 25% of that number?
(a) 162 (b) 132
(c) 152 (d) 142
(e) None of these

25. The difference between 42% and 28% of a number is 210. What is 59% of that number?
(a) 630 (b) 885
(c) 420 (d) 900
(e) None of these

26. In an examination it is required to get 40% of the aggregate marks to pass. A student gets 261 marks and is declared failed by 4% marks. What are the maximum aggregate marks a student can get?
(a) 700 (b) 730
(c) 745 (d) 765
(e) None of these

27. The difference between 58% of a number and 39% of the same number is 247. What is 82% of that number ?
(a) 1300 (b) 1066
(c) 1052 (d) 1000
(e) None of these

28. 56% of a number is 463.68. What is 25% of that number?
(a) 202 (b) 204
(c) 206 (d) 208
(e) None of these

29. Manish invests ₹ 3,818, which is 20% of his monthly income, in insurance policies. What is his monthly income?
(a) ₹19090 (b) ₹19900
(c) ₹19990 (d) ₹19009
(e) None of these

30. There are 1556 employees in an organization. Out of these, 25% got transferred to different places. How many such employees got the transfer?
(a) 394 (b) 404
(c) 419 (d) 399
(e) None of these

31. In an examination Nisha scores a total of 555 marks out of 850. What is her approximate percentage in the examination?
(a) 59 (b) 72
(c) 68 (d) 65
(e) 70

32. What is the value of 280% of 460?
(a) 1188 (b) 1284
(c) 1288 (d) 1280
(e) None of these

33. A student scores 64% marks in 6 papers of 150 marks each. He scores 25% of his total obtained marks in Hindi and English together. How much is his total score for both these papers?
(a) 120 (b) 124
(c) 140 (d) 144
(e) 150

34. Sumit obtained a total of 1012 marks out of 1150 in an examination. What is his percentage in the examination?
(a) 86 (b) 88
(c) 84 (d) 90
(e) None of these

35. 570 % of ? = 377910
(a) 64900 (b) 66300
(c) 64100 (d) 65600
(e) None of these

36. The population of a town is 198000. It increases by 7% in the 1st year and decreases by 5% in the 2nd year. What is the population of the town at the end of 2 years?
(a) 211860 (b) 201267
(c) 222453 (d) 198900
(e) None of these

37. The difference between 38% of a number and 24% of the same number is 135.10. What is 40% of that number?
(a) 394 (b) 370
(c) 378 (d) 386
(e) None of these

38. The total number of boys in a school is 24% more than the total number of girls in the school. What is the respective ratio of the total number of boys to the total number of girls in the school?
(a) 25 : 31 (b) 31 : 25
(c) 91 : 21 (d) Cannot be determined
(e) None of these

39. In an examination it is required to get 256 of the total maximum aggregate marks to pass. A student gets 192 marks and is declared failed. The difference of marks obtained by the student and that required to pass is 10%. What are the maximum aggregate marks a student can get?
(a) 690 (b) 670
(c) 640 (d) Cannot be determined
(e) None of these

39. The difference between 58% of a number and 37% of the same number is 399. What is 72% of that number?
(a) 1913 (b) 1330
(c) 1425 (d) 1368
(e) None of these

40. What is the value of 150% of 3342 ?
(a) 4869 (b) 5013
(c) 5163 (d) 5019
(e) None of these

41. There are 1850 employees in an organization. Out of these 38% got transferred to different places. How many such employees got the transfer?
(a) 740 (b) 723
(c) 703 (d) 717
(e) None of these

42. 70% of a number is 644. What is 30% of that number?
(a) 274 (b) 302
(c) 252 (d) 328
(e) None of these

43. Manish invests ₹ 3,960, which is 30% of his monthly income, in insurance policies. What is his monthly income?
(a) ₹13,200 (b) ₹13,400
(c) ₹13,600 (d) ₹13,800
(e) None of these

44. In an examination Krish scores a total of 654 marks out of 950. What is his approximate percentage in the examination?
(a) 74 (b) 65
(c) 63 (d) 78
(e) 69

45. Swapana spent ₹ 44,620 on Deepawali Shopping, ₹ 32,764 on buying Laptop and the remaining 32% of the total amount was left as cash with her. What was the total amount?
(a) ₹ 36,416 (b) ₹ 1,13,800
(c) ₹ 77,384
(d) Cannot be determined
(e) None of these

46. 12% of 550 + ?% of 320 = 82
(a) 6 (b) 8
(c) 5 (d) 9
(e) None of these

47. In a examination it is required to get 40% of the aggregate marks to pass. A student gets 265 marks and is declared failed by 55 marks. What is the maximum aggregate marks a student can get ?
(a) 800 (b) 750
(c) 650 (d) Cannot be determined
(e) None of these

48. 64% of (?) – 96% of 1120 = 499.2
(a) 2600 (b) 2540
(c) 2460 (d) 2280
(e) None of these

49. If the numerator of a fraction is increased by 200% and the denominator is increased by 160%, the resultant fraction is $\frac{7}{13}$. What is the original fraction?
(a) $\frac{7}{15}$ (b) $\frac{2}{5}$
(c) $\frac{8}{15}$ (d) $\frac{5}{7}$
(e) None of these

50. 58% of 960 – ? % of 635 = 277.4
(a) 24 (b) 36
(c) 44 (d) 58
(e) None of these

51. 65% of 599 = ?
(a) 345.65 (b) 389.35
(c) 413.75 (d) 436.85
(e) None of these

52. (18% of 250 + 25% of 144) of ? = 54

(a) $\frac{2}{3}$ (b) $\frac{3}{2}$

(c) $\frac{4}{9}$ (d) $\frac{1}{3}$

(e) None of these

53. 36% of 4800 × 0.2% of 1320 = ?

(a) 4535.52 (b) 4551.36

(c) 4561.92 (d) 4572.48

(e) None of these

54. ? % of 35568 ÷ 650 = 456

(a) 12 (b) 16

(c) 18 (d) 14

(e) None of these

55. 60% of $8\frac{1}{4}+\frac{6}{5}$ = 15 - ?

(a) 5.55 (b) 6.27

(c) 8.85 (d) 6.13

(e) None of these

56. 35% of 160 + ?% of 180 = 50% of 310

(a) 35 (b) 55

(c) 65 (d) 45

(e) None of these

57. 137% of 12345 ≈ ?

(a) 17000 (b) 15000

(c) 1500 (d) 14300

(e) 900

58. (8.2% of 365) – (1.75% of 108) = ?

(a) 16.02 (b) 28.04

(c) 42.34 (d) 53.76

(e) None of these

59. (739% of 383) ÷ 628 ≈ ?

(a) 10.00 (b) 4.50

(c) 15.75 (d) 19.25

(e) 24.15

60. 94.5% of 550 = ?

(a) 506.45 (b) 521.65

(c) 518.55 (d) 519.75

(e) None of these

61. $\frac{7}{8}$ of 248 + 20% of 110 = ?

(a) 192 (b) 202

(c) 212 (d) 239

(e) None of these

62. Bovina spent ₹ 44,668 on her air tickets, ₹ 56,732 on buying gifts for the family members and the remaining 22% of the total amount she had as cash with her. What was the total amount?

(a) ₹ 28,600 (b) ₹ 1,30,000

(c) ₹ 1,01,400 (d) ₹ 33,800

(e) None of these

63. In a college election between two candidates, one candidate got 55% of the total valid votes. 15% of the votes were invalid. If the total votes were 15,200, what is the number of valid votes the other candidate got ?

(a) 7106 (b) 6840

(c) 8360 (d) 5814

(e) None of these

64. 15% of 45% of a number is 105.3. What is 24% of that number?

(a) 385.5 (b) 374.4

(c) 390 (d) 375

(e) None of these

65. On a test consisting of 250 questions, Jassi answered 40% of the first 125 questions correctly. What percent of the other 125 questions does she need to answer correctly for her grade on the entire exam to be 60% ?

(a) 75 (b) 80

(c) 60 (d) Cannot be determined

(e) None of these

66. The population of a town was 48600. It increased by 25% in the first year and decreased by 8% in the second year. What will be the population of the town at the end of 2 years?

(a) 65610 (b) 55580

(c) 60750 (d) 64850

(e) None of these

67. Twenty five percent of Pranab's annual salary is equal to eighty percent of Surya's annual salary. Surya's monthly salary is forty percent of Dheeru's monthly salary. If Dheeru's annual salary is ₹ 6 lacs,what is Pranab's monthly salary ? (At some places annual income and in some place monthly income is given.)

(a) ₹ 7.68 lacs (b) ₹ 56,000

(c) ₹ 8.4 lacs (d) ₹ 64,000

(e) None of these

68. In a test, minimum passing percentage for girls and boys is 30% and 45% respectively. A boy scored 280 marks and failed by 80 marks. How many more marks did a girl require to pass in the test if she scored 108 marks ?

(a) 132 (b) 140

(c) 160 (d) 112

(e) None of these

69. Two candidates fought an election. One of them got 64% of the total votes and won with 992 votes. What was the total number of votes polled ?

(a) 1500 (b) 1580

(c) 1550 (d) Cannot be determined

(e) None of these

70. In an examination it is required to get 336 aggregate marks to pass. A student gets 35% marks and is declared failed by 42 marks. What are the maximum aggregate marks a student can get?

(a) 800 (b) 825

(c) 850 (d) Cannot be determined

(e) None of these

71. Mr. Khanna took a loan of ₹ 10,000 on simple interest for two years at the rate of 3 p.c.p.a. The total amount that he will be paying as interest in 2 years is 13% of his monthly salary. What is his monthly salary?

(a) ₹30,000 (b) ₹16,000
(c) ₹20,000 (d) ₹12,000
(e) None of these

72. If the numerator of certain fraction is increased by 200% and the denominator is increased by 150% the new fraction is thus formed is $\frac{9}{10}$. What is the original fraction?

(a) $\frac{3}{4}$ (b) $\frac{1}{4}$
(c) $\frac{3}{5}$ (d) $\frac{2}{5}$
(e) None of these

73. Yesterday Priti typed an essay of 5000 words at the speed of 60 words per minute. Today she typed the same essay faster and her speed was 15% more than yesterday. What is the approximate difference in the time she took to type yesterday and the time she took to type today?
(a) 20 minutes (b) 30 minutes
(c) 10 minutes (d) 40 minutes
(e) 1 hour

74. 71% of a number is more than its 46% by 120. What is 30% of that number?
(a) 160 (b) 150
(c) 140 (d) 148
(e) None of these

75. Latika spends 45% of her monthly income on food and 30% of the monthly income on transport. Remaining amount ₹4500 She saves. What is her monthly income?
(a) ₹16000 (b) ₹18000
(c) ₹16500 (d) ₹18500
(e) None of these

76. Last year there were 610 boys in a school. The number decreased by 20 percent this year. How many girls are there in the school if the number of girls is 175 percent of the total number of boys in the school this year ?
(a) 854 (b) 848
(c) 798 (d) 782
(e) None of these

77. Aryan got 350 marks and Vidya scored 76 percent marks in the same test. If Vidya scored 296 marks rltere than Aryan what were the maximum marks of the test ?
(a) 650 (b) 900
(c) 850 (d) 950
(e) None of these

78. A student was awarded certain marks in an examination. However, after re-evaluation, his marks were reduced by 40% of the marks that were originally awarded to him so that the new score now became 96. How many marks did the student lose after re-evaluation?
(a) 58 (b) 68
(c) 63 (d) 56
(e) 64

79. 855 candidates applied for a job, out of which 80% of the candidates were rejected. How many candidates were selected for the job?
(a) 684 (b) 151
(c) 676 (d) 179
(e) None of these

80. What should come in place of the question mark so that it satisfies equality of the equation?
32% of 750 <?
(a) 23% of 600 (b) 46% of 207
(c) 98% of 250 (d) 75% of 320
(e) None of these

81. Mathew scored 42 marks in Biology, 51 marks in Chemistry. 58 marks Mathematics, 35 marks in Physics and 48 marks in English. The maximum marks a student can score in each subject are 60. How much overall percentage did Mathev. get in this exam?
(a) 76 (b) 82
(c) 68 (d) 78
(e) None of these

82. Kajal spends 55% of her monthly income on grocery, clothes and education in the ratio of 4 : 2 : 5 respectively. If the amount spent on clothes is ₹5540/-, what is Kajal's monthly income?
(a) ₹55,400/- (b) ₹54,500/-
(c) ₹55,450/- (d) ₹55,650/-
(e) None of these

83. 35 percent of a number is two times 75 percent of another number. What is the ratio between the first and the second number respectively?
(a) 35:6 (b) 31:7
(c) 23:7 (d) 32:9
(e) None of these

84. If the numerator of a fraction is increased by 20% and the denominator is increased by 25%, the fraction obtained is $\frac{3}{5}$ What was the original fraction ?

(a) $\frac{5}{7}$ (b) $\frac{4}{7}$
(c) $\frac{3}{8}$ (d) Cannot be determined
(e) None of these

85. The number of employees in Companies A, B and C are it i ratio of 4 : 5 : 6 respectively. If the number of employees m the Companies is increased by 25%, 30% and 50% respectively, what will be the new ratio of employees working in Companies A, B and C respectively?
(a) 13:10:18 (b) 10:13:17
(c) 13:15:18 (d) Cannot be determinec
(e) None of these

86. 65% of a number is more than its $\frac{2}{5}$ th by 140. What is 30% of that number ?
(a) 186 (b) 168
(c) 164 (d) 182
(e) None of these

87. Sonali invests 15% of her monthly salary in insurance policies. She spends 55% of her monthly salary in shopping and on household expenses. She saves the remaining amount of ₹12,750. What is Sonali's monthly income?
(a) ₹42,500 (b) ₹38,800
(c) ₹40,000 (d) ₹35,500
(e) None of these

88. Mr. Davar spends 38% of his monthly income on food, 25% on children's education and 12% on transport and the remaining amount of ₹5.800 he saves. What is Mr. Davar's monthly income?
(a) ₹23,200 (b) ₹24,200
(c) ₹23,800 (d) ₹24,400
(e) None of these

89. 56% of a number is less than its 72% by 56. What is 70% of that number?
(a) 300 (b) 235
(c) 240 (d) 350
(e) None of these

90. Nandkishore gives 35% of the money he had to hiswife and gave 50% of the money he had to his sons. Remaining amount of ₹11250 he kept for himself. What was the total amount of money Nandkishore had ?
(a) ₹63750 (b) ₹75000
(c) ₹73650 (d) ₹72450
(e) None of these

91. Mr. Nair's monthly salary is ₹22,500. He took a loan of ₹30,000 on simple interest for 3 years at the rate of 5 p.c.p.a The amount that he will be paying as simple interest in 3 years is what percent of his monthly salary?
(a) 10 (b) 18
(c) 20 (d) 25
(e) None of these

92. The sum of 15% of a positive number and 10% of the same number is 70. What is twice of that number ?
(a) 440 (b) 280
(c) 560 (d) 140
(e) None of these

93. Vikram scored 72 per cent marks in five subjects together, viz; Hindi, Science, Maths, English and Sanskrit together, where in the maximum marks of each subject were 100. How many marks did Vikram score in Science if he scored 80 marks in Hindi, 70 marks in Sanskrit, 76 marks in Maths and 65 marks in English?
(a) 72 (b) 69
(c) 59 (d) 71
(e) None of these

94. In order to pass in an exam a student is required to get 975 marks out of the aggregate marks. Priya got 870 marks and was declared failed by 7 per cent. What are the maximum aggregate marks a student can get in the examination?
(a) 1500 (b) 1000
(c) 1200 (d) Cannot be determined
(e) None of these

95. Six-eleventh of a number is equal to twenty-two percent of second number. Second number is equal to the one-fourth of third number. The value of the third number is 2400. What is 45% of first number ?
(a) 109.8 (b) 111.7
(c) 117.6 (d) 123.4
(e) None of these

96. HR company employees 4800 people, out of which 45 percent are males & 60 percent of the males are either 25 years or older. How many males are employed in that HR company who are younger than 25 years ?
(a) 2640 (b) 2160
(c) 12% (d) 864
(e) None of these

97. A team played 40 games in a season a won in 24 of them. What percent of games played did the team win?
(a) 70% (b) 40%
(c) 60% (d) 35%
(e) None of these

98. In an examination, Raman scared 25 marks less than Rohit. Rohit scored 45 more marks than Sonia. Rohan scored 75 marks which is 10 more than Sonia. Ravi's score is 50 less than, max marks of the test. What approximate percentage of marks did Ravi score in the examination, if he gets 34 marks more than Raman?
(a) 90 (b) 70
(c) 80 (d) 60
(e) 85

99. Mr. Giridhar spends 50% of his monthly income on household items and out of the remaining he spends 50% on transport 25% of entertainment, 10% on sports and the remaining amount of? 900 is saved. What is Mr. Giridhar's monthly income?
(a) 6000 (b) 12000
(c) 9000 (d) Cannot be determined
(e) None of these

100. Sum of 3 consecutive numbers is 2262. What is 41% of the highest number ?
(a) 301.51 (b) 303.14
(c) 308.73 (d) 306.35
(e) 309.55

101. Akash scored 73 marks in subject A. He scored 56% marks in subject B and X marks in subject C. Maximum marks in each subject were 150. The overall percentage marks obtained by Akash in all the three subjects together were 54%. How many marks did he score in subject C?
(a) 84 (b) 86
(c) 79 (d) 73
(e) None of these

Answer Key

1	**(b)**	19	**(b)**	37	**(d)**	55	**(c)**	73	**(c)**	91	**(c)**
2	**(b)**	20	**(c)**	38	**(b)**	56	**(b)**	74	**(e)**	92	**(c)**
3	**(b)**	21	**(a)**	39	**(c)**	57	**(a)**	75	**(b)**	93	**(b)**
4	**(c)**	22	**(e)**	40	**(b)**	58	**(b)**	76	**(a)**	94	**(a)**
5	**(b)**	23	**(a)**	41	**(c)**	59	**(b)**	77	**(c)**	95	**(e)**
6	**(d)**	24	**(d)**	42	**(e)**	60	**(d)**	78	**(e)**	96	**(d)**
7	**(e)**	25	**(b)**	43	**(a)**	61	**(d)**	79	**(e)**	97	**(c)**
8	**(b)**	26	**(e)**	44	**(e)**	62	**(b)**	80	**(c)**	98	**(b)**
9	**(e)**	27	**(b)**	45	**(b)**	63	**(d)**	81	**(d)**	99	**(b)**
10	**(d)**	28	**(e)**	46	**(c)**	64	**(b)**	82	**(a)**	100	**(e)**
11	**(c)**	29	**(a)**	47	**(a)**	65	**(b)**	83	**(e)**	101	**(b)**
12	**(c)**	30	**(e)**	48	**(c)**	66	**(e)**	84	**(e)**		
13	**(d)**	31	**(d)**	49	**(a)**	67	**(d)**	85	**(e)**		
14	**(a)**	32	**(c)**	50	**(c)**	68	**(a)**	86	**(b)**		
15	**(e)**	33	**(d)**	51	**(b)**	69	**(e)**	87	**(a)**		
16	**(a)**	34	**(b)**	52	**(a)**	70	**(e)**	88	**(a)**		
17	**(b)**	35	**(b)**	53	**(c)**	71	**(c)**	89	**(e)**		
18	**(a)**	36	**(b)**	54	**(e)**	72	**(a)**	90	**(b)**		

ANSWERS & EXPLANATIONS

1. (b) Number of transferred employees
$= 40\%$ of 1225

$= \dfrac{1225 \times 40}{100} = 490$

2. (b) Let the original fraction be $\dfrac{x}{y}$.

Then, $\dfrac{x+5x}{y+3y} = 2\dfrac{4}{7}$

$\Rightarrow \quad \dfrac{6x}{4y} = \dfrac{18}{7}$

$\Rightarrow \quad \dfrac{x}{y} = \dfrac{72}{42} = \dfrac{12}{7}$

3. (b) $\dfrac{25}{100} \times \dfrac{50}{100} \times \dfrac{2}{3} \times 630$
$= 52.5$

4. (c) Let the income of Shilpa be = ₹x

$\left[x - \dfrac{(8+25+17)x}{100}\right]\left(1 - \dfrac{25}{100}\right) = 6000$

$\dfrac{50x}{100} \times \dfrac{75}{100} = 6000$

$x = \dfrac{6000 \times 100 \times 100}{50 \times 75} = 16,000$

$\therefore$ Expenditure on rent $= 16000 \times \dfrac{25}{100} =$ ₹4000

5. (b) $\therefore (89-73)\%$ of $x = 448$

$\Rightarrow$ Number $= \dfrac{448 \times 100}{16} = 2800$

$\therefore \quad 49\%$ of $2800 = \dfrac{2800 \times 49}{100} = 1372$

6. (d) $740 \times \dfrac{75}{100} \times \dfrac{3}{5} = 333$

7 (e) Required production $= 70\left(1 + \dfrac{8}{100}\right)^2$ lakh tonnes

$= 70\left(1 + \dfrac{2}{25}\right)^2$ lakh tonnes

$= 70 \times \dfrac{27}{25} \times \dfrac{27}{25} = 81.648$ lakh tonnes

8. (b) Accoring to the question,
$(58-39)\%$ of $x = 247$

or, number $= \dfrac{247 \times 100}{19} = 1300$

$\therefore 62\%$ of $1300 = 1300 \times \dfrac{62}{100} = 806$

9. (e) $240\%\ \text{of}\ 700$

$= 700 \times \frac{240}{100} = 1680$

10. (d) $\frac{15}{100} \times 6500 = \frac{?}{100} \times 12500$

$? = \frac{15 \times 6500}{12500} = 7.8$

11. (c) Population at the end of 2nd year

$= 126800 \times \left(1 + \frac{15}{100}\right) \times \left(1 - \frac{20}{100}\right)$

$= 126800 \times \frac{115}{100} \times \frac{80}{100} = 116656$

12. (c) $8926 - \frac{?}{100} \times 650 = 8848$

$\Rightarrow \quad \frac{?}{100} \times 650 = 8926 - 8848 = 78$

$\Rightarrow \quad ? = \frac{78 \times 100}{650} = 12$

13. (d) $666 \times \frac{52}{100} + ? = 500$

$\therefore\ ? = 500 - 346.32 = 153.68$

14. (a) Let the number be x.

$\therefore \quad \frac{75x}{100} - \frac{20x}{100} = 378.4$

or, $\quad x = \frac{378.4 \times 100}{55}$

$\therefore \quad \frac{40x}{100} = \frac{378.4 \times 100}{55} \times \frac{40}{100} = 275.2$

15. (e) Fraction is $\frac{x}{y}$

$\therefore \quad \frac{x + \frac{200}{100}x}{y + \frac{150}{100}y} = \frac{9}{35}$

$\Rightarrow \quad \frac{x + 2x}{y + 1.5y} = \frac{9}{35}$

$\Rightarrow \quad \frac{3x}{2.5y} = \frac{9}{35}$

$\therefore \quad \frac{x}{y} = \frac{9 \times 2.3}{3 \times 35} = \frac{3}{14}$

16. (a) Let the number be = x

$\Rightarrow \quad x = \frac{153 \times 4 \times 100 \times 100}{3 \times 15 \times 40} = 3400$

17. (b) $? \times \frac{680}{100} = 290360$

or $? = \frac{290360 \times 100}{680} = 42700$

18. (a) $\frac{920 \times ? \times 7.5}{100} = 2898$

or $? = \frac{2898 \times 100}{920 \times 7.5} = 42$

19. (b) According to the question,

$(42 - 35)\%$ of $x = 110.6$

or, number $= \frac{110.6 \times 100}{7} = 1580$

$\therefore\ 60\%\ \text{of}\ 1580 = \frac{1580 \times 60}{100} = 948$

20. (c) Let the original fraction be $= \frac{x}{y}$

According to the question,

$\frac{x \times \frac{350}{100}}{y \times \frac{400}{100}} = \frac{7}{9}$

$\Rightarrow \frac{7x}{8y} = \frac{7}{9} \Rightarrow \frac{x}{y} = \frac{7}{9} \times \frac{8}{7} = \frac{8}{9}$

21. (a) Weight of low quality of wheat in 150 kgs of wheat

$= \frac{150 \times 10}{100} = 15$ kg.

Suppose that x kgs of good quality wheat is mixed.

According to the question,

$\frac{(x + 150) \times 5}{100} = 15$

or, $x = 150$ kg.

22. (e) Required value $= 6100 \times \frac{10}{13} \times \frac{55}{100} \times \frac{26}{100} = 671$

23. (a) Let the number be = x

According to the question,

$\therefore\ \frac{x}{8} = 17.25$

or $x = 17.25 \times 8 = 138$

$\therefore\ 73\%\ \text{of}\ 138 = 138 \times \frac{73}{100} = 100.74$

24. (d) According to the question,

$\therefore \quad x \times \frac{45}{100} = 255.6$

or $\quad x = 255.6 \times \frac{20}{9} = 568$

$\therefore$ 25% of number $= x \times \frac{25}{100}$

$= 568 \times \frac{25}{100} = 142$

25. (b) Difference in % $= 42 - 28 = 14\%$

$\therefore$ Number $= \frac{210 \times 100}{14} = 1500$

$\therefore$ Required answer $= \frac{59}{100} \times 1500 = 885$

26. (e) According to the question,
$(40 - 4)\%$ of $x = 261$

$\therefore$ Max. marks $= \frac{261}{36} \times 100 = 725$

27. (b) $(58 - 39)\%$ of number

$\therefore$ Number $\times \frac{56}{100} = 463.68$

$\Rightarrow$ Number $= \frac{463.68 \times 100}{56} = 828$

$\therefore$ 25% of number $= 828 \times \frac{25}{100} = 207$

28. (e) According to the question,

$\because$ *number* $\times \frac{56}{100} = 463.68$

$\Rightarrow$ *number* $= \frac{463.68 \times 100}{56} = 828$

$\therefore$ 25% of $x = 828 \times \frac{25}{100} = 207$

29. (a) The monthly salary of Manish will be

$= \frac{3818 \times 100}{20} =$ ₹19090

30. (e) Required number of transferred employees

$= \frac{1556 \times 25}{100} = 389$

31. (d) Required % $= \frac{555 \times 100}{850} = 65.294\%$

$= 65\%$ (approx.)

32. (c) Required answer $= 460 \times \frac{280}{100} = 1288$

33. (d) Total marks obtained by the student

$= 6 \times \frac{64}{100} \times 150 = 576$

Marks obtained in Hindi and English

$= 25\%$ of $576 = 576 \times \frac{25}{100} = 144$

34. (b) Required percentage $= \frac{1012}{1150} \times 100 = 88$

35. (b) $? \times \frac{570}{100} = 377910$

or $? = \frac{377910 \times 100}{570} = 66300$

36. (b) Population of the town after 2 years

$= 198000 \left(1 + \frac{7}{100}\right)\left(1 - \frac{5}{100}\right)$

$= \frac{198000 \times 107 \times 95}{100 \times 100} = 201267$

37. (d) Accordin to the question,
$(38 - 24)\%$ of number $= 135.10$

or, number $\times \frac{14}{100} = 135.10$

or, number $= \frac{135.10 \times 100}{14} = 965$

$\therefore$ 40% of $965 = 965 \times \frac{40}{100} = 386$

38. (b) Let the number of girls in the school be = 100
$\therefore$ Number of boys = 124
$\therefore$ Required ratio $= 124 : 100 = 31 : 25$

39. (c) According to the question,
5% of max. marks $= 296 - 259$

$\therefore$ Max.marks $= \frac{3700}{5} = 740$

40. (b) Required number $= 3342 \times \frac{150}{100} = 5013$

41. (c) Required number of employees

$= \frac{1850 \times 38}{100} = 703$

42. (e) $\because \frac{x \times 70}{100} = 644$

$\Rightarrow$ Number $= \frac{644 \times 100}{70}$

$\therefore$ 30% of number $= \frac{644 \times 100}{70} \times \frac{30}{100} = 276$

43. (a) Required monthly income

$= \frac{3960 \times 100}{30} =$ ₹13200

44. (e) Required approximate percentage

$$=\frac{654\times100}{950}\%=68.84\%\approx69\%$$

45. (b) Total amount spent
$=44620+32764=₹77384$
Percentage of amount spent $=100-32=68\%$
$\therefore 68\%=77384$

$$\therefore 100\%=\frac{77384\times100}{68}=₹113800$$

46. (c) $\frac{550\times12}{100}+\frac{320\times?}{100}=82$

$\Rightarrow 66+3.2\times?=82$
$\Rightarrow 3.2\times?=82-66$

$$\Rightarrow ?=\frac{16}{3.2}=5$$

47. (a) Let the maximum marks be x

$$\therefore \quad (265+55)=\frac{40x}{100}$$

or $320\times100=40x$

$$\therefore \quad x=\frac{320\times100}{40}=800$$

48. (c) $\frac{?\times64}{100}-\frac{1120\times96}{100}=499.2$

or $?\times\frac{64}{100}-1075.2=499.2$

or $?\times\frac{64}{100}=499.2+1075.2$

or $?\times\frac{64}{100}=1574.4$

$$\therefore ?=\frac{1574.4\times100}{64}=2460$$

49. (a) Let the original fraction $=\frac{x}{y}$

According to the question,

$$\frac{\frac{300x}{100}}{\frac{260y}{100}}=\frac{7}{13}$$

or $\frac{30x}{26y}=\frac{7}{13}$

$$\therefore \frac{x}{y}=\frac{7}{13}\times\frac{26}{30}=\frac{7}{15}$$

50. (c) $960\times\frac{58}{100}-\frac{635\times?}{100}=277.4$

$\Rightarrow 960\times58-635\times?=277.4\times100$
$\Rightarrow 55680-635\times?=27740$
$\Rightarrow 635\times?=55680-27740=27940$

$$\Rightarrow ?=\frac{27940}{635}=44$$

51. (b) $?=\frac{599\times65}{100}=389.35$

52. (a) $\left(250\times\frac{18}{100}+144\times\frac{25}{100}\right)$ of $?=54$

$\Rightarrow (45+36)$ of $?=54$
$\Rightarrow 81\times?=54$

$$\Rightarrow ?=\frac{54}{81}=\frac{2}{3}$$

53. (c) $?=\frac{36}{100}\times4800\times\frac{0.2}{100}\times1320$

$=1728\times2.64=4561.92$

54. (e) $\frac{?}{100}\times\frac{35568}{650}=456$

$$\Rightarrow \frac{456\times100\times650}{35568}\simeq903$$

55. (c) $15-\frac{6}{5}-60\%$ of $8\frac{1}{4}$

$=13.8-\frac{60}{100}\times\frac{33}{4}$

$=13.80-4.95=8.85$

56. (b) $160\times\frac{35}{100}+\frac{180\times?}{100}=\frac{310\times50}{100}$

or $160\times35+180\times?=310\times50$
or $5600+180\times?=15500$
or $180\times?=15500-5600=9900$

or $?=\frac{9900}{180}=55$

57. (a) 137% of 12345

$$=\frac{12345\times137}{100}=16912.65\approx17000$$

58. (b) $?=365\times\frac{8.2}{100}-108\times\frac{1.75}{100}$

$=29.93-1.89=28.04$

59. (b) $?=\left(383\times\frac{739}{100}\right)\div628$

$$\approx\left(\frac{380\times740}{100}\right)\div630\approx2812\div630\approx4.46\approx4.50$$

60. (d) 94.5% of $550 = ?$

$$? = 550 \times \frac{94.5}{100} = 519.75$$

61. (d) $? = 248 \times \frac{7}{8} + 110 \times \frac{20}{100}$

$= 217 + 22 = 239$

62. (b) Total expenditure $= 44668 + 56732 = 101400$
Total percentage expenditure $= 100 - 22 = 78\%$

$$\therefore \text{Total amount} = \frac{101400 \times 100}{78} = ₹130000$$

63. (d) Total valid votes $= 85\%$ of $15200 = 12920$
$\therefore$ Number of valid votes to other candidate
$= 45\%$ of $12920 = 5814$

64. (b) Let the number be x.

$$\text{then, } x \times \frac{15}{100} \times \frac{45}{100} = 105.3$$

$$\Rightarrow x = \frac{105.3 \times 100 \times 100}{15 \times 45} = 1560$$

So, 24% of $1560 = 374.4$

65. (b) 60% of $250 = 150$
40% of $125 = 50$
No. of correct answers in remaining 125 questions $=$
$150 - 50 = 100$

$$\therefore \text{Percentage} = \frac{100 \times 100}{125} = 80\%$$

66. (e) Population after two years

$$= 48600 \times \frac{125}{100} \times \frac{92}{100} = 55890$$

67. (d) $$\text{Dhreeu's monthly salary} = \frac{600000}{12} = ₹\,50000$$

$$\text{Surya's monthly salary} = 50000 \times \frac{40}{100} = ₹\,20000$$

$$\text{Pranab's monthly salary} = 20000 \times \frac{80}{25} = ₹\,64000$$

68. (a) $$\text{Total marks in the test} = (280 + 80) \times \frac{100}{45} = 800$$

$$\text{Passing marks for girls} = 800 \times \frac{30}{100} = 240$$

$\therefore$ Required marks
$= 240 - 108 = 132$

69. (e) Votes obtained by winner candidate $= 64\%$
Votes obtained by loser candidate
$= (100 - 64) = 36\%$
Difference of votes $= (64 - 36) = 28\%$
According to question,

$$\text{Total votes} = \frac{992 \times 100}{28} = 3542$$

70. (e) Let the maximum marks be x
According to the question,

$$\because \frac{35x}{100} + 42 = 336$$

$$\therefore x = 840$$

71. (c) $$\text{SI} = \frac{10,000 + 2 + 3}{100} = 600$$

Let his monthly salary be x
3% of $x = 600$

$$\frac{3}{100}x = 600$$

$$x = \frac{600 + 100}{3} = 20,000$$

72. (a) Let the numerator be x & denominator be y

$$\frac{x + 200\% \text{ of } x}{y + 150\% \text{ of } y} = \frac{9}{10}$$

$$\frac{x + \frac{200}{100}x}{y + \frac{150y}{100}} = \frac{9}{10}$$

$$\frac{3x}{2.5y} - \frac{9}{10}$$

$$\frac{x}{y} = \frac{9 + 2.5}{10 + 3} = \frac{22.5}{30}\frac{225}{300} = \frac{3}{4}$$

73. (c) $$\text{Time taken yesturday} = \frac{\text{No. of words typed}}{\text{Typing speed}}$$

$$= \frac{5000}{60} = 83.33 \text{ mins.}$$

Speed today $= 60 \times 115\% = 69$

$$\text{Time taken} = \frac{5000}{69} = 72.46 \text{ mins}$$

Diff. $= 83.33 - 72.46$
$= 10.87$ or approx 10 minutes

74. (e) $(71 - 46)\%$ of $x = 120$
25% of $x = 120$

$$x = 120 \times \frac{100}{25} = 480$$

30% of $480 = 144$

75. (b) Percentage of imcome saved
$= 100 - (45 + 30) = 25\%$
$\therefore 25\%$ of $x = 4500$

$$x = 4500 \times \frac{100}{25} = 1800$$

76. (a) No. of boys this year $= 610 \times 80\% = 488$
No. of girls $= 488 \times 175\% = 854$

77. (c) Vidya scored = 350 + 296 = 646
76% of Max marks = 646

$\therefore$ Max marks = $646 \times \frac{100}{76} = 850$

78. (e) Let the marks originally awarded be x.
$x - 40\%$ of $x = 96$

$$x - \frac{40x}{100} = 96$$

$$\frac{60x}{100} = 96$$

$$\therefore x = \frac{96 \times 100}{60}, \quad x = 160$$

79. (e) No. of candidate selected = 855 × 20% = 171

80. (c) 98% of 250 = 245 & 32 % of 750 = 240
$\therefore$ 32 of 750 < 98% of 250.

81. (d) Marks scored by Mathew = 42 + 51 + 58 + 35 +48 = 234
Max.Marks = 60 × 5 = 300

$$\text{Percentage scored} = \frac{234}{300} \times 100 = 78\%$$

82. (a) Ratio of Expenses = 4 : 2 : 5,
therefore amount spend on clothes, i.e. 2x = 5540
$\therefore$ x = 2770
Total exp = (4 + 2 + 5)x = 11x
= 11 × 2770
Total income be x.
55% of x = 30470

$$x = 30470 \times \frac{100}{20} = 55400$$

83. (e) Let the 1st number be x & the IInd number be y.
35% of x = 2 × 75% of y

$$\frac{35x}{100} = \frac{150y}{100}$$

$$\frac{x}{y} = \frac{150}{35} = 30 : 7$$

84. (e) $\frac{x + 20\% \text{ of } x}{y + 25\% \text{ of } y} = \frac{3}{5}$

$$\frac{120x}{100} \div \frac{125y}{100} = \frac{3}{5}$$

$$\frac{120x}{100} \times \frac{100}{125y} = \frac{3}{5}$$

$$\frac{x}{y} = \frac{3}{5} \times \frac{125}{120} = \frac{5}{8}$$

85. (e) New Ratio = [4 × 125% : 5 × 130% : 6 × 150%]
= (5 : 6.5 : 9) × 2 = 10 : 13 : 18

86. (b) Let the number be x

$$65\% \text{ of } x - \frac{2x}{5} = 140$$

$$\frac{65x}{100} - \frac{2x}{5} = 140$$

$$\frac{65x - 40x}{100} = 140$$

$$\frac{25x}{100} = 140$$

$$x = 140 \times \frac{100}{25} = 560$$

87. (a) Percentage saving of Sonali = 100 – (15 + 55) = 30%
Let her monthly income be x

$$x \times \frac{30}{100} = 12750$$

$$x = 12750 \times \frac{100}{30} = 42,500$$

88. (a) Percentage savings of Mr.Davar = 100 – (38 + 25 + 12)
= 25%
Let his monthly income be x
25% of x = 5800

$$x = 5800 \times \frac{100}{25} = 23,200$$

89. (e) (72 – 56)% of x = 56
16% of x = 56

$$x = 56 \times \frac{100}{16} = 350$$

70% of 350 = 245

90. (b) Percentage of money left with Nand Kishore
= 100 – (50 + 35) = 15%
15% of x = 11250

$$x = 11250 \times \frac{100}{15} = 75,000$$

91. (c) $SI = \frac{30,000 \times 3 \times 5}{100} = 4500$

x% of 22,500 = 4500

$$x = \frac{4500 \times 100}{22,500} = 20\%$$

92. (c) Let the number be x
15% of x + 10% of x = 70
25% of x = 70

$$x = 70 \times \frac{100}{25} = 280$$

Twice of that number = 280 × 2 = 560

93. (b) Total marks = 500
Marks scored by Vikram = 500 × 72% = 360
Marks scored in Science
= 360 – [80 + 70 + 76 + 65] = 69

94. (a) Priya fails by (975 – 870) = 105 marks
So, 7% of max marks = 105

$$\therefore \text{Max. Marks} = 105 \times \frac{100}{7} = 1500$$

95. (e) $\frac{6x}{11} = \frac{22y}{100}$

$$y = \frac{1z}{4}, \text{ but } z = 2400 \text{ (given)}$$

$$\therefore y = 1 \times \frac{2400}{4} = 600$$

$$\text{So, } \frac{6x}{11} = \frac{22 + 600}{100} = 132$$

$$x = 132 + \frac{11}{6} = 242$$

45% of 242 = 108.9

96. (d) Male employees less than 25 years of age

$$= 4800 \times \frac{45}{100} + \frac{40}{100}$$

($\therefore$ 60% are above 25, therefore it implies that 40% are below 25)

97. (c) Win percentage = $\frac{24}{40} \times = 60\%$

98. (b) Sonia's score = 75 – 10 = 65
Rohit's score = 65 + 45 = 110
Raman's score = 110 – 25 = 85
Ravi's score = 85 + 34 = 119
Max. Marks = 119 + 50 = 169

$$\text{Percentage marks of Ravi} = \frac{119}{169} + 100$$

= 70.4 ~ 70%

99. (b) Let Mr. Giridhar's income tax

$$\left(x - \frac{50x}{100}\right)\left(1 - \frac{(50 + 25 + 10)}{100}\right) = 900$$

$$\frac{50x}{100} + \frac{15}{100} = 900$$

$$x = \frac{900 + 100 + 100}{50 + 15} = 12,000$$

100. (e) x + x + 1 + x + 2 = 2262
3x + 3 = 2262
3x = 2262 – = 2259

$$x = \frac{2259}{3} = 753$$

Highest number = 753 + 2 = 755
41% of 755 = 309.55

101. (b) Marks scored in subject B = 150 × 56% = 84
Total marks scored in all the 3 subjects
= (150 × 3) × 54% = 243
Marks scored in subject C = 243 – 73 – 84 = 86

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CHAPTER

4

SIMPLE & COMPOUND INTEREST

INTEREST

Basic terms associatted with this topic:

Interest : It is the time value of money. It is the cost of using capital.

Principal : It is the borrowed amount.

Amount : It is the sum total of Interest and Principal.

Rate : It is the rate percent payable on the amount borrowed.

Period : It is the time for which the principal is borrowed.

Interest can be classified as: Simple Interest : Simple Interest is payable on principal.

Compound Interest : Compound Interest is payable on Amount.

Basic formulas related to Simple Interest

❖ Simple Interest (SI) $= \dfrac{P \times R \times T}{100}$

Here P = principal, R = rate per annum, T = time in years

Amount $(A) = P + \dfrac{PRT}{100} = P\left(1 + \dfrac{RT}{100}\right)$ or P + SI

If time is given in month, & Rate is given per annum,

then $\text{SI} = \dfrac{\text{P} \times \text{R} \times \text{T}}{12 \times 100}$

If time is given in weeks, & Rate is given per annum,

then $\text{SI} = \dfrac{\text{P} \times \text{R} \times \text{T}}{365 \times 100}$

❖ Also,

$\text{Rate} = \dfrac{\text{SI} \times 100}{\text{P} \times \text{T}}$

$\text{Time} = \dfrac{\text{SI} \times 100}{\text{P} \times \text{R}}$

$\text{Principal} = \dfrac{\text{SI} \times 100}{\text{T} \times \text{R}}$

If amount is given then,

$\text{Principal} = \dfrac{\text{Amt} \times 100}{100 + (\text{R} \times \text{T})}$

ILLUSTRATION ▶ 1 : Find the simple interest and amount when ₹ 1000 is lent at 5% per annum for 5 years.

Sol. By the formula, $SI = \dfrac{P \times R \times T}{100} = \dfrac{1000 \times 3 \times 2}{100} = ₹\,60$

$\therefore$ Amount $= P + SI = 100 + 60 = ₹\,1060$

ILLUSTRATION ▶ 2 : Find the principal when simple intrest is ₹ 60 at 4% per anum for 4 years.

Sol. Principal $= \dfrac{SI \times 100}{RT} = \dfrac{60 \times 100}{4 \times 2} = ₹\,750$

ILLUSTRATION ▶ 3 : In how many years will the sum of ₹500 become ₹ 620 if the rate of simple interest is 4% per annum?

Sol. Using the formula,

$$T = \frac{SI \times 100}{R \times P}$$

Here, SI $= 620 - 500 = ₹\,120$

$\therefore \quad T = \dfrac{120 \times 100}{500 \times 4} = 6$ years

ILLUSTRATION ▶ 4 : At what rate percent per annum will a sum of money double in 8 years?

Sol. Let principal = ₹ P

Then SI = ₹ P

and Time = 8 years

$\therefore \quad \text{Rate} = \dfrac{SI \times 100}{P \times T}$

$= \dfrac{P \times 100}{P \times 8} = \dfrac{100}{8}$

$= \dfrac{25}{2} = 12\dfrac{1}{2}$ % per annum

Basic formulas related to Compound Interest

If interest is compounded annually,

$\text{Amt} = \text{P}\left(1 + \dfrac{\text{R}}{100}\right)^{\text{N}}$

If interest is compounded half yearly,

$$\text{Amt} = P\left(1+\frac{R}{200}\right)^{2N}$$

If interest is componded quarterly,

$$\text{Amt} = P\left(1+\frac{R}{400}\right)^{4N}$$

If the rate of interest changes over the years, then

$$\text{Amt} = P\left(1+\frac{R_1}{100}\right)\left(1+\frac{R_2}{100}\right).....$$

Compound Interest for all the above cases = Amt – Principal.
Difference between C.I &

$$\text{SI for two years} = P\left(\frac{R}{100}\right)^2$$

$$\text{Difference between CI \& SI for three years} = \frac{PR^2(300+R)}{(100)^3}$$

ILLUSTRATION ▶ 5 : Find the compound interest on ₹ 2000 at 5% per annum for 3 years, compound annually.

Sol. $\text{Compound interest} = \text{Principal}\left[\left(1+\frac{Rate}{100}\right)^{Time}-1\right]$

$$=2000\left[\left(1+\frac{5}{100}\right)^3-1\right]$$

$$=2000\left[\left(\frac{21}{20}\right)^3-1\right]=2000\left[\frac{9261-8000}{8000}\right]$$

$$=2000\times\frac{1261}{8000}=₹315.25$$

ILLUSTRATION ▶ 6 : Find the compound interest on ₹ 5000 for 3 years at 6 % per annum compounded half yearly.

Sol. Using the formula, $A=P\left[1+\left(\frac{R}{200}\right)\right]^{2T}$

$$=5000\left[1+\left(\frac{6}{200}\right)\right]^{3\times2}$$

$= 5000\,(1.03)^6 = 5971$ (to nearest rupee)

Compound interest = 5971 - 5000 = ₹ 971

ILLUSTRATION ▶ 7 : Find the compound interest on ₹ 51200 for 9 months at 15 % per annum compounded quarterly.

Sol. Here, Time = 9 months = 3 quarters

Now, using the formula

$$A=P\left[1+\left(\frac{R}{400}\right)\right]^{4T}=51200\times\left[1+\frac{15}{400}\right]^3$$

$$=51200\times\left(400+\frac{15}{400}\right)^3=51200\times\left(\frac{415}{400}\right)^3$$

$$=51200\times\frac{83}{80}\times\frac{83}{80}\times\frac{83}{80}$$

$$=₹57178.70$$

$$\therefore \quad \text{C.I.} = ₹(57178.70-51200)$$

$$=₹5978.70$$

ILLUSTRATION ▶ 8 : Find the compound interest on ₹ 5000 for 3 years at 6 % per annum for first year, 7% for the second year and 8% for the third year

Sol. Using the formula,

$$=P\left\{1+\frac{R_1}{100}\right\}\left\{1+\frac{R_2}{100}\right\}\left\{1+\frac{R_3}{100}\right\}$$

$$\left(1+\frac{6}{100}\right)\left(1+\frac{7}{100}\right)\left(1+\frac{8}{100}\right)$$

$$=₹6125$$

$$\therefore \text{C.I.} = 6125-5000=₹1125$$

ILLUSTRATION ▶ 9 : The compound interest on ₹3000 in 2 years is ₹ 696.30 and simple interest on the same amount is ₹ 660. What is rate of interest per annum?

Sol. $\text{Difference of interest} = P\left(\frac{R}{100}\right)^2$

$$\Rightarrow \quad 696.30-660=3000\left(\frac{R}{100}\right)^2$$

$$\Rightarrow \quad \frac{12.1}{1000}=\frac{R^2}{10000}$$

$$\Rightarrow \quad R^2=121 \quad \Rightarrow R=11\%$$

ILLUSTRATION ▶ 10 : The difference between compound interest and simple interest on a certain sum of money in 3 years at the rate of 7% per annum is ₹ 225.645. What is the principal?

Sol. $\text{Difference of interest} = P\frac{R^2(300+R)}{(100)^3}$

$$\Rightarrow \quad 225.645=P\times\frac{(7)^2(300+7)}{(100)^3}$$

$$\Rightarrow \quad P=\frac{225.645\times100\times100\times100}{49\times307}$$

$$=₹15000$$

ILLUSTRATION ▶ 11 : A person has taken a loan amount at the rate of 10 % annual compound interest and he pays that amount in two instalments of ₹ 968 each. How much loan did he take?

Sol. $\text{Loan taken} = \frac{968}{\left(1+\frac{10}{100}\right)^1}+\frac{968}{\left(1+\frac{10}{100}\right)^2}$

$$=968\left[\frac{1}{\left(\frac{11}{10}\right)}+\frac{1}{\left(\frac{11}{10}\right)^2}\right]=968\left[\frac{10}{11}+\left(\frac{10}{11}\right)^2\right]$$

$$= 968\left[\frac{10\times11+10\times10}{121}\right] = 968\left[\frac{10(11+10)}{11\times11}\right]$$

$$= 968\times\frac{10}{11}\times\frac{21}{11} = ₹1680$$

ILLUSTRATION ▶ 12 : A sum of money doubles itself in 5 years. Find the simple rate of interest.

Sol. Let the sum of money, i.e.

P = 100

It doubles itself, i.e.

Amt = 200

SI = Amt – Principal

= 200 – 100 = 100

Time = 5 years

$$\text{Rate} = \frac{\text{SI}\times100}{\text{P}\times\text{T}}$$

$$= \frac{\cancel{100}\times100}{\cancel{100}\times5} = 20\%$$

Alternately

In these types of questions,

$$\text{Rate} = \frac{(\text{No. of time}-1)\times100}{\text{Time}}$$

$$= \frac{(2-1)100}{\text{Time}}$$

$$= \frac{100}{5} = 20\%$$

The same formula can even be applied for tinding time in the above pattern of questions.

ILLUSTRATION ▶ 13 : Mohan borrows ₹10,000@ 8% pa for 4 years. At the end of the period, he pays ₹ 6000 in cash, and for the balance amount, he gave his mobile. Find the cost of the mobile.

Sol. $\text{SI} = \frac{\text{P}\times\text{R}\times\text{T}}{100} = \frac{10,000\times8\times4}{100} = 3200$

Amount = P + SI = 10,000 + 3200 = 13,200

Cost of Mobile = 13,200 – 6000 = 7200

ILLUSTRATION ▶ 14: Mohan borrows ₹10,000 from two money lenders at a rate of 6% pa and 8% pa respectively, for a period of 3 years. If the total interest he paid was ₹ 1980, find the amount borrowed at the rate of 6% pa.

Sol. Let the amount borrowed at 6% pa be x. and the amount borrowed at 8% be y

So, x + y = 10,000 ....(i)

Now,

$$\text{SI} = \frac{x\times6\times3}{100} = \frac{18x}{100}, \text{ and}$$

$$\text{Also SI} = \frac{y\times8\times3}{100} = \frac{24y}{100}$$

According to the condition,

$$\frac{18x}{100}+\frac{24y}{100} = 1980 \text{ or}$$

18x + 24y = 198000 ....(ii)

On equating (i) and (ii), we get

x = 7000 and y = 3000.

Therefore, amount borrowed @ 6% pa = 7000.

SOLVED EXAMPLES

EXAMPLE ▶ 1: What would be the simple interest obtained on an amount of ₹ 6,535 at the rate of 10% p.a. after 6 years?

(a) ₹ 3414 **(b) ₹ 3921**
(c) ₹ 3807 **(d) ₹ 3149**
(e) None of these

Sol. (b) $\text{Simple interest} = \frac{P \times R \times T}{100}$

$= ₹3921$

EXAMPLE ▶ 2: What would be the compound interest obtained on an amount of ₹ 7800 at the rate of 5% p.a. after 3 years ?

(a) ₹ 1235.685 **(b) ₹ 1229.475**
(c) ₹ 1287.68 **(d) ₹ 1248.750**
(e) None of these

Sol. (b) $\text{Compound interest} = 7800\left[\left(1+\frac{5}{100}\right)^3 - 1\right]$

$= 7800\left[\left(\frac{105}{100}\right)^3 - 1\right]$

$= 7800\left[\frac{105\times105\times105 - 100\times100\times100}{100\times100\times100}\right]$

$= (7800 \times 0.157625)$

$= ₹1229.475$

EXAMPLE ▶ 3: If the difference between the simple and the compound interest earned on a sum of money at the rate of 5% p.a. for 2 years is ₹ 16, find the principal.

(a) ₹6,200 **(b) ₹6,400**
(c) ₹6,250 **(d) Cannot be determined**
(e) None of these

Sol. (b) If the difference between CI and SI for two years is given, then

$$\text{Principal} = \frac{\text{Difference} \times (100)^2}{(\text{Rate})^2}$$

$$= \frac{16\times100\times100}{5\times5} = ₹6400$$

EXAMPLE ▶ 4: The simple interest accrued on an amount of ₹ 19,800 at the end of three years is ₹ 7,128. What would be the compound interest accrued on the same amount at the same rate in the same period?

(a) ₹ 8934.6784 **(b) ₹ 8017.5744**
(c) ₹ 7861.8754 **(d) Cannot be determined**
(e) None of these

Sol. (b) $\text{Rate} = \frac{\text{Interest} \times 100}{\text{Principal} \times \text{Time}} = \frac{7128\times100}{19800\times3} = 12\%\text{p.a.}$

$$\text{C.I.} = \text{Principal}\left[\left(1+\frac{\text{Rate}}{100}\right)^{\text{Time}} - 1\right]$$

$$= 19800\left[\left(1+\frac{12}{100}\right)^3 - 1\right]$$

$19800\,[(1.12)^3 - 1]$

$= ₹8017.5744$

EXERCISE

1. Anil invested an amount for three year at a simple interest rate of 9% p.a. He got an amount of ₹ 19,050 at the end of three years. What principal amount did he invest?
   (a) ₹14,500 (b) ₹11,050
   (c) ₹1,440 (d) ₹10,950
   (e) None of these
2. What will be the compound interest on an amount of ₹ 5,000 for a period of 2 year at 8% p.a?
   (a) ₹ 840 (b) ₹ 400
   (c) ₹ 823 (d) ₹ 416
   (e) None of these
3. What is the interest received on a principal of ₹ 450 for 2 yea if the interest received on ₹ 1 after four year at the same rate of simple interest is ₹ 0.40?
   (a) ₹ 90 (b) ₹ 180
   (c) ₹ 36 (d) Cannot be determined
   (e) None of these
4. Ms. Sandhya deposits an amount of ₹ 31,400 to obtain a simple interest at the rate of 12 per cent per annum for 8 years. What total amount will Ms. Sandhya get at the end of 8 years?
   (a) ₹31,444 (b) ₹61,544
   (c) ₹41,544 (d) ₹31,144
   (e) None of these
5. What amount of compound interest can be obtained on the

principal amount of ₹ 15800 at the rate of 6 per cent per annum at the end of 2 year ?
(a) ₹1,986 (b) ₹2,012.48
(c) ₹1,952.88 (d) ₹1,956
(e) None of these

6. Mr. Deepak invested an amount of ₹ 21,250 for 6 years. At what rate of simple interest will he obtain the total amount of ₹ 26,350 at the end of 6 years?
(a) 6 % p.a (b) 5 % p.a
(c) 8 % p.a (d) 12 % p.a
(e) None of these

7. What approximate amount of compound interest can be obtained on an amount of ₹ 3,080 at the rate of 7% p.a. at the end of 3 year ?
(a) ₹586 (b) ₹693
(c) ₹646 (d) ₹596
(e) ₹621

8. Arunima invests an amount of ₹ 10,250@4% p.a. to obtain a total amount of ₹ 12,710 on simple interest after a certain period. For how many year did she invest the amount to obtain the total sum?
(a) 6 years (b) 8 years
(c) 5years (d) 4 years
(e) None of these

9. Sudhanshu invested ₹ 15,000 at interest @ 10% p.a for one year. If the interest is compounded every six months what amount will Sudhanshu get at the end of the year?
(a) ₹16,537.50 (b) ₹16,5000
(c) ₹16,525.50 (d) ₹18,150
(e) None of these

10. What should be the simple interest obtained on an amount of ₹ 5,760 at the rate of 6% p.a. after 3 years?
(a) ₹1036.80 (b) ₹1666.80
(c) ₹1336.80 (d) ₹1063.80
(e) None of these

11. Ms Suchi deposits an amount of ₹ 24,000 to obtain a simple interest at the rate of 14% p.a. for 8 years. What total amount will Ms Suchi get at the end of 8 years?
(a) ₹52080 (b) ₹28000
(c) ₹50880 (d) ₹26880
(e) None of these

12. Asmita invests an amount of ₹ 9535 at the rate of 4 per cent per annum to obtain a total amount of ₹ 11442 on simple interest after a certain period. For how many year did she invest the amount to obtain the total sum?
(a) 10 years (b) 2 years
(c) 5 years (d) 4 years
(e) None of these

13. Ms. Neelam deposits an amount of ₹ 16420 at simple interest and obtained ₹ 25451 at the end of 5 years. What was the rate of interest per year?
(a) 10.5% (b) 13%
(c) 12.5% (d) 11%
(e) None of these

14. Girish invested a certain amount at the rate of 8% p.a. for 6 year to obtain an amount of ₹ 28,046. How much amount did Girish obtain as simple interest?
(a) ₹12,550 (b) ₹9,096
(c) ₹18,950 (d) Cannot be determined
(e) None of these

15. Ms. Maya deposits an amount of ₹ 17,800 and obtained ₹ 31,684 at the end of 6 years. What was the rate of simple interest per year?
(a) 14.5 (b) 11
(c) 12.5 (d) 13
(e) None of these

16. The simple interest accrued on an amount of ₹ 84,000 at the end of three year is ₹ 30,240. What would be the compound interest accrued on the same amount at the same rate in the same period?
(a) ₹ 30,013.95 (b) ₹ 31,013.95
(c) ₹ 32,013.95 (d) ₹ 33,013.95
(e) ₹ 34,013.95

17. Veena obtained an amount of ₹ 8, 376/- as simple interest on a certain amount at 8% p.a. after 6 years. What is the amount invested by Veena?
(a) ₹ 17,180 (b) ₹ 18,110
(c) ₹ 16,660 (d) ₹ 17,450
(e) None of these

18. What will be the difference between the compound interest and simple interest at the rate of 5% p.a. on an amount of ₹ 4,000 at the end of two years?
(a) ₹ 10 (b) ₹ 20
(c) ₹ 30 (d) Data inadequate
(e) None of these

19. If the compound interest accrued on an amount of ₹14,500 in two year is ₹4676.25, what is the rate of interest % p.a. ?
(a) 11 (b) 9
(c) 15 (d) 18
(e) None of these

20. The compound interest accrued on an amount of ₹ 25,500 at the end of three year is ₹ 8,440.5. What would be the simple interest accrued on the same amount at the same rate in the same period?
(a) ₹ 4,650 (b) ₹ 5,650
(c) ₹ 6,650 (d) ₹ 7,650
(e) None of these

21. The simple interest obtained on an amount of ₹ 45,000 at the end of 4 year is ₹ 15,300. What would be the approximate compound interest obtained on the same amount at the same rate of interest in the same period ?
(a) ₹ 18,244 (b) ₹ 18,244
(c) ₹ 16,285 (d) ₹ 18,566
(e) ₹ 17,364

22. The simple interest accrued on a sum of certain principal is ₹ 1,200 in four year at the rate of 8% p.a. What would be the simple interest accrued on thrice of that principal at the rate of 6% p.a in 3 year ?

(a) ₹2,025 (b) ₹3,025
(c) ₹2,250 (d) ₹2,150
(e) None of these

23. What would be the simple interest accured in 4 years on a principal of ₹16,500 at the rate of p.c.p.a?
(a) 11,560 (b) 10,250
(c) 12,500 (d) 9,980
(e) None of these

24. What is the difference between the C.I and S.I. accured on an amount of ₹12,000 at the end of three years at the rate of 12%?
(a) 539,136 (b) 602.242
(c) 495.248 (d) 488.322
(e) None of these

25. What amount of C.I. can be obtained on an amount of ₹8,840 at the rate of 5 p.c.p.a at the end of 3 years?
(a) 1393.136 (b) 1326
(c) 1384.50 (d) 1340
(e) None of these

26. What is the C.I accured on an amount of ₹8500 in two years @ 10 p.c.p.a interest?
(a) 1875 (b) 1885
(c) 1775 (d) 1765
(e) None of these

27. S.I. accured on an amount in 8 years at the rate of 12 p.c.p.a is ₹5520. What is the principal ?
(a) 5750 (b) 8500
(c) 5650 (d) 8250
(e) None of these

28. How much will be the C.I. to be paid on a principal amount of ₹85,000 after 3 years at the rate of 6 p.c.p.a?
(a) 16623.36 (b) 16236.36
(c) 16326.36 (d) 16632.36
(e) None of these

29. In how many years will ₹4600 amount to ₹5428 at 3 p.c.p.a simple interest?
(a) 3 (b) 5
(c) 6 (d) 4
(e) None of these

30. The S.I. accrued on a sum of certain principal years at the rate of 13% per year is ₹6500. What would be the C.I. accrued on that principal at the rate of 8% per year in 2 years?
(a) ₹1040 (b) ₹1020
(c) ₹1060 (d) ₹1200
(e) None of these

31. Amount of S.I. accrued on an amount of ₹28,500 in seven years is ₹23940. What is the rate of interest per annum?
(a) 10.5 (b) 12.5
(c) 11 (d) 12
(e) None of these

32. Mr. Sharma invested an amount of ₹25,000 in fixed deposit @ 8% p.a. C.I. for two years. What amount Mr. Sharma will get on maturity?
(a) 28540 (b) 29160
(c) 29240 (d) 28240
(e) None of these

33. S.I. accrued on an amount in eight years @ 11% p.a. is 57200. What was the principal amount?
(a) 72000 (b) 82000
(c) 75000 (d) 65000
(e) None of these

34. What is C.I. accrued on an amount of ₹45,000 in two years at the rate of 9 p.c.p.a?
(a) 8600 (b) 8565.40
(c) 8464.50 (d) 8540
(e) None of above

35. A principal of ₹10,000 after 2 years compounded annualy, the rate of interest being 10% p.a. during the first year and 12% p.a. during the second year will amount to:
(a) 12,000 (b) 12,320
(c) 12,500 (d) 11,320

36. What is the difference between the S.I. & C.I. on 7300 at the rate of 6 p.c.p.a in 2 years?
(a) ₹29.37 (b) 26.28
(c) 31.41 (d) 23.22
(e) 21.34

37. A sum of money becomes 3 times in 5 years. In how many years will the same sum becomes 6 times at the same rate of SI?
(a) 10 years (b) 12 years
(c) $12\frac{1}{2}$ years (d) 13 years
(e) None of these

38. A certain sum becomes $\frac{7}{3}$ times itself in 10 years under S.I Find the rate of interest.
(a) $7\frac{1}{2}\%$ (b) 20%
(c) 10% (d) $13\frac{1}{3}\%$
(e) None of these

39. An amount is lent at y% p.a. S.I for two years. However, is it had been lent at 2y% p.a. S.I. for x more years, then the interest would have been 5 times the earlier interest. Find the value of y.
(a) 2 (b) 3
(c) 4 (d) 5
(e) None of these

40. According to a new plan declared by the CSIR Bank, the rate of simple interest on a sum of money is 6% p.a. for the first two years, 8% p.a. for the next three years and 10% p.a for the period beyond first 5 years. Simple interest accrued on a sum for a period of 8 years is ₹6600. Find the sum.
(a) 24,000 (b) 16,000
(c) 10,000 (d) 15,000
(e) None of the above

41. Rahul has borrowed Rs. 20,000 from two money tenders. Or one he had to pay 8% p.a. S.I. and on the other amount he

had to pay 12% p.a. SI. After 3 years, he paid total interest of ₹5760, find the amount borrowed at 12% p.a.
(a) 12,000 (b) 8000
(c) 5000 (d) 10,000
(e) 6000

42. Mohan borrowed ₹18,000 at 10% p.a. simple interest and then lend it to Sohan at 10% C.I. After 3 years he will earn a profit of
(a) 558 (b) 555
(c) 560 (d) 600
(e) None of the above

43 A sum of money borrowed at 10% p.a. for two years at compound interest amounts to ₹14520. Find the sum borrowed.
(a) 10,000 (b) 11,000
(c) 12,000 (d) 13,000
(e) None of the above

44. Surya borrowed ₹25,000 @ 15% p.a. S.I. for 5 years. After 5 years he repaid ₹15,000 and promised to pay the balance amount after 3 years. Find the amount repayable as final settlement.
(a) 26,000 (b) 32,000
(c) 20,100 (d) 41687.5
(e) None of the above

45. Kamakshi was in need of funds. So, she borrowed ? 50,000 at the rate of 8 p.c. p.a. S.I. After 2 years, she was unable to pay back the amount. Therefore, she gave her bike to repay back the loan. Find the price of the bike.
(a) 60,000 (b) 58,000
(c) 55,000 (e) 62,000
(e) None of the above

Answer Key									
1	**(e)**	11	**(c)**	21	**(e)**	31	**(d)**	41	**(a)**
2	**(e)**	12	**(c)**	22	**(a)**	32	**(b)**	42	**(a)**
3	**(a)**	13	**(d)**	23	**(e)**	33	**(d)**	43	**(c)**
4	**(b)**	14	**(b)**	24	**(a)**	34	**(c)**	44	**(d)**
5	**(c)**	15	**(d)**	25	**(a)**	35	**(b)**	45	**(b)**
6	**(e)**	16	**(e)**	26	**(e)**	36	**(b)**		
7	**(b)**	17	**(d)**	27	**(a)**	37	**(c)**		
8	**(a)**	18	**(a)**	28	**(b)**	38	**(d)**		
9	**(a)**	19	**(c)**	29	**(c)**	39	**(b)**		
10	**(a)**	20	**(d)**	30	**(a)**	40	**(c)**		

ANSWERS & EXPLANATIONS

1. (e) Let the principal be = ₹x
∴ Interest = (19050 – x)
Now,

$$\text{Principal} = \frac{\text{Interest} \times 100}{\text{Time} \times \text{Rate}}$$

$$\Rightarrow \quad x = \frac{(19050 - x) \times 100}{3 \times 9}$$

$$\Rightarrow 27x = 1905000 - 100x$$

$$\Rightarrow 127x = 1905000$$

$$\Rightarrow x = \frac{1905000}{127} = ₹15000$$

2. (e) $\text{Amount} = \text{Principal}\left(1 + \frac{\text{Rate}}{100}\right)^{\text{Time}}$

$$= 5000\left(1 + \frac{8}{100}\right)^2 = 5000\left(1 + \frac{2}{25}\right)^2$$

$$= 5000 \times \frac{27}{25} \times \frac{27}{25} = 5832₹$$

∴ CI = ₹ (5832 – 5000) = 832₹

3. (a) Interest on ₹ 1 in 4 years = ₹ 0.4
∴ Interest on ₹ 100 in 4 years = ₹ 40
∴ Interest on ₹ 100 in 1 year = ₹ 10

$$\therefore \quad \text{Interest} = \frac{\text{Principal} \times \text{Time} \times \text{Rate}}{100}$$

$$= \frac{450 \times 2 \times 10}{100} = ₹90$$

4. (b) $\text{Simple Interest} = \frac{P \times R \times T}{100}$

$$\frac{31400 \times 8 \times 12}{100} = ₹30144$$

∴ Required amount = ₹ (31400 + 30144)
= ₹ 61544

5. (c) Compound Interest $= P\left[\left(1+\frac{R}{100}\right)^{T}-1\right]$

$=15800\left[\left(1+\frac{6}{100}\right)^{2}-1\right]$

$=15800\times[(1.06)^2-1)]$

$=15800\times(1.1236-1)$

$=15800\times0.1236$

$=₹1952.88$

6. (e) Rate $=\frac{(26350-21250)\times100}{21250\times6}$

$=\frac{510000}{127500}=4\%$

7. (b) Compound Interest

$=3080\left[\left(1+\frac{7}{100}\right)^{3}-1\right]$

$=3080\left[\left(\frac{107}{100}\right)^{3}-1\right]$

$=3080\times\left[\frac{1225043-1000000}{1000000}\right]$

$=3080\times\frac{225043}{1000000}$

$=₹693$ (approximate)

8. (a) SI $=₹(12710-10250)=₹2460$

$\text{time}=\frac{\text{S.I.}\times100}{\text{Principal}\times\text{Rate}}=\frac{2460\times100}{10250\times4}=6$ years

9. (a) Required Amount $=15000\left(1+\frac{5}{100}\right)^{2}=₹16537.50$

10. (a) Required Simple Interest $=\frac{5760\times3\times6}{100}=₹1036.80$

11. (c) Required Amount $=24000\left(1+\frac{14\times8}{100}\right)$

$=24000\times\frac{212}{100}=₹50880$

12. (c) Let the required time = t years

Simple interest $=(11442-9535)=₹1907$

$\text{Simple}=\frac{P\times T\times R}{100}$

$1907=\frac{9535\times4\times t}{100}$

$\therefore t=\frac{1907\times100}{9535\times4}=5$ years

13. (d) Interest $=(25451-16420)=₹9031$

$\text{Rate}=\frac{\text{Interest}\times100}{\text{Principal}\times\text{Time}}$

$\frac{9031\times100}{16420\times5}=11\%$

14. (b) Let the principal be $=₹100$

$\therefore$ Simple interest

$=\frac{100\times8\times6}{100}=₹48$

$\therefore$ Amount $(100+48)=₹148$

$\therefore$ When the amount is $=₹148$, the principal $=₹100$

$\therefore$ When amount $=₹28046$, the principal

$=\frac{100}{48}\times28046=₹18950$

$\therefore$ Simple interest $=(₹28046-18950)=₹9096$

15. (d) Rate of Interest $=\frac{(31684-17800)\times100}{17800\times6}\%$

$=\frac{1388400}{106800}=13\%$

16. (e) Rate $=\frac{30240\times100}{84000\times3}=12\%$

Compound interest

$=84000\left(1+\frac{12}{100}\right)^{3}-84000$

$=118013.95-84000$

$=₹34013.95$

17. (d) Amount invested $=\frac{8376\times100}{8\times6}=₹17450$

18. (a) Simple interest

$=\frac{4000\times5\times2}{100}=₹400$

Compound interest

$=4000\left(1+\frac{5}{100}\right)^{2}-4000$

$=\frac{4000\times105\times105}{100\times100}-4000$

$=4410-4000=₹410$

$\therefore$ Difference $=410-400$

$=₹10$

19. (c) $14500\left(1+\frac{r}{100}\right)^{2}$

$=14500+4676.25$

$\Rightarrow\left(1+\frac{r}{100}\right)^{2}=\frac{19176.25}{14500}=\frac{529}{400}$

$\Rightarrow \left(1+\frac{r}{100}\right)^2=\left(\frac{23}{20}\right)^2$

$\Rightarrow 1+\frac{r}{100}=\frac{23}{20}$

$\Rightarrow \frac{r}{100}=\frac{23}{20}-1=\frac{3}{20}$

$\Rightarrow r=\frac{100\times 3}{20}=15$

20. (d) $25500\left(1+\frac{r}{100}\right)^3-25500=8440.5$

$\Rightarrow 25500\left(1+\frac{r}{100}\right)^3=8440.5+25500$

$\Rightarrow \left(1+\frac{r}{100}\right)^3=\frac{33940.5}{25500}=\frac{1331}{1000}=\left(\frac{11}{10}\right)^3$

$\Rightarrow \left(1+\frac{r}{100}\right)=\left(\frac{11}{10}\right)$

$\Rightarrow 1+\frac{r}{100}=\frac{11}{10}$

$\Rightarrow \frac{r}{100}=\frac{11}{10}-1=\frac{1}{10}$

$\Rightarrow r=\frac{100}{10}=10$

$\therefore$ Simple interest

$=\frac{25500\times 10\times 3}{100}=₹7650$

21. (e) Rate $=\frac{15300\times 100}{45000\times 4}=8.5\%$

Compound interest

$=45000\left(1+\frac{8.5}{100}\right)^4-45000$

$=45000\left\{\left(\frac{108.5}{100}\right)^4-1\right\}$

$=45000\times 0.3858=₹17364$ (approx)

22. (a) Principal $=\frac{1200\times 100}{4\times 8}=₹3750$

Simple interest on thrice that principal

$=\frac{3750\times 3\times 6\times 3}{100}=₹2025$

23. (e) Simple interest

$\frac{\text{principal}\times\text{time}\times\text{rate}}{100}=\frac{16500\times 4\times 16}{100}=₹10560$

24. (a) $SI=\frac{\text{principal}\times\text{time}\times\text{rate}}{100}$

$=\frac{12000\times 3\times 12}{100}=₹4320$

$CI=P\left[\left(1+\frac{\text{rate}}{100}\right)^{\text{time}}-1\right]$

$=12000\left[\left(1+\frac{12}{100}\right)^3-1\right]$

$=12000\left[\left(\frac{28}{25}\right)^3-1\right]$

$=12000\left[\frac{21952}{15625}-1\right]$

$=12000\times\frac{6327}{15625}=₹4859.136$

$\therefore$ Required difference $=4859.136-4320=₹539.136$

25. (a) $\text{Amt}=8840\left(1+\frac{5}{100}\right)^3=10233.405$

$CI=\text{Amt}-\text{Principal}$

$=10233.405-8840$

$=1393.405$

26. (e) $\text{Amt}=8500\left(1+\frac{10}{100}\right)^2=10285$

$CI=102850-8500=1785$

27. (a) $\text{Principal}=\frac{SI\times 100}{R\times T}=\frac{5520\times 100}{12\times 8}=5750$

28. (a) $\text{Amt}=8500\left(1+\frac{6}{100}\right)^3=101236.36$

$CI=101236.36-85000=16236.36$

29. (c) $\text{Time}=\frac{S.I\times 100}{P\times R}=\frac{828\times 100}{4600\times 3}=6\text{ years}$

$SI=\text{Amt}-\text{Principal}=5428-4600=828$

30. (a) $\text{Principal} = \frac{\text{S.I} \times 100}{\text{R} \times \text{T}} = \frac{6500 \times 100}{13 \times 8} = 6250$

$\text{Amt} = 6250\left(1+\frac{8}{100}\right)^2 = 7290$

$\text{CI} = \text{Amt} - \text{Principal} = 7290 - 6250 = 1040$

31. (d) $\text{Rate of interest} = \frac{\text{SI} \times 100}{\text{P} \times \text{T}} = \frac{23940 \times 100}{28500 \times 7} = 12\%\text{p.a.}$

32. (b) $\text{Amount} = 25,000\left(1+\frac{8}{100}\right)^2 = 29160$

33. (d) $\text{Principal} = \frac{\text{SI} \times 100}{\text{R} \times \text{T}} = \frac{57200 \times 100}{11 \times 8} = 65000$

34. (c) $\text{Amt} = 45000\left(1+\frac{9}{100}\right)^2 = 53464.5$

$\text{CI} = 53464.5 - 45000 = 8464.5$

35. (b) $\text{Amt} = 10,000\left(1+\frac{10}{100}\right)\left(1+\frac{12}{100}\right) = 12320$

36. (b) $\text{Difference} = \text{P}\left(\frac{\text{R}}{100}\right)^2 = 7300\left(\frac{6}{100}\right)^2$

$= 7300 \times \frac{36}{10000} = 26.28$

37. (c) $\text{Rate} = \frac{(3-1) \times 100}{40} = 40\%$

$\text{Time} = \frac{(6-1) \times 100}{40} = 12.5\,\text{years}$

38. (d) $\text{Rate} = \frac{\left(\frac{7}{3}-1\right) \times 100}{10} = 13.33\%$

39. (b) $\text{SI} = \frac{\text{P} \times \text{y} \times 2}{100} = \frac{2\text{yp}}{100}$

$\text{SI} = \frac{\text{p} \times \text{y} \times 2}{100} = \frac{2\text{yp}}{100}$

$5 \times \frac{2\text{yp}}{100} = 2\text{yp}\frac{(2+\text{x})}{100}$

$5 = 2 + \text{x}, \quad 5 - 2 = \text{x} = 3$

40 (c) Let the amount deposited be x.

$\text{SI for first 2 years} = \frac{\text{x} \times 6 \times 2}{100} = \frac{12\text{x}}{100}$

$\text{SI for next 3 years} = \frac{\text{x} \times 8 \times 3}{100} = \frac{24\text{x}}{100}$

$\text{SI for (8 – 5) i.e. 3 years} = \frac{\text{x} \times 10 \times 3}{100} = \frac{30\text{x}}{100}$

So, $\frac{12\text{x}}{100} + \frac{24\text{x}}{100} + \frac{30\text{x}}{100} = 6600$

$\frac{66\text{x}}{100} = 6600$

$\text{x} = \frac{6600 \times 100}{66} = 10,000$

41. (a) Let amount borrowed at 8% be x,
Let amount borrowed at 12% will be (20,000 – x)

$\frac{\text{x} \times 8 \times 3}{100} + \frac{(20,000 - \text{x}) \times 12 \times 3}{100} = 5760$

On solving x = 8000 which is the amt.borrowed at 8%.
So, amt. borrowed at 12% = 20,000 – 8000 = 12,000

42. (a) $\text{SI} = \frac{18000 \times 10 \times 3}{100} = 5400$

$\text{Amt} = 18000\left(1+\frac{10}{100}\right)^3 = 23958$

$\text{CI} = 23958 - 18000 = 5958$
$\text{Profit} = 5958 - 5400 = 558$

43. (c) $\text{Amt} = \text{P}\left(1+\frac{10}{100}\right)^2, \quad 14520 = \text{P}\left(\frac{110}{100}\right)^2$ or

$\text{P} = 14520 \times \frac{100}{110} \times \frac{100}{110} = 12,000$

$\text{P} = 14520 \times \frac{100}{110} \times \frac{100}{110} = 12,000$

44. (d) $\text{SI} = \frac{25,000 \times 15 \times 5}{100} = 18750$
$\text{Amt} = 25000 + 18750 = 43750$
$\text{Balance} = 43750 - 15000 = 28750$

$\text{SI} = \frac{28750 \times 15 \times 3}{100} = 12937.5$
$\text{Amt} = 28750 + 12937.5 = 41687.5$

45. (b) $\text{SI} = \frac{50,000 \times 8 \times 2}{100} = 8000$
$\text{Amt} = 50,000 + 8000 = 58,000$

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CHAPTER

5

PROFIT & LOSS

PROFIT AND LOSS

This chapter helps you to understand the intricacies of business world and the computation of profit or loss arising out ofbusiness Transactions.

Various concepts related to this topic are :

Cost Price (CP): It is the price at which the item is procured by the seller.

Selling Price (SP): It is the price at which the item is sold by the seller.

Profit: It is the excess of the selling price over cost price, i.e. Profit = SP – CP

Loss: It is the excess of cost price over the selling price, i.e.

Loss = CP – SP

Profit Percent : It is profit, expressed as a percentage of cost price, i.e.

$$\text{Profit Percent} = \frac{\text{Profit}}{\text{CP}} \times 100$$

Loss Percent: It is loss, expressed as a percentage of cost price,

$$\text{i.e, Loss Percent} = \frac{\text{Loss}}{\text{CP}} \times 100$$

Note: It should be kept in mind, that both profit and loss percent are calculated on cost price.

Formulas to ascertain cost price or selling price when profit or loss percent are given-

To Find SP when Profit or Loss Percent & CP are given-

- In case Profit percent & CP is given,
  Then
- In case Loss percent & CP is given,
  Then

$$\text{SP} = \left[\frac{100 - \text{Loss}\%}{100}\right] \times \text{CP}.$$

ILLUSTRATION ▶ 1: A shopkeeper buys scientific calculators in bulk for ₹ 15 each. He sells them for ₹ 40 each.
Calculate the profit on each calculator in rupees, and as a percentage of the cost price.

Sol. Given: cost price = ₹ 15,
selling price = ₹ 40
profit = selling price - cost price
= ₹ 40 – 15 = ₹ 25
the profit as a percentage of the cost price:

$$\text{Profit \%} = \frac{\text{profit}}{\text{cost price}} \times 100\%$$

$$= \frac{25 \times 100}{15}\% = 166.7\%$$

ILLUSTRATION ▶ 2 : If the cost price of a book is ₹ 150 and selling price is 137.50, then calculate the loss and percentage loss on the book?

Sol. Here, cost price = ₹ 150
and selling price = ₹ 137.50
∴ Loss = Cost price – selling price
= ₹ (150 – 137.50) = ₹ 12.50

$$\text{Now, Percentage Loss} = \frac{\text{Loss} \times 100}{\text{Cost Price}}\ \%$$

$$= \frac{12.50 \times 100}{150}\%$$

$$= 8.33\%$$

ILLUSTRATION ▶ 3 : A chair was purchased for ₹ 470 and sold at a profit of 10%. Find the selling price.

Sol. Using the formula

$$\text{Selling price} = \text{cost price} \left(\frac{100 + \text{profit}\%}{100}\right)$$

$$= 470\left(\frac{100 + 10}{100}\right)$$

$$= 470 \times \frac{110}{100} = ₹ 517$$

ILLUSTRATION ▶ 4 : A person bought a table for ₹ 420 and sold it at a loss of 15% . Find the selling price of the table.

Sol. $\text{Selling price} = \text{cost price} \left(\frac{100 - \text{Loss}\%}{100}\right)$

$$= ₹ 420\left(\frac{100 - 15}{100}\right) = \frac{420 \times 85}{100} = ₹ 357$$

- **When selling price and percentage profit are given, then**

$$\text{Cost price} = \text{selling price}\left(\frac{100}{100+\text{profit}\%}\right)$$

To find CP when profit or loss percent & SP are given-

- In case profit percent & SP is given,

$$\text{Then CP} = \left[\frac{100}{100+\text{Profit}\%}\right]\times \text{SP}$$

- In case loss percent & SP is given,

$$\text{Then CP} = \left[\frac{100}{100-\text{Loss}\%}\right]\times \text{SP}$$

ILLUSTRATION ▶ 5 : A Chair was sold for ₹ 517 at a profit of 10%. Find the cost price of the chair.

Sol. Here, selling price = ₹ 517
and profit = 10%

$$\therefore \quad \text{Cost price} = \text{selling price}\left(\frac{100}{100+\text{profit}\%}\right)$$

$$= 517\left(\frac{100}{100+10}\right)$$

$$= 517\times\frac{100}{110} = ₹470$$

ILLUSTRATION ▶ 6 : Ram sold a watch for ₹ 376 at a loss of 6%. Find the cost price of the watch.

Sol. $\text{Cost price} = \text{selling price}\left(\frac{100}{100-\text{Loss}\%}\right)$

$$= ₹376\times\left(\frac{100}{100-6}\right)$$

$$= ₹376\times\frac{100}{94} = ₹400$$

Advanced Conditions

- If two items are sold each at rupees R, one at a gain of x% and other at a loss of x %, there is always an overall loss given by $\frac{x^2}{100}$ % and the value of loss is given by $\frac{2x^2R}{(100^2-x^2)}$. In case the cost price of both the items is the same and percentage loss and gain are equal, then net loss or profit is zero. The difference between the two cases is that the cost price in the first case is not the same, and in the second case it is the same.

ILLUSTRATION ▶ 7 : Ram sells two Mobile phones for ₹ 1000 each, one at a profit of 10% and other at a loss of 10%. Find his gain or loss percentage.

Sol. Using the formula, Loss %

$$= \left(\frac{x^2}{100}\right)\% = \left(\frac{10\times10}{100}\right)\% = 1\%$$

$$\text{Loss in terms of rupees} = \frac{2x^2R}{(100^2-x^2)}$$

$$= \frac{2\times10^2\times1000}{100^2-10^2} = \frac{200000}{9900}$$

$$= ₹20.20$$

- **A dishonest shopkeeper claims to sell goods at cost price, but uses a lighter weight, then his Gain %**

$$= \left[\frac{100\times\text{excess}}{(\text{original value}-\text{excess})}\right]$$

Where excess = amount by which the correct weight is more than the lighter weight.

ILLUSTRATION ▶ 9 : A shopkeeper professes to sell sugar at cost price, but uses a false weight which reads 1000 gms for 900 gm. What is his profit percent?

Sol. Using the formula,

$$\text{Profit Percent} = \frac{100\times\text{excess}}{\text{original value}-\text{excess}}$$

$$= \frac{100\times(1000-900)}{1000-100}$$

$$= \frac{100\times100}{900}\frac{100}{9} = 11.11\%$$

Alternet Method: Shopkeeper net profit = 100gms
$\therefore$ CP of 1000 gms = SP of 900 gms

$$\text{So profit percent} = \frac{100}{900}\times100$$

$$= 11.11\%$$

ILLUSTRATION ▶ 9 : A shopkeeper sells rice to a customer, using false weights and gains $\frac{100}{8}$ % on his cost. What weight has he substituted for a kilogram?

Sol: Using the formula, Gain %

$$= \left[\frac{100\times\text{excess}}{(\text{original value}-\text{excess})}\right]$$

$$\Rightarrow \frac{100}{8} = \left[\frac{100\times\text{excess}}{(1-\text{excess})}\right]$$

From here, Excess = 0.111 Kg, which is 111.11 grams
Weight used by shopkeeper = 1000 - 111.11 = 888.89 grams

Alternet Method: To earn a profit of $\left(\frac{100}{8}\right)\%$ i.e. 12.5%, the shopkeeper needs to make 1.125 kgs out of 1 kg. So he will be selling $\frac{1000}{1.125}\text{gms} = 888.88\,\text{gms}$ in place of 1 kg.

To find profit or loss percent, when price of goods is not specified, i.e. only quantity purchased and sold is given–

In these questions cost prices of a given units of goods is compared with the selling price of another units of goods. Following formula is used to ascertain Profit/Loss percent

$$= \frac{\text{Difference in goods}}{\text{goods sold}} \times 100$$

ILLUSTRATION ▶ 10 : The CP of 50 articles is equal to the selling price of 40 articles. What is profit or loss percent?

Sol: Since, loss items are sold to recover the cost of more items, Terefore it is a case of profit.

$$\therefore \text{ Profit percent} = \frac{10}{40} \times 100$$

ILLUSTRATION ▶ 11 : The CPof 50 articles is equal to the selling price of 70 articles. What is the profit/loss percent?

Sol: Since, more items are sold to recover the cost of less items, then it is a condition of loss.

$$\therefore \text{ Profit percent} = \frac{20}{70} \times 100 = 28.57\%$$

Ready to Explore some more:

List Price: This price is fixed by the shopkeeper over and above the selling price in anticipation that he would be asked for a discount. It is also known as market- up price.

$$LP \xrightarrow{\%\text{decrease}} SP \xrightarrow{\%\text{ Profit/Loss}} CP.$$

To find markup percent over price when profit and discout

$$\text{percent are given} = \left[\frac{MP}{CP} - 1\right] \times 100 .$$

ILLUSTRATION ▶ 12 : After selling an article at a discount of 20%, profit percentage obtained is 10%. What is the mark-up over CP?

Sol: 0.8 MP = 1.1 CP

$$\frac{MP}{CP} = \frac{1.1}{0.8}$$

$$\text{Mark-up percent} = \left[\frac{MP}{CP} - 1\right] \times 100 = \left[\frac{1.1}{0.8} - 1\right] \times 100$$

$$= \frac{1.1 - 0.8}{0.8} \times 100 = 37.5\%$$

Computation of discount percent when buy 'x' get 'y' free scheme is launched:

$$\text{Discount percent} = \frac{\text{Free Units}}{\text{Total Units}} \times 100$$

ILLUSTRATION ▶ 13 : Big Bazaar is offering "Buy 2, get 1 free" on household items. What is the net percentage discount being offered by the store?

Sol: According to the formula given above,

$$\text{Net Discount Percent} = \frac{\text{Free Unit}}{\text{Total Unit}} \times 100$$

$$= \frac{1}{(2+1)} \times 100 = 33.33\%$$

ILLUSTRATION ▶ 14 : A Shopkeeper marks up his goods by 20% and gives a discount of 5%. Also, he uses a false balance, which reads 1000 gins for 750 gins. What is his total profit percent?

Sol: Let the CP per gm be 0.10

Accordingly CP of 1 kg i.e. 1000 gms = ₹100.

Selling price of 750 gms

= [100 × 120% – 5% of 120]

= 120 – 6 = 114.

Cost Price of 750 gms = 75.

Profit = 114 – 75 = 39

$$\text{Profit percent} = \frac{39}{75} \times 100 = 52\%$$

When goods are purchased in bulk, and then sold in parts, then to find required profit percent on remaining goods, so as to earn an overall profit percent:

ILLUSTRATION ▶ 14 : A dealer in toys, bought some electronic Chinese toys for ₹10,000. He sold half of the goods @ 10% profit. At what percent profit should be sell the remaining goods so as to earn an overall profit of 20% ?

Sol. Desired Total profit $= 10,000 \times \frac{20}{100} = 2000.$

$$\text{Profit on goods sold} = 5000 \times \frac{10}{100} = 500$$

Remaining Profit = 2000 – 500 = 1500.

$$\text{Profit Percent} = \frac{1500}{5000} \times 100 = 30\%$$

Alternate Method:

$$\frac{1}{2} \times 10 + \frac{1}{2} \times (x) = 20$$

$$5 + \frac{x}{2} = 20$$

$$\frac{x}{2} = 15$$

$$x = 15 \times 2 = 30\%$$

Note : If an article is sold at a gain of say, 20% then S.P = 120% of C.P. So, instead of first finding 20% of CP and then adding, it would be simple to calculate it as given above.

Also, if an article is sold at a loss of say, 20%, then S.P = 80% of CP.

Formulae to Remember

When selling price of an article is greater than the cost price:

- Profit = Selling price – cost price
- Selling price = cost price + profit
- Cost price = selling price – profit
- $\text{Profit \%} = \frac{\text{profit}}{\text{cost price}} \times 100$
- $\text{Profit} = \frac{\text{cost price} \times \text{profit\%}}{100}$
- $\text{Profit} = \text{cost price} \times \left(\frac{100 + \text{profit\%}}{100}\right)$
- $\text{Selling price} = \text{cost price} \times \left(\frac{100 \times \text{selling price}}{100 + \text{profit\%}}\right)$

When selling price of an article is less than the cost price:

- Loss = cost price – selling price
- Selling price = cost price – loss
- Cost price = selling price + loss
- $\text{Loss\%} = \frac{\text{Loss}}{\text{Cost price}} \times 100$
- $\text{Loss} = \frac{\text{Cost price} \times \text{Loss\%}}{100}$
- $\text{Selling price} = \text{cost price} \times \frac{(100 - \text{Loss\%})}{100}$
- $\text{Cost price} = \frac{100 \times \text{selling price}}{100 - \text{Loss\%}}$

SOLVED EXAMPLES

EXAMPLE ▶ 1: The owner of a cellphone shop charges his customers 32% more than the cost price. If a customer paid ₹ 6600 for the cellphone, then what was the cost price of the cell phone ?

(a) ₹ 5800 **(b) ₹ 6100**
(c) ₹ 5000 **(d) ₹ 5400**
(e) None of these

Sol. (c) CP of a cellphone

$$\frac{SP \times 100}{100 + Profit\%}$$

$$= 6600 \times \frac{100}{100 + 32}$$

$$= \frac{6600 \times 100}{132} = 5000$$

EXAMPLE ▶ 2 : Mohan bought a cycle for ₹ 475 and then sold it at a loss of 8% of the cost price. For how much did he sell the cycle ?

(a) ₹ 453 **(b) ₹ 419**
(c) ₹ 441 **(d) ₹ 437**
(e) None of these

Sol. (d) SP of the cycle $= CP\frac{[100 - loss\%]}{100}$

$$= \left(\frac{92}{100} \times 475\right) = ₹437$$

EXAMPLE ▶ 3 : A person subscribing to Sky Cable for one year pays ₹1,785. If the monthly subscription is ₹ 175, how much discount does a yearly subscriber get ?

(a) 18% **(b) 11%**
(c) 13% **(d) 15%**
(e) None of these

Sol. (d) Total annual subscription = ₹ (175 × 12) = ₹ 2100
Actual subscription = ₹ 1785
∴ Discount = ₹ (2100 – 1785) = ₹ 315

$$\therefore \text{ Discount percent} = \frac{315}{2100} \times 100 = 15\%$$

Note: It is calculated on total cost.

EXAMPLE ▶ 4 : The labelled price of a product is ₹750. If it is sold at a 20% discount and still the dealer earns a 25% profit, what is the cost price ?

(a) ₹ 550 **(b) ₹ 450**
(c) ₹ 435 **(d) ₹ 480**
(e) None of these

Sol. (d) SP of the product = List Price – Discount

$$\text{or, } \frac{(100 - discount\%)}{100} \times LP$$

$$\frac{SP \times 100}{100 + Profit\%}$$

$$= \left(\frac{80}{100} \times 750\right) = ₹600$$

Profit = 25 %

$$\therefore \quad CP = \frac{100}{125} \times 600 = ₹480$$

In a single step

$$CP = \left[\frac{100 - discount\%}{100}\right]\left[\frac{100}{100 + Profit\%}\right] \times LP$$

EXAMPLE ▶ 5 : In a sale, a pair of trousers is available at 15% discount on the selling price. The trousers' discounted selling price is ₹ 837.25 in the sale. What was the original selling price of the trousers?

(a) ₹ 995 **(b) ₹ 990**
(c) ₹ 1,005 **(d) ₹ 985**
(e) ₹ 1,012

Sol. (d) Required selling price

$$= \left(\frac{100}{85} \times 837.25\right) ₹ = 985 ₹$$

EXAMPLE ▶ 6 : A gold bracelet is sold for ₹ 14,500 at a loss of 20%. What is the cost price of the gold bracelet?

(a) ₹ 18,125 **(b) ₹ 17,400**
(c) ₹ 15,225 **(d) ₹ 16,800**
(e) None of these

Sol. (a) Cost price of bracelet $= \frac{\text{selling price} \times 100}{100 - Loss\%}$

$$\therefore \text{ Cost Price of bracelet} = \frac{14500 \times 100}{80} = ₹18125$$

EXAMPLE ▶ 7 : The cost of 16 kgs of sugar is ₹ 448. The cost of 18kgs of rice is ₹ 756 and the cost of 14 kgs of wheat is ₹ 546. What is the total cost of 23 kgs of sugar, 26 kgs of rice and 21 kgs of wheat?

(a) ₹ 2,585 **(b) ₹ 2,615**

(c) ₹ 2,555 **(d) ₹ 2,600**

(e) None of these

Sol. (c) $\because$ CP of 16 kg of sugar = ₹ 448

$\therefore$ CP of 23kg of sugar $\frac{448}{16} \times 23 = ₹644$

similarly, CP of 26 kg of rice

$= \frac{756 \times 26}{18} = ₹1092$

and CP of 21 kg of wheat

$= \frac{546}{14} \times 21 = ₹819$

Required price

= ₹(644 + 1092 + 819)

= ₹2555

EXAMPLE ▶ 8 : The profit earned after selling an article for ₹ 996 is the same as loss incurred after selling the article for ₹ 894. What is the cost price of the article ?

(a) ₹ 935 **(b) ₹ 905**

(c) ₹ 945 **(d) ₹ 975**

(e) None of these

Sol. (c) Cost price $= \frac{996 + 894}{2}$

$= ₹945$

EXAMPLE ▶ 10 : Shri Ramlal purchased a TV set for ₹ 12,500 and spent ₹ 300 on transportation and ₹ 800 on installation. At what price should he sell it so as to earn an overall profit of 15%?

(a) ₹ 14,560 **(b) ₹ 14,375**

(c) ₹ 15,460 **(d) ₹ 15,375**

(e) None of these

Sol. (e) Selling price

$= (12500 + 300 + 800) \times \frac{115}{100}$

$= 13600 \times \frac{115}{100}$

$= ₹ 15640$

EXERCISE

1. Mohan bought a watch with 25% discount on the selling price. If the watch cost him ₹ 1,545, what is the original selling price of the watch?
   (a) ₹ 2,050 (b) ₹ 2,000
   (c) ₹ 2,040 (d) Cannot be determined
   (e) None of these
2. The owner of an electronics shop charges his customer 22% more than the cost price. If a customer paid ₹ 10,980 for a DVD player, then what was the cost price of the DVD player?
   (a) ₹ 8000 (b) ₹ 8800
   (c) ₹ 9500 (d) ₹ 9200
   (e) None of these
3. The owner of a stationery shop charges his customers 28% more than the cost price. If a customer paid ₹ 4544 for school books, then what was the cost price of the school books ?
   (a) ₹3550 (b) ₹3500
   (c) ₹3450 (d) ₹3400
   (e) None of these
4. When the original price of a toy was increased by 25% the price of one dozen toys was ₹ 300. What was the original price of one toy?
   (a) ₹ 24 (b) ₹ 29
   (c) ₹ 30 (d) ₹ 15
   (e) ₹ 20
5. The owner of an electronics shop charges his customers 25% more than the cost price. If a customer paid ₹ 11,500 for a television set, then what was the cost price of the television set?
   (a) ₹9,200 (b) ₹7,200
   (c) ₹8,600 (d) ₹9,800
   (e) ₹10,000
6. Vinita bought a watch with 24% discount on the selling price. If the watch cost her ₹ 779, what is the original selling price of the watch?
   (a) ₹ 1000 (b) ₹ 950
   (c) ₹ 1040 (d) Cannot be determined
   (e) None of these
7. The owner of a toy shop charges his customers 33% more than the cost price. If the customer paid ₹4,921 for a toy, then what was the cost price of the toy?
   (a) ₹ 3,850 (b) ₹ 3,700
   (c) ₹ 3,550 (d) ₹ 3,900
   (e) None of these
8. Mohan purchased an article and sold it for ₹ 2817.50 and earned 15 percent profit on the cost price. What was the cost price of the article?
   (a) ₹ 2,500 (b) ₹ 2,450
   (c) ₹ 2,540 (d) ₹ 3,315
   (e) None of these
9. The profit earned after selling an article for ₹ 1,754 is the same as loss incurred after selling the article for ₹ 1,492. What is the cost price of the article?
   (a) ₹ 1,623 (b) ₹ 1,523
   (c) ₹ 1,689 (d) ₹ 1,589
   (e) None of these
10. Prathik sold a music system to Karthik at 20% gain and Karthik sold it to Swasthik at 40% gain. If Swasthik paid ₹10,500 for the music system, what amount did Prathik pay for the same?
   (a) ₹ 8,240 (b) ₹ 7,500
   (c) ₹ 6,250 (d) Cannot be determined
   (e) None of these
11. In a sale, a perfume is available at a discount of 15% on the selling price. If the perfume's discounted selling price is ₹ 3675.40, what was the original selling price of the perfume?
   (a) ₹ 4,324 (b) ₹ 4,386
   (c) ₹ 4,400 (d) ₹ 4,294
   (e) None of these
12. What profit/loss percent did Ravi earn if he purchased an item of ₹ 5,600 and sold it at three-fourth of its cost price?
   (a) Loss of 20 percent
   (b) Gain of 25 percent
   (c) Neither gain nor loss
   (d) Loss of 25 percent
   (e) None of these
13. An article was purchased for 78,350/–. Its price was marked up by 30%. It was sold at a disount of 20% on the marked up price. What was the profit percent on the cost price?
   (a) 10 (b) 6
   (c) 4 (d) 2
   (e) None of the above
14. Manhar sold an item for ₹8400 and incurred a loss of 25%. At what price should be have sold the item to have gained a profit of 40%?
   (a) ₹15,680 (b) ₹16,220
   (c) ₹14,540 (d) Cannot be determined
   (e) None of the above

15. Prashant incurred a loss of 75% on selling an article for ₹6800. What was the cost price of the article ?
(a) 27,700 (b) 25,600
(c) 21,250 (d) 29,000
(e) None of these

16. A milkman sells 120 litres of milk for ₹3360 and he sells 240 litres of milk for ₹6120. How much discount does the trader
27. give per litre of milk, when he sells 240 litres of milk?
(a) ₹2 (b) ₹3.5
(c) ₹2.5 (d) ₹1.5
(e) None of the above

17. Ghanshyam purchased an article for ₹1850. At what price
28. should he sell it so that 30% profit is earned?
(a) ₹2450 (b) ₹2245
(c) ₹2405 (d) ₹2425
(e) None of the above

18. Vandana sells an article for ₹3240 and earns a profit of 20%. What is the cost price of the article?
(a) ₹2800 (b) ₹2820
(c) ₹2750 (d) ₹2700
(e) None of these

19. A DVD player was purchased for ₹4860. At what price it should be sold so that 25% profit is earned?
(a) ₹6225 (b) ₹6275
(c) ₹6075 (d) ₹6025
(e) None of these

Directions (20-22) : Study the information given below and answer the questions that follow:

30.

An article was bought for ₹5600. Its price was marked up by 12%. Thereafter it was sold at a discount of 5% on the marked price

20. What was the marked price of the article ?
(a) ₹6207 (b) ₹6242
(c) ₹6292 (d) ₹6192
(e) ₹6272

21. What was the percent profit on the transaction?
(a) 6.8% (b) 6.3%
(c) 6.4% (d) 6.6%
(e) 6.2%

22. What was the amount of discount given?
(a) ₹319.6 (b) ₹303.6
(c) ₹306.3 (d) ₹313.6
(e) ₹316.9

23. 21 articles were bought for ₹6531 and sold for ₹ 9954. How much was the approximate profit percentage per article ?
(a) 56% (b) 43%
(c) 52% (d) 49%
(e) 61%

24. The C.P. of an article is ₹1700. If it was sold at a price of 33. ₹2006, what was the percentage profit on the transaction ?
(a) 18 (b) 12
(c) 10 (d) 15
(e) 20

25. Meera purchased 23 bracelets at the rate of ₹160 per bracelet. At what rate per bracelet should she sell the bracelets so that profit earned is 15%?
(a) ₹184 (b) ₹186
(c) ₹192 (d) ₹198
(e) None of these

26. 'A' got 30% concession on the label price of an article sold for ₹8750 with 25% profit on the price he bought. The label price was
(a) ₹10,000 (b) ₹13,000
(c) ₹16,000 (d) ₹12,000
(e) None

27. The C.P. of a book is ₹ 150. At what price should it be sold to gain 20%?
(a) ₹80 (b) ₹120
(c) ₹180 (d) ₹100
(e) None

28. If books bought at prices ranging from ₹150 to ₹300 are sold at prices ranging from ₹250 to ₹350, what is the greatest possible profit that might be made in selling 15 books?
(a) ₹3000 (b) Cannot be determined
(c) ₹750 (d) ₹4250
(e) None

29. A man sold two articles at ₹375 each. On one, he gains 25% and on the other he loses 25%. The gain or loss % on the whole transaction is:
(a) 6% (b) $4\frac{1}{6}\%$
(c) ₹50 (d) $6\frac{1}{4}$
(d) None

30. A bought an article, paying 5% less than the original price. A sold it with 20% profit on the price he had paid. What percent of profit did A earn on the original price ?
(a) 10 (b) 13
(c) 14 (d) $\frac{17}{2}$
(d) None

31. The profit percent of a bookseller if he sells book at marked price after enjoying a commission of 25% on marked price will be:
(a) 30% (b) 25%
(c) 20% (d) 33%
(e) None

32. The printed price of a book is ₹320. A retailer pay ₹244.80 for it. He gets successive discounts of 10% and an another rate. His second rate is:
(a) 15% (b) 16%
(c) 14% (d) 12%
(e) None

33. A sells an article to B at a gain of 10%. B sells it to C at a gain of 5%. If C pays ₹462 for it, what did it cost to A?
(a) ₹500 (b) ₹450
(c) ₹600 (d) ₹400
(e) None

34. The profit obtained by selling a book for ₹56 is the same as the loss obtained by selling this book for ₹42. What is the cost price of the book ?
(a) ₹40 (b) ₹49
(c) ₹50 (d) ₹55
(e) None

35. By selling a toy for `150, a shop owner lost $\frac{1}{16}$th of what it cost to him. What is the C.P. of toy?
(a) `160 (b) `150
(c) `140 (d) `120
(e) None

36. Profit as a percentage of the selling price is 25%. Express it as apercentage of cost price.
(a) 25% (b) 20%
(c) $33\frac{1}{3}\%$ (d) 15%
(e) None

37. A man sold a book at a profit of 10%. if he had charged ₹45 more, his profit percentage would have been 25%. Find the C.P. of the book.
(a) ₹300 (b) ₹250
(c) ₹200 (d) ₹150
(e) None

38. A fruit-vendor buys 200 bananas for `10. How many bananas a rupee can he sell, so that his profit percentage is 25%.
(a) 10 (b) 14
(c) 16 (d) 20
(e) None

39. A shopkeeper professes to sell his good at C.P. only. But he uses 750 gm weight at the place of 1000 gm weight for a kg. What is his net profit percentage?
(a) 33.33% (b) 25%
(c) 20% (d) 16.67%
(e) None

40. Mohan bought a jute bag @ 30% discount on the list price. He then sold it at a price which is 160% of the list price thereby making a profit of `81. What is the list price of the bag?
(a) ₹90 (b) ₹100
(c) ₹180 (d) ₹200
(e) None

Answer Key

1	**(e)**	9	**(a)**	17	**(c)**	25	**(a)**	33	**(d)**
2	**(e)**	10	**(c)**	18	**(d)**	26	**(a)**	34	**(b)**
3	**(a)**	11	**(a)**	19	**(c)**	27	**(c)**	35	**(a)**
4	**(e)**	12	**(d)**	20	**(e)**	28	**(a)**	36	**(c)**
5	**(a)**	13	**(c)**	21	**(c)**	29	**(d)**	37	**(a)**
6	**(e)**	14	**(a)**	22	**(d)**	30	**(c)**	38	**(c)**
7	**(b)**	15	**(e)**	23	**(c)**	31	**(d)**	39	**(a)**
8	**(b)**	16	**(c)**	24	**(a)**	32	**(a)**	40	**(a)**

ANSWERS & EXPLANATIONS

1. (e) Let the marked price (SP) = ₹ x
According to the question,
75% of x = 1545

$$\text{or, } x = \frac{1545 \times 100}{75} = ₹\ 2060$$

2. (e) CP of DVD player = ₹ x
According to the question,

$$\because \quad x\left(1+\frac{22}{100}\right) = ₹\ 10980$$

$$\therefore \quad x = 10980 \times \frac{50}{61} = ₹\ 9000$$

3. (a) Cost Price

$$= \text{SP}\left[\frac{100}{100 + \text{Profit}\,\%}\right]$$

$$= 4544 \times \frac{100}{128} = 3550$$

4. (e) Cost Price of 12 toy's

$$= \text{SP} \times \frac{100}{100 + \text{Profit}\,\%}$$

$$= 300 \times \frac{100}{125} = 240$$

$$\therefore \text{ CP of 1 toy} = \frac{240}{120} = 20$$

5. (a) CP of television set

$$= ₹\left(\frac{11500 \times 100}{125}\right) = ₹9200$$

6. (e) Let the original selling price of watch = ₹x
According to the question,

$$x \times \frac{76}{100} = 779$$

$$\text{or, } x = \frac{779 \times 100}{76} = ₹1025$$

7. (b) Required cost price $= \dfrac{\text{SP} \times 100}{100 + \text{Profit}}$

$$= \frac{100 \times 4921}{133} = ₹3700$$

8. (b) Cost price $= \dfrac{2817.50 \times 100}{115}$

$$= ₹\,2450$$

9. (a) Cost price

$$= \frac{1754 + 1492}{2} = ₹1623$$

10. (c) Required amount

$$= \frac{10500 \times 100 \times 100}{120 \times 140} = ₹6250$$

11. (a) Original selling price

$$= \frac{3675.4 \times 100}{85}$$

$$= ₹\,4324$$

12. (d) Loss = 1/4 of the CP

$$\left(1 - \frac{3}{4}\right) = \frac{1}{4} \times 100$$

$$= 25\%$$

13. (c) MP = 78,350 × 130% = 101855
SP = 101855 × 80% = 81484
Profit = 81484 – 78350 = 3134

$$\text{Profit \%} = \frac{3134}{78350} \times 100 = 4\%$$

14. (a) $$\text{C.P.} = \frac{\text{SP} \times 100}{100 - \text{loss\%}}$$

$$= 8400 \times \frac{100}{100 - 25} = 111,200$$

$$\text{S.P} = \text{CP} \times \frac{100 + \text{P\%}}{100}$$

$$= 11,200 \times \frac{140}{100} = 15,680$$

15. (e) $$\text{CP} = \text{SP} \times \frac{100}{100 - \text{loss\%}}$$

$$= 6800 \times \frac{100}{100 - 75} = 27,200$$

16. (c) SP of 120 litres = 3360

$$\therefore \text{ SP of 1 litre} = \frac{3360}{120} = 28$$

SP of 240 litres = 6120

$$\therefore \text{ SP of 1 litre} = \frac{6120}{240} = 25.5$$

Discount per litre = 28 – 25.5 = 2.5

17. (c) $$\text{SP} = \text{CP} \times \frac{(100 + \text{Profit \%})}{100}$$

$$= 1850 \times \frac{130}{100} = 2405$$

18. (d) $$\text{CP} = \text{SP} \times \frac{100}{100 + \text{Profit \%}}$$

$$3240 \times \frac{100}{120} = 2700$$

19. (c) $$\text{SP} = \text{CP} \times \frac{(100 + \text{Profit \%})}{100}$$

$$= 4860 \times \frac{125}{100} = 6075$$

20. (e) M.P = 5600 × 112% = 6272

21. (c) SP = 6272 × 95% = 5958.4
Profit = 5958.4 – 5600 = 358.4

$$\text{Profit \%} = \frac{358.4}{5600} \times 100 = 6.4\%$$

22. (d) Discount = 6272 – 5958.4 = 313.6

23. (c) $$\text{Profit \%} = \frac{9954 - 6531}{6531} \times 100$$

= 52.41 or 52% approx
(It is irrelevant whether profit is ascertained on the whole transaction or per unit)

24. (a) $$\text{Profit\%} = \frac{2006 - 1700}{1700} \times 100$$

= 18%

25. (a) $$\text{SP} = \text{CP} \times \frac{(100 + \text{P\%})}{100}$$

$$= 160 \times \frac{115}{100} = 184$$

26. (a) $$\text{CP} = \text{SP} \times \frac{100}{100 + \text{P\%}}$$

$$= 8750 \times \frac{100}{125} = 7000$$

$$\text{MP} = \text{CP} \times \frac{100}{100 - 0\%}$$

$$= 7000 \times \frac{100}{100 - 30\%} = 7000 \times \frac{100}{70} = 10,000$$

27. (c) $$\text{SP} = \text{CP} \frac{(100 + \text{P\%})}{100}$$

$$= 150 \times \frac{120}{100} = 180$$

28. (a) Min. C.P = ₹150
Max. SP = ₹350
Profit = 350 – 150 = 200
Profit on 15 books = 200 × 15 = 3000

29. (d) $$\text{Percentage loss} = \frac{(\text{Percentge})^2}{100}$$

$$= \frac{(25)^2}{100} = \frac{625}{100} = 6.25\%$$

30. (c) Suppose original price is ₹100
A pays ₹95 for it
He sellls it for (95 × 120%) = 114

$$\text{Profit\%} = \frac{14}{100} \times 100 = 14\%$$

31. (d) $$\text{Profit\%} \frac{\text{Commission on MP}}{100 - \text{Commission}} \times 100$$

$$= \frac{25}{100 - 25} \times 100 = 33\frac{1}{3}\%$$

32. (a) $$320\left(1 - \frac{10}{100}\right)\left(1 - \frac{D_2}{100}\right) = 244.80$$

$$288\times\left(1-\frac{D_2}{100}\right)=244.80$$

$$288-\frac{288D_2}{100}=244.80$$

$$\frac{-288D_2}{100}=244.80-288$$

$$\frac{288D_2}{100}=43.2$$

$$D_2=\frac{43.2\times100}{288}=15\%$$

33. (d) $\text{CP for B}=\text{SP}\times\frac{100}{100+\text{P}\%}$

$$=462\times\frac{100}{105}=440$$

$$\text{CP for A}=\text{SP}\times\frac{100}{100+\text{P}\%}=440\times\frac{100}{110}=400$$

34. (b) $\text{CP}=\text{SP}-\text{Profit}$
$=56-x$ .....(1)
$\text{CP}=\text{SP}+\text{Loss}$
$=42+x$ .....(2)
$56-x=42+x$
$56-42=x+x$

$$14=2x,\ x=\frac{14}{2}=7$$

$\text{CP}=56-7=49.$

35. (a) Let the CP be x

$$\text{Loss}=\frac{1}{16}\times x=\frac{x}{16}$$

$\text{SP}=\text{CP}-\text{Loss}$

$$150=x-\frac{x}{16}$$

$$150=\frac{15x}{16}\ \text{or}\ x=\frac{150\times16}{15}$$

=160

36. (c) $\text{Perccentage of cost}=\frac{\text{Profit}\%}{100-\text{P}\%}\times100$

$$=\frac{25}{100-25}\times100=33\frac{1}{3}\%.$$

37. (a) $15\%\ \text{of}\ x=45$

$$x=\frac{45\times100}{15}$$

$=300$

38. (c) $\text{CP of 1 banana}=\frac{100}{200}=0.05\,\text{paisa}$

$$\text{SP}=\text{CP}\times\frac{100+\text{P}\%}{100}$$

$$=0.05\times\frac{125}{100}=0.0625$$

$$\text{In 1 rupee he should sell}=\frac{1}{0.0625}=16\ \text{bananas}$$

39. (a) $\text{Profit}\%=\frac{\text{Error}}{1000-\text{Error}}\times100$

$$=\frac{250}{1000-250}\times100$$

$$=33\frac{1}{3}\%$$

40. (a) Let the LP be 100
So, cost price = 100 × 70%
=70
SP = 100 × 160% = 160
Profit = 160 – 70 = 90
When profit is 90, LP = 100

$$\text{When profit is 81 LP}=\frac{100\times81}{90}=90$$

◆◆◆

CHAPTER

6

AVERAGE

AVERAGE

In the pure mathematical sense, an average is a calculated value, obtained by adding values and dividing the sum by the number of values. In English, this value is called the mean.

Hence, average = $\frac{\text{sum of elements}}{\text{number of elements}}$

For example : To find the average of 3, 5 and 7.

Solution

Step 1: Find the sum of the numbers.

$3 + 5 + 7 = 15$

Step 2: Calculate the total number.

There are 3 numbers.

Step 3: Finding average.

$\frac{15}{3} = 5$

QUICKER METHOD TO SOLVE QUESTIONS ON AVERAGE

❖ **Sum of elements = average × no. of elements**

ILLUSTRATION ▶ 1 : The average of marks obtained by 4 students in a class is 65. Find the sum of marks obtained?

Sol. Here, number of students = 4

Average = 65

∴ sum of marks obtained = $65 \times 4 = 260$

❖ **Number of elements =** $\frac{\text{Sum of elements}}{\text{Average}}$

ILLUSTRATION ▶ 2 : If the sum of elements and average are respectively 65 and 13, then find the number of elements.

Sol. Number of elements = $\frac{\text{Sum of elements}}{\text{Average}}$

$= \frac{65}{13} = 5$

❖ **Average of a group consisting of two different groups whose averages are known:**

Let a group with average a contain m quantities and another group of n quantities whose average is b, then the average of group c containing at $a + b$ quantities

$= \frac{ma + nb}{m + n}$

ILLUSTRATION ▶ 3 : There are 30 students in a class. The average age of the first 10 students is 12.5 years. The average age of the next 20 students is 13.1 years. Find the average age of the whole class.

Sol. Total age of 10 students

$= 12.5 \times 10 = 125$ years

Total age of 20 students

$= 13.1 \times 20 = 262$ years

∴ Average age of 30 students

$= \frac{125 + 262}{30} = \frac{387}{30} = 12.9$ years

❖ If in a group one or more new quantities are added or excluded, then new quantity or sum

= [change in no. of quantities × original average] ± [change in average × final no. of quantities]

Take + ve sign if quantities are added and take –ve sign if quantities are removed

ILLUSTRATION ▶ 4 : The average weight of 24 students in a class is 35 kg. if the weight of the teacher is included, the average weight rises by 400 gms. Find the weight of the teacher.

Sol. Total weight of 24 students

$= (24 \times 35)$ kg $= 840$ kg

Total weight of 24 students and the teacher

$= (25 \times 35.4)$ kg $= 885$ kg

∴ Weight of teacher

$= (885 - 840)$ kg $= 45$ kg

Formulas to Remember

- The average of first n natural numbers = $\frac{n+1}{2}$
- The average of the first n consecutive even numbers = $(n + 1)$
- The average of the first n consecutive odd numbers = n
- The average of the first n odd natural numbers = $\left(\frac{\text{Last odd number} + 1}{2}\right)$
- The average of the first n even numbers = $\left(\frac{\text{Last even number} + 1}{2}\right)$
- The average of the squares of the first n natural numbers can be shown to be $\frac{1}{6}(n + 1)(2n + 1)$
- The average of the squares of the first n even natural numbers = $\frac{2(n+1)(2n+1)}{3}$
- The average of the squares of the first n odd natural numbers = $\frac{(2n-1)(2n+1)}{3}$
- The average of the cubes of the first n natural numbers = $\frac{n(n+1)^2}{4}$

SOLVED EXAMPLES

EXAMPLE ▶ 1: The average of 5 consecutive odd numbers A, B, C, D and E is 45. What is the product of B and D ?

(a) 2107 **(b) 2205**
(c) 1935 **(d) 2021**
(e) None of these

Sol. (d) Let the first odd number, A be x.
According to the question
$A + B + C + D + E = 5 \times 45$
$\Rightarrow x + x + 2 + x + 4 + x + 6 + x + 8 = 225$
$\Rightarrow 5x + 20 = 225$
$\Rightarrow 5x = 225 - 20 = 205$
$\Rightarrow x = \frac{205}{5} = 41$
$\therefore A = 41, B = 43, C = 45, D = 47$
$\therefore B \times D = 43 \times 47 = 2021$

EXAMPLE ▶ 2 : Find the average of the following set of scores
566, 455, 231, 678, 989, 342, 715

(a) 590 **(b) 555**
(c) 568 **(d) 513**
(e) None of these

Sol. (c) Average score
$= \frac{566 + 455 + 231 + 678 + 989 + 342 + 715}{7}$
$= \frac{3976}{7} = 568$

EXAMPLE ▶ 3: The average age of five officers in a department is 32 years. If the age of their supervisor is added the average is increased by 1. What is the supervisor's age?

(a) 32 years **(b) 48 years**
(c) 38 years **(d) 42 years**
(e) None of these

Sol. (c) Supervisor's age = 32 + 6 = 38 years

EXAMPLE ▶ 4: The average of 5 consecutive numbers A,B,C,D and E is 48. What is the product of A and E ?

(a) 2162 **(b) 2208**
(c) 2024 **(d) 2300**
(e) None of these

Sol. (d) Let the five consecutive numbers be x, x+1, x+2, x+3 and x+4 respectively.
Then, according to the question,
$x + x + 1 + x + 2 + x + 3 + x + 4 = 5 \times 48$
or $5x + 10 = 5 \times 48$
or $5 (x + 2) = 5 \times 48$
or $x + 2 = 48$
or $x = 48 - 2 = 46$
$\therefore$ $A = x = 46$
and $E = x + 4 = 46 + 4 = 50$
$\therefore$ $A \times E = 46 \times 50 = 2300$

EXAMPLE ▶ 5: If 47a + 47b = 5452 then what is the average of a and b ?

(a) 11 **(b) 23.5**
(c) 96 **(d) 58**
(e) None of these

Sol. (d) $\therefore 47a + 47b = 5452$

$\Rightarrow 47(a+b) = 5452$

$\Rightarrow \frac{a+b}{2} = \frac{5452}{47 \times 2}$

$\therefore$ Required average $= 58$

EXAMPLE ▶ 6: The average age of a man and his son is 33 years. The ratio of their ages is 8:3. What is the man's age ?

(a) 48 years **(b) 44 years**
(c) 42 years **(d) 50 years**
(e) None of these

Sol. (a) Average age of father and son = 33 years

Sum of their ages = $2 \times 23 = 66$ years

$\because 8x + 3x = 2 \times 33$

$\Rightarrow 11x = 66$

$\Rightarrow x = 6$

$\therefore$ Father's age = $8 \times 6 = 48$ years

EXAMPLE ▶ 7: The total of the ages of a class of 75 girls is 1050, the average age of 25 of them is 12 years and that of another 25 is 16 years. Find the average age of the remaining girls.

(a) 12 years **(b) 13 years**
(c) 14 years **(d) 15 years**
(e) None of these

Sol. (c) Average age of remaining girls

$$= \frac{1050 - (25 \times 12 + 25 \times 16)}{75 - (25 + 25)}$$

$$= \frac{1050 - 700}{25} = 14 \text{ years}$$

EXAMPLE ▶ 8 : The average marks of a student in seven subjects is 41. After re-evaluation in one subject the marks were changed to 42 from 14 and in remaining subjects the marks remain unchanged. What is the new average marks?

(a) 45 **(b) 44**
(c) 46 **(d) 47**
(e) None of these

Sol. (d) New average marks $= \frac{7 \times 41 - 14 + 42}{7}$

$$= \frac{287 + 28}{7} = \frac{315}{7} = 45$$

EXERCISE

1. The average of five numbers is 281. The average of the first two numbers is 280 and the average of the last two numbers is 178.5. What is the third number ?
   (a) 488 (b) 336
   (c) 228 (d) 464
   (e) None of these
2. The average age of 3 friends is 32 years. If the age of a fourth friend is added, their average age comes to 31 years. What is the age of the fourth friend ?
   (a) 32 years (b) 28 years
   (c) 24 years (d) 26 years
   (e) None of these
3. Find the average of the following set of scores.
   965, 362, 189, 248, 461, 825, 524, 234
   (a) 476 (b) 504
   (c) 461 (d) 524
   (e) None of these
4. If the value of 21a + 21b=1134, what is the average of a+b?
   (a) 29 (b) 27
   (c) 58 (d) 54
   (e) None of these
5. Out of three given numbers, the first number is twice the second and thrice the third. If the average of the three numbers is 154, what is the difference between the first and the third number?
   (a) 126 (b) 42
   (c) 166 (d) 52
   (e) None of these
6. Average weight of three boys P, T and R is $54\frac{1}{3}$ kgs while the average weight of three boys, T, F and G is 53 kgs. What is the average weight of P, T, R, F and G?
   (a) 53.8kgs (b) 52.4kgs
   (c) 53.2kgs (d) Cannot be determined
   (e) None of these
7. Find the average of the following set of scores
   221, 231, 441, 359, 665, 525
   (a) 399 (b) 428
   (c) 407 (d) 415
   (e) None of these
8. The average of 5 consecutive even numbers A, B,C,D and E is 52. What is the product of B and E?
   (a) 2916 (b) 2988
   (c) 3000 (d) 2800
   (e) None of these

9. The average of 5 consecutive numbers A, B, C, D and E is 48. What is the product of A and E?
(a) 2162 (b) 2208
(c) 2024 (d) 2800
(e) None of these

10. Find the average of the following set of scores:
341, 292, 254, 375, 505, 639
(a) 401 (b) 399
(c) 405 (d) 397
(e) None of these

11. Find the average of the following set of scores:
118, 186, 138, 204, 175, 229
(a) 148 (b) 152
(c) 156 (d) 160
(e) 175

12. Find the average of the following set of scores:
178, 863, 441, 626, 205, 349, 462, 820
(a) 505 (b) 441
(c) 349 (d) 493
(e) None of these

13. Out of the three given numbers, the first number is twice the second and thrice the third. If the average of the three numbers is 121, what is the difference between the first and the third number?
(a) 132 (b) 99
(c) 77 (d) 144
(e) None of these

14. If the value of 16a + 16b = 672, what is the average of a and b?
(a) 44 (b) 21
(c) 24 (d) 42
(e) None of these

15. The average of 5 consecutive odd numbers A, B, C, D and E is 41. What is the product of A and E?
(a) 1977 (b) 1517
(c) 1665 (d) 1591
(e) None of these

16. Find the average of the following set of scores:
361, 188, 547, 296, 656, 132, 263
(a) 278 (b) 449
(c) 356 (d) 296
(e) None of these

17. If 37a + 37b = 5661, what is the average of a and b?
(a) 74.5 (b) 151
(c) 76.5 (d) 153
(e) None of these

18. The average of 5 consecutive even number A, B, C, D and E is 34. What is the product of B and D?
(a) 1088 (b) 1224
(c) 1368 (d) 1152
(e) None of these

19. Find the average of the following set of scores:
191, 257, 384, 466, 525, 631
(a) 409 (b) 376
(c) 413 (d) 398
(e) None of these

20. The average weight of a group of 75 girls was calculated as 47 kgs. It was later discovered that the weight of one of the girls was read as 45 kgs., whereas her actual weight was 25 kgs. What is the actual average weight of the group of 75 girls? (Rounded off to two digits after decimal)
(a) 46.73 kgs. (b) 46.64 kgs.
(c) 45.96 kgs. (d) Cannot be determined
(e) None of these

21. Abhishek purchased 140 shirts and 250 trousers @ ₹ 450 and @ ₹ 550 respectively. What should be the overall average selling price of shirts and trousers so that 40% profit is earned? (Rounded off to next integer)
(a) ₹ 725 (b) ₹ 710
(c) ₹ 720 (d) ₹ 700
(e) None of these

22. The sum of five numbers is 290. The average of the first two numbers is 48.5 and the average of last two numbers is 53.5. What is the third number?
(a) 72 (b) 84
(c) 96 (d) 108
(e) None of these

23. The average weight of 45 students in a class was calculated as 36 kgs. It was later found that the weight of two students in the class was wrongly mentioned. The actual weight of one of the boys in the class was 32 kgs. but it was mentioned as 34 kgs and the weight of another boy in the class was 45 kgs. whereas it was mentioned as 40 kgs. What is the actual average weight of the 45 students in the class? (Rounded off to two-digits after decimal)
(a) 36.07 kg. (b) 36.16 kgs.
(c) 35.84 kgs. (d) Cannot be determined
(e) None of these

24. The average weight of a group of 53 girls was calculated as 58 kgs. It was later discovered that the weight of one of the girls was read as 65 kgs., whereas her actual weight was 45 kgs. What is the actual average weight of the group of 53 girls? (rounded off to two digits after decimal)
(a) 58.62 (b) 58.37
(c) 57.37 (d) 57.62
(e) None of these

25. Seema's present age is four times her son's present age and four-seventh of her father's present age. The average of the present ages of all three of them is 32 years. What is the difference between the Seema's son's present age and Seema's father's present age ?
(a) 44 years (b) 48 years
(c) 46 years (d) Cannot be determined
(e) None of these

26. What is the average of the following set of numbers?
38, 92, 45, 25 60
(a) 48 (b) 54
(c) 56 (d) 50
(e) None of these

27. The average of four positive integers is 73.5. The highest integer is 108 and the lowest integer is 29. The difference between the remaining two integers is 15. Which of the following is the smaller of the remaining two integers ?
(a) 80 (b) 86
(c) 73 (d) Cannot be determined
(e) None of these

28. The average monthly income of a family of four earning members was ₹ 15,130. One of the daughters in the family got married and left home, so the average monthly income of the family came down to ₹14,660. What is the monthly income of the married daughter?
(a) ₹ 15,350
(b) ₹ 12,000
(c) ₹ 16,540
(d) Cannot be determined
(e) None of these

29. If 25a + 25b = 115, then what is the average of a and b ?
(a) 4.6 (b) 2.5
(c) 4.5 (d) 3.4
(e) None of these

30. The average of 5 positive integers is 436. The average of the first two numbers is 344 and the average of the last two numbers is 554. What is the third number ?
(a) 482 (b) 346
(c) 556 (d) 384
(e) None of these

Answer Key									
1	(a)	7	(c)	13	(a)	19	(a)	25	(b)
2	(b)	8	(d)	14	(b)	20	(a)	26	(e)
3	(a)	9	(e)	15	(c)	21	(c)	27	(e)
4	(b)	10	(a)	16	(e)	22	(e)	28	(c)
5	(e)	11	(e)	17	(c)	23	(a)	29	(e)
6	(d)	12	(d)	18	(d)	24	(d)	30	(d)

ANSWERS & EXPLANATIONS

1. (a) Assume the third number = x

According to question

$2 \times 280 + x + 178.5 \times 2 = 281 \times 5$

or, $560 + x + 357 = 1405$

or, $x + 917 = 1405$

or, $x = 1405 - 917 = 488$

2. (b) Age of the fourth friend = $31 \times 4 - 32 \times 3$

$= 124 - 96 = 28$ years

3. (a) Required average

$$= \frac{965+362+189+248+461+825+524+234}{8}$$

$$= \frac{3808}{8} = 476$$

4. (b) $21a + 21b = 1134$

or, $21 (a + b) = 1134$

$$a + b = \frac{1134}{21} = 54$$

$$\therefore \text{Required average} = \frac{a+b}{2} = \frac{54}{2} = 27$$

5. (e) Let the first number be = 6x

$\therefore$ Second number = 3x

and the third number = 2x

According to the question,

$6x + 3x + 2x = 154 \times 3$

or, $11x = 154 \times 3$

$$\therefore x = \frac{154 \times 3}{11} = 42$$

$\therefore$ Required difference = $6x - 2x = 4x = 4 \times 42 = 168$

7. (c) Average score

$$= \frac{1}{6}[221 + 231 + 441 + 359 + 665 + 525]$$

$$= \frac{1}{6}[2442] = 407$$

8. (d) Let the five consecutive even numbers be x, $x + 2$, $x + 4$, $x + 6$ and $x + 8$ respectively.

According to the question,

$x + x + 2 + x + 4 + x + 6 + x + 8 = 5 \times 52$

or $5x + 20 = 260$

or $5x = 260 - 20$

$$\text{or } x = \frac{240}{5} = 48$$

$\therefore B = x + 2 = 48 + 2 = 50$ and $E = x + 8 = 48 + 8 = 56$

$\therefore B \times E = 50 \times 56 = 2800$

9. (e) Let $A = x$

According to the question

$x + x + 1 + x + 2 + x + 3 + x + 4$

$= 5 \times 48$

$\Rightarrow 5x + 10 = 240$

$\Rightarrow 5x = 230$

$\therefore x = 46$

$\therefore E = 46 + 4 = 50$

$\therefore A \times E = 46 \times 50 = 2300$

10. (a) Required average

$$= \frac{(341+292+254+375+505+639)}{6}$$

$$= \frac{2406}{6} = 401$$

11. (e) Required average

$$= \frac{118+186+138+204+175+229}{6}$$

$$= \frac{1050}{6} = 175$$

12. (d) Required average

$$= \frac{178+863+441+626+205+349+462+820}{8}$$

$$= \frac{3944}{8} = 493$$

13. (a) Let the third number be = x

$\therefore$ First number = 3x and second number = $\frac{3x}{2}$

According to the question.

or, $3x + \frac{3x}{2} + x = 3 \times 121$

or, $\frac{6x+3x+2x}{2} = 3 \times 121$

or, $\frac{11x}{2} = 3 \times 121$

$\therefore x = \frac{3 \times 121 \times 2}{11} = 66$

$\therefore$ Third number = 66

Required difference = 3x – x = 2x = 2 × 66 = 132

14. (b) 16a + 16b = 672

or, 16 (a + b) = 672

$\therefore a + b = \frac{672}{16} = 42$

Required average = $\frac{a+b}{2} = \frac{42}{2} = 21$

15. (c) Let the consecutive odd numbers be

x, x + 2, x + 4, x + 6 and x + 8

According to the question.

$$\frac{x+x+2+x+4+x+6+x+8}{5} = 41$$

or, 5x + 20 = 41 × 5 = 205

or, 5x = 205 – 20 = 185

$\therefore x = \frac{185}{5} = 37$

$\therefore$ A = 37 and E = 37 + 8 = 45

Required product = 37 × 45 = 1665

16. (e) Required average

$$= \frac{361+188+547+296+656+132+263}{7}$$

$$= \frac{2443}{7} = 349$$

17. (c) 37a + 37b = 5661

or, 37(a + b) = 5661

or, $a + b = \frac{5661}{37} = 153$

$\therefore$ Average = $\frac{a+b}{2} = \frac{153}{2} = 76.5$

18. (d) Let A = x,

According to the question,

$\because$ A + B + C + D + E

= x + (x + 2) + (x + 4) + (x + 6) + (x 8)

$\Rightarrow$ 5x + 20 = 34 × 5 = 170

$\Rightarrow$ B × D = 32 × 36 = 1152

19. (a) Required average

$$= \frac{191+257+384+466+525+631}{6}$$

$$= \frac{2454}{6} = 409$$

20. (a) Additional weight = 45 – 25 = 20 kg.

$\therefore$ Actual average weight = $47 - \frac{20}{75}$

= 46.73 kg.

21. (c) Average selling price

$$= \frac{140 \times 450 + 250 \times 550}{140+250} \times \frac{140}{100}$$

$$= \frac{200500}{390} \times \frac{140}{100}$$

= ₹ 720 (approx.)

22. (e) Third number = 290

– (48.5 × 2) – (53.5 × 2)

= 290 – 97 – 107 = 86

23. (a) Actual average weight

$$= 36 + \frac{(32+45-34-40)}{45}$$

$$= 36 + \frac{3}{45}$$

= 36 + 0.07

= 36.07 kgs.

24. (d) Increase in weight

= 65 – 45

= 20 kg.

$\therefore$ Increase in average

$$= \frac{20}{53} = 0.38$$

$\therefore$ Actual average weight

= 58 – 0.38

= 57.62

25. (b) Let Seema's present age be x years.

Then, Seema's son's present age = $\frac{x}{4}$ years

Seema's father's present age = $\frac{7x}{4}$ years.

Then, $x+\frac{x}{4}+\frac{7x}{4}=32\times3$

$\Rightarrow$ $12x = 96 \times 4$

$\Rightarrow$ $x = \frac{96\times4}{12}=32$

$\therefore$ Required difference = $\frac{7\times32}{4}-\frac{32}{4}$

$= 56 - 8 = 48$ years

26. (e) Average $= \frac{38+92+45+25+60}{5}=52$

27. (e) Sum of four integers $= 73.5 \times 4 = 294$

$\therefore$ Sum of two middle integers $= 294 - (108 + 29) = 157$

Difference between two integers = 15

$\therefore$ The smaller number = $\frac{157-14}{2}=71$

28. (c) Monthly income of the married daughter

$= 15130 \times 4 - 14660 \times 3$

$= 60520 - 43980 = ₹ 16540$

29. (e) $25a + 25b = 115$

$\Rightarrow a + b = \frac{115}{25} = 4.6$

$\therefore$ Average of a and b = $\frac{4.6}{2} = 2.3$

30. (d) Third number = $(436 \times 5) - (344 \times 2 + 554 \times 2)$

$= 2180 - 1796$

$= 384$

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CHAPTER

7

RATIO AND PROPORTION

RATIO AND PROPORTION

Ratio

Ratio gives us a relation between two quantities having similar unit. The ratio of A to B is written as A : B or $\frac{A}{B}$, where A is called the antecedent and B the consequent.

Proportion

Proportion is an expression in which two ratios are equal. For example $\frac{A}{B}=\frac{C}{D}$, $\Rightarrow$ A : B : : C : D

Here, $AD = BC$

Properties of Ratios & Proportion

- $a : b = ma : mb$, where m is a constant
- $a : b : c = A : B : C$ is equivalent to $\frac{a}{A}=\frac{b}{B}=\frac{c}{C}$,

  This is an important property and has to be used in the ratio of three quantities.

  If a : b = c : d, i.e

  $\frac{b}{a}=\frac{d}{c}$, this is the property of Invertendo.

  If a : b = c : d, i.e

  $\frac{a}{b}=\frac{c}{d}$, then

  $\frac{a}{c}=\frac{b}{d}$, this is the property of Alternendo.

- If $\frac{a}{b}=\frac{c}{d}$, then $\frac{(a+b)}{b}=\frac{(c+d)}{d}$

  This property is called **Componendo**

  Also,

- $\frac{(a-b)}{b}=\frac{(c-d)}{d}$

  This property is called **Dividendo**

  It also follows that:

- $\frac{(a+b)}{(a-b)}=\frac{(c+d)}{(c-d)}$

  This property is called **Componendo and Dividendo**

- If $\frac{a}{b}=\frac{c}{d}=\frac{e}{f}\cdots$, then

  $\frac{(a+c+e+...)}{(b+d+f+...)}$ = each individual ratio i.e. $\frac{a}{b}$ or $\frac{c}{d}$

- If A > B then $\frac{(A+C)}{(B+C)}<\frac{A}{B}$

  Where A, B and C are natural numbers

  In a proportion it should be remembered that -

  Product of means = Product of extremes, i.e. b × c = a × d.

ILLUSTRATION 1 : If 12 : 18 :: x : 24, then find the value of x.

Sol. 12 : 18 : : x : 24

$\Rightarrow$ $12 \times 24 = 18 \times x$

$\Rightarrow$ $x=\frac{12\times 24}{18}=16$

Types of Proportion

Continued Proportion: If three numbers a, b and c are in continued proportion,then:

We can say that a, b and c are in proportion.

i.e., $\frac{a}{b}=\frac{b}{c}$

$b^2 = ac \Rightarrow b = \sqrt{ac}$

Here we can say that a is called first proportion, c is called third proportion and b is called mean proportion.

Also, if two nos. are given, and you arer required to find mean proportion, then it should be written as-

a : x :: x : b,

And is third proportion is to be computed, then it should be written as-

a : b : : : x.

ILLUSTRATION 1 : Two numbers are given as 9 and 4. Find its

(i) Mean proportion, and

(ii) Third proportion.

Sol. (i) To finid Mean Proportion-
$9 : x :: x : 4$,
i.e. $x^2 = 9 \times 4 = 36$, or

$$x = \sqrt{36} = 6$$

(ii) To find third proportion-
$9 : 4 :: 4 : x$,
i.e. $9x = 16$

$$x = \frac{16}{9}$$

Direct Proportion: If *X* is directly proportional to *Y*, that means any increase or decrease in any of two quantities will have proportionate effect on the other quantity. If *X* increases then *Y* will also increase and vice-versa.

Inverse Proportion: If *X* is inversely proportional to *Y*, that means any increase or decrease in any of two quantities will have inverse proportionate effect on the other quantity. This means if *X* increases, then *Y* decreases and if *X* decreases then *Y* increases and vice-versa for *Y*.

Applications of Ratio and Proportion

PARTNERSHIP

To find profit-shaving ratio on the basis of capital contribution.

ILLUSTRATION ▶ 2 : Ram, Rohan and Ravi are partners in a firm. Ram contributed ₹10,000 for 6 months, where as Rohan and Ravi, both contributed ₹7500 for the full year. If at the end of the year profit is 2500, what is Ram's share?

Sol. Proportionate capital of Ram, Rohan and Ravi
$= 10{,}000 \times 6 : 7500 \times 12 : 7500 \times 12$
$= 60{,}000 : 90{,}000 : 90{,}000$
or
ratio $= 2 : 3 : 3$

$$\text{Ram's share} = 2500 \times \frac{2}{8} = ₹625$$

MIXTURES AND ALLIGATION

"Mixtures and alligations" is about mixing different objects in order to get desired levels/percentage/concentration of different objects.

ILLUSTRATION ▶ 3 : If 100 ml water is mixed with 1000 ml of milk, what is the ratio of the mixture solution?

Sol. Using basic percentages, total solution = 1100 ml,

$$\frac{\text{Water}}{\text{Total solution}} = \frac{100}{1100} = \frac{1}{11}$$

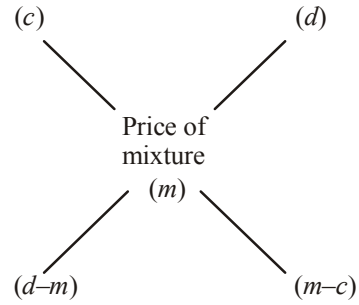
Water : milk = 1 : 10
This can also be read as milk solution **10 : 11**, where if milk is **10**, water is 1 and total solution is **11**.

Quicker Method to Solve Questions of Mixture and Alligation.

This rule helps us in solving questions where two varieties (of different prices) are mixed to get a new variety with a new Average price.

$$\frac{\text{Quantity of cheaper variety}}{\text{Quantity of dearer variety}} = \frac{\text{Price of Dearer variety} - \text{Average price}}{\text{Average price} - \text{Price of cheaper variety}}$$

$$\Rightarrow \frac{c}{d} = \frac{d-m}{m-c}$$



Then, (Cheaper quantity) : (dearer quantity)

$$= (d-m) : (m-c) \Rightarrow \frac{c}{d} = \frac{d-m}{m-c}$$

ILLUSTRATION ▶ 4 : In what ratio should tea at the rate ₹. 40/kg be mixed with tea at the rate ₹ 27/kg, so that mixture may cost ₹ 30kg?

Sol. Using the above formula

$$\frac{\text{Quantity of cheaper}}{\text{Quantity of dearer}} = \frac{(40-30)}{(30-27)} = \frac{10}{3}$$

So, the two should be mixed in the ratio $\frac{10}{3}$.

Points to Remember

- If in a partnership the investments made by first, second and third partners are x_1, x_2, x_3 respectively, the time period be t_1, t_2, t_3 then the ratio of profits is given by $x_1 t_1 : x_2 t_2 : x_3 t_3$.
- If $x_1 : x_2 : x_3$ is the ratio of investments and $P_1 : P_2 : P_3$ be the ratio of Profit then time periods are given by $= \frac{P_1}{x_1} : \frac{P_2}{x_2} : \frac{P_3}{x_3}$
- If $P_1 : P_2 : P_3$ is the ratio of profit on investments and $t_1 : t_2 : t_3$ be the ratio of time periods, then the ratio of investments will be $= \frac{P_1}{t_1} : \frac{P_2}{t_2} : \frac{P_3}{t_3}$

SOLVED EXAMPLES

EXAMPLE ▶ 1: There are 1224 students in a school in which 600 are girls. What is the ratio of boys to girls in the school?

(a) 26 : 25 **(b) 21 : 17**
(c) 18 : 13 **(d) 5 : 4**
(e) None of these

Sol. (a) Total number of students = 1224

Total number of girls = 600

∴ Total number of boys = 1224 - 600 = 624

∴ Required ratio = 624 :600 = 26 : 25

EXAMPLE ▶ 2 : Amar started a business investing ₹ 45,000. Six months later Prakash joined him with ₹ 30,000. In what ratio should the profit, they earn be distributed at the end of the year ?

(a) 3:1 **(b) 3:4**
(c) 3:2 **(d) Data inadequate**
(e) None of these

Sol. (a) Rate of the equivalent capitals of Amar and Prakash for 1 month

= 45000 × 12 : 30000 × 6

= 540000 : 180000 = 3 : 1

∴ Ratio of profit sharing = 3 : 1

EXAMPLE ▶ 3 : Avinash, Manoj and Arun started a business in partnership investing in the ratio of 3:2:5 respectively. At the end of the year they earned a profit of Rs 45,000 which is 15% of their total investment. How much did Manoj invest?

(a) ₹ 60,000 **(b) ₹ 1,80,00**
(c) ₹ 30,000 **(d) ₹ 90,000**
(e) None of these

Sol. (a) Total investment $= \frac{100}{15} \times 45000 = ₹\ 300000$

∴ Avinash : Manoj : Arun = 3 : 2 : 5

∴ Investment of Manoj $= \left(\frac{2}{10} \times 300000\right) = ₹\ 60000$

EXAMPLE ▶ 4 : The ratio of managers to management trainees is 3:5. When 21 new management trainees are recruited the ratio will become 3:8 How many managers will there be in the group ?

(a) 27 **(b) 24**
(c) 21 **(d) Cannot be determined**
(e) None of these

Sol. (c) Let the number of manager and management trainees be 3x and 5x respectively.

According to the question,

$$\frac{3x}{5x+21} = \frac{3}{8}$$

$\Rightarrow$ 24 x = 15x + 63

$\Rightarrow$ 9x = 63 $\Rightarrow$ x = $\frac{63}{9}$ =7

∴ Number of managers = 3x = 3 × 7 = 21

EXAMPLE ▶ 5 : The ages of Aarzoo and Arnav are in the ratio of 11:13 respectively. After 7 years the ratio of their ages will be 20:23. What is the difference in years between their ages?

(a) 4 years **(b) 7 years**
(c) 6 years **(d) 5 years**
(e) None of these

Sol. (c) Let the present ages of Aarzoo and Arnav be 11x and 13x years respectively.

According to the question,

$$\text{or, } \frac{11x+7}{13x+7} = \frac{20}{23}$$

or, 260x + 140 = 253x + 161

or, 260x - 253x = 161 - 140

or, 7x = 21

$$\therefore\ x = \frac{21}{7} = 3$$

Difference between their ages = 13x - 11x

= 2x = 2 × 3 = 6 years

EXAMPLE ▶ 6 : Samir's age is one-fourth of his father's age and two-third of his sister Reema's age. What is the ratio of the ages of Samir, Reema and their father respectively?

(a) 3 : 2 : 8 **(b) 3 : 4 : 8**
(c) 2 : 3 : 8 **(d) 4 : 3 : 8**
(e) None of these

Sol. (c) Let Sameer's age be x years

Then his father's age

= 4x years

Reema's age = $\frac{3x}{2}$ years

$$\therefore \text{ Ratio} = x : \frac{3x}{2} : 4x$$

= 2 : 3 : 8

EXERCISE

1. The total number of students in a school is 819. If the number of girls in the school is 364, then what is the respective ratio of the total number of boys to the total number of girls in the school ?
   (a) 26 : 25 (b) 21 : 17
   (c) 18 : 13 (d) 5 : 4
   (e) None of these
2. If a dividend of ₹ 57,834 is to be divided among Meena, Urmila and Vaishali in the proportion of 3:2:1, find Urmila's share.
   (a) ₹19,281 (b) ₹17,350
   (c) ₹23,133 (d) ₹19,278
   (e) None of these
3. A sum of money is to be divided among Z, X, Y in the respective proportion of 4:5:6 and another sum to be divided between A and B equally. If Z got ₹ 2000 less than A, how much did X get?
   (a) ₹ 10,000 (b) ₹ 5,000
   (c) ₹ 4,000 (d) Cannot be determined
   (e) None of these
4. The ratio of the present ages of Sushma and Karishma is 6:7 respectively. The ratio of their ages 8 years hence would be 8:9 respectively. What would be the respective ratio of their ages after 12 years ?
   (a) 17 : 19 (b) 15 : 17
   (c) 9 : 10 (d) 10 : 11
   (e) None of these
5. The total number of boys in a school are 16% more than the total number of girls in the school. What is the ratio of the total number of boys to the total number of girls in the school ?
   (a) 25:21 (b) 29:35
   (c) 25:29 (d) Cannot be determined
   (e) None of these
6. A sum of money is to be divided equally amongst P, Q and R in the respective ratio of 5:6:7 and another sum of money is to divided between S and T equally. If S got ₹ 2,100 less than P, how much amount did Q receive?
   (a) ₹2,500 (b) ₹2,000
   (c) ₹1,500 (d) Cannot be determined
   (e) None of these
7. Ratio of the earning of A and B is 4:7 respectively. If the earnings of A increase by 50% and the earnings of B decrease by 25% the new ratio of their earnings becomes 8:7 respectively. What are A's earnings?
   (a) ₹ 26,000 (b) ₹ 28,000
   (c) ₹ 21,000 (d) Data inadequate
   (e) None of these
8. Pinku, Rinku and Tinku divide an amount of ₹ 4,200 amongst themselves in the ratio of 7:8:6 respectively. If an amount of ₹ 200 is added to each of their shares, what will be the new respective ratio of their shares of amount?
   (a) 8 : 9 : 6 (b) 7 : 9 : 5
   (c) 7 : 8 : 6 (d) 8 : 9 : 7
   (e) None of these
9. Rinku and Pooja started a business initially with ₹ 5,100 and ₹ 6,600 respectively. If the total profit is ₹ 2,730 what is Rinku's share in the profit ?
   (a) ₹1,530 (b) ₹1,540
   (c) ₹1,200 (d) ₹1,180
   (e) None of these
10. The ratio of the ages of Richa and Shelly is 5 : 8. The ratio of their ages 10 years hence would be 7:10. What is the present age of Shelly?
    (a) 45years (b) 40years
    (c) 35years (d) 30years
    (e) 25years
11. The average age of a woman and her daughter is 42 years. The ratio of their ages is 2:1. What is the daughter's age?
    (a) 28 years (b) 48 years
    (c) 52 years (d) 32 years
    (e) None of these
12. The total number of boys in a school is 15% more than the total number of girls in the school. What is the ratio of the total number of boys to the total number of girls in the school?
    (a) 17 : 23 (b) 24 : 11
    (c) 23 : 20 (d) 11 : 24
    (e) None of these
13. The ratio of the present ages of Smita and Kavita is 3:8 respectively. Seven years hence the ratio of their ages will be 4:9. What is Kavita's present age?
    (a) 56 years (b) 63 years
    (c) 42 years (d) 49years
    (e) None of these
14. A and B started a business by investing ₹ 35,000 and ₹ 20,000 respectively. B left the business after 5 months and C joined the business with a sum of ₹ 15,000. The profit earned at the end of the year is ₹ 84,125. What is B's share of profit?
    (a) ₹14133 (b) ₹15,000
    (c) ₹13,460 (d) Cannot be determined
    (e) None of these

15. The average age of a man and his son is 48 years. The ratio of their ages is 5 : 3 rspectively. What is the son's age ?
(a) 36 years (b) 48 years
(c) 60 years (d) 24 years
(e) None of these

16. The ages of Nishi and Vinnee are in the ratio of 6 : 5 respectively. After 9 years the ratio of their ages will be 9 : 8. What is the difference in their ages?
(a) 9 years (b) 7 years
(c) 5 years (d) 3 years
(e) None of these

17. The difference between the present ages of Arun and Deepak is 14 years. Seven years ago the ratio of their ages was 5 : 7 respectively. What is Deepak's present age?
(a) 49 years (b) 42 years
(c) 63 years (d) 35 years
(e) None of these

18. Ninad, Vikas and Manav enter into a partnership. Ninad invests some amount at the beginning. Vikas invests double the amount after 6 months and Manav invests thrice the amount invested by Ninad after 8 months. They earn a profit of ₹45, 000 at the end of the year. What is Manav's share in the profit?
(a) ₹ 25,000 (b) ₹ 15,000
(c) ₹ 12,000 (d) ₹ 9,000
(e) None of these

19. Ratio of Rani's and Komal's age is 3 : 5. Ratio of Komal's and Pooja's age is 2 : 3. If Rani is two-fifth Pooja's age, what is Rani's age?
(a) 10 years (b) 15 years
(c) 24 years (d) Cannot be determined
(e) None of these

20. In a mixture of milk and water the proportion of water by weight was 75%. If in the 60 gms of this mixture 15 gm. water was added, what would be the percentage of water?
(a) 75% (b) 88%
(c) 90% (d) 100%
(e) None of these

21. In a college the students in Arts and Commerce faculties were in the ratio of 4 : 5 respectively. When 65 more students joined Commerce faculty the ratio became 8 : 11. How many students are there in Arts faculty?
(a) 520 (b) 650
(c) 715 (d) Cannot be determined
(e) None of these

22. Sarita started a boutique investing an amount of ₹ 50,000. Six months later Neeta joined her with an amount of ₹ 80,000. At the end of one year they earned a profit of ₹ 18, 000. What is Sarita's share in the profit?
(a) ₹ 9,000 (b) ₹ 8,000
(c) ₹ 12,000 (d) ₹ 10,000
(e) None of these

23. The ratio between the boys and girls in a class is 6 : 5. If 8 more boys join the class and two girls leave the class then the ratio becomes 11 : 7. What is the number of boys in the class now?
(a) 28 (b) 38
(c) 44 (d) 36
(e) None of these

24. The ratio between the present ages of P and Q is 3 : 4. Four years hence Q will be five years older than P. What is P's present age?
(a) 15 years
(b) 20 years
(c) 25 years
(d) Cannot be determined
(e) None of these

25. At present Meena is eight times her daughter's age. Eight years from now, the ratio of the ages of Meena and her daughter will be 10 : 3. What is Meena's present age ?
(a) 32 years (b) 40 years
(c) 36 years (d) Cannot be determined
(e) None of these

26. If $\frac{1}{2}$ of Sunit's salary is equal to $\frac{2}{5}$ of Rajan's salary and their total salary is ₹ 36,000, find Rajan's salary.
(a) ₹16,000 (b) ₹20,000
(c) ₹22,000 (d) ₹14,000
(e) None of these

27. Which number should replace both the question marks in the following equation?

$$\frac{?}{84} = \frac{189}{?}$$

(a) 126 (b) 124
(c) 130 (d) 132
(e) 136

28. The ratio of the ages of a father and son is 17 : 7. 6 years ago the ratio of their ages was 3 : 1 . What is the father's present age?
(a) 64 (b) 51
(c) 48 (d) Cannot be determined
(e) None of these

29. A sum of money is divided among A, B, C and D in the ratio of 3 : 4 : 9 : 10 respectively. If the share of C is ₹ 2,580/- more than the share of B, then what is the total amount of money of A and D together?
(a) ₹ 5,676 (b) ₹ 6,192
(c) ₹ 6,708 (d) ₹ 7,224
(e) None of these

30. The largest and the second largest angles of a triangle are in the ratio of 13 : 12. The smallest angle is 20% of the sum of the largest and the second largest angles. What is the sum of the smallest and the second largest angles ?

(a) 120° (b) 108°
(c) 100° (d) 102°
(e) None of these

31. Mr. Pandit owned 950 gold coins all of which he distributed amongst his three daughters Lalita, Amita and Neeta. Lalita gave 25 gold coins to her husband, Amita donated 15 gold coins and Neeta made jewellery out of 30 gold coins. The new respective ratio of the coins left with them was 20 : 73 : 83. How many gold coins did Amita receive from Mr. Pandit?
(a) 380 (b) 415
(c) 400 (d) 350
(e) None of these

32. The ratio of the present ages of Swati and Trupti is 4: 5. Six years hence the ratio of their ages will be 6 : 7. What is the difference between their ages?
(a) 2 years (b) 3 years
(c) 4 years (d) Cannot be determined
(e) None of these

33. The ratio of the ages of A and B seven years ago was 3 : 4 respectively. The ratio of their ages nine years from now will be 7 : 8 respectively. What is B's age at present?
(a) 16 years (b) 19 years
(c) 28 years (d) 23 years
(e) None of these

34. The ratio of ducks and frogs in a pond is 37 : 39 respectively. The average number of ducks and frogs in the pond is 152. What is the number of frogs in the pond?
(a) 148 (b) 152
(c) 156 (d) 144
(e) None of these

35. 75% of a numer is equal to three seventh of another number. What is the ratio between the first number and the second number respectively?
(a) 4:7 (b) 7:4
(c) 12:7 (d) 7:12
(e) None of these

36. Srikant and Vividh started a business investing amounts of ₹1,85,000 and ₹2,25,000 respectively, If Vividh's share in the profit earned by them is ₹9,000, what is the total profit earned by them together?
(a) ₹17,400 (b) ₹16,400
(c) ₹16,800 (d) ₹17,800
(e) None of these

37. Populations of two villages X and Y are in the ratio of 5 : 7 respectively If the population of village Y increases by 25000 and the population of village X remains unchanged the 45. respective ratio of their populations becomes 25 :36. What is the population of village A'?
(a) 625000 (b) 675000
(c) 875000 (d) 900000
(e) None of these

38. Four-seventh of a number is equal to 40% of another number. What is the ratio between the first number and second number respectively?
(a) 5:4 (b) 4:5
(c) 10:7 (d) 7:10
(e) None of these

39. Beena and Meena started a boutique investing amount of ₹35000 and ₹56000 respectively. If Beena's share in the profit earned by them is ₹45000, what is the total profit earned?
(a) ₹81000 (b) ₹127000
(c) ₹72000 (d) ₹117000
(e) None of these

40. 52% students from a college participated in a survey. What is the respective ratio between the number of students who did not participate in the survey to the number of students who participated?
(a) 11:13 (b) 12:13
(c) 12:17 (d) Cannot be determined
(e) None of these

41. The ratio of roses and lillies in a garden is 3 : 2 respectively. The average number of roses and lillies is 180. What is the number of lillies in the garden?
(a) 144 (b) 182
(c) 216 (d) 360
(e) None of these

42. The respective ratio between Pooja's, Prarthana's and Falguni's monthly income is 53 : 70 : 57. If Prarthana's annual income is ₹4,20,000, what is the sum of Pooja's and Falguni's annual incomes? (In some cases monthly income and in some cases annual income is used.)
(a) ₹5,92,500 (b) ₹6,83,500
(c) ₹6,60,000 (d) ₹7,79,200
(e) None of these

43. Number of students studying in colleges A and B are in the ratio of 3 :4 respectively. If 50 more students join college A and there is no change in the number of students in college B, the respective ratio becomes 5 : 6. What is the number of students in college B?
(a) 450 (b) 500
(c) 400 (d) 600
(e) None of these

44. At present Kavita is twice Sarita's age. Eight years hence, the respective ratio between Kavita's and Sarita's ages then will be 22 : 13. What is Kavita's present age?
(a) 26 years (b) 18 years
(c) 42 years (d) 36 years
(e) None of these

45. 80% of a number is equal to three-fifth of another number. What is the ratio between the first and the second number respectively?
(a) 3:4 (b) 4:3
(c) 4:5 (d) 5:4
(e) None of these

46. The respective ratio between the present ages of father, mother and daughter is 7 : 6 : 2. The difference between mother's and the daughter's age is 24 years. What is the father's age at present?
(a) 43 years (b) 42 years
(c) 39 years (d) 38 years
(e) None of these

47. 28% members of a certain group are married. What is the respective ratio between the number of married members to the number of unmarried members?
(a) 7:17 (b) 5:18
(c) 7:18 (d) Cannot be determined
(e) None of these

48. The ratio of age of two boys is 5 : 6 after two years the ratio will be 7: 8. The ratio of their ages after 12 years will be
(a) 11/12 (b) 22/24
(c) 15/16 (d) 17/18
(e) None of these

49. A invests ₹64,000 in a business. After few months B joined him with ₹48,000. At the end of year, the total profit was divided between them in the ratio 2:1. After how many months did B join?
(a) 7 (b) 8
(c) 4 (d) 6
(e) None of these

50. A and B started a business investing amounts of ₹150000 and 250000 respectively. What will be B's share in the profit of ₹160000?
(a) ₹100000 (b) ₹60000
(c) ₹80000 (d) ₹110000
(e) None of these

51. Area of rectangular field is 3584 m and the length and the breadth are in the ratio 7:2 respectively. What is the perimeter of the rectangle?
(a) 246m (b) 292m
(c) 286m (d) 288m
(e) None of these

52. Present ages of father and son are in the ratio of 6 : 1 respectively. Four years after the ratio of their ages will become 4 : 1 respectively. What is the son's present age?
(a) 10 years (b) 6 years
(c) 4 years (d) 8 years
(e) None of these

ANSWER KEY

1	**(d)**	10	**(b)**	19	**(d)**	28	**(b)**	37	**(a)**	46	**(b)**
2	**(d)**	11	**(a)**	20	**(e)**	29	**(c)**	38	**(d)**	47	**(c)**
3	**(d)**	12	**(c)**	21	**(a)**	30	**(d)**	39	**(d)**	48	**(d)**
4	**(c)**	13	**(a)**	22	**(d)**	31	**(a)**	40	**(b)**	49	**(c)**
5	**(e)**	14	**(c)**	23	**(c)**	32	**(b)**	41	**(a)**	50	**(a)**
6	**(d)**	15	**(a)**	24	**(a)**	33	**(d)**	42	**(c)**	51	**(d)**
7	**(d)**	16	**(d)**	25	**(a)**	34	**(c)**	43	**(d)**	52	**(b)**
8	**(d)**	17	**(e)**	26	**(b)**	35	**(e)**	44	**(d)**		
9	**(e)**	18	**(b)**	27	**(a)**	36	**(b)**	45	**(a)**		

ANSWERS & EXPLANATIONS

1. (d) Total number of students in the school = 819
Number of girls = 364
∴ Number of boys = 819 - 364 = 455
∴ Required ratio = 435 : 364 = 5 : 4

2. (d) Share of Urmila in dividend
$= \left(\frac{2}{6} \times 57834\right) = ₹19278$

4. (c) Let the present ages of Sushama and Karishma be 6x and 7x respectively.
$\therefore \quad \frac{6x+8}{7x+8} = \frac{8}{9}$
or $56x + 64 = 54x + 72$
$x = \frac{8}{2} = 4$

Required ratio $= \frac{6\times4+12}{7\times4+12} = \frac{36}{40} = 9:10$

5. (e) Let the number of girls = x
∴ Number of boys = 1.16 x
∴ Required ratio = 1.16 x : x
= 116 : 100 = 29 : 25

7 (d) According to the question,
$\frac{A}{B} = \frac{4}{7}$ ... (i)
and $\frac{A\left(1+\frac{50}{100}\right)}{B\left(1-\frac{25}{100}\right)} = \frac{8}{7}$ ... (ii)

From equations (i) and (ii), we cannot find the earning of A and B.

8. (d) Ratio of the amounts received by A, B and C = 7 : 8 : 6
$\therefore$ Sum of the ratios = 7 + 8 + 6 = 21
Sum received by

$$\text{Pinku} = \frac{7}{21} \times 4200 = ₹1400$$

$$\text{Rinku} = \frac{8}{21} \times 4200 = ₹1600$$

$$\text{Tinku} = \frac{6}{21} \times 4200 = ₹1200$$

According to the question,
On adding ₹200 to the share of each one,
the required ratio
= 1600 : 1800 : 1400
= 8 : 9 : 7

9. (e) Ratio of the capital of Rinku and Pooja

$$= \frac{5100}{6600} = \frac{51}{66} = \frac{17}{22}$$

$$\therefore \text{Rinku's share} = \frac{2730 \times 17}{17 + 22} = ₹1190$$

10. (b) Let the present ages of Richa and Shelly be 5x and 8x years.
According to the question,
After 10 years,

$$\frac{5x + 10}{8x + 10} = \frac{7}{10}$$

or, 56x + 70 = 50x + 100
or, 56x – 50x = 100 – 70
or, 6x = 30

$$\therefore x = \frac{30}{6} = 5$$

$\therefore$ Shelly's present age = 8x
= 8 × 5 = 40 years

11. (a) Let the age of woman be 2x years and that of her daughter be x years.
According to the question,
2x + x = 2 × 42
or, 3x = 84

$$\text{or, } x = \frac{84}{3} = 28$$

$\therefore$ Daughter's age = 28 years

12. (c) Let the number of girls be = x

$$\therefore \text{Number of the boys} = \frac{115x}{100}$$

$$\therefore \text{Required ratio} = \frac{115x}{100} . x = 23 : 20$$

13. (a) Let the present ages of Smita and Kavita be 3x and 8x years respectively
According to questions,

$$\frac{3x + 7}{8x + 7} = \frac{4}{9}$$

or, 32x + 28 = 27x + 63
or, 32x – 27x = 63 – 28
or, 5x = 35

$$\text{or, } x = \frac{35}{5} = 7$$

$\therefore$ Kavita's present age = 8x
= 8 × 7 = 56 years

14. (c) Ratio of equivalent capitals of A, B and C for 1 month
= 35000 × 12 : 20000 × 5 : 15000 × 7
= 35 × 12 : 20 × 5 : 15 × 7
= 84 : 20 : 21
Sum of the ratios = 84 + 20 + 21 = 125

$$\therefore \text{B's share} = ₹\left(\frac{20}{125} \times 84125\right)$$

= ₹13460

15. (a) Let the ages of man and his son be 5x and 3x respectively.
$\because$ 5x + 3x = 2 × 48
$\Rightarrow$ 8x = 96

$$\Rightarrow x = \frac{96}{8} = 12$$

$\therefore$ Son's age = 12 × 3 = 36 years

16. (d) Difference in age

$$= \frac{9 \times (6 - 5)(9 - 8)}{6 \times 8 - 9 \times 5}$$

$$= \frac{9 \times 1 \times 1}{3} = 3 \text{ years}$$

17. (e) Let Arun's present age be x years.
Then, Deepak's present age = (x + 14) years
Then,

$$\frac{x - 7}{x + 14 - 7} = \frac{5}{7}$$

$\Rightarrow$ 7x – 5x = 35 + 49

$$\Rightarrow x = \frac{84}{2} = 42$$

$\therefore$ Deepak's present age
= 42 + 14 = 56 years

18. (b) Ratio of profit = 1 × 12 : 2 × 6 : 3 × 4
= 1 : 1 : 1
$\therefore$ Manav's share

$$= 45000 \times \frac{1}{3} = ₹15000$$

19. (d) Data is given in ratio. So age can't be determined.

20. (e) In 60 gms mixture proportion of water

$$= 60 \times \frac{75}{100} = 45 \text{ gms}$$

Total proportion of water in new mixture
= 45 + 15 = 60 gms.
$\therefore$ Percentage of water

$$= \frac{60}{60 + 15} \times 100 = 80\%$$

21. (a) Let number of students in Arts and Commerce were 4x and 5x respectively.
Then,

$$\frac{4x}{5x + 65} = \frac{8}{11}$$

$\Rightarrow 44x - 40x = 520$

$\Rightarrow x = \frac{520}{4} = 130$

$\therefore$ Number of students in Arts
$= 4 \times 130$
$= 520$

22. (d) Ratio of capital
$= 50000 \times 12 : 80000 \times 6$
$= 5 : 4$

$\therefore$ Sarita's share $= \frac{18000 \times 5}{(5+4)}$

$= ₹ 10000$

23. (c) Let the original number of boys and girls be 6x and 5x respectively.

Then, $\frac{6x+8}{5x-2} = \frac{11}{7}$

$\Rightarrow 55x - 42x = 56 + 22$

$\Rightarrow x = \frac{78}{13} = 6$

$\therefore$ Number of boys
$= 6 \times 6 + 8 = 44$

24. (a) Let the present ages of P and Q be 3x and 4x respectively.
Then,
$(4x+4) - (3x+4) = 5$
$\Rightarrow 4x - 3x = 5$
$\Rightarrow x = 5$
$\therefore$ P's present age
$= 3 \times 5 = 15$ yrs.

25. (a) Present age of Meena

$= \frac{8 \times 8 \times (10-3)}{24-10}$

$= \frac{8 \times 8 \times 7}{14} = 32$ years

26. (b) Ratio of the salaries of Sumit and Rajan

$= \frac{2}{5} : \frac{1}{2} = 4 : 5$

Rajan's salary $= \frac{5}{9} \times 36000 = ₹ 20000$

27. (a) $\frac{?}{84} = \frac{189}{?}$

or $?^2 = 84 \times 189$
or $?^2 = 21 \times 4 \times 21 \times 9$
or $?^2 = 21^2 \times 2^2 \times 3^2$
$\therefore ? = 21 \times 2 \times 3 = 126$

28. (b) Let the present age of father and son be 17x and 7x respectively.

Then, $\frac{17x-6}{7x-6} = \frac{3}{1}$

$\Rightarrow 21x - 17x = 18 - 6$
$\Rightarrow x = 12 \div 4 = 3$
$\therefore$ Father's present age
$= 17 \times 3 = 51$ years.

29. (c) Required amount

$= \frac{2580}{(9-4)} \times (3+10) = \frac{2580 \times 13}{5} = ₹ 6708$

30. (d) Smallest angle

$= (13+12) \times \frac{20}{100} = 5$

$\therefore$ Ratio of angles = 13 : 12: 5
$\therefore$ Sum of smallest and second largest angles

$= \frac{180 \times (12+5)}{(13+12+5)}$

$= \frac{180 \times 17}{30} = 102°$

31. (a) Required number of gold coins

$= \frac{\{950 - (25+15+30)\} \times 73}{(20+73+83)} + 15$

$= 365 + 15$
$= 380$

32. (b) Let the present ages be 4x and 5x respectively.

Then, $\frac{4x+6}{5x+6} = \frac{6}{7}$

$\Rightarrow 30x - 28x = 42 - 36$

$\Rightarrow x = \frac{6}{2} = 3$

$\therefore$ Difference in age
$= 5x - 4x$
$= x = 3$ years

33. (d) Let A's present age = x
B's present age = y

$\frac{x-7}{y-7} = \frac{3}{4}$

$4x - 28 = 3y - 21$
$4x - 3y = 7$ .....(i)

Also, $\frac{x+9}{y+9} = \frac{7}{8}$

$8x + 72 = 7y + 63$
$8x - 7Y = -9$ .....(ii)
On equanting (i) & (ii), we get y = 23

34. (c) Total number of ducks anda frogs = 152 × 2= 304

No. of frogs $= 304 \times \frac{39}{76} = 156$

35. (e) Let the Ist no. be x and IInd no. be y.

$\frac{75}{100} x = \frac{3}{7} y$

$.75x = .43\,y$

$\frac{x}{y} = \frac{.43}{.75} = \frac{43}{75}$

36. (b) Ratio of capitals of Srikant and Vividh
$= 185000 : 225000$
$37 : 45$

Vividh's share i.e. $\frac{45}{82} \times x = 9000$

$\therefore x = 9000 \times \frac{82}{45} = 16,400$

37. (a) $x : y = 5 : 7$ or $\frac{x}{y} = \frac{5}{7}$ or $7x = 5y$

or $7x - 5y = 0$ .....(i)

$$\frac{x}{y + 25000} = \frac{25}{36}$$

$36x = 25y + 625000$
$36x - 25y = 625000$ .....(ii)
On equating (i) and (ii), we get
$x = 625000$

38. (d) Let the numbers be x and 4

$$\frac{4x}{7} = \frac{40}{100}y$$

$$\frac{x}{y} = \frac{40}{100} \times \frac{7}{4} = 7 : 10$$

39. (d) Ratio of capital = 35000 : 56000
5 : 8

$$\text{Beena's share} = \frac{5}{13} \times x = 45000$$

$$x = 45000 \times \frac{13}{5} = 117000$$

40. (b) 52% participated, that means 48% did not participate.
Ratio = 48 : 52
= 12 : 13

41. (a) Total no. of Roses & Lilies = 180 × 2 = 360

$$\text{No. of Lilies} = 360 \times \frac{2}{5} = 144$$

42. (c) $70x = 4{,}20{,}000$

$$\therefore x = \frac{4,20,000}{70} = 6000$$

Pooja's income = 53 × 6000 = 318000
Falgun's income = 57 × 6000 = 342000
Total income = 318000 + 342000 = 6,60,000

43. (d) $\frac{A}{B} = \frac{3}{4}$ or $4A - 3B = 0$ .....(i)

$$\frac{A + 50}{B} = \frac{5}{6}$$

$6A + 300 = 5B$
$6A - 5B = -300$

44. (d) Kavita's age = x
Savita's age = y
$x = 2y$ or $x - 2y = 0$ .....(i)

$$\frac{x + 8}{y + 8} = \frac{22}{13}$$

$13x + 104 = 22y + 176$
$13x - 22y = 176 - 104$
$13x - 22y = 72$ .....(ii)
On equating (i) & (ii), we get, B = 600.

45. (a) Let the numbers be x and y.

$$\frac{80x}{100} = \frac{3y}{5}$$

$$\frac{x}{y} = \frac{3}{5} \times \frac{100}{80} = 3 : 4$$

46. (b) $6x - 2x = 24$,
i.e. $4x = 24$ or

$$x = \frac{24}{4} = 6$$

Father's age = 7 × 6 = 42

47. (c) 28% are married it implies that 72% are unmarried.
Ratio = 28 : 72
= 7 : 18

48. (d) Let the ages be x & y.

$$\frac{x}{y} = \frac{5}{6} \text{ or}$$

$6x - 5y = 0$ .....(i)

$$\frac{x + 2}{y + 2} = \frac{7}{8}$$

$8x + 16 = 7y + 14$
$8x - 7y = -2$ .....(ii)
On equating (i) & (ii), we get
$x = 5$ & $y = 6$
After 12 years
$x = 17$ $y = 18$
Ratio = 17 : 18

49. (c) $\frac{64000 \times 12}{48000 \times x} = \frac{2}{1}$

$$\frac{768000}{48000x} = \frac{2}{1}$$

$768000 = 2 \times 48000x$

$$\text{or } \frac{768000}{48000 \times 2} = x = 8$$

i.e. B joined after 4 months

50. (a) Ratio of capitals = 1,50000 : 250000
3 : 5

$$\text{B's share} = 1,60,000 \times \frac{5}{8} = 1,00,000$$

51. (d) Area i.e. $7x \times 2x = 3584$
$14x^2 = 3584$

$$x^2 = \frac{3584}{14} = 256$$

$$x = \sqrt{256} = 16$$

Length = 7 × 16 = 112
Breath = 2 × 16 = 32
Perimeter = $2(l \times b) = 2(112 + 32) = 288$.

52. (b) Ages of father & son = x & y

$$\frac{x}{y} = \frac{6}{1} \quad x = 6y \text{ or}$$

$x - 6y = 0$ .....(i)

$$\frac{x + 4}{y + 4} = \frac{4}{1}$$

$x + 4 = 4y + 16$
$x - 4y = 12$ .....(ii)
On equating (i) & (ii), we get $y = 6$

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CHAPTER

8

WORK & TIME

WORK AND TIME

In this chaper we will study the following two topics

(i) Work and Time

(ii) Pipes and Cisterns

Quicker Method to solve the Questions of Work and Time

❖ **Work is the job assigned or job completed. The rate of work is the speed or speed of work.**

If a person completes a job in *n* days then he will complete $\frac{1}{n}$ th part in one day.

Above fact is clear from the followong examples:

ILLUSTRATION 1 : Ram will do a piece of work in 15 days; what part of work will he do in two days?

Sol. Here, Man × Days = Man days

$1 \times 15 = 15$, as given work will take 15 days

Therefore in **one day,**

$\frac{1}{15}$ th of the work will be done

and in **2 days**

$\frac{1}{15} \times 2 = \frac{2}{15}$ of the work will be done.

❖ **A works twice as good as B, he will finish the work in half the time**

ILLUSTRATION 2 : Ram is twice as good as Shyam in work; Shyam will do a piece of work in 30 days; in how many days Ram will do the work?

Sol. Since Ram is **twice** as good,

he will do the work in $\frac{30}{2} = 15$ days

❖ **If A and B can do a piece of work in *X* and *Y* days respectively while working alone, they will together take $\frac{xy}{(x+y)}$ days to complete it.**

Proof: A's 1 day of work $= \frac{1}{x}$

B's 1 day of work $= \frac{1}{y}$

So $(A + B)$'s total 1 day work

$= \left(\frac{1}{x} + \frac{1}{y}\right)$ of the total work.

Let total work be W.

Now, $\left(\frac{1}{x} + \frac{1}{y}\right)$ of W can be finished in 1 day

W (total work) can be finished in

$\frac{1}{\frac{1}{x} + \frac{1}{y}} = \frac{xy}{x+y}$ days.

ILLUSTRATION 3 : Shyam will do a piece of work in 30 days; Ram can do same work in 15 days; in how many days can both do the work together?

Sol. As per the formula, required days

$= \frac{30 \times 15}{30 + 15} = \frac{450}{45} = 10$ days

❖ **If *A* , *B* , *C* can do a piece of work in *X* , *Y* , *Z* days respectively while working alone , they will together take $\frac{xyz}{[xy + yz + zx]}$ days to finish it**

ILLUSTRATION 4 : Shyam will do a piece of work in 30 days; Ram can do same work in 15 days, Bhuvan can do the same work in 10 days; in how many days can all three do the work together?

Sol. As per the formula, required days

$= \frac{30 \times 15 \times 10}{[30 \times 15 + 15 \times 10 + 30 \times 10]}$

$= \frac{4500}{900} = 5$ days

❖ **If A can finish a work in x days and B in y days and A, B and C together in s day then :**

❖ C can finish the work alone in $\frac{sxy}{xy - sy - sx}$

❖ $B + C$ can finish in $\frac{sx}{x - s}$ and

❖ $A + C$ can finish in $\frac{sy}{y - s}$

PIPES AND CISTERNS

Pipes and cisterns problems use the same principles as of time and work. Here a pipe connected with a cistern is called an inlet pipe to fill it or an outlet pipe to empty it.

Quicker Method to solve Questions on Pipes and Cisterns

❖ If an inlet pipe can fill a cistern in A hours, the part filled in 1 hour = $\frac{1}{A}$ (*same as work and time fundamentals*)

❖ If pipe A is 'x' times bigger than pipe B , then pipe A will take $\frac{1}{x^{th}}$ of the time taken by pipe B to fill the cistern.

ILLUSTRATION 5 : It takes 4 hrs for pipe A to empty a 100 liter tank; if another pipe B which is double the size of pipe A is employed, how long will it take to empty the tank?

Sol. Since the Pipe is double the size,

it will take $\frac{1}{2}$ time of the time taken by the smaller pipe

Therefore $\frac{1}{2} \times 4 = 2$ hrs

❖ If an inlet pipe can fill a tank in a hours and an outlet pipe empties the full tank in b hours, then the net part filled in 1 hour when both the pipes are opened = $\frac{1}{a} - \frac{1}{b}$

In 1 hour, the part filled (or emptied) = $\frac{1}{a} - \frac{1}{b}$

Time required to fill or empty the tank = $\frac{ab}{b - a}$ hours.

if both are open

❖ **If x and y fill/empty a cistern in 'm' and 'n' hours, then together they will take**

$\left(\frac{mn}{m+n}\right)$ hours to fill/empty the cistern

and in one hour $\frac{n+m}{nm}$ th part of the cistern will be filled/ emptied. (*same as time and work*)

ILLUSTRATION 6 : There are two pipes (inlet and outlet) attached with a tank of 1000 litres. The inlet pipe can fill the tank in 2 hrs. The outlet pipe can empty the tank in 4 hrs. What is the time required to fill the tank in case both are open? In one hour what part of the tank will be filled?

Sol. For Inlet pipe, time to fill the tank = 2 hrs

For Outlet pipe, time to empty the tank = 4 hrs

Time to fill the tank

$= \frac{2 \times 4}{4 - 2} = \frac{8}{2} = 4$ hrs

Net part filled/emptied in one hour $= \frac{1}{2} - \frac{1}{4} = \frac{1}{4}$ th part of the tank, which is obvious from the earlier result.

❖ **If an inlet pipe fills a cistern in 'a' minutes and takes 'x' minutes longer to fill the cistern due to a leak in the cistern, then the time in which the leak will empty the cistern is**

$a\left(1 + \frac{a}{x}\right)$

ILLUSTRATION 7 : There is a pipe attached with a tank of 1000 liters. The inlet pipe can fill the tank in 2 hrs. There is a leak in the tank due to which it takes 2 hrs more to fill the tank. In what time can the leak empty the tank?

Sol. Time taken by pipe to empty the tank = 2 hrs

Extra time taken due to the leak = 2 hrs

By the formula, Time taken for the leak to empty the tank

$= \left(1 + \frac{a}{x}\right) = 2\left(1 + \frac{2}{2}\right)$

$= 2 \times 2 = 4$ hours

SOLVED EXAMPLES

EXAMPLE ▶ 1 : 26 men can complete a piece of work in 17 days. How many more men must be hired to complete the work in 13 days ?

(a) 9 **(b) 8**
(c) 6 **(d) 18**
(e) None of these

Sol. (b)

Days	Men
17 ↑	26 ↓
13	x

where x is the number of men required to complete the work in 13 days

$\Rightarrow 13 : 17 = 26 : x$

$\Rightarrow 13x = 17 \times 26$

$\Rightarrow x = \frac{17 \times 26}{13} = 34$ Men

$\therefore$ Number of additional men $= 34 - 26 = 8$

EXAMPLE ▶ 2 : 18 men can complete a piece of work in 5 days. In how many days can 21 men complete the same piece of work?

(a) $3\frac{17}{21}$ **(b)** $4\frac{2}{7}$
(c) 4 **(d) Cannot be determined**
(e) None of these

Sol. (b) $\because$ 18 men can complete the work in 5 days.

$\therefore$ 1 man will complete the work in 18×5 days

$\therefore$ 21 men will do the work in $\frac{18 \times 5}{21} = \frac{30}{7} = 4\frac{2}{7}$ days.

EXAMPLE ▶ 3 : Work done by A in one day is half of the work done by B in one day. Work done by B is half of the work done by C in one day. If C alone can complete the work in 7 days, in how many days can A, B and C together complete the work?

(a) 28 **(b) 14**
(c) 4 **(d) 21**
(e) None of these

Sol. (c) Ratio of work efficiency of A, B and C

$= 1 : 2 : 4$

Ratio of time taken to finish the work

$= 8 : 4 : 2 = 4 : 2 : 1$

Time taken to finish the work by B alone

$= 7 \times 2 = 14$ days

Time taken to finish the work by A alone

$= 7 \times 4 = 28$ days

$\therefore$ work done in 1 day by A, B and C

$$= \frac{1}{28} + \frac{1}{14} + \frac{1}{7} = \frac{1+2+4}{28}$$

$$= \frac{7}{28} = \frac{1}{4}$$

So time taken to complete the work by A, B and C together = 4 days.

EXERCISE

1. 15 persons complete a job in 3 days. How many days will 10 persons take to complete the same job?
   (a) 2 (b) 5
   (c) $2\frac{2}{3}$ (d) $3\frac{1}{4}$
   (e) $4\frac{1}{2}$
2. 16 men can complete a piece of work in 8 days. In how many days can 12 men complete the same piece of work?
   (a) 10 (b) $9\frac{1}{3}$
   (c) $10\frac{2}{3}$ (d) Cannot be determined
   (e) None of these
3. 17 men can complete a piece of work in 12 days. In how many days can 6 men complete the same piece of work?
   (a) 28 days (b) 34 days
   (c) 26 days (d) 32 days
   (e) None of these
4. 'A' can complete a piece of work in 12 days. 'A' and 'B' together can complete the same piece of work in 8 days. In how many days can 'B' alone complete the same piece of work?
   (a) 15 days (b) 18 days
   (c) 24 days (d) 28 days
   (e) None of these
5. A alone can make 100 baskets in 6 days and B alone can make 100 baskets in 12 days. In how many days can A & B together make 100 baskets?
   (a) 3 days (b) 5 days
   (c) $2\frac{1}{2}$ days (d) $3\frac{1}{2}$ days
   (e) None of these

6. 12 Men can complete one-third of the work in 8 days. In how many days can 16 men complete that work?
(a) 18 (b) 12
(c) 24 (d) Cannot be determined
(e) None of these

7. Computer A takes 3 minutes to process an input while computer B takes 5 minutes. If computers A, B and C can process an average of 14 inputs in one hour, how many minutes does Computer C alone take to process one input ?
(a) 10 (b) 4
(c) 6 (d) 8
(e) None of these

8. 21 binders can bind 1400 books in 15 days. How many binders will be required to bind 800 books in 20 days?
(a) 7 (b) 9
(c) 12 (d) 14
(e) None of these

9. Vikas gets ₹ 350 for every day that he works. If he earns ₹ 9,800 in a month of 31 days, for how many days did he work ?
(a) 25 days (b) 30 days
(c) 24 days (d) 28 days
(e) None of these

10. George takes 8 hours to copy a 50 page manuscript while Sonia can copy the same manuscript in 6 hours. How many hours would it take them to copy a 100 page manuscript, if they work together ?
(a) $6\frac{6}{7}$ (b) 9
(c) $9\frac{5}{7}$ (d) 14
(e) None of these

11. A can finish a work in 18 days and B can do the same work in half the time taken by A. Then, working together, what part of the same work can they finish in a day?
(a) $\frac{1}{6}$ (b) $\frac{1}{9}$
(c) $\frac{2}{5}$ (d) $\frac{2}{7}$
(e) None of these

12. A and B can finish a work in 10 days while B and C can do it in 18 days. A started the work, worked for 5 days, then B worked for 10 days and the remaining work was finished by C in 15 days. In how many days could C alone have finished the whole work ?
(a) 30 days (b) 15 days
(c) 45 days (d) 24 days
(e) None of these

13. Two pipes A and B can fill a cistern in 10 and 15 minutes respectively. Both fill pipes are opened together, but at the end of 3 minutes, 'B' is turned off. How much time will the cistern take to fill ?
(a) 6 min (b) 8 min
(c) 10 min (d) 12 min
(e) None of these

14. A is 30% more efficient than B. How much time will they, working together, take to complete a job which A alone could have done in 23 days?
(a) 11 days (b) 13 days
(c) $20\frac{3}{17}$ days (d) None of these
(e) None of these

15. A sum of ₹ 25 was paid for a work which A can do in 32 days, B in 20 days, B and C together in 12 days and D in 24 days. How much did C receive if all the four work together?
(a) ₹ $\frac{14}{3}$ (b) ₹ $\frac{16}{3}$
(c) ₹ $\frac{15}{3}$ (d) ₹ $\frac{17}{3}$
(e) None of these

16. Sunil and Pradeep can complete a work in 5 days and 15 days respectively. They both work for one day and then Sunil leaves. In how many days will the remaining work be completed by Pradeep ?
(a) 11 days (b) 12 days
(c) 15 days (d) 8 days
(e) None of these

17. Two pipes A and B can fill a tank in 15 and 12 hours respectively. Pipe B alone is kept open for $\frac{3}{4}$ of the time and both pipes are kept open for the remaining time. In how many hours will the tank will be full ?
(a) 18 h (b) 20 h
(c) 10 h (d) 13.5 h
(e) None of these

18. Suresh can finish a piece of work by himself in 42 days. Mahesh, who is $\frac{1}{5}$ times more efficient as Suresh, requires X days to finish the work if working all by himself. Then what is the value of X ?
(a) 25 days (b) 30 days
(c) 35 days (d) 20 days
(e) None of these

19. If 6 men and 8 boys can do a piece of work in 10 days while 26 men and 48 boys can do the same in 2 days, the time taken by 15 men and 20 boys in doing the same work will be:

(a) 4 days (b) 5 days
(c) 6 days (d) 7 days
(e) None of these

20. 12 men complete a work in 9 days. After they have worked for 6 days, 6 more men join them. How many days will they take to complete the remaining work?

(a) 2 days (b) 3 days
(c) 4 days (d) 5 days
(e) None of these

21. A and B can do a job in 16 days and 12 days respectively. B has started the work alone 4 days before finishing the job, A joins B. How many days has B worked alone?

(a) 6 days (b) 4 days
(c) 5 days (d) 7 days
(e) None of these

22. A can do 50% more work than as B can do in the same time. B alone can do a piece of work in 20 hours. A, with help of B, can finish the same work in how many hours ?

(a) 12 (b) 8
(c) $13\frac{1}{3}$ (d) $5\frac{1}{2}$
(e) None of these

23. Three pipes A, B and C when working alone, can fill a tank from empty to full in 30 minutes, 20 minutes and 10 minutes respectively. When the tank is empty, all the three pipes are opened. A, B and C discharge chemical solutions P, Q and R respectively. What is the proportion of solution R in the liquid in the tank after 3 minutes ?

(a) $\frac{5}{11}$ (b) $\frac{6}{11}$
(c) $\frac{7}{11}$ (d) $\frac{8}{11}$
(e) None of these

24. Three taps A, B and C can fill a tank in 12, 15 and 20 hours respectively. If A is open all the time and B and C are open for one hour each alternately, then the tank will be full in :

(a) 6 hrs. (b) $6\frac{2}{3}$ hrs.
(c) 7 hrs. (d) $7\frac{1}{2}$ hrs.
(e) None of these

25. Two pipes A and B when working alone can fill a tank in 36 min. and 45 min. respectively. A waste pipe C can empty the tank in 30 min. First A and B are opened. After 7 min., C is also opened. In how much time will the tank be full ?

(a) 1/60 (b) 1/30
(c) 7/20 (d) 13/20
(e) None of these

Answer Key

1	(e)	6	(a)	11	(a)	16	(a)	21	(c)
2	(c)	7	(c)	12	(c)	17	(c)	22	(b)
3	(b)	8	(b)	13	(b)	18	(c)	23	(b)
4	(c)	9	(d)	14	(b)	19	(a)	24	(c)
5	(e)	10	(a)	15	(b)	20	(a)	25	(a)

ANSWERS & EXPLANATIONS

1. (e) ∵ 15 men can do the work in 3 days.
∴ 1 man can do the work in 3×15 days.
∴ 10 men can do the same work in
$\frac{3\times15}{10} = \frac{9}{2} = 4\frac{1}{2}$ days

2. (c) ∵ 16 men can complete the work in 8 days.
∴ 1 man can complete the work in 8×16
∴ 12 men can complete the same work in
$\frac{16\times8}{12} = \frac{32}{3} = 10\frac{2}{3}$ days.

3. (b) ∵ 17 men can complete the work in 12 days
∴ 1 man can complete the work in 12×17 days
∴ 6 men can complete the work in $\frac{12\times17}{6} = 34$ days

4. (c) Number of days $= \frac{12\times8}{12-8}$
$= 24$ days

5 (e) Required number of days
$= \frac{6\times12}{6+12}$
$= 4$ days

6. (a) 112 men can complete the whole work in
$8 \times 3 = 24$ days
∴ Required no. of days
$= \frac{12\times24}{16} = 18$

7. (c) Part processed by computer A in 1 minute $= \frac{1}{3}$

Part processed by computer B in 1 minute $= \frac{1}{5}$

Part processed by computer C in 1 minute
$= \frac{42}{60} - \frac{1}{3} - \frac{1}{5}$
$= \frac{42-20-12}{60} = \frac{10}{60} = \frac{1}{6}$

Hence, computer C will process 1 input in 6 minutes.

8 (b) Required no. of binders $= \frac{800\times21\times15}{1400\times20} = 9$

9. (d) Required no. of days
$= \frac{9800}{350} = 28$ days

10. (a) In an hour, George and Sonia together can copy $\frac{1}{6}+\frac{1}{8} = \frac{7}{24}$ of a 50-page manuscript.

i.e. In an hour they together can copy $\frac{7}{48}$ of the 100-page manuscript.
i.e. They together can copy a 100-page manuscript in $\frac{48}{7}$ hours, i.e. $6\frac{6}{7}$ hours.

11. (a) A's 1 day's work = $\frac{1}{18}$ and B's 1 day's work = $\frac{1}{9}$.

∴ (A + B)'s 1 day's work = $\left(\frac{1}{18}+\frac{1}{9}\right) = \frac{1}{6}$.

12. (c) Let C completes the work in x days.

Work done by (A + B) in 1 day = $\frac{1}{10}$

Work done by (B +C) in 1 day = $\frac{1}{18}$

A's 5 days' work + B's 10 days' work
+ C's 15 days' work = 1
or (A + B)'s 5 days' work + (B + C)'s 5 days' work
+ C's 10 days' work = 1

or $\frac{5}{10}+\frac{5}{18}+\frac{10}{x} = 1$

∴ $x = 45$ days

13. (b) In one min, (A + B) fill the cistern

$= \frac{1}{10} + \frac{1}{15} = \frac{1}{6}$ th

In 3 mins, (A + B) fill the cistern

$= \frac{3}{6} = \frac{1}{2}$ th

Remaining part $= 1 - \frac{1}{2} = \frac{1}{2}$

$\because \frac{1}{10}$ th part is filled by A in one min.

$\therefore \frac{1}{2}$ nd part is filled by A in $10 \times \frac{1}{2} = 5$ min.

$\therefore$ Total time = 3 + 5 = 8 min.

14. (b) Ratio of times taken by A and B

$= 100 : 130 = 10 : 13.$

Suppose B takes x days to do the work.

Then, 10 : 13 : : 23 : x

$\Rightarrow x = \left(\frac{23 \times 13}{10}\right) \Rightarrow x = \frac{299}{10}.$

A's 1 day's work

$= \frac{1}{23}$; B's 1 day's work $= \frac{10}{299}.$

(A + B)'s 1 day's work $= \left(\frac{1}{23} + \frac{10}{299}\right) = \frac{23}{299} = \frac{1}{13}.$

$\therefore$ A and B together can complete the job in 13 days.

15. (b) A's one day's work $= \frac{1}{32}$

B's one day's work $= \frac{1}{20}$

(B + C)'s one day's work $= \frac{1}{12}$

$\therefore$ C's one day's work $= \frac{1}{12} - \frac{1}{20} = \frac{1}{30}$

D's one day's work $= \frac{1}{24}$

$\therefore$ (A + B + C + D)'s one day's work

$= \frac{1}{32} + \frac{1}{20} + \frac{1}{30} + \frac{1}{24} = \frac{15 + 24 + 16 + 20}{480}$

$= = \frac{5}{32}$

$\therefore$ Out of $\frac{5}{32}$ of work done,

$\frac{1}{30}$ of the work is done by C.

$\Rightarrow$ Out of Rs. 25 paid for the work, C will receive

₹ $\frac{1/30}{5/32} \times 25$, i.e. $\frac{1}{30} \times \frac{32}{5} \times 25$ i.e. ₹ $\frac{16}{3}$

16. (a) Sunil takes 5 days and Pradeep takes 15 days to do the work.

In a day they would complete $\frac{1}{5} + \frac{1}{15}$ i.e., $\frac{4}{15}^{\text{th}}$ work.

The remaining $\frac{11}{15}$ th work would be completed by

Pradeep in $\frac{11}{15} \times 15$ i.e. 11 days.

17. (c) Let the required time to fill the tank be x hours

According to question

$\frac{1}{12}\left(\frac{3}{4}x\right) + \frac{1}{15}\left(x - \frac{3}{4}x\right) + \frac{1}{12}\left(x - \frac{3}{4}x\right) = 1$

$\Rightarrow \frac{x}{16} + \frac{x}{60} + \frac{x}{48} = 1$

$\therefore$ x = 10 hours.

18. (c) Suresh, working alone for 42 days = 1 unit of work.

Mahesh is 1/5 times more efficient than Suresh. So Mahesh is 6/5 times as efficient as Suresh. Hence Mahesh should require 5/6th of the time taken by Suresh.

Therefore time taken by Mahesh

$= \frac{5}{6} \times 42 = 35$ days.

19. (a) Let 1 man's 1 day's work = x and

1 boy's 1 day's work = y.

Then, $6x + 8y = \frac{1}{10}$ and $26x + 48y = \frac{1}{2}.$

Solving these two equations, we get :

$x = \frac{1}{100}$ and $y = \frac{1}{200}.$

$\therefore$ (15 men + 20 boys)'s 1 day's work

$= \left(\frac{15}{100} + \frac{20}{200}\right) = \frac{1}{4}.$

$\therefore$ 15 men and 20 boys can do the work in 4 days.

20. (a) 1 man's 1 day's work $= \frac{1}{108}.$

12 men's 6 day's work $= \left(\frac{1}{9} \times 6\right) = \frac{2}{3}.$

Remaining work $= \left(1 - \frac{2}{3}\right) = \frac{1}{3}.$

18 men's 1 day's work $= \left(\frac{1}{108} \times 18\right) = \frac{1}{6}.$

$\frac{1}{6}$ work is done by them in 1 day.

$\therefore \frac{1}{3}$ work is done by them in $6 \times \frac{1}{3} = 2$ days

21. (c) A's one day's work = $\frac{1}{16}$th work

B's one day's work = $\frac{1}{12}$th work

Let the number of days B has worked alone = x days.
Then,
A's amount of work + B's amount of work = 1

$$\Rightarrow 4\left(\frac{1}{16}\right)+(x+4)\left(\frac{1}{12}\right)=1$$

$$\Rightarrow \frac{1}{4}+\frac{x+4}{12}=1 \Rightarrow x=\frac{3}{4}\times 12-4$$

$$\Rightarrow x = 5 \text{ days}$$

22. (b) B alone can do a work in 20 hours.

$\therefore$ A alone can do $\frac{3}{2}$ of the work in 20 hours.

i.e., A alone can do the same work in $\frac{40}{3}$ hours

$\therefore$ (A + B)'s one hour's work

$$=\frac{3}{40}+\frac{1}{20}=\frac{5}{40}=\frac{1}{8}$$

$\Rightarrow$ A and B together can finish the whole work in 8 hours.

23. (b) Part filled by (A + B + C) in 3 minutes

$$=3\left(\frac{1}{30}+\frac{1}{20}+\frac{1}{10}\right)=\left(3\times\frac{11}{60}\right)=\frac{11}{20}$$

Part filled by C in 3 minutes = $\frac{3}{10}$

$\therefore$ Required ratio = $\left(\frac{3}{10}\times\frac{20}{11}\right)=\frac{6}{11}$

24. (c) (A + B)'s 1 hour's work = $\left(\frac{1}{12}+\frac{1}{15}\right)=\frac{9}{60}=\frac{3}{20}$

(A + C)'s 1 hour's work = $\left(\frac{1}{12}+\frac{1}{20}\right)=\frac{8}{60}=\frac{2}{15}$

Part filled in 2 hrs = $\left(\frac{3}{20}+\frac{2}{15}\right)=\frac{17}{60}$

Part filled in 6 hrs = $\left(3\times\frac{17}{60}\right)=\frac{17}{20}$

Remaining part = $\left(1-\frac{17}{20}\right)=\frac{3}{20}$

Now, it is the turn of A and B and $\frac{3}{20}$ part is filled by A and B in 1 hour.
$\therefore$ Total time taken to fill the tank
= (6 + 1) hrs = 7 hrs.

25. (a) Part filled in 7 min. = $7\times\left(\frac{1}{36}+\frac{1}{45}\right)=\frac{7}{20}$

Remaining part = $\left(1-\frac{7}{20}\right)=\frac{13}{20}$

Part filled by (A + B + C) in 1 min.

$$=\left(\frac{1}{36}+\frac{1}{45}-\frac{1}{30}\right)=\frac{1}{60}.$$

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CHAPTER

9

TIME, SPEED & DISTANCE

In this chapter, we will learn about the following two types of questions :

(i) Time, Speed and Distance

(ii) Boat and Stream

TIME, SPEED AND DISTANCE

Speed:

The distance covered per unit time is called speed. Speed is directly proportional to distance and inversely to time

- Distance = speed × time
- Speed = $\frac{\text{distance}}{\text{time}}$
- Time = $\frac{\text{distance}}{\text{speed}}$

Main Units

- **Time :** Seconds, minutes, hours
- **Distance :** meter, kilometer
- **Speed :** km/ hr, m /sec

Conversion

- 1 km / hr = $\frac{5}{18}$ metre / second
- 1 metre / second = $\frac{18}{5}$ km / hr
- 1 Km/hr = $\frac{5}{8}$ mile / hr
- 1 mile / hr = $\frac{22}{15}$ foot / second

ILLUSTRATION 1: A scooter travels at the speed of 45 kmph. What is the distance covered by the scooter in 4 minutes ?

Sol. Speed of scooter = 45 km / hr

$= \frac{45 \times 1000}{60} = 750$ metre / minute

$\therefore$ Distance covered in 4 minutes

$= 4 \times 750 = 3000$ metre $= 3$ km

Quicker Method to solve the questions on Time, Speed and Distance

- **Average speed: The average speed is given by total distance divided by total time taken.**
- Average Speed = $\frac{\text{Total Distance}}{\text{Total Time}}$

$$= \frac{(d_1 + d_2 + d_3 + \ldots\ldots d_n)}{(t_1 + t_2 + \ldots\ldots\ldots t_n)}$$

- **The average speed in case of a journey from X to Y at speed of A m/sec and returning back to X at a speed of B m/sec, is**

$$\left[\frac{2AB}{(A+B)}\right] \text{ metre / second}$$

ILLUSTRATION 2 : Sunil travels from Delhi to Patna at the speed of 40 km/hr and returns at the speed of 50 km/hr. What is the average speed of the journey?

Sol. Using the formula,

$$\left[\frac{2AB}{(A+B)}\right] = \frac{2 \times 40 \times 50}{40 + 50}$$

$$= \frac{4000}{90} = 44.44 \text{ Km/hr}$$

- **Relative speed**

As the name suggests, the concept is regarding the relative speed between two or more objects. The basic concept in relative speed is that speeds get added in case objects are moving from opposite directions and get subtracted in case objects are moving in the same direction. For example, if two trains are moving in opposite directions with a speed of X km/hr and Y km/hr respectively, then $(X + Y)$ is their relative speed. In the other case if two trains are moving in the same direction with a speed of X km/hr and Y km/hr respectively, then $(X - Y)$ is their relative speed.

For the first case the time taken by the trains in passing each other

$= \frac{L_1 + L_2}{(X+Y)}$ hours,

where L_1 and L_2 are lengths of the trains.

For the second case the time taken by the trains in passing each other

$= \frac{L_1 + L_2}{(X-Y)}$ hours,

where L_1 and L_2 are lengths of the trains.

ILLUSTRATION ▶ 3 : Two trains, 100 m and 80 m in length are running in the same direction. The first runs at the rate of 51 m/s and the second at the rate of 42 m/s. How long will they take to cross each other?

Sol. Here Length of first train = 100m,
Length of second train = 80m
And Speed of first train = 51 m/s
Speed of second train = 42 m/s
Relative speed = 51 - 42 = 9 m/s
(since trains are running in the same direction)

As per the formula = $\frac{L_1 + L_2}{x - y}$

$= \frac{100+80}{9} = 20$ seconds

ILLUSTRATION ▶ 4 : Two trains, 100 m and 80 m in length are running in opposite directions. The first runs at the rate of 10 m/s and the second at the rate of 15 m/s. How long will they take to cross each other?

Sol. Here Length of first train = 100 m
Length of second train = 80 m
And Speed of first train = 10 m/s
Speed of second train = 15 m/s
Relative speed = 10 + 15 = 25 m/s
(since trains are running in opposite directions)

As per the formula = $\frac{L_1 + L_2}{x + y}$

$= \frac{100+80}{25} = 7.2$ seconds

❖ **The time taken by a train X meters long to pass a signal post is the time taken for the train to cover X meters.**

ILLUSTRATION ▶ 5 : A train 300 meters long has a speed of 10 m/s. How long will it take to pass an electric pole?

Sol. Time = $\frac{\text{Distance}}{\text{Speed}}$

the distance here will be same as the length of the train.
That is 300 meters.

$\therefore$ Time = $\frac{300}{10} = 30$ seconds

❖ **The time taken by a *x* meters long train in passing any object which is *y* meters long is the time taken for the train to cover the distance *x* + *y*.**

ILLUSTRATION ▶ 6 : A train 300 meters long has a speed of 10 m/s. How long will it take to pass a platform of 50 meters?

Sol. Time = $\frac{\text{Distance}}{\text{Speed}}$

The distance here will be same as the length of the train + the length of the platform.
This is 300 + 50 = 350 m

Therefore, Time = $\frac{350}{10} = 35$ seconds

BOAT AND STREAM

When we move upstream, our speed gets deducted from the speed of the stream. Similarly when we move downstream our speed gets added to the speed of the stream.

Let the speed of a boat in still water be A km/hr and the speed of the stream (or current) be B km/hr, then

- Speed of boat with the stream = (A + B) km/hr
- Speed of boat against the stream = (A - B) km/hr

Quicker Method to solve the questions on Boat and Stream

❖ **Boat's speed in still water**

$= \frac{\text{speed downstream + speed upstream}}{2}$

ILLUSTRATION ▶ 7: A boat travels equal distances upstream and downstream. The upstream speed of boat was 10 km/hr, whereas the downstream speed is 20 km/hr. What is the speed of the boat in still water?

Sol. Upstream speed = 10 km/hr
Downstream speed = 20 km/hr
As per formula, Boat's speed in still water

$= \frac{\text{speed downstream + speed upstream}}{2}$

Therefore, Boat's speed in still water

$= \frac{10+20}{2} = 15$ km/hr

❖ **Speed of current**

$= \frac{\text{Speed downstream – Speed upstream}}{2}$

ILLUSTRATION ▶ 8 : A boat travels equal distance upstream and downstream. The upstream speed of boat is 10 km/hr, whereas the downstream speed is 20 km/hr. What is the speed of the current?

Sol. Upstream speed = 10 km/hr
Downstream speed = 20 km/hr
As per formula, Speed of current

$= \frac{\text{Speed downstream – Speed upstream}}{2}$

Therefore, Speed of current

$= \frac{20-10}{2} = \frac{10}{2} = 5$ km/hr

SOLVED EXAMPLES

EXAMPLE ▶ 1: A 175 meters long train crosses a 35 meters platform in 12 seconds. What is the speed of the train in km/hr ?

(a) 42 **(b) 64**
(c) 63 **(d) 59**
(e) None of these

Sol. (c) Speed of train

$$= \frac{\text{Length (platform + train)}}{\text{Time}}$$

$$= \frac{175+35}{12} = \frac{210}{12} = \text{m/s}$$

$$= \frac{210}{12} \times \frac{18}{5} \text{ kmph} = 63 \text{ kmph.}$$

EXAMPLE ▶ 2 : A train running at speed of 90 km per hour crosses a platform double its length in 36 seconds. What is the length of the platform in meters ?

(a) 450 **(b) 200**
(c) 600 **(d) Cannot be determined**
(e) None of these

Sol. (c) Let the length of the train be = x metres

$\therefore$ Length of the platform = 2x metres

Speed of train = 90 kmph

$$= 90 \times \frac{5}{18} = 25 \text{ m/sec.}$$

According to the question,

$$\frac{x+2x}{25} = 36$$

or, $3x = 25 \times 36$

or, $x = \frac{25 \times 36}{3} = 300\,\text{m}$

$\therefore$ length of platform = 2x = 600 m

EXAMPLE ▶ 3 : A car travels a distance of 75 km at the speed of 25km/ hr. It covers the next 25 km of its journey at the speed of 5 km/hr and the last 50 km of its journey at the speed of 25 km/hr. What is the average speed of the car?

(a) 40 km/hr **(b) 25km/hr**
(c) 15 km/hr **(d) 12.5km/hr**
(e) None of these

Sol. (c) Time taken to cover first 75 km of distance

$$= \frac{75}{25} = 3 \text{ hours}$$

Time taken to cover next 25 km of distance

$$= \frac{25}{5} = 5 \text{ hours}$$

Time taken to cover last 50 km of its journey

$$= \frac{50}{25} = 2 \text{ hours}$$

Total distance = 75 + 25 + 50 = 150 km

Total time taken = 3 + 5 + 2 = 10 hours

$\therefore$ Average speed = $\frac{150}{10} = 15$ kmph.

EXAMPLE ▶ 4: Raman drove from home to another town at the speed of 50km/hr and on his return journey, he drove at the speed of 45km/hr and took an hour longer to reach home. What distance did he cover each way?

(a) 450 km **(b) 225 km**
(c) 900 km **(d) 500 km**
(e) None of these

Sol. (a) Let the distance be x km.

Then, $\frac{x}{45} - \frac{x}{50} = 1$

$$\Rightarrow x = \frac{45 \times 50}{5} = 450 \text{ Km.}$$

EXAMPLE ▶ 5 : A 240 - meter long train running at the speed of 60 kmph will take how much time to cross another 270 - meter long train running in the opposite direction at the speed of 48 kmph ?

(a) 17 seconds **(b) 3 seconds**
(c) 12 seconds **(d) 8 seconds**
(e) None of these

Sol. (a) Relative speed

$$= (60 + 48) \times \frac{5}{18}$$

= 30 m/sec.

$\therefore$ Time taken

$$= \frac{240+270}{30}$$

$$= \frac{510}{30}$$

= 17 seconds

EXERCISE

1. A car covers a distance of 816 kms in 12 hours. What is the speed of the car ?
   (a) 60kmph (b) 62kmph
   (c) 64kmph (d) cannot be determined
   (e) None of these
2. A bus covers a distance of 2,924 kms in 43 hours. What is the speed of the bus?
   (a) 72 kmph (b) 60kmph
   (c) 68kmph (d) Cannot be determined
   (e) None of these
3. A train covers a distance of 1560 kms in 26 hours. What is the speed of the train?
   (a) 72 kms/hr (b) 62 kms/hr
   (c) 68 kms/hr (d) Cannot be determined
   (e) None of these
4. A bus travels at the speed of 49 kmph and reaches its destination in 7 hours. What is the distance covered by the bus?
   (a) 343km (b) 283km
   (c) 353km (d) 245km
   (e) 340km
5. A car travels a distance of 45 kms at the speed of 15 kmph. It covers the next 50 kms of its journey at the speed of 25 kmph and the last 25 kms of its journey at the speed of 10 kmph. What is the average speed of the car?
   (a) 40 kmph (b) 24 kmph
   (c) 15 kmph (d) 18 kmph
   (e) None of these
6. Nilesh goes to school from his village & returns at the speed of 4 km/hr. If he takes 6 hours in all, then what is the distance between the village and the school?
   (a) 6km (b) 5km
   (c) 4km (d) Cannot be determined
   (e) None of these
7. A 200 meter long train crosses a platform double its length in 36 seconds. What is the speed of the train in km/hr ?
   (a) 60 (b) 48
   (c) 64 (d) 66
   (e) None of these
8. A 160 meter long train running at a speed of 90 km/h crosses a platform in 18 seconds. What is the length of the platform in meters?
   (a) 210 (b) 240
   (c) 290 (d) 310
   (e) None of these
9. Excluding the stoppages, the speed of a bus is 64 km/hr and including the stoppages the speed of the bus is 48 km/hr. For how many minutes does the bus stop per hour?
   (a) 12.5 minutes (b) 15 minutes
   (c) 10 minutes (d) 18 minutes
   (e) None of these
10. A car covers a distance of 540 km in 9 hours. Speed of a train is double the speed of the car. Two-third the speed of the train is equal to the speed of a bike. How much distance will the bike cover in 5 hours ?
    (a) 450 km (b) 360 km
    (c) 400 km (d) 500 km
    (e) None of these
11. The ratio between the speed of a train and a car is 18 : 13 . Also, a bus covered a distance of 480 kms. in 12 hours. The speed of the bus is five-ninth the speed of the train. How much distance will the car cover in 5 hours ?
    (a) 250 km. (b) 280 km.
    (c) 260 km. (d) Cannot be determined
    (e) None of these
12. A 300 meter long train moving with an average speed of 126 km/hr crosses a platform in 24 seconds. A man crosses the same platform in 5 minutes. What is the speed of the man in meters/second
    (a) 1.8 m/s (b) 1.2 m/s
    (c) 1.5 m/s (d) Cannot be determined
    (e) None of these
13. Train A crosses a stationary train B in 35 seconds and a pole in 14 seconds with the same speed. The length of the train A is 280 meters. What is the length of the stationary train B ?
    (a) 360 meters (b) 480 meters
    (c) 400 meters (d) Cannot be determined
    (e) None of these
14. A bike covers a certain distance at the speed of 64 km/hr in 8 hours. If a bike was to cover the same distance in approximately 6 hours, at what approximate speed should the bike travel?
    (a) 80 km./hr. (b) 85 km/hr.
    (c) 90 km./hr. (d) 75 km/hr.
    (e) 70 km./hr
15. A train running between two stations A and B arrives at its destination 10 minutes late when its speed is 50 km/h and 50 minutes late when its speed is 30km/h. What is the distance between the stations A and B ?
    (a) 40 km (b) 50 km
    (c) 60 km (d) 70 km
    (e) None of these
16. A train covered a certain distance at a uniform speed. If the train had been 6 km/h faster, then it would have taken 4 hours less than the scheduled time. And, if the train were slower by 6 km/h, then the train would have taken 6 hours more than the scheduled time. The length of the journey is
    (a) 700 km (b) 740 km
    (c) 720 km (d) 760 km
    (e) None of these
17. On a journey across Bombay, a tourist bus averages 10 km/h for 20% of the distance, 30 km/h for 60% of it and 20 km/h for the remainder. The average speed for the whole journey was
    (a) 10 km/h (b) 30 km/h
    (c) 5 km/h (d) 20 km/h
    (e) None of these

18. A train leaves station X at 5 a.m. and reaches station Y at 9 a.m. Another train leaves station Y at 7 a.m. and reaches station X at 10: 30 a.m. At what time do the two trains cross each other ?
(a) 7 : 36 am (b) 7 : 56 am
(c) 8 : 36 am (d) 8 : 56 am
(e) None of these

19. A man rides a horse at the rate of 11 miles an hour, but stops for 5 min to change horse at the end of every seventh mile. How long will he take to cover a distance of 96 miles ? (Approx.)
(a) 7 hr. 20 min. (b) 6 hr. 25 min.
(c) 8 hr. 42 min. (d) 9 hr. 48 min.
(e) None of these

20. A man starts from B to K and another from K to B at the same time. After passing each other they complete their journeys in $3\frac{1}{3}$ and $4\frac{4}{5}$ hours, respectively. Find the speed of the second man if the speed of the first is 12 km/hr.
(a) 12.5 kmph (b) 10 kmph
(c) 12.66 kmph (d) 20 kmph
(e) None of these

21. The driver of a car driving @ 36 kmph locates a bus 40 meters ahead of him. After 20 seconds the bus is 60 meters behind. The speed of the bus is :
(a) 36 kmph (b) 20 m/sec.
(c) 72 m/sec. (d) 18 kmph
(e) None of these

22. Two trains 100 meters and 120 meters long are running in the same direction with speeds of 72 km/h and 54 km/h. In how much time will the first train cross the second?
(a) 50 sec (b) 44 sec
(c) 38 sec (d) 42 sec
(e) None of these

23. A train overtakes two persons walking along a railway track. The first one walks at 4.5 km/h. The other one walks at 5.4 km/h. The train needs 8.4 and 8.5 seconds respectively to overtake them. What is the speed of the train if both the persons are walking in the same direction as the train?
(a) 66 km/h (b) 72 km/h
(c) 78 km/h (d) 81 km/h
(e) None of these

24. A train 100 metres long takes $3\frac{3}{5}$ seconds to cross a man walking at the rate of 6 km/h in a direction opposite to that of the train. Find the speed of the train.
(a) 94 m/s (b) 100 m/s
(c) 110 m/s (d) 108 m/s
(e) None of these

25. Subbu starts from a point O at 10:00 a.m., overtakes Ajay, who is moving in the same direction, at 11:00 a.m. and Bhuvan moving in the opposite direction at 12:00 (noon). If the speed of Bhuvan is one fourth the speed of Subbu, at what time will Ajay and Bhuvan cross each other ?
(a) 1 : 30 p.m. (b) 2:00 p.m.
(c) 2 : 30 p.m. (d) Cannot be determined
(e) None of these

26. A monkey ascends a greased pole 12 meters high. He ascends 2 meters in the first minute and slips down 1 meter in the next minute and so on . In which minute does it he reaches the top?
(a) 21st (b) 22nd
(c) 23rd (d) 24th
(e) None of these

27. A man covers a certain distance on a scooter. If the scooter moved 4 km/h faster, it would take 30 minutes less. If it moved 2 km/h slower, it would have taken 20 minutes more. Find the distance.
(a) 60 km (b) 58 km
(c) 55 km (d) 50 km
(e) None of these

28. A boat running downstream covers a distance of 16 km in 2 hours while for covering the same distance upstream, it takes 4 hours. What is the speed of the boat in still water?
(a) 4 km/h (b) 6 km/h
(c) 8 km/h (d) Data inadequate
(e) None of these

29. R and S start walking towards each other at 10 AM at the speeds of 3 km/h and 4 km/h respectively. They were initially 17.5 km apart. At what time do they meet?
(a) 2 : 30 PM (b) 11 : 30 AM
(c) 1 : 30 PM (d) 12 : 30 PM
(e) None of these

30. In a 800 m race around a stadium having the circumference of 200 m, the top runner meets the last runner on the 5th minute of the race. If the top runner runs at twice the speed of the last runner, what is the time taken by the top runner to finish the race ?
(a) 20 min (b) 15 min
(c) 10 min (d) 5 min
(e) None of these

31. A long distance runner runs 9 laps of a 400 meters track everyday. His timings (in minutes) for four consecutive days are 88, 96, 89 and 87 resplectively. On an average, how many meters/minute does the runner cover ?
(a) 40 m/min (b) 45 m/min
(c) 38 m/min (d) 49 m/min
(e) None of these

32. Mohan travels 760 km to his home, partly by train and partly by car. He takes 8 hours if he travels 160 km by train and the rest by car. He takes 12 minutes more if he travels 240 km by train and the rest by car. The speed of the train and the car, respectively are:
(a) 80 km/h, 100 km/h (b) 100 km/h, 80 km/h
(c) 120 km/h, 120 km/h (d) 100 km/h, 120 km/h
(e) None of these

33. A boy rows a boat against a stream flowing at 2 kmph for a distance of 9 km, and then turns round and rows back with the current. If the whole trip occupies 6 hours, find the boy's rowing speed in still water.
(a) 4 kmph (b) 3 kmph
(c) 2 kmph (d) 5 kmph
(e) None of these

Answer Key									
1	(e)	8	(c)	15	(b)	22	(b)	29	(d)
2	(c)	9	(b)	16	(c)	23	(d)	30	(c)
3	(e)	10	(c)	17	(d)	24	(a)	31	(a)
4	(a)	11	(c)	18	(b)	25	(d)	32	(a)
5	(e)	12	(a)	19	(d)	26	(a)	33	(a)
6	(e)	13	(e)	20	(b)	27	(a)		
7	(a)	14	(b)	21	(d)	28	(b)		

ANSWERS & EXPLANATIONS

1. (e) $\text{Speed of the car} = \frac{\text{Distance Covered}}{\text{Time Taken}}$

$= \frac{816}{12} = 68$ kmph.

2. (c) $\text{Speed of bus} = \frac{\text{Distance covered}}{\text{Time taken}}$

$= \frac{2924}{43} = 68$ kmph.

3. (e) $\text{Speed of train} = \frac{1560}{26}$

$= 60$ kmph.

4. (a) Distance covered = Speed × Time
$= 49 \times 7 = 343$km

5. (e) Time taken to cover a distance of 45 kms

$= \frac{45}{15} = 3$ hours

Time taken to cover a distance of 50 kms

$= \frac{50}{25} = 2$ hours

Time taken to cover distance of 25 kms

$= \frac{25}{10} = 2.5$ hours

Total distance = (45 + 50 + 25) kms = 120 kms
Total time = (3 + 2 + 2.5) hours = 7.5 hours

$\therefore$ Required average speed $= \frac{120}{7.5} = 16$ kmph

6. (e) Let the distance between the village and the school be x km.

According to the question,

$\frac{x}{4} + \frac{x}{2} = 6$

or, $\frac{x + 2x}{4} = 6$

or, $3x = 6 \times 4$

$\therefore x = \frac{6 \times 4}{3} = 8$ km

7. (a) Speed of train

$= \frac{(200 + 400)}{36} \times \frac{18}{5}$

$= 60$ km/hr.

8. (c) Distance covered in 18 seconds

$= 90 \times \frac{5}{18} \times 18 = 450\ m$

$\therefore$ length of platform
$= 450 - 160 = 290$ m

9. (b) Stoppage minutes per hour

$= \frac{(64 - 48) \times 60}{64} = 15$ minutes.

10. (c) Speed of car

$= \frac{540}{9}$

$= 60$ kms/hr.

Speed of bike

$= 60 \times 2 \times \frac{2}{3}$

$= 80$ kms/hr.

Distance covered by bike
$= 80 \times 5$
$= 400$ kms.

11. (c) Speed of bus

$= \frac{480}{12} = 40$ km/hr

Speed of train

$= 40 \times \frac{9}{5} = 72$ km/hr

Speed of car

$= \frac{72}{18} \times 13 = 52\,\text{km/hr}$

Distance covered by car

$= 52 \times 5 = 260$ km

12. (a) Length of platform

$= 126 \times \frac{5}{18} \times 24 - 300 = 540$ meter

$\therefore$ Speed of man $= \frac{540}{5 \times 60}$

$= 1.8$ meter/second

13. (e) Speed of train A $= \frac{280}{14} = 20$ meter/second

Length of train B $= 20 \times 35 - 280$ meter

$= 700 - 280$ meter

$= 420$ meter

14. (b) Distance $= 64 \times 8$

$= 512$ km

$\therefore$ Speed $= \frac{512}{6}$

$= 85$ km/hr (approx.)

15. (b) Let the distance between the two stations be x km.

Then, $\frac{x}{50} - \frac{10}{60} = \frac{x}{30} - \frac{50}{60}$

$\Rightarrow \frac{x}{50} - \frac{1}{6} = \frac{x}{30} - \frac{5}{6}$

or $\frac{x}{30} - \frac{x}{50} = \frac{2}{3}$ or $x = 50$ km

Thus distance between the station A and B = 50 km

16. (c) Let the length of the journey be x km.
Suppose speed of the train be y km/h.

$\therefore$ Time taken to cover x km $= \frac{x}{y}$ hours

$\therefore \quad \frac{x}{y+6} = \frac{x}{y} - 4, \frac{x}{y-6} = \frac{x}{y} + 6$

Solving these equations, we get
$y = 30$, $x = 720$.

$\therefore$ Length of the journey = 720 km.

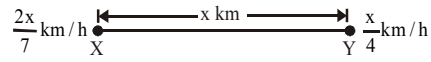
17. (d) Let the average speed be x km/h.
and Total distance = y km. Then,

$\frac{0.2}{10}y + \frac{0.6}{30}y + \frac{0.2}{20}y = \frac{y}{x}$

$\Rightarrow x = \frac{1}{0.05} = 20\,\text{km/h}$

18. (b) Let the distance between X and Y be x km.
Then, the speed of A is

$\frac{x}{4}$ km/h and that of B is $\frac{2x}{7}$ km/h.



Relative speeds of the trains

$= \left(\frac{x}{4} + \frac{2x}{7}\right) = \frac{15x}{28}$ km/h

Therefore the distance between the trains at 7 a.m.

$= x - \frac{x}{2} = \frac{x}{2}$ km

Hence, time taken to cross each other

$= \frac{\frac{x}{2}}{\frac{15x}{28}} = \frac{x}{2} \times \frac{28}{15x} = \frac{14}{15} \times 60 = 56\,\text{min}$

Thus, both of them meet at 7 : 56 a.m.

19. (d)

Time taken to travel 96 miles

$= \frac{96}{11}$ hrs. = 8 hrs and 43 minutes

During the journey of 96 miles, he has to stop for 13 times to change the horse.
$\therefore$ Total stoppage time
$= 13 \times 5 = 65$ mins. $= 1$ hr and 5 mins.
Hence the total time
= 8 hrs and 43 mins + 1 hr and 5 mins.
= 9 hrs and 48 mins.

20. (b) $\frac{\text{1st man's speed}}{\text{2nd man's speed}} = \frac{\sqrt{b}}{\sqrt{a}} = \frac{\sqrt{b}}{\sqrt{a}} = \sqrt{\frac{4\frac{4}{5}}{3\frac{1}{3}}}$

$= \sqrt{\frac{24}{5} \times \frac{3}{10}} = \sqrt{\frac{36}{25}} = \frac{6}{5}$

$\therefore \frac{12}{\text{2nd man's speed}} = \frac{6}{5}$

$\therefore$ 2nd man's speed $= \frac{60}{6} = 10$ km/hr.

21. (d) Net distance gained by car over the bus
$= 40 + 60 = 100$m, in 20 sec.

$\text{Time} = \frac{\text{Distance}}{\text{Relative speed}}$

$\Rightarrow 20 = \frac{100}{\left(36 \times \frac{5}{18}\right) - S_2}$

$\Rightarrow S_2 = 5$ m/s $= 18$ kmph.

22. (b) Relative speed of the trains
$= (72 - 54)$ km/h $= 18$ km/h

$= \left(18 \times \frac{5}{18}\right)$ m/sec $= 5$ m/sec.

Time taken by the trains to cross each other
= Time taken to cover (100 + 120) m at 5 m/sec

$= \left(\frac{220}{5}\right)$ sec = 44 sec.

23. (d) 4.5 km/h $= \left(4.5 \times \frac{5}{18}\right)$ m/sec = 1.25 m/sec,

& 5.4 km/h $= \left(5.4 \times \frac{5}{18}\right)$ m/sec = 1.5 m/sec.

Let the speed of the train be S m/sec.
Then, $(S - 1.25) \times 8.4 = (S - 1.5) \times 8.5$
$\Rightarrow 8.4S - 10.5 = 8.5S - 12.75$
$\Rightarrow 0.1S = 2.25 \Rightarrow S = 22.5.$

$\therefore$ Speed of the train $= \left(22.5 \times \frac{18}{5}\right)$ km/h = 81 km/h.

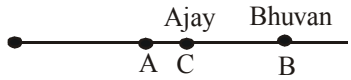
24. (a) Let speed of train be S km/h.
Speed of train relative to man
= [S – (– 6)] km/h

$= (S + 6) \times \frac{5}{18}$ m/s

Now $(S + 6) \times \frac{5}{18} = \frac{100}{18/5}$

$\Rightarrow S = 94$ m/s

25. (d) Let the speed of Ajay be V and the speed of Bhuvan and Subbu be 1 and 4 respectively.
Then OA = 4 and OB = 4.
At 12:00 noon.



Let Ajay be at C at 12:00 noon at a distance of V from A (towards B)
$\therefore$ Time taken for them to meet from 12:00 noon.

$= \frac{4 - V}{1 + V}$

Since V is not known $\frac{4 - V}{1 + V}$ cannot be determined.

26. (a) In 2 minutes, he ascends = 1 metre
$\therefore$ 10 metres, he ascends in 20 minutes.
$\therefore$ He reaches the top in 21st minute.

27. (a) Let the distance be x km. Let speed of train be y km/h.
Then by question, we have

$\frac{x}{y + 4} = \frac{x}{y} - \frac{30}{60}$ ...(i)

and $\frac{x}{y - 2} = \frac{x}{y} + \frac{20}{60}$ ...(ii)

On solving (i) and (ii), we get x = 3y
Put x = 3y in (i) we get

$\frac{3y}{y + 4} = 3 - \frac{1}{2}$ $\Rightarrow y = 20$

Hence, distance = 20 × 3 = 60 km.

28. (b) Rate downstream

$= \left(\frac{16}{2}\right)$ kmph = 8 kmph;

Rate upstream

$= \left(\frac{16}{4}\right)$ kmph = 4 kmph.

$\therefore$ Speed in still water

$= \frac{1}{2}(8 + 4) = 6$ km/h.

29. (d) Let them meet after t hours, then,
3t + 4t = 17.5 $\Rightarrow$ t = 2.5
$\therefore$ Time = 10 am + 2.5 h = 12 : 30pm

30. (c) After 5 minutes (before meeting), the top runner covers 2 rounds i.e., 400 m and the last runner covers 1 round i.e., 200 m.
$\therefore$ Top runner covers 800 m race in 10 minutes.

31. (a) Average speed $= \frac{\text{Total distance}}{\text{Total time}}$

$= \frac{400 \times 4 \times 9}{88 + 96 + 89 + 87} = \frac{400 \times 4 \times 9}{360}$

= 40 metres /minutes

32. (a) Let speed of the train be x km/h and that of the car be y km/h.

Now, $\frac{160}{x} + \frac{600}{y} = 8$ …(i)

and $\frac{240}{x} + \frac{520}{y} = \frac{41}{5}$ …(ii)

Solving (i) and (ii), we have x = 80 km/h and y = 100 km/h.

33. (a) Let the speed of rowing be X. Then the equation formed is $\frac{9}{X - 2} + \frac{9}{X + 2} = 6$.

On solving, we get the value of X as 4.

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CHAPTER

10

AREA & VOLUME

MENSURATION

Mensuration is a branch of mathematics which is concerned with the measurement of area, perimeter and volume of two dimensional and three dimensional figures. For solving questions related to this chapter, following formulae are necessary:

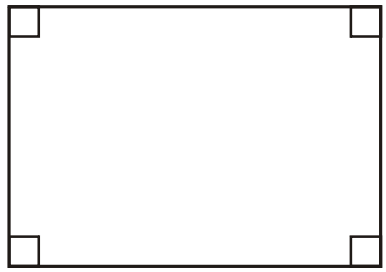
Two Dimensional Figures

❖ **Rectangle**

Area = Length × breadth

Perimeter = 2(Length + breadth)

Diagonal = $\sqrt{(\text{Length})^2 + (\text{breadth})^2}$

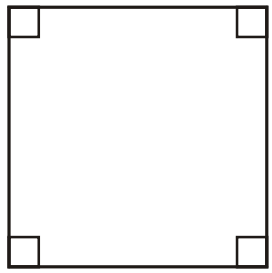


❖ **Square**

Area = $(\text{side})^2$

Perimeter = 4 × side

Diagonal = $\sqrt{2}$ × side

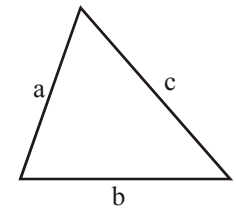


❖ **Triangles**

(i) If a, b and c are the lengths of the first, second and third sides of a triangle respectively, then

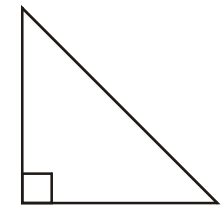
$s = \frac{a+b+c}{2}$, where s = semi-perimeter

and Area = $\sqrt{s(s-a)(s-b)(s-c)}$



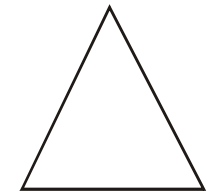
(ii) For a right angled triangle, Area

$= \frac{1}{2} \times$ base × height



(iii) For an equilateral triangle

Area = $\sqrt{\frac{3}{4}} \times (\text{side})^2$

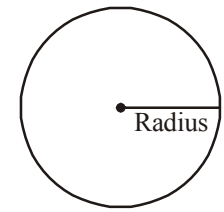


❖ **Circle**

Area = $\pi \times (\text{Radius})^2$

Circumference = $2\pi \times$ Radius

Radius = $\frac{\text{Diameter}}{2}$



❖ Area of the walls of a room

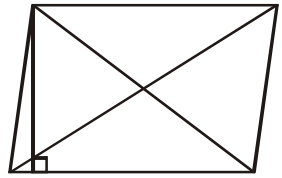
= 2 × height (length + breadth)

Height = $\frac{\text{Wall Area}}{2(\text{length} + \text{breadth})}$

❖ **Quadrilaterals**

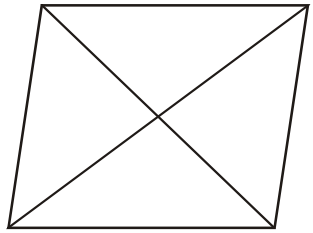
(i) Parallelogram

Area = base × height



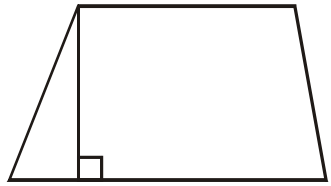
(ii) Rhombus

$$\text{Area} = \frac{1}{2} \times \text{product of diagonals}$$



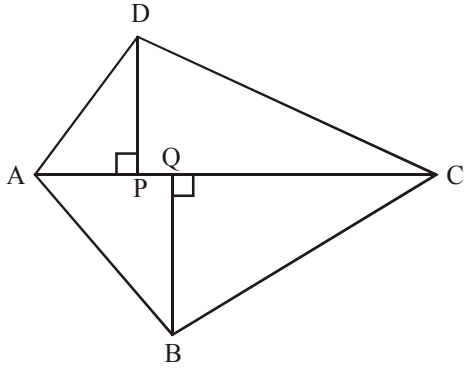
(iii) Trapezium

$$\text{Area} = \frac{1}{2} \times (\text{Sum of parallel sides}) \times \text{height}$$



(iv) Scalene Quadrilateral

$$\text{Area} = \frac{1}{2}(DP + BQ) \times AC$$



Three dimensional figures

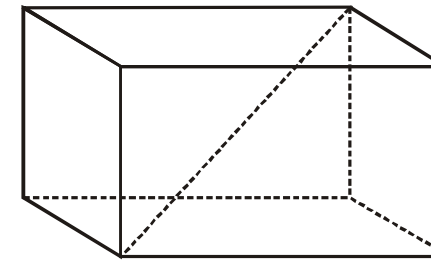
❖ **Cuboid**

If L, *B* and *H* are length, breadth and height of the cuboid, then

Volume = $L \times B \times H$

Surface area = $2(L \times B + B \times H + H \times L)$

Diagonal = $\sqrt{L^2 + B^2 + H^2}$



❖ **Cube**

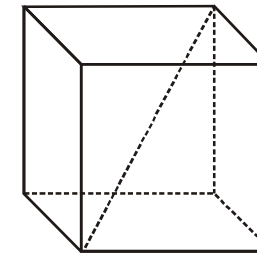
If *a* is each side of the cube, then

Volume = $a \times a \times a = a^3$

Surface area = $2(a \times a + a \times a + a \times a)$

$= 6a^2$

Diagonal of cube = $\sqrt{a^2 + a^2 + a^2} = \sqrt{3}a$



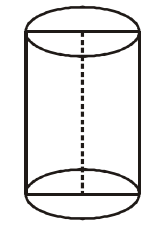
❖ **Cylinder**

If radius of cylinder is *r* and height or length is h, then

Volume = $\pi r^2 h$

Lateral surface Area = $2\pi rh$

Whole surface area = $(2\pi rh + 2\pi r^2)$



❖ **Cone**

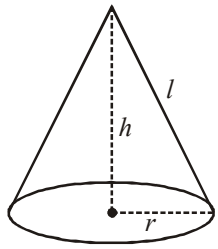
If base-radius, vertical height and slanting height of a cone are *r*, *h* and *l* respectively, then

Volume = $\frac{1}{3}\pi r^2 h$

Lateral surface area = πrl

Total surface area = $\pi rl + \pi r^2$

Vertical height = $l = \sqrt{r^2 + h^2}$

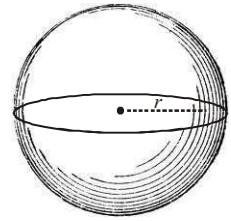


❖ **Sphere**

If r is the

radius of the sphere, then volume = $\frac{4}{3}\pi r^3$

Surface Area = $4\pi r^2$

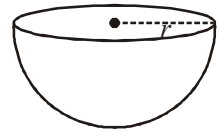


❖ **Hemisphere**

Volume = $\frac{2}{3}\pi r^3$

Curved surface area = $2\pi r^2$

Total surface area = $2\pi r^2 + \pi r^2 = 3\pi r^2$



Formulae to Remember

Some units related to volume

- 1 litre = 1000 cm^3
- 1 $Hectometer^3$ = 1000000 $meter^3$
- 1 $Decameter^3$ = 1000 $meter^3$
- 1 $Meter^3$ = 1000000 cm^3
- 1 $Decimeter^3$ = 1000 cm^3
- 1 $Milimeter^3 = \frac{1}{1000}$ cm^3

Some units related to area

- 1 Hectare = 10000 metre square
- 1 kilometre square = 1000000 metre square
- 1 Decametre square = 100 metre square
- 1 Decimeter square = $\frac{1}{100}$ metre square
- 1 Centimeter square = $\frac{1}{10000}$ metre square
- 1 Milimeter square = $\frac{1}{1000000}$ metre square

SOLVED EXAMPLES

EXAMPLE ▶ 1 : Area of a circular jogging track is 3850 sq. metres. What is the circumference of the jogging track?

(a) 225 metres (b) 214 metres
(c) 220 metres (d) 235 metres
(e) None of these

Sol. (c) Let the radius of the circular jogging track be r metre.

$\therefore \pi r^2 = 3850$

or, $\frac{22}{7} \times r^2 = 3850$

or, $r^2 = \frac{3850 \times 7}{22} = 1225$

$\therefore r = \sqrt{1225} = 35$ metre

$\therefore$ Circumference $= 2\pi r = 2 \times \frac{22}{7} \times 35 = 220$ metre

EXAMPLE ▶ 2 : The area of a rectangle is 4 times the area of a square. The length of the rectangle is 90 cm and the breadth of the rectangle is $\frac{2}{3}$ of the side of the square. What is the side of the square ?

(a) 10cm (b) 20cm
(c) 9cm (d) Cannot be determined
(e) None of these

Sol. (e) Let the side of the square be x cm.

Area of square $= x^2$

Area of rectangle $= 90 \times \frac{2}{3}x$

$90 \times \frac{2}{3}x = 4x^2 \Rightarrow x = 15$ cm

EXAMPLE ▶ 3 : If the perimeter of a square is equal to the radius of a circle whose area is 39424 sq.cms., what is the area of the square?

(a) 1225 Sq.cms.
(b) 441 Sq.cms.
(c) 784 Sq.cms.
(d) Cannot be determined
(e) None of these

Sol. (c) Radius of circle, $= \sqrt{\frac{39424 \times 7}{22}} = 112$ cm

Perimeter of square = 112 cm.

Side of square $= \frac{112}{4} = 28$ cm

$\therefore$ Area of square = 28 × 28 = 784 cm^2

EXAMPLE ▶ 4 : The length and breadth of a rectangle are in the ratio 9 : 5. If its area is 720 m^2, find its perimeter.

(a) 112 metre (b) 115 metre
(c) 110 metre (d) 118 metre
(e) None of these

Sol. (a) Let the length and breadth of a rectangle are 9 x and 5 x respectively.

In a rectangle, area = length × breadth

$\therefore$ $720 = 9x \times 5x$

or $x^2 = 16$

$\Rightarrow x = 4$

Thus, length = 9 × 4 = 36 m

and breadth = 5 × 4 = 20 m

Therefore, perimeter of rectangle = 2(36 + 20) = 112 m

EXAMPLE ▶ 5 : How many squares are there in a 5 inch by 5 inch square grid, if the grid is made up of one inch by one inch squares?

(a) 50 (b) 150
(c) 55 (d) 25
(e) None of these

Sol. (d) Required no. of squares $= \frac{5^2}{1^2} = 25$

EXAMPLE ▶ 6 : The cost of paint is ₹ 36.50 per kg. If 1 kg of paint covers 16 square feet, how much will it cost to paint outside of a cube having 8 feet each side?

(a) ₹ 692 (b) ₹ 768
(c) ₹ 876 (d) ₹ 972
(e) None of these

Sol. (c) Surface area of the cube = (6×8^2) sq. ft. = 384 sq. ft.

Quantity of paint required

$= \left(\frac{384}{16}\right)$ kg = 24 kg.

$\therefore$ Cost of painting = ₹ (36.50 × 24) = ₹ 876.

EXAMPLE ▶ 7 : The capacity of a cylindrical tank is 246.4 litres. If its height is 4 metres, what is the diameter of the base of the tank?

(a) 1.4 m (b) 2.8 m
(c) 14 m (d) 4.8 m
(e) None of these

Sol. (e) Volume of the tank = 246.4 litres = 246400 cm^3.

Let the radius of the base be r cm. Then,

$\left(\frac{22}{7} \times r^2 \times 400\right) = 246400$

$\Rightarrow r^2 = \left(\frac{246400 \times 7}{22 \times 400}\right) = 196$

$\Rightarrow r = 14$

$\therefore$ Diameter of the base = 2r = 28 cm = 0.28 m

EXERCISE

1. What is the cost of painting a hall whose area is 729 sq.meters if the rate of painting per square meter is ₹ 28?
   (a) ₹ 3,042 (b) ₹ 3,756
   (c) ₹ 3,024 (d) Cannot be determined
   (e) None of these
2. 25% of the total cost of a plot of area 280 sq feet is ₹ 1,32,370. What is the rate per sq.ft. of the plot?
   (a) ₹ 2091 (b) ₹ 1981
   (c) ₹ 1991 (d) ₹ 1891
   (e) None of these
3. The length of a rectangular plot is twice its breadth. If the area of the rectangular plot is 2592 sq metres, what is the length of the rectangular plot?
   (a) 76 metre (b) 36 metre
   (c) 74 metre (d) 37 metre
   (e) None of these
4. The ratio of the length to the breadth of a rectangular plot is 6: 5 respectively; if the breadth of the plot is 34 metre less than the length, what is the perimeter of the rectangular plot?
   (a) 374 metres (b) 408 metre
   (c) 814 metre (d) 748 metre
   (e) None of these
5. An order was placed for supply of carpet of breadth 3 metres, and length 1.44 times of breadth. Subsequently the breadth and length were increased by 25 and 40 percent respectively. At the rate of ₹ 45 per square metre, what would be the increase in the cost of the carpet?
   (a) ₹ 1020.6 (b) ₹ 398.8
   (c) ₹ 437.4 (d) ₹ 583.2
   (e) None of these
6. The length of a rectangular plot is thrice its breadth. If the area of the rectangular plot is 7803 sq. mts., what is the breadth of the rectangular plot?
   (a) 51 metre (b) 153 metre
   (c) 104 metre (d) 88 metre
   (e) None of these
7. Area of a rectangle is equal to the area of the circle whose radius is 21 cm. If the length and the breadth of the rectangle are in the ratio of 14 : 11 respectively, what is its perimeter?
   (a) 142 cm. (b) 140 cm.
   (c) 132 cm. (d) 150 cm.
   (e) None of these
8. What is the area of a circle whose circumference is 1047.2 metres?
   (a) 87231.76 sq. m. (b) 85142.28 sq. m.
   (c) 79943.82 sq . m. (d) 78621.47 sq .m.
   (e) 69843.23 sq. m.
9. The ratio between the angles of a quadrilateral is 3 : 4 : 6 : 5. Two-third the largest angle of the quadrilateral is equal to the smaller angle of a parallelogram. What is the value of adjacent angle to the smaller angle of the parallelogram ?
   (a) 120° (b) 110°
   (c) 100° (d) 130°
   (e) None of these
10. The area of a square is 196 sq. cm. Its side is half the radius of a circle. The circumference of the circle is equal to the breadth of a rectangle. If perimeter of the rectangle is 712 cm, what is the length of the rectangle ?
    (a) 196 cm (b) 186 cm
    (c) 180 cm (d) 190 cm
    (e) None of these
11. The total area of a circle and a square together are equal to 2611 sq. cm. The diameter of the circle is 42 cms. What is the sum of the circumference of the circle and the perimeter of the square ?
    (a) 272 cms. (b) 380 cms.
    (c) 280 cms. (d) Cannot be determined
    (e) None of these
12. The ratio between three angles of a quadrilateral is 1 : 6 : 2 respectively. The value of the fourth angle of the quadrilateral is 45°. What is the difference between the value of the largest and the smallest angles of the quadrilateral ?
    (a) 165° (b) 140°
    (c) 175° (d) 150°
    (e) None of these
13. The area of a triangle is 615 m^2. If one of its sides is 123 metre, find the length of the perpendicular dropped on that side from opposite vertex.
    (a) 15 metre (b) 12 metre
    (c) 10 metre (d) 18 metre
    (e) None of these
14. A square carpet with an area 169 m^2 must have 2 metres cut off one of its edges in order to be a perfect fit for a rectangualar room. What is the area of the rectangular room?
    (a) 180 m^2 (b) 164 m^2
    (c) 152 m^2 (d) 143 m^2
    (e) None of these
15. A rectangular plot 15 m ×10 m has a path of grass outside it. If the area of grassy pathway is 54 m^2, find the width of the path.
    (a) 4 m (b) 3 m
    (c) 2 m (d) 1 m
    (e) None of these

16. A cylindrical bucket of height 36 cm and radius 21 cm is filled with sand. The bucket is emptied on the ground and a conical heap of sand is formed, the height of the heap being 12 cm. The radius of the heap at the base is :
(a) 63 cm (b) 53 cm
(c) 56 cm (d) 66 cm
(e) None of these

17. The area of a square field is 576 km^2. How long will it take for a horse to run around it at the speed of 12 km/h ?
(a) 12 h (b) 10 h
(c) 8 h (d) 6 h
(e) None of these

18. A cube of 384 cm^2 surface area is melted to make x number of small cubes each of 96 mm^2 surface area. The value of x is
(a) 80,000 (b) 8
(c) 8,000 (d) 800
(e) None of these

19. A right circular cone and a right circular cylinder have equal base and equal height. If the radius of the base and the height are in the ratio 5 : 12, then the ratio of the total surface area of the cylinder to that of the cone is
(a) 3 : 1 (b) 13 : 9
(c) 17 : 9 (d) 34 : 9
(e) None of these

20. A spherical ball of lead, 3 cm in diameter, is melted and recast into three spherical balls. The diameter of two of these balls are 1.5 cm and 2 cm respectively. The diameter of the third ball is
(a) 2.5 cm (b) 2.66 cm
(c) 3 cm (d) 3.5 cm
(e) None of these

21. How many spherical bullets can be made out of a lead cylinder 28 cm high and with base radius 6 cm, each bullet being 1.5 cm in diameter?
(a) 1845 (b) 1824
(c) 1792 (d) 1752
(e) None of these

22. The length, breadth and height of a cuboid are in the ratio 1 : 2 : 3. The length, breadth and height of the cuboid are increased by 100%, 200% and 200%, respectively. Then, the increase in the volume of the cuboid will be :
(a) 5 times (b) 6 times
(c) 12 times (d) 17 times
(e) None of these

23. A circular grass lawn of 35 metres in radius has a path 7 metres wide running around it on the outside. Find the area of the path.
(a) 1694 m^2 (b) 1700 m^2
(c) 1598 m^2 (d) 1750 m^2
(e) None of these

24. The circumference of a circle is 44 metres. Find the area of the circle.
(a) 154 m^2 (b) 160 m^2
(c) 175 m^2 (d) 168 m^2
(e) None of these

25. Four sheets of 50 cm × 5 cm are arranged without overlapping to form a square having side 55 cm. What is the area of the inner square so formed?
(a) 2500 cm^2 (b) 2025 cm^2
(c) 1600 cm^2 (d) 1650 cm^2
(e) None of these

26. The ratio of height of a room to its semi-perimeter is 2 : 5. It costs ₹ 260 to paper the walls of the room with paper 50 cm wide at ₹ 2 per metre allowing an area of 15 sq. m for doors and windows. The height of the room is:
(a) 2.6 m (b) 3.9 m
(c) 4 m (d) 4.2 m
(e) None of these

27. The length of a rectangular field is double its width. Inside the field there is a square-shaped pond 8 m long. If the area of the pond is 1/8 of the area of the field, what is the length of the field?
(a) 32 m (b) 16 m
(c) 64 m (d) 20 m
(e) None of these

28. A cuboidal block of 6 cm × 9 cm × 12 cm is cut up into an exact number of equal cubes. The least possible number of cubes will be:
(a) 6 (b) 9
(c) 24 (d) 30
(e) None of these

29. If the radius of a sphere is increased by 2 cm, then its surface area increases by 352 cm^2. The radius of the sphere before the increase was:
(a) 3 cm (b) 4 cm
(c) 5 cm (d) 6 cm
(e) None of these

30. If the perimeter and diagonal of a rectangle are 14 cm and 5 cm respectively, find its area.
(a) 12 cm^2 (b) 16 cm^2
(c) 20 cm^2 (d) 24 cm^2
(e) None of these

31. In an isosceles right angled triangle, the perimeter is 20 metre. Find its area.
(a) 9,320 m^2 (b) 8,750 m^2
(c) 7,980 m^2 (d) 8,000 m^2
(e) None of these

32. If the area of a circle decreases by 36%, then the radius of the circle decreases by
(a) 20% (b) 18%
(c) 36% (d) 64%
(e) None of these

33. The floor of a rectangular room is 15 m long and 12 m wide. The room is surrounded by a verandah of width 2 m on all its sides. The area of the verandah is :
(a) 124 m^2 (b) 120 m^2
(c) 108 m^2 (d) 58 m^2
(e) None of these

Answer Key									
1	(e)	8	(a)	15	(c)	22	(d)	29	(d)
2	(d)	9	(c)	16	(a)	23	(a)	30	(a)
3	(e)	10	(c)	17	(c)	24	(a)	31	(a)
4	(d)	11	(a)	18	(c)	25	(b)	32	(a)
5	(c)	12	(c)	19	(c)	26	(c)	33	(a)
6	(a)	13	(c)	20	(a)	27	(a)		
7	(d)	14	(d)	21	(c)	28	(c)		

ANSWERS & EXPLANATIONS

1. (e) Cost of paining $= 729 \times 28 = 20412$ ₹

2. (d) Total cost of the plot $= (4 \times 132370$ ₹)

$\therefore$ Cost of the plot/sq.ft

$$= ₹\left(\frac{4\times132370}{280}\right)$$

$$= ₹\ 1891$$

3. (e) Let the breadth of rectangular plot = x metre

$\therefore$ Length = 2x metre

According to the question,

$2x \times x = 2592$

$$\text{or, } x^2 = \frac{2592}{2} = 1296$$

$$\therefore x = \sqrt{1296} = 36$$

$\therefore$ Length of rectangular plot = 2x

$= 2 \times 36 = 72$ metre

4. (d) Length of rectangular plot $= 6 \times 34 = 204$ metre

Breadth of rectangular plot

$= 5 \times 34 = 170$ metre

$\therefore$ Perimeter $= 2\ (204 + 170)$

$= 748$ metre

5. (c) Length of carpet

$= 3 \times 1.44 = 4.32$ m

Area of carpet $= 3 \times 4.32 = 12.96$ m^2

New area of carpet

$$= 3\times\frac{125}{100}\times4.32\times\frac{140}{100}$$

$= 22.68$ m^2

$\therefore$ Increase in area

$= 22.68 - 12.96$

$= 9.72$ m^2

$\therefore$ Increase in cost $= 9.72 \times 45 =$ ₹ 437.40

6. (a) Let the breadth be x metres.

Then, length = 3x metres

$\therefore$ Area $\Rightarrow 3x \times x = 7803$

$$\Rightarrow x^2 = \frac{7803}{3} = 2601$$

$$\Rightarrow x = \sqrt{2601} = 51 \text{ metres}$$

7. (d) Area of rectangle

= Area of circle

$$= \frac{22}{7}\times21\times21$$

$= 1386$ cm^2

Let the length and breadth of rectangle be $14x$ and $11x$ respectively.

Then $14x \times 11x = 1386$

$$\Rightarrow x^2 = \frac{1386}{14\times11} = 9$$

$$\Rightarrow x = \sqrt{9} = 3$$

Perimeter of rectangle

$= 2\ (14x + 11x) \Rightarrow 2 \times 25 \times 3$

$= 150$ cm.

8 (a) Circumference of circle, $2\pi r = 1047.2$

$$r = \frac{1047.2\times7}{2\times22} = 166.6$$

$\therefore$ Area of circle, πr^2

$$= \frac{22}{7}\times(166.6)^2$$

$= 87231.76$ m^2

9. (c) Smaller angle of parallelogram

$$= \frac{6}{18}\times360\times\frac{2}{3}$$

$= 80°$

Adjacent angle of parallelogram $= 180° - 80° = 100°$

10. (c) Radius of circle
$= \sqrt{196} \times 2$
$= 28$ cms.
Circumference of circle
$= 2 \times \frac{22}{7} \times 28$
$= 176$ cm.
So, $2 (L + 176) = 712$
$\Rightarrow L = \frac{712}{2} - 176$
$= 180$ cm.

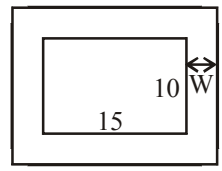
11. (a) Area of circle
$= \frac{22}{7} \times \left(\frac{42}{2}\right)^2$
$= 1386$ cm^2
Area of square
$= 2611 - 1386 = 1225$ cm^2
Side of square
$= \sqrt{1225} = 35$ cm.
$\therefore$ Required sum
$= 2 \times \frac{22}{7} \times 21 + 4 \times 35$
$= 132 + 140$
$= 272$ cm.

12. (c) Value of remaining three angles
$= 360 - 45°$
$= 315°$
Angles of quadrilateral
$= 315 \times \frac{1}{9} = 35°$
$315 \times \frac{6}{9} = 210°$
$315 \times \frac{2}{9} = 70°$
$\therefore$ Required difference
$= 210 - 35 = 175°$

13. (c) In a triangle,
$\text{Area} = \frac{1}{2} \times \text{length of perpendicular} \times \text{base}$
or $615 = \frac{1}{2} \times \text{length of perpendicular} \times 123$
$\therefore$ Length of perpendicular $= \frac{615 \times 2}{123} = 10$ m.

14. (d) Side of square carpet $= \sqrt{\text{Area}} = \sqrt{169} = 13$m
After cutting of one side,
Measure of one side $= 13 - 2 = 11$ m
and other side = 13 m (remain same)
$\therefore$ Area of rectangular room $= 13 \times 11 = 143$ m^2

15. (c)



Let the width of the path = W m
then, length of plot with path = (15 + 2W) m
and breadth of plot with path = (10 + 2 W) m
Therefore, Area of rectangular plot (without path)
$= 15 \times 10 = 150$ m^2
and Area of rectangular plot (with path)
$= 150 + 54 = 204$ m^2
Hence, $(15 + 2W) \times (10 + 2W) = 204$
$\Rightarrow 4W^2 + 50 W - 54 = 0$
$\Rightarrow 2W^2 + 25 W - 27 = 0$
$\Rightarrow (W - 2) (W + 27) = 0$
Thus $W = 2$ or -27
$\therefore$ with of the path = 2 m

16. (a) Volume of the bucket = volume of the sand emptied
Volume of sand $= \pi (21)^2 \times 36$
Let r be the radius of the conical heap.
Then, $\frac{1}{3}\pi r^2 \times 12 = \pi(21)^2 \times 36$
or $r^2 = (21)^2 \times 9$ or $r = 21 \times 3 = 63$ cm

17. (c) Area of field = 576 km^2. Then,
each side of field $= \sqrt{576} = 24$ km
Distance covered by the horse
= Perimeter of square field
$= 24 \times 4 = 96$ km
$\therefore$ Time taken by horse $= \frac{\text{distance}}{\text{speed}} = \frac{96}{12} = 8$ hrs

18. (c) Let 'A' be the side of bigger cube and 'a' be the side of smaller cube
Surface area of bigger cube = 6 A^2
or $384 = 6A^2$
$\therefore A = 8$ cm.
Surface area of smaller cube = 6 a^2
$96 = 6a^2$
$\therefore a = 4$ mm $= 0.4$ cm
So, Number of small cubes
$= \frac{\text{Volume of bigger cube}}{\text{Volume of smaller cube}}$
$= \frac{(8)^3}{(0.4)^3} = \frac{512}{0.064} = 8,000$

19. (c) Let the radius of the base and height be 5k and 12k respectively

$$\therefore \quad \frac{\text{Total surface area of the cylinder}}{\text{Total surface area of the cone}}$$

$$= \frac{2\pi r \times h + 2\pi r^2}{\pi r\sqrt{r^2+h^2} + \pi r^2}$$

$$= \frac{2h+2r}{\sqrt{r^2+h^2}+r} + \frac{24k+10k}{\sqrt{25k^2+144k^2}+5k}$$

$$= \frac{34k}{13k+5k} = \frac{34k}{18k} = \frac{17}{9}$$

20. (a) Let radius of the 3rd spherical ball be R,

$$\therefore \quad \frac{4}{3}\pi\left(\frac{3}{2}\right)^3 = \frac{4}{3}\pi\left(\frac{3}{4}\right)^3 + \frac{4}{3}\pi(1)^3 + \frac{4}{3}\pi R^3$$

$$\Rightarrow \quad R^3 = \left[\left(\frac{3}{2}\right)^3 - \left(\frac{3}{4}\right)^3\right] - 1^3$$

$$= \frac{27}{8} - \frac{27}{64} - 1 = \frac{125}{64} = \left(\frac{5}{4}\right)^3 \Rightarrow \quad R = \frac{5}{4} = 1.25$$

$\therefore$ Diameter of the third spherical ball
$= 1.25 \times 2 = 2.5$ cm.

21. (c) Volume of cylinder
$= (\pi \times 6 \times 6 \times 28)\text{cm}^3 = (36 \times 28)\pi \text{ cm}^3$.

$$\text{Volume of each bullet} = \left(\frac{4}{3}\pi \times \frac{3}{4} \times \frac{3}{4} \times \frac{3}{4}\right)\text{cm}^3$$

$$= \frac{9\pi}{16}\text{cm}^3.$$

$$\text{Number of bullets} = \frac{\text{Volume of cylinder}}{\text{Volume of each bullet}}$$

$$= \left[(36\times 28)\pi \times \frac{16}{9\pi}\right] = 1792.$$

22. (d) Let the length, breadth and height of the cuboid be x, 2x and 3x, respectively.
Therefore, volume = $x \times 2x \times 3x = 6x^3$
New length, breadth and height = 2x, 6x and 9x, respectively.
New volume = $108x^3$
Thus, increase in volume = $(108 - 6)x^3 = 102\ x^3$

$$\frac{\text{Increase in volume}}{\text{Original volume}} = \frac{102x^3}{6x^3} = 17$$

23. (a) Radius of a circular grass lawn (without path) = 35 m
$\therefore$ Area = $\pi r^2 = \pi(35)^2$
Radius of a circular grass lawn (with path)
$= 35 + 7 = 42$ m
$\therefore$ Area = $\pi r^2 = \pi(42)^2$
$\therefore$ Area of path = $\pi(42)^2 - \pi(35)^2$
$= \pi(42^2 - 35^2)$
$= \pi(42 + 35)(42 - 35)$

$$= \pi \times 77 \times 7 = \frac{22}{7} \times 77 \times 7 = 1694\,\text{m}^2$$

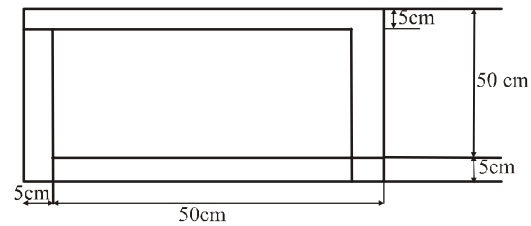
24. (a) In a circle, circumference = $2\pi r$

Hence, $44 = 2\pi r \quad \therefore \ r = \frac{44}{2\pi}$

Now, area of circle = πr^2

$$= \pi \times \frac{44}{2\pi} \times \frac{44}{2\pi} = 154\ \text{m}^2$$

25. (b)



Side of the inner square = 55 – 10 = 45
$\therefore$ Area of inner square = 45 × 45 = 2025 sq. m.

26. (c) Let h = 2x metres and (l + b) = 5x metres.
Length of the paper

$$= \frac{\text{Total cost}}{\text{Rate per m}} = \frac{260}{2} \text{ m} = 130 \text{ m}.$$

Area of the paper

$$= \left(130 \times \frac{50}{100}\right)\text{m}^2 = 65\,\text{m}^2.$$

Total area of 4 walls
$= (65 + 15)\ \text{m}^2 = 80\ \text{m}^2$.
$\therefore\ 2(l + b) \times h = 80$
$\Rightarrow 2 \times 5x \times 2x = 80$
$\Rightarrow x^2 = 4 \Rightarrow x = 2$.
$\therefore$ Height of the room = 4 m.

27. (a) Let width of the field = b m
$\therefore$ length = 2 b m
Now, area of rectangular field = $2b \times b = 2b^2$
Area of square shaped pond = $8 \times 8 = 64$
According to the question,

$$64 = \frac{1}{8}(2b^2) \Rightarrow b^2 = 64 \times 4 \Rightarrow b = 16\text{m}$$

$\therefore$ length of the field = $16 \times 2 = 32$ m

28. (c) Volume of block = $(6 \times 9 \times 12)\ cm^3 = 648\ cm^3$.
Side of largest cube
= H.C.F. of 6 cm, 9 cm, 12 cm = 3 cm.
Volume of the cube = $(3 \times 3 \times 3) = 27\ cm^3$.

$\therefore$ Number of cubes = $\left(\frac{648}{27}\right) = 24.$

29. (d) $4\pi (r + 2)^2 - 4\pi r^2 = 352$

$\Rightarrow (r + 2)^2 - r^2 = \left(352 \times \frac{7}{22} \times \frac{1}{4}\right) = 28.$

$\Rightarrow (r + 2 + r)(r + 2 - r) = 28$

$\Rightarrow 2r + 2 = \frac{28}{2} \Rightarrow 2r + 2 = 14$

$\Rightarrow r = 6$ cm

30. (a) In a rectangle,

$$\frac{(\text{perimeter})^2}{4} = (\text{diagonal})^2 + 2 \times \text{area}$$

$$\Rightarrow \frac{(14)^2}{4} = 5^2 + 2 \times \text{area}$$

$49 = 25 + 2 \times$ area

$\therefore$ Area = $\frac{49 - 25}{2} = \frac{24}{2} = 12 cm^2$

31. (a) In an isosceles right angled triangle,
Area = $23.3 \times \text{perimeter}^2$
$= 23.3 \times 20^2 = 9320\ m^2$

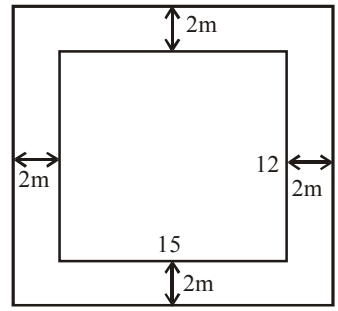
32. (a) If area of a circle is decreased by x % then the radius of the circle decreases by

$(100 - 10\sqrt{100 - x})\% = (100 - 10\sqrt{100 - 36})\%$

$= (100 - 10\sqrt{64})\%$

$= 100 - 80 = 20\%$

33. (a) Area of the outer rectangle
$= 19 \times 16 = 304\ m^2$



Area of the inner rectangle = $15 \times 12 = 180\ m^2$
Required area = $(304 - 180) = 124\ m^2$

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CHAPTER

11

NUMBER SERIES

NUMBER SERIES

Number Series tests are a type of numerical aptitude test which require you to find the missing or wrong number in a sequence. This missing or wrong number may be at the beginning or middle or at the end of sequence.

In these questions a number series is given and candidates are asked to either insert a missing number or find the one that does not follow the pattern of the series. The only thing to understand for solving these questions is the pattern on which a number series is written. A number series can be framed by using various methods. Therefore, it is advisable for the students to practice as many questions as possible.

Type of Questions

▶ **Type I** **Find the Missing Number**

ILLUSTRATION ▶ 1: What should come in place of the question mark (?) in the following number series?

0, 3, 12, 30, ?, 105, 168

Sol.

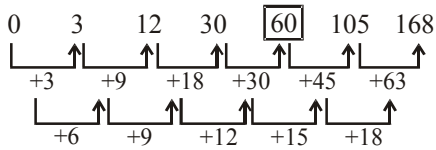


ILLUSTRATION ▶ 2 : What should come in place of the question mark (?) in the following number series?

2 9 30 105 ? 2195

Sol. The series is as follows starting from the second number denote the previous number in the series by x.

$x \times 1 + 1 \times 7, x \times 2 + 2 \times 6, x \times 3 + 3 \times 5, x \times 4 + 4 \times 4, x \times 5 + 5 \times 3$

So the missing number ? = 436

ILLUSTRATION ▶ 3: What should come in place of the question mark (?) in the following number series?

3 4 12 45 ? 1005

Sol. The series is as follows starting from second number

$x \times 1 + 1^2, x \times 2 + 2^2, x \times 3 + 3^2, x \times 4 + 4^2, x \times 5 + 5^2$

(x denotes the previous number in the series)

$\therefore\ ? = x \times 4 + 4^2 = 45 \times 4 + 16 = 196$

▶ **Type II** **Find the Next Number**

ILLUSTRATION ▶ 4 : What should be the next number in the following number series?

48, 32, 24, 20

Sol.

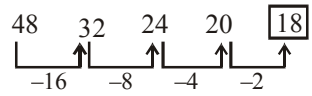


ILLUSTRATION ▶ 5: What should be the next number in the following number series?

198, 194, 185, 169, ...

Sol.

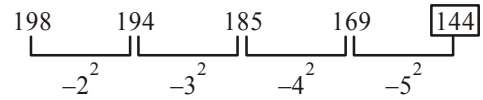


ILLUSTRATION ▶ 6 : What should be the next number in the following number series?

6, 9, 7, 10, 8, 11, ...

Sol. The series is as follows

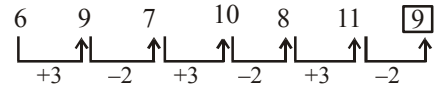
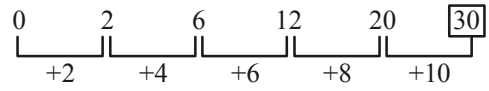


ILLUSTRATION ▶ 7 : What should be the next number in the following number series?

0, 2, 6, 12, 20, ...

Sol.



▶ **Type III** **Find the Wrong Number**

ILLUSTRATION ▶ 8 : In the following number series, a wrong number is given. Find out that wrong number.

9, 15, 24, 34, 51, 69, 90

Sol.

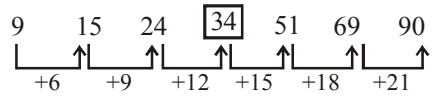


ILLUSTRATION ▶ 9 : In the following number series, a wrong number is given. Find out that wrong number.

10 15 24 35 54 75 100

Sol. The series is as follows

+ 5, +9, + 13, +17 ....difference of two consecutive terms (9 – 5 = 13 – 9 = 17 – 13) is 4.

Hence, 35 is wrong number in the series. It should be 37.

ILLUSTRATION ▶ 10 : In the following number series, a wrong number is given. Find out that wrong number.

1 3 4 7 11 18 27 47

Sol. Third number is the sum of first two numbers

Hence 27 is wrong number in the series. It should be 29.

SOLVED EXAMPLES

EXAMPLE ▶ 1 : What should come in place of the question mark (?) in the following number series?

18 38 120 ? 2480 14910

(a) 394 (b) 450
(c) 492 (d) 486
(e) None of these

Sol. (c) The given number series is based on the following pattern:

$18 \times 2 + 2 \times 1 = 38$

$38 \times 3 + 3 \times 2 = 120$

$120 \times 4 + 4 \times 3 = \boxed{492}$

$492 \times 5 + 5 \times 4 = 2480$

$2480 \times 6 + 6 \times 5 = 14910$

Hence, 492 will come in place of the question mark.

EXAMPLE ▶ 2 : What should come in place of the question mark (?) in the following number series?

1 3 9 31 ? 651

(a) 97 (b) 127
(c) 129 (d) 109
(e) None of these

Sol. (c) The series is as follows

$\times 1 + 2, \times 2 + 3, \times 3 + 4, \ldots$

EXAMPLE ▶ 3 : What should come in place of the question mark (?) in the following number series?

5 ? 4 7.5 17 45

(a) 3.5 (b) 3
(c) 2.5 (d) 2
(e) None of these

Sol. (b) The series is as follows

$\times 0.5 + 0.5, \times 1 + 1, + 1.5 + 1.5, \ldots.$

EXAMPLE ▶ 4 : What should come in place of the question mark (?) in the following number series?

15 30 ? 40 8 48

(a) 10 (b) 20
(c) 18 (d) 12
(e) None of these

Sol. (a) The series is as follows

$\times 2, \times \frac{1}{3}, \times 4, \times \frac{1}{5}, \ldots..$

EXAMPLE ▶ 5 : In the following number series one of the numbers is wrong. Find out the wrong number.

14 28 112 672 5374 53760

(a) 112 (b) 672
(c) 5374 (d) 28
(e) None of these

Sol. (c) The sequence is

$\times 2, \times 4, \times 6, \times 8, \times 10$

5374 should be 5376

EXAMPLE ▶ 6 : In the following number series one of the numbers is wrong. Find out the wrong number.

3 2 3 6 12 37.5 115. 5

(a) 37.5 (b) 3
(c) 6 (d) 2
(e) 12

Sol. (e) The series is as follows

$\times 0.5 + 0.5, \times 1 + 1, \times 1.5 + 1.5 \ldots$

Hence, 12 is wrong number in the seies, it should be 14.

EXAMPLE ▶ 7 : What should be the next number in the following number series?

6 42 294 2058 14406 ?

(a) 100842 (b) 72030
(c) 86436 (d) 115248
(e) 129654

Sol. (a) $6 \times 7 = 42$

$42 \times 7 = 294$

$294 \times 7 = 2058$

$2058 \times 7 = 14406$

$14406 \times 7 = 100842$

EXAMPLE ▶ 8 : What should be the next number in the following number series?

20 33 50 69 92 ?

(a) 196 (b) 100
(c) 169 (d) 144
(e) 121

Sol. (e) Here,

$20 + 13 = 33$

$33 + 17 = 50$

$50 + 19 = 69$

$69 + 23 = 92$

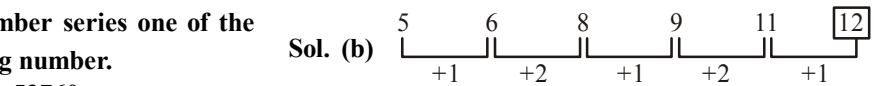
$92 + 29 = 121$

EXAMPLE ▶ 9 : What should be the next number in the following number series?

5, 6, 8, 9, 11, ...

(a) 15 (b) 12
(c) 17 (d) 20
(e) None of these

Sol. (b)



EXAMPLE ▶ 10 : What should be the next number in the following number series?

35, 30, 25, 20, 15, 10, ...

(a) 15 (b) 10
(c) 5 (d) 2
(e) None of these

Sol. (c) Series is in descending order of 5.

EXERCISE

1. What should come in place of the question mark (?) in the following number series?

   3 3 12 108 ? 43200

   (a) 2700 (b) 1728
   (c) 972 (d) 432
   (e) None of these

2. What should come in place of the question mark (?) in the following number series?

   8 20 50 125 ? 781.25

   (a) 300 (b) 295.5
   (c) 315 (d) 312.5
   (e) None of these

Directions (Q. 3-7) : In the following number series, a wrong number is given. Find out that wrong number.

3. 2 11 38 197 1172 8227 65806

   (a) 11 (b) 38
   (c) 197 (d) 1172
   (e) 8227

4. 16 19 21 30 46 71 107

   (a) 19 (b) 21
   (c) 30 (d) 46
   (e) 71

5. 7 9 16 25 41 68 107 173

   (a) 107 (b) 16
   (c) 41 (d) 68
   (e) 25

6. 4 2 3.5 7.5 26.25 118.125

   (a) 118.125 (b) 26.25
   (c) 3.5 (d) 2
   (e) 7.5

7. 16 4 2 1.5 1.75 1.875

   (a) 1.875 (b) 1.75
   (c) 1.5 (d) 2
   (e) 4

Directions (Q. 8-28) :What should come in place of the question mark (?) in the following number series.

8. 12 6.5 7.5 12.75 27.5 71.25 ?

   (a) 225.75 (b) 216.75
   (c) 209.75 (d) 236.75
   (e) 249.75

9. 16 24 36 54 81 121.5 ?

   (a) 182.25 (b) 174.85
   (c) 190.65 (d) 166.55
   (e) 158.95

10. 12 12 18 45 180 1170 ?

    (a) 13485 (b) 14675
    (c) 15890 (d) 16756
    (e) 12285

11. 22 23 27 36 52 77 ?

    (a) 111 (b) 109
    (c) 113 (d) 117
    (e) 115

12. 16 14 24 66 256 1270 ?

    (a) 8564 (b) 5672
    (c) 4561 (d) 7608
    (e) 6340

13. 6417, 5704, 4991, 4278, 3565, 2852 ?

    (a) 2408 (b) 2426
    (c) 7310 (d) 7130
    (e) 2139

14. 3 7 13 ? 31 43

    (a) 18 (b) 19
    (c) 23 (d) 21
    (e) None of these

15. 250, 100, 40 ? 6.4, 2.56

    (a) 16 (b) 20
    (c) 24 (d) 12
    (e) None of these

16. 13 20 14 19 15 ?

    (a) 16 (b) 18
    (c) 21 (d) 17
    (e) 20

17. 9 27 36 63 99 ?

    (a) 151 (b) 167
    (c) 152 (d) 162
    (e) 157

18. 7 26 63 124 215 ?

    (a) 330 (b) 321
    (c) 342 (d) 356
    (e) 339

19. 7413 7422 7440 ? 7503 7548

    (a) 7464 (b) 7456
    (c) 7466 (d) 7477
    (e) None of these

20. 4 16 36 64 100 ?
(a) 120 (b) 180
(c) 136 (d) 144
(e) None of these

21. 12 33 96 ? 852 2553
(a) 285 (b) 288
(c) 250 (d) 384
(e) None of these

22. 70000 14000 2800 ? 112 22.4
(a) 640 (b) 420
(c) 560 (d) 540
(e) None of these

23. 102 104 99 97 106 ?
(a) 96 (b) 95
(c) 100 (d) 94
(e) None of these

24. 0 5 18 43 84 145 ?
(a) 220 (b) 240
(c) 260 (d) 280
(e) None of these

25. 10 17 48 165 688 3475 ?
(a) 27584 (b) 25670
(c) 21369 (d) 20892
(e) None of these

26. 1 3 24 360 8640 302400 ?
(a) 14525100
(b) 154152000
(c) 14515200
(d) 15425100
(e) None of these

27. 12 14 32 102 416 2090 ?
(a) 15522 (b) 12552
(c) 13525 (d) 17552
(e) None of these

28. 10 25 50 75 75 37.5 ?
(a) 4.375 (b) 3.2375
(c) 4.6275 (d) 3.575
(e) None of these

Directions (Q. 29-33) : In the following number series only one number is wrong. Find out the wrong number.

29. 4 6 18 49 201 1011
(a) 1011 (b) 201
(c) 18 (d) 49
(e) None of these

30. 48 72 108 162 243 366
(a) 72 (b) 108
(c) 162 (d) 243
(e) None of these

31. 2 54 300 1220 3674 7350
(a) 3674 (b) 1220
(c) 300 (d) 54
(e) None of these

32. 8 27 64 125 218 343
(a) 27 (b) 218
(c) 125 (d) 343
(e) None of these

33. 19 68 102 129 145 154
(a) 154 (b) 129
(c) 145 (d) 102
(e) None of these

Directions (Q. 34-53) : What should come in place of the question mark (?) in the following number series?

34. 10 14 25 55 140 (?)
(a) 386 (b) 398
(c) 388 (d) 396
(e) None of these

35. 119 131 155 191 239 (?)
(a) 289 (b) 290
(c) 279 (d) 280
(e) None of these

36. 11 57 149 333 701 (?)
(a) 1447 (b) 1347
(c) 1368 (d) 1437
(e) None of these

37. 697 553 453 389 353 (?)
(a) 328 (b) 337
(c) 362 (d) 338
(e) None of these

38. 336 224 168 140 126 (?)
(a) 119 (b) 118
(c) 116 (d) 121
(e) None of these

39. 588 587 583 574 558 ? 497
(a) 545 (b) 543
(c) 551 (d) 557
(e) None of these

40. 64 54 69 49 74 44 ?
(a) 89 (b) 69
(c) 59 (d) 99
(e) None of these

41. 4000 2008 1012 ? 265 140.5 78.25
(a) 506 (b) 514
(c) 520 (d) 512
(e) None of these

42. 5 5 15 75 ? 4725 51975
(a) 520 (b) 450
(c) 525 (d) 300
(e) None of these

43. 52 26 26 39 78 ? 585
(a) 195 (b) 156
(c) 234 (d) 117
(e) None of these

44. 29, 23, ?, 17, 13, 11, 7
(a) 19 (b) 21
(c) 23 (d) 27
(e) None of these

45. 8, 15, 28, 53, ?
(a) 106 (b) 98
(c) 100 (d) 102
(e) None of these

46. 24, 49, ?, 94, 15, 31, 59, 58
(a) 51 (b) 63
(c) 77 (d) 95
(e) None of these

47. 5, 10, 13, 26, 29, 58, ?, 122
(a) 60 (b) 61
(c) 111 (d) 91
(e) None of these

48. 2, 3, 10, 15, 26, ?, 55
(a) 32 (b) 33
(c) 34 (d) 35
(e) None of these

49. 2, 4, ?, 16, 32
(a) 6 (b) 10
(c) 8 (d) 12
(e) None of these

50. 0, 7, 26, ?, 124, 215
(a) 37 (b) 51
(c) 63 (d) 88
(e) None of these

51. 4, 15, 16, ?, 36, 63, 64
(a) 25 (b) 30
(c) 32 (d) 35
(e) None of these

52. 1, 8, 9, ?, 25, 216, 49
(a) 60 (b) 64
(c) 70 (d) 75
(e) None of these

53. 336, 210, 120, ?, 24, 6, 0
(a) 40 (b) 50
(c) 60 (d) 70
(e) None of these

Answer Key

1	(b)	12	(d)	23	(b)	34	(c)	45	(d)
2	(d)	13	(e)	24	(e)	35	(e)	46	(d)
3	(d)	14	(d)	25	(d)	36	(d)	47	(b)
4	(a)	15	(a)	26	(c)	37	(b)	48	(d)
5	(d)	16	(b)	27	(b)	38	(a)	49	(c)
6	(c)	17	(d)	28	(e)	39	(e)	50	(c)
7	(b)	18	(c)	29	(c)	40	(e)	51	(d)
8	(b)	19	(e)	30	(e)	41	(b)	52	(b)
9	(a)	20	(d)	31	(a)	42	(c)	53	(c)
10	(e)	21	(a)	32	(b)	43	(a)		
11	(c)	22	(c)	33	(d)	44	(a)		

ANSWERS & EXPLANATIONS

1. (b) The pattern of the series is as follows
$\times 1^2, \times 2^2, \times 3^2, \times 4^2, \times 5^2$
Hence, required number = 1728.

2. (d) The pattern of the series is as follows :
$8 \times 2.5 = 20$
$20 \times 2.5 = 50$
$50 \times 2.5 = 125$
$\therefore ? = 125 \times 2.5 = 312.5$

3. (d) The series is based on the following pattern:
$2 \times 3 + 5 = 11$
$11 \times 4 - 6 = 38$
$38 \times 5 + 7 = 197$
$197 \times 6 - 8 = \boxed{1174}$; not 1172
$1174 \times 7 + 9 = 8227$
$8227 \times 8 - 10 = 65806$
Clearly, 1172 is the wrong number and it should be replaced by 1174.

4. (a) The series is based on the following pattern :
$16 + 1^2 = 17$; not $\boxed{19}$
$17 + 2^2 = 21$
$21 + 3^2 = 30$
$30 + 4^2 = 46$
$46 + 5^2 = 71$
$71 + 6^2 = 107$
Clearly, 19 should replaced by 17.

5. (d) The series is based on the following pattern :
$7 + 9 = 16$
$9 + 16 = 25$
$16 + 25 = 41$
$25 + 41 = 66$; $\boxed{68}$
$41 + 66 = 107$
$66 + 107 = 173$
Clearly, 68 should be replaced by 66

6. (c) The series is based on the following pattern
$4 \times .5 = 2$
$2 \times 1.5 = \boxed{3}$; not 3.5
$3 \times 2.5 = 7.5$
$7.5 \times 3.5 = 26.25$
$26.25 \times 4.5 = 118.125$
Clearly, 3.5 should be replaced by 3.

7. (b) The series is based on the following pattern:
$16 \times 0.25 = 4$
$4 \times 0.50 = 2$
$2 \times 0.75 = 1.5$
$1.5 \times 1.00 = \boxed{1.5}$; not 1.75
$1.5 \times 1.25 = 1.875$
Clearly, 1.75 should be replaced by 1.5.

8. (b) The given number series is based on the following pattern:
$12 \times 0.5 + 0.5 = 6.5$
$6.5 \times 1 + 1 = 7.5$
$7.5 \times 1.5 + 1.5 = 12.75$
$12.75 \times 2 + 2 = 27.5$
$27.5 \times 2.5 + 2.5 = 71.25$
$\therefore ? = 71.25 \times 3 + 3$
$= 213.75 + 3 = 216.75$
Hence, 216.75 will replace the question mark.

9. (a) The given number series is based on the following pattern:
$16 \times \frac{3}{2} = 8 \times 3 = 24$
$24 \times \frac{3}{2} = 12 \times 3 = 36$
$36 \times \frac{3}{2} = 18 \times 3 = 54$

$54 \times \frac{3}{2} = 81$

$81 \times \frac{3}{2} = 121.5$

$\therefore ? = 121.5 \times \frac{3}{2} = 182.25$

Hence, the number 182.25 will replace the question mark.

10. (e) The pattern of series is as follows :
12 × 1 = 12,
12 × 1.5 = 18, [0.5 + 1 = 1.5]
18 × 2.5 = 45, [1+ 1.5 = 2.5]
45× 4 = 180, [1.5 + 2.5 = 4]
180 × 6.5 = 1170, [2.5 + 4 = 6.5]
∴ ? = 1170 × 10.5 = 12285
Hence, 12285 will replace the question mark.

11. (c) The given number series is based on the following pattern:
$22 + 1^2 = 22 + 1 = 23$
$23 + 2^2 = 23 + 4 = 27$
$27 + 3^2 = 27 + 9 = 36$
$36 + 4^2 = 36 + 16 = 52$
$52 + 5^2 = 52 + 25 = 77$
$\therefore ? = 77 + 6^2$
= 77 + 36 = 113

12. (d) The given number series is based on the following pattern:
16 × 1 - 2 = 14
14 × 2 - 4 = 24
24 × 3 - 6 = 66
66 × 4 - 8 = 256
256 × 5 - 10 = 1270
∴ ? = 1270 × 6 - 12
= 7620 - 12 = 7608
Hence, 7608 will replace the question mark.

13. (e) The given number series is based on the following pattern:
6417 – 713 = 5704
5704 – 713 = 4991
4991 – 713 = 4278
4278 – 713 = 3565
3565 – 713 = 2852
? = 2852 – 713 = 2139
Hence, 2139 will replace the question mark.

14. (d) The given number series is based on the following pattern:
7 + 6 = 13
13 + 8 = $\boxed{21}$
21 + 10 = 31
31 + 12 = 43
Hence, the number 21 will replace the question mark.

15. (a) The given number series is based on the following pattern:
$250_{\div 2.5}$ $100_{\div 2.5}$ $40_{\div 2.5}$ $16_{\div 2.5}$ $6.4_{\div 2.5}$ 2.56
Hence, the number 16 will replace the question mark.

16. (b) 13 20 14 19 15 ?
Hence, question mark (?) should be replaced by 18.

17. (d) Here,
9 + 27 = 36
27 + 36 = 63
36 + 63 = 99
63 + 99 = 162.

18. (c) $7 = 2^3 - 1$
$26 = 3^3 - 1$
$63 = 4^3 - 1$
$124 = 5^3 - 1$
$215 = 6^3 - 1$
$? = 7^3 - 1 = 342$

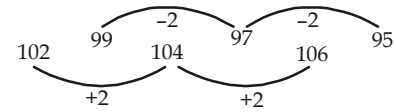
19. (e) The series is as follows
+ 9, + 18, + 27, +36, + 45
Hence, ? = 7440 + 27 = 7467

20. (d) The series is as follows
$(2)^2, (4)^2, (6)^2, (8)^2, (10)^2, (12)^2$
Hence, $? = (12)^2 = 144$

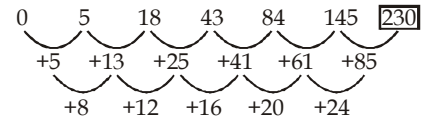
21. (a) The series is as follows: × 3 – 3
Hence, ? = 96 × 3 – 3 = 285

22. (c) The series is as follows: ÷ 5
Hence, ? = 2800 ÷ 5 = 560

23. (b) The series is as follows



24. (e)



25. (d) The series is as follows
×1 + (7 × 1), ×2 + (7 × 2), × 3 + (7 × 3), ×4 + (7× 4), × 5 + (7 × 5), × 6 + (7 × 6)....
Hence, ? = 3475 × 6 + (7 × 6)
= 20892

26. (c) The series is as follows
×3, ×8, × 15, ×24, ×35, ×48
Hence, ? = 302400 × 48
= 14515200

27. (b) The series is as follows
×1 + 2, ×2 + 4, ×3 + 6, ×4 + 8, × 5 + 10, × 6 + 12...
Hence, ? = 2090 × 6 + 12 = 12552

28. (e) The series is as follows
×2.5, ×2, ×1.5, ×1, ×0.5, ×0
Hence, ? = 37.5 × 0 = 0

29. (c) The series is
× 1 + 2, × 2 + 3, × 3 + 4, × 4 + 5, × 5 + 6
The wrong number is 18.
It should be 6 × 2 + 3 = 15

30. (e) The series is × 1.5
The wrong number is 366
It should be 243 × 1.5 = 364.5

31. (a) The series is
× 6 + 42, × 5 + 30, × 4 + 20, × 3 + 12, × 2 + 6,
The wrong number is 3674
It should be 1220 × 3 + 12 = 3672

32. (b) The series is $(2)^3$, $(3)^3$, $(4)^3$, $(5)^3$, $(6)^3$, $(7)^3$,
The wrong number is 218
It should be $(6)^3 = 216$

33. (d) The series is + $(7)^2$, + $(6)^2$, + $(5)^2$, + $(4)^2$, + $(3)^2$
The wrong number is 102.
It should be 68 + $(6)^2$ = 104

34. (c) The series is as follows:
× 3 – 16, × 3 – 17, × 3 – 20, × 3 – 25, × 3 – 32
Hence, ? = 140 × 3 – 32 = 388

35. (e) The series is as follows:
+ (12 × 1), + (12 × 2), + (12 × 3), + (12 × 4), + (12 × 5)
Hence, ? = 239 + (12 × 5) = 299

36. (d) The series is as follows: ×2 + 35
Hence, ? = 701 × 2 + 35 = 1437

37. (b) The series is as follows:
– 12^2, – 10^2, – 8^2, – 6^2, – 4^2
Hence, ? = 353 – 4^2 = 337

38. (a) The series is as follows:
– 112, – 56, – 28, – 14, – 7
Hence, ? = 126 – 7 = 119

39. (e) The series is as follows:
– 1^2, – 2^2, –3^2, – 4^2, – 5^2, – 6^2
Hence, ? = 558 – 5^2 = 533

40. (e) The series is as follows:
64 + 5 = 69;
69 + 5 = 74;
74 + 5 = 79
54 – 5 = 49;
49 – 5 = 44

41. (b) The series is as follows:
÷ 2 + 8
Hence, ? = 1012 ÷ 2 + 8 = 514

42. (c) The series is as follows:
× 1, × 3, × 5, × 7, × 9, × 11
Hence, ? = 75 × 7 = 525

43. (a) The series is as follows:
$\times \frac{1}{2}, \times 1, \times 1\frac{1}{2}, \times 2, \times 2\frac{1}{2}, \times 3$
Hence, ? = 78 × $2\frac{1}{2}$ = 195

44. (a) This is a series of prime numbers :

45. (d) Let x = 8
then 15 = 2x – 1 = y
28 = 2y – 2 = z
53 = 2z – 3 = m
Next term in the pattern should be
2m – 4 = 2 × 53 – 4
= 102

46. (d) It is a combination of two series, namely
24, 49, ?, 94; and 15, 31, 59, 58
The two series correspond to
x, (2x + 1), (4x – 1), (4x – 2)
Hence the missing term is
4 x 24 – 1 = 95

47. (b) Add 3 after doubling the previous number.

48. (d) The series exhibits the pattern of $n^2 + 1$, $n^2 - 1$, alternatively, n taking values 1, 2.....1

49. (c) The terms exhibit the pattern 2^1, 2^2, 2^3 and so on.

50. (c) Try the pattern $n^3 - 1$. n = 1, 2, ...

51. (d) Pattern is 2^2, $4^2 - 1$,4^2 , $6^2 - 1$, 6^2 and so on.

52. (b) Can you see that the pattern is
1^2, 2^3, 3^2, 4^3, 5^2, 6^3, 7^2

53. (c) Note that
$0 = 1^3 - 1$
$6 = 2^3 - 2$
$24 = 3^3 - 3$

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CHAPTER

12

PERMUTATION, COMBINATION & PROBABILITY

INTRODUCTION

Factorial : The important mathematical term "Factorial" has extensively used in this chapter.

The product of first n consecutive **natural numbers** is defined as **factorial of n**. It is denoted by n! or $\lfloor n$. Therefore,

$$\boxed{n! = 1 \times 2 \times 3 \times ..... \times (n-1) \times n}$$

For example, $5! = 5 \times 4 \times 3 \times 2 \times 1 = 120$

$$\frac{n!}{r!} \neq \left(\frac{n}{r}\right)!$$

$0! = 1$

The factorials of fractions and negative integers are not defined.

EXAMPLE 1. Prove that n! + 1 is not divisible by any natural number between 2 and 'n'.

Sol. Since $n! = 1 \cdot 2 \cdot 3 \cdot 4 \ldots (n-1) \cdot n$

Therefore n! is divisible by any number from 2 to 'n'.

Consequently n! + 1, when divided by any number between 2 and 'n' leaves 1 as remainder.

Hence, n! + 1 is not divisible by any number between 2 and 'n'.

FUNDAMENTAL PRINCIPLES OF COUNTING

1. **Principle of Addition :** If an event can occur in 'm' ways and another event can occur in 'n' ways independent of the first event, then either of the two events can occur in (m + n) ways.
2. **Principle of Multiplication :** If an operation can be performed in 'm' ways and after it has been performed in any one of these ways, a second operation can be performed in 'n' ways, then the two operations in succession can be performed in (m × n) ways.

EXAMPLE 2. In a class there are 10 boys and 8 girls. The class teacher wants to select a student for monitor of the class. In how many ways the class teacher can make this selection ?

Sol. The teacher can select a student for monitor in two exclusive ways

(i) Select a boy among 10 boys, which can be done in 10 ways OR

(ii) Select a girl among 8 girls, which can be done in 8 ways.

Hence, by the fundamental principle of addition, either a boy or a girl can be selected in 10 + 8 = 18 ways.

EXAMPLE 3. In a class there are 10 boys and 8 girls. The teacher wants to select a boy and a girl to represent the class in a function. In how many ways can the teacher make this selection?

Sol. The teacher has to perform two jobs :

(i) To select a boy among 10 boys, which can be done in 10 ways.

(ii) To select a girl, among 8 girls, which can be done in 8 ways.

Hence, the required number of ways = 10 × 8 = 80.

EXAMPLE 4. There are 6 multiple choice questions in an examination. How many sequences of answers are possible, if the first three questions have 4 choices each and the next three have 5 choices each?

Sol. Each of the first three questions can be answered in 4 ways and each of the next three questions can be answered in 5 different ways.

Hence, the required number of different sequences of answers = $4 \times 4 \times 4 \times 5 \times 5 \times 5 = 8000$.

EXAMPLE 5. Five persons entered a lift cabin on the ground floor of an 8-floor house. Suppose that each of them can leave the cabin independently at any floor beginning with the first. What is the total number of ways in which each of the five persons can leave the cabin at any of the 7 floors?

Sol. Any one of the 5 persons can leave the cabin in 7 ways independent of other.

Hence the required number of ways = $7 \times 7 \times 7 \times 7 \times 7 = 7^5$.

Method of Sampling : Sampling process can be divided into following forms :

1. The order is IMPORTANT and the repetition is ALLOWED, each sample is then a SEQUENCE.
2. The order is IMPORTANT and the repetition is NOT ALLOWED, each sample is then a PERMUTATION.
3. The order is NOT IMPORTANT and repetition is ALLOWED, each sample is then a MULTISET.
4. The order is NOT IMPORTANT and repetition is NOT ALLOWED, each sample is then a COMBINATION.

PERMUTATION

Each of the arrangements, which can be made by taking, some or all of a number of things is called a PERMUTATION.

For Example : Formation of numbers, word formation, sitting arrangement in a row.

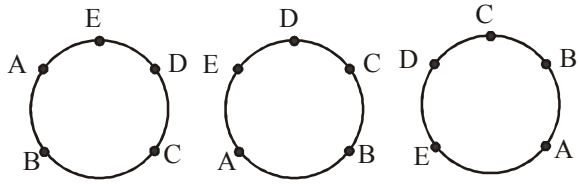
The number of permutations of 'n' things taken 'r' at a time is denoted by ${}^nP_r$. It is defind as, ${}^nP_r = \frac{n!}{(n-r)!}$.

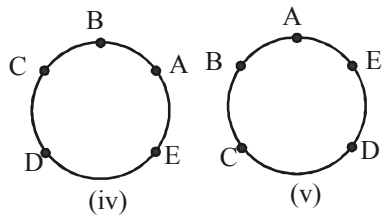
${}^nP_n = n!$

Circular permutations:

(i) Arrangements round a circular table :

Consider five persons A, B, C, D and E to be seated on the circumference of a circular table in order (which has no head). Now, shifting A, B, C, D and E one position in anticlockwise direction we will get arrangements as follows:





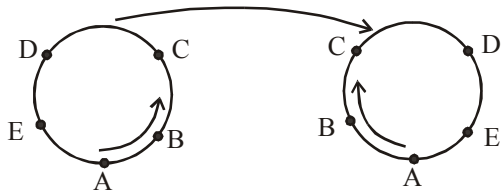
we see that arrangements in all figures are same.

∴ The number of circular permutations of n different things taken all at a time is $\frac{{}^nP_n}{n} = (n-1)!$, if clockwise and anticlockwise orders are taken as different.

(ii) Arrangements of beads or flowers (all different) around a circular necklace or garland:

Consider five beads A, B, C, D and E in a necklace or five flowers A, B, C and D, E in a garland etc. If the necklace or garland on the left is turned over we obtain the arrangement on the right, i.e., anticlockwise and clockwise order of arrangements are not different.

Thus the number of circular permutations of 'n' different things taken.



all at a time is $\frac{1}{2}(n-1)!$, if clockwise and anticlockwise orders are taken to be some.

EXAMPLE 6. Prove that ${}^nP_r = {}^{n-1}P_r + r.\,{}^{n-1}P_{r-1}$

Sol. ${}^{n-1}P_r + r.{}^{n-1}P_{r-1} = \frac{(n-1)!}{(n-1-r)!} + r\frac{(n-1)!}{(n-1-r+1)!}$

$= (n-1)!\left\{\frac{1}{(n-1-r)!} + \frac{r}{(n-r)!}\right\}$

$= (n-1)!\left\{\frac{n-r+r}{(n-r)!}\right\} = \frac{n!}{(n-r)!} = {}^nP_r$

EXAMPLE 7. Prove that ${}^nP_r = (n-r+1)\ {}^nP_{r-1}$

Sol. We have

$(n-r+1)\ {}^nP_{r-1} = (n-r+1)\frac{n!}{(n-r+1)!}$

$= (n-r+1)\frac{n!}{(n-r+1)(n-r)!}$

$= \frac{n!}{(n-r)!} = {}^nP_r$

EXAMPLE 8. The number of four digit numbers with distinct digits is :

(a) $9\times{}^9C_3$ **(b)** $9\times{}^9P_3$

(c) ${}^{10}C_3$ **(d)** ${}^{10}P_3$

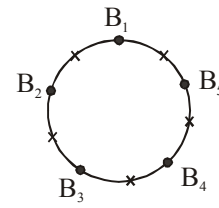
Sol. (b) The thousandth place can be filled up in 9 ways with any one of the digits 1, 2, 3, ..., 9. After that the other three places can be filled up in ${}^9P_3$ ways, with any one of the remaining 9 digits including zero. Hence, the number of four digit numbers with distinct digits = $9\times{}^9P_3$.

EXAMPLE 9. The number of ways in which 10 persons can sit round a circular table so that none of them has the same neighbours in any two arrangements.

Sol. 10 persons can sit round a circular table in 9! ways. But here clockwise and anticlockwise orders will give the same neighbours. Hence the required number of ways = $\frac{1}{2}9!$

EXAMPLE 10. In how many different ways can five boys and five girls form a circle such that the boys and girls are alternate?

Sol. After fixing up one boy on the table the remaining can be arranged in 4! ways.



There will be 5 places, one place each between two boys which can be filled by 5 girls in 5! ways.

Hence by the principle of multiplication, the required number of ways = 4! × 5! = 2880.

EXAMPLE 11. In how many ways can 5 boys and 5 girls be seated at a round table no two girls may be together ?

Sol. Leaving one seat vacant between two boys may be seated in 4! ways. Then at remaining 5 seats, 5 girls any sit in 5! ways. Hence the required number = 4! × 5!

Conditional Permutations

1. Number of permutations of n things taking r at a time, in which a particular thing always occurs = $r.\ {}^{n-1}P_{r-1}$.

Distinguishable Permutations

Suppose a set of n objects has n_1 of one kind of object, n_2 of a second kind, n_3 of a third kind, and so on, with $n = n_1 + n_2 + n_3 + \ldots + n_k$, Then the number of distinguishable permutations of the n objects is $\frac{n!}{n_1!\, n_2!\, n_3!\, \ldots\ldots\, n_k!}$

EXAMPLE 12. In how many distinguishable ways can the letters in BANANA be written?

Sol. This word has six letters, of which three are A's, two are N's, and one is a B. Thus, the number of distinguishable ways the letters can be written is

$$\frac{6!}{3!\,2!\,1!} = \frac{6\times5\times4\times3!}{3!\,2!} = 60$$

EXAMPLE 13. How many 4 digits number (repetition is not allowed) can be made by using digits 1-7 if 4 will always be there in the number?

Sol. Total digits (n) = 7

Total ways of making the number if 4 is always there $= r \times {}^{n-1}P_{r-1} = 4 \times {}^{6}P_3 = 480$.

2. Number of permutations of n things taking r at a time, in which a particular thing never occurs = ${}^{n-1}P_r$.

EXAMPLE 15. How many different 3 letter words can be made by 5 vowels, if vowel 'A' will never be included?

Sol. Total letters (n) = 5

So total number of ways = ${}^{n-1}P_r = {}^{5-1}P_3 = {}^{4}P_3 = 24$.

3. Number of permutations of n different things taking all at a time, in which m specified things always come together $= m!(n-m+1)!$.

4. Number of permutations of n different things taking all at a time, in which m specified things never come together = $n! - m!(n-m+1)!$

EXAMPLE 15. In how many ways can we arrange the five vowels, a, e, i, o & u if :

(i) two of the vowels e and i are always together.

(ii) two of the vowels e and i are never together.

Sol. (i) Using the formula $m!(n-m+1)!$

Here n = 5, m = 2(e & i)

$\Rightarrow$ Required no. of ways = $2!(5-2+1)! = 2\times4! = 48$

Alternative :

As the two vowels e & i are always together we can consider them as one, which can be arranged among themselves in 2! ways.

Further the 4 vowels (after considering e & i as one) can be arranged in 4! ways.

Total no. of ways = $2! \times 4! = 48$

(ii) No. of ways when e & i are never together

= total no. of ways of arranging the 5 vowels – no. of ways when e & i are together = 5! – 48 = 72

Or use $n! - m!(n-m+1)! = 5! - 48 = 72$

5. The number of permutations of 'n' things taken all at a time, when 'p' are alike of one kind, 'q' are alike of second, 'r' alike of third, and so on $= \frac{n!}{p!\, q!\, r!}$.

EXAMPLE 16. How many different words can be formed with the letters of the world MISSISSIPPI.

Sol. In the word MISSISSIPPI, there are 4 I's, 4S's and 2P's.

Thus required number of words = $\frac{(11)!}{4!\,2!\,4!} = 34650$

6. The number of permutations of 'n' different things, taking 'r' at a time, when each thing can be repeated 'r' times = n^r

EXAMPLE 17. In how many ways can 5 prizes be given away to 4 boys, when each boy is eligible for all the prizes?

Sol. Any one of the prizes can be given in 4 ways; then any one of the remaining 4 prizes can be given again in 4 ways, since it may even be obtained by the boy who has already received a prize.

Hence 5 prizes can be given $4\times4\times4\times4\times4 = 4^5$ ways.

EXAMPLE 18. How many numbers of 3 digits can be formed with the digits 1, 2, 3, 4, 5 when digits may be repeated?

Sol. The unit place can be filled in 5 ways and since the repetitions of digits are allowed, therefore, tenth place can be filled in 5 ways.

Furthermore, the hundredth place can be filled in 5 ways also.

Therefore, required number of three digit numbers is $5\times5\times5 = 125$.

EXAMPLE 19. In how many ways 8 persons can be arranged in a circle?

Sol. The eight persons can be arranged in a circle in $(8-1)! = 7! = 5040$.

EXAMPLE 20. Find the number of ways in which 18 different beads can be arranged to form a necklace.

Sol. 18 different beads can be arranged among themselves in a circular order in $(18-1)! = 17!$ ways. Now in the case of necklace there is no distinct between clockwise and anticlockwise arrangements. So, the required number of arrangements = $\frac{1}{2}(17!) = \frac{17!}{2}$

COMBINATION

Each of the different selections that can be made with a given number of objects taken some or all of them at a time is called a COMBINATION.

The number of combinations of 'n' dissimilar things taken 'r' at a time is denoted by ${}^nC_r$ or C(n, r). It is defined as,

$${}^nC_r = \frac{n!}{r!(n-r)!}$$

EXAMPLE **21. If ${}^nP_r = {}^nP_{r+1}$ and ${}^nC_r = {}^nC_{r-1}$, then the values of n and r are**

(a) 4, 3 **(b) 3, 2**
(c) 4, 2 **(d) None of these**

Sol. (b) We have, ${}^nP_r = {}^nP_{r+1}$

$$\Rightarrow \frac{n!}{(n-r)!} = \frac{n!}{(n-r-1)!} \Rightarrow \frac{1}{(n-r)} = 1$$

or $n - r = 1$ ...(1)

Also, ${}^nC_r = {}^nC_{r-1} \Rightarrow r + r - 1 = n \Rightarrow 2r - n = 1$ ...(2)

Solving (1) and (2), we get $r = 2$ and $n = 3$

EXAMPLE **22. Prove that**

$${}^nC_{r-2} + 3.\ {}^nC_{r-1} + 3.\ {}^nC_r + {}^nC_{r+1} = {}^{n+2}C_{r+2}$$

Sol. ${}^nC_{r-2} + 3\,{}^nC_{r-1} + 3\,{}^nC_r + {}^nC_{r+1}$

$= {}^nC_{r-2} + {}^nC_{r-1} + 2({}^nC_{r-1} + {}^nC_r) + ({}^nC_r + {}^nC_{r+1})$

$= {}^{n+1}C_{r-1} + 2.\ {}^{n+1}C_r + {}^{n+1}C_{r+1}$

$= ({}^{n+1}C_{r-1} + {}^{n+1}C_r) + ({}^{n+1}C_r + {}^{n+1}C_{r+1})$

$= {}^{n+2}C_r + {}^{n+2}C_{r+1} = {}^{n+3}C_{r+1}$

EXAMPLE **23. If ${}^nP_r = 720\ {}^nC_r$, then r is equal to**

(a) 3 **(b) 7**
(c) 6 **(d) 4**

Sol. (c) ${}^nP_r = 720{}^nC_r$

or $\frac{n!}{(n-r)!} = \frac{720(n!)}{(n-r)!r!}$

$\Rightarrow r! = 720 = 1 \times 2 \times 3 \times 4 \times 5 \times 6!$

or $r = 6$

EXAMPLE **24. In how many ways a hockey team of eleven can be elected from 16 players?**

Sol. Total number of ways $= {}^{16}C_{11} = \frac{16!}{11! \times 5!} = 4368.$

$$= \frac{16 \times 15 \times 14 \times 13 \times 12}{5 \times 4 \times 3 \times 2 \times 1} = 4368.$$

REMEMBER

★ ${}^nC_0 = 1,\ {}^nC_n = 1;\ {}^nP_r = r!\,{}^nC_r$

★ ${}^nC_r = {}^nC_{n-r}$

★ ${}^nC_{r-1} + {}^nC_r = {}^{n+1}C_r$

★ ${}^nC_x = {}^nC_y \Rightarrow x + y = n$

★ ${}^nC_r = {}^nC_{r+1} = {}^{n+1}C_r$

★ ${}^nC_r = \frac{n}{r}.\ {}^{n-1}C_{r-1}$

★ ${}^nC_r = \frac{1}{r}(n - r + 1)\,{}^nC_{r-1}$

★ ${}^nC_1 = {}^nC_{n-1} = n$

Conditional Combinations

1. Number of combinations of n distinct things taking r $(\le n)$ at a time, when k $(0 \le k \le r)$ particular objects always occur $= {}^{n-k}C_{r-k}$.

2. Number of combinations of n distinct objects taking r$(\le n)$ at a time, when k $(0 \le k \le r)$ particular objects never occur $= {}^{n-k}C_r$.

3. Number of selections of r things from n things when p particular things are not together in any selection $= {}^nC_r - {}^{n-p}C_{r-p}$

4. Number of selection of r consecutive things out of n things in a row $= n - r + 1$

5. Number of selection of r consecutive things out of n things along a circle

$$= \begin{cases} n, \text{ when } r < n \\ 1, \text{ when } r = n \end{cases}$$

6. The number of Combinations of 'n' different things taking some or all at a time

$= {}^nC_1 + {}^nC_2 + {}^nC_3 + \ldots\ldots\ldots + {}^nC_n = 2^n - 1$

EXAMPLE **25. In a class of 25 students, find the total number of ways to select two representative,**

(i) if a particular person will never be selected.
(ii) if a particular person is always there.

Sol. (i) Total students (n) = 25

A particular students will not be selected (p) = 1,
So total number of ways $= {}^{25-1}C_2 = {}^{24}C_2 = 276.$

(ii) Using ${}^{n-p}C_{r-p}$ no. of ways $= {}^{25-1}C_{2-1} = {}^{24}C_1 = 24.$

NOTE : *If a person is always there then we have to select only 1 from the remaining 25 – 1 = 24*

EXAMPLE **26. There are 10 lamps in a hall. Each of them can be switched on independently. The number of ways in which the hall can be illuminated is**

(a) 10^2 **(b) 1023**
(c) 2^{10} **(d) 10 !**

Sol. Since each bulb has two choices, either switched on or off, therefore required number $= 2^{10} - 1 = 1023.$

7. The number of ways of dividing 'm + n' things into two groups containing 'm' and 'n' things respectively

$= {}^{m+n}C_m\ {}^nC_n = \frac{(m+n)!}{m!n!}$

8. The number of ways of dividing 'm + n + p' things into three groups containing 'm', 'n' and 'p' things respectively

$= {}^{m+n+p}C_m \cdot {}^{n+p}C_p = \frac{(m+n+p)!}{m!\ n!\ p!}$

(i) If $m = n = p$ ie. '3m' things are divided into three equal groups then the number of combinations is

$$\frac{(3m)!}{m!\,m!\,m!\,3!} = \frac{(3m)!}{(m!)^3\,3!}$$

(ii) But if '3m' things are to be divided among three persons, then the number of divisions is $\frac{(3m)!}{(m!)^3}$

9. If mn distinct objects are to be divided into m groups. Then, the number of combination is

$\frac{(mn)!}{m!\,(n!)^m}$, when the order of groups is not important and

$\frac{(mn)!}{(n!)^m}$, when the order of groups is important

EXAMPLE 27. The number of ways in which 52 cards can be divided into 4 sets, three of them having 17 cards each and the fourth one having just one card

(a) $\frac{52!}{(17!)^3}$ **(b)** $\frac{52!}{(17!)^3\,3!}$

(c) $\frac{51!}{(17!)^3}$ **(d)** $\frac{51!}{(17!)^3\,3!}$

Sol. Here we have to divide 52 cards into 4 sets, three of them having 17 cards each and the fourth one having just one card. First we divide 52 cards into two groups of 1 card and 51 cards. this can be done in $\frac{52!}{1!\,51!}$ ways.

Now every group of 51 cards can be divided into 3 groups of 17 each in $\frac{51!}{(17!)^3\,3!}$.

Hence the required number of ways

$$= \frac{52!}{1!\,51!} \cdot \frac{51!}{(17!)^3\,3!} = \frac{52!}{(17!)^3\,3!}$$

NUMBER OF RECTANGLES AND SQUARES

(a) Number of rectangles of any size in a square of size n × n is $\sum_{r=1}^{n} r^3$ and number of squares of any size is $\sum_{r=1}^{n} r^2$.

(b) Number of rectangles of any size in a rectangle size n × p (n < p) is $\frac{np}{4}(n+1)(p+1)$ and number of squares of any size is $\sum_{r=1}^{n} (n+1-r)(p+1-r)$.

EXAMPLE 28. The number of squares that can be formed on a chessboard is

(a) 64 **(b) 160**

(c) 224 **(d) 204**

Sol. (d) A chessboard is made up of 9 equispaced horizontal and vertical line. To make a 1 × 1 square, we must choose two consecutive horizontal and vertical lines from among these. This can be done in $8 \times 8 = 8^2$ ways. A 2 × 2 square needs three consecutive horizontal and vertical lines, and we can do this in $7 \times 7 = 7^2$ ways. Continuing in this manner, the total number of square is

$$8^2 + 7^2 + 6^2 + ... + 2^2 + 1^2 = \frac{8(8+1)[(2\times 8)+1]}{6} = 204.$$

EXERCISE

1. In how many different ways can be letters of the word SOFTWARE be arranged in such a way that the vowels always come together?
   (a) 13440 (b) 1440
   (c) 360 (d) 120
   (e) None of these
2. In how many different ways can a group of 4 men and 4 women be formed out of 7 men and 8 women?
   (a) 2450 (b) 105
   (c) 1170 (d) Cannot be determined
   (e) None of these
3. A bag contains 2 red, 3 green and 2 blue balls. 2 balls are to be drawn randomly. What is the probability that the balls drawn contain no blue ball?
   (a) $\frac{5}{7}$ (b) $\frac{10}{21}$
   (c) $\frac{2}{7}$ (d) $\frac{11}{21}$
   (e) None of these
4. In how many different ways can the letters of the word BOOKLET be arranged such that B and T always come together?
   (a) 360 (b) 720
   (c) 480 (d) 5040
   (e) None of these
5. In a box there are 8 red, 7 blue and 6 green balls. One ball is picked up randomly. What is the probability that it is neither red nor green?
   (a) $\frac{7}{19}$ (b) $\frac{2}{3}$
   (c) $\frac{3}{4}$ (d) $\frac{9}{21}$
   (e) None of these
6. In how many different ways can the letters of the word RUMOUR be arranged?
   (a) 180 (b) 720
   (c) 30 (d) 90
   (e) None of these
7. 765 chairs are to be arranged in a column in such a way that the number of chairs in each column should be equal to the columns. How many chairs will be excluded to make this arrangement possible?
   (a) 6 (b) 36
   (c) 19 (d) 27
   (e) None of these
8. In how many different ways can the letters of the word JUDGE be arranged so that the vowels always come together?
   (a) 48 (b) 24
   (c) 120 (d) 60
   (e) None of these
9. How many words can be formed from the letters of the word SIGNATURE so that the vowels always come together?
   (a) 720 (b) 1440
   (c) 3600 (d) 2880
   (e) None of these
10. In how many ways a committee consisting of 5 men and 6 women can be formed from 8 men and 10 women?
    (a) 266 (b) 86400
    (c) 11760 (d) 5040
    (e) None of these
11. Out of 15 students studying in a class, 7 are from Maharashtra, 5 are from Karnataka and 3 are from Goa. Four students are to be selected at random. What are the chances that at least one is from Karnataka?
    (a) $\frac{12}{13}$ (b) $\frac{11}{13}$
    (c) $\frac{10}{15}$ (d) $\frac{1}{15}$
    (e) None of these
12. 4 boys and 2 girls are to be seated in a row in such a way that the two girls are always together. In how many different ways can they be seated?
    (a) 120 (b) 720
    (c) 148 (d) 240
    (e) None of these
13. In how many different ways can the letters of the word DETAIL be arranged in such a way that the vowels occupy only the odd positions?
    (a) 120 (b) 60
    (c) 48 (d) 32
    (e) None of these
14. In a box carrying one dozen of oranges, one-third have become bad. If 3 oranges are taken out from the box at random, what is the probability that at least one orange out of the three oranges picked up is good?
    (a) $\frac{1}{55}$ (b) $\frac{54}{55}$
    (c) $\frac{45}{55}$ (d) $\frac{3}{55}$
    (e) None of these
15. Letters of the word DIRECTOR are arranged in such a way that all the vowels come together. Find out the total number of ways for making such arrangement.
    (a) 4320 (b) 2720
    (c) 2160 (d) 1120
    (e) None of these

16. A box contains 5 green, 4 yellow and 3 white marbles, 3 marbles are drawn at random. What is the probability that they are not of the same colour?
(a) $\frac{13}{44}$ (b) $\frac{41}{44}$
(c) $\frac{13}{55}$ (d) $\frac{52}{55}$
(e) None of these

17. How many different letter arrangements can be made from the letters of the word RECOVER?
(a) 1210 (b) 5040
(c) 1260 (d) 1200
(e) None of these

18. How many three digit numbers can having only two consecutive digits identical is
(a) 153 (b) 162
(c) 168 (d) 163
(e) None of these

19. How many total numbers of seven-digit numbers can be formed having sum of whose digits is even is
(a) 9000000 (b) 4500000
(c) 8100000 (d) 4400000
(e) None of these

20. How many total numbers of not more than 20 digits that can be formed by using the digits 0, 1, 2, 3, and 4 is
(a) 5^{20} (b) $5^{20} - 1$
(c) $5^{20} + 1$ (d) 6^{20}
(e) None of these

21. The number of six digit numbers that can be formed from the digits 1, 2, 3, 4, 5, 6 and 7 so that digits do not repeat and the terminal digits are even is
(a) 144 (b) 72
(c) 288 (d) 720
(e) None of these

22. Three dice are rolled. The number of possible outcomes in which at least one dice shows 5 is
(a) 215 (b) 36
(c) 125 (d) 91
(e) None of these

23. The number of ways in which ten candidates $A_1, A_2, ..., A_{10}$ can be ranked so that A_1 is always above A_2 is
(a) $\frac{10!}{2}$ (b) 10 !
(c) 9 ! (d) $\frac{8!}{2}$
(e) None of these

24. How many total number of ways in which n distinct objects can be put into two different boxes is
(a) n^2 (b) 2^n
(c) 2n (d) 3^n
(e) None of these

25. In how many ways can the letters of the word 'PRAISE' be arranged. So that vowels do not come together?
(a) 720 (b) 576
(c) 440 (d) 144
(e) None of these

26. There are 6 tasks and 6 persons. Task 1 cannot be assigned either to person 1 or to person 2; task 2 must be assigned to either person 3 or person 4. Every person is to be assigned one task. In how many ways can the assignment be done?
(a) 144 (b) 180
(c) 192 (d) 360
(e) None of these

27. The number of ways in which one or more balls can be selected out of 10 white, 9 green and 7 blue balls is
(a) 892 (b) 881
(c) 891 (d) 879
(e) None of these

28. If 12 persons are seated in a row, the number of ways of selecting 3 persons from them, so that no two of them are seated next to each other is
(a) 85 (b) 100
(c) 120 (d) 240
(e) None of these

29. The number of all possible selections of one or more questions from 10 given questions, each question having one alternative is
(a) 3^{10} (b) $2^{10} - 1$
(c) $3^{10} - 1$ (d) 2^{10}
(e) None of these

30. A lady gives a dinner party to 5 guests to be selected from nine friends. The number of ways of forming the party of 5, given that two of the friends will not attend the party together is
(a) 56 (b) 126
(c) 91 (d) 94
(e) None of these

31. All possible two factors products are formed from the numbers 1, 2, 3, 4, ..., 200. The number of factors out of total obtained which are multiples of 5 is
(a) 5040 (b) 7180
(c) 8150 (d) 7280
(e) None of these

Directions (Qs. 32-33): Answer these questions on the basis of the information given below:
From a group of 6 men and 4 women a committee of 4 persons is to be formed.

32. In how many different ways can it be done so that the committee has at least one woman?
(a) 210 (b) 225
(c) 195 (d) 185
(e) None of these

33. In how many different ways can it be done so that the committee has at least 2 men?
(a) 210 (b) 225
(c) 195 (d) 185
(e) None of these

34. In how many different ways can the letters of the word ORGANISE be arranged in such a way that all the vowels always come together and all the consonants always come together?
(a) 576 (b) 1152
(c) 2880 (d) 1440
(e) None of these

ANSWER KEY

1	(e)	5	(e)	9	(e)	13	(e)	17	(c)	21	(d)	25	(b)	29	(c)	33	(d)
2	(a)	6	(a)	10	(c)	14	(b)	18	(b)	22	(d)	26	(a)	30	(c)	34	(b)
3	(b)	7	(b)	11	(b)	15	(c)	19	(b)	23	(a)	27	(d)	31	(b)		
4	(b)	8	(a)	12	(d)	16	(b)	20	(a)	24	(b)	28	(c)	32	(c)		

ANSWERS & EXPLANATIONS

1. (e)

O, A, E	S	F	T	W	R

When the vowels are always together, then treat all the vowels as a single letter and then all the letters can be arranged in 6! ways and also all three vowels can be arranged in 3! ways. Hence, required no. of arrangements = $6! \times 3! = 4320$.

2. (a) Reqd no. of ways = ${}^{7}C_4 \times {}^{8}C_4$

$$= \frac{7\times6\times5\times4}{1\times2\times3\times4} \times \frac{8\times7\times6\times5}{1\times2\times3\times4}$$

$$= 35 \times 70 = 2450$$

3. (b) Reqd probability $= \frac{{}^{5}C_2}{{}^{7}C_2} = \frac{5\times4}{7\times6} = \frac{10}{21}$

4. (b) Treat B and T as a single letter. Then the remaining letters (5 + 1 = 6) can be arranged in 6! ways. Since, O is repeated twice, we have to divide by 2 and the B and T letters can be arranged in 2! ways.

Total no. of ways $= \frac{6!\times2!}{2} = 720$

5. (e) If the drawn ball is neither red nor green, then it must be blue, which can be picked in ${}^{7}C_1 = 7$ ways. One ball can be picked from the total (8 + 7 + 6 = 21) in ${}^{21}C_1 = 21$ ways.

$\therefore$ Reqd probability $= \frac{7}{21} = \frac{1}{3}$

6. (a) Reqd. number of ways

$$\frac{6!}{2!\times2!} = \frac{6\times5\times4\times3}{1\times2} = 180$$

7. (b) $27^2 < 765 < 28^2$

$\therefore$ required no. of chairs to be excluded $= 765 - 729 = 36$

8. (a) Reqd. number = $4! \times 2! = 24 \times 2 = 48$

9. (e) The word SIGNATURE consists of nine letters comprising four vowels (A, E, I and U) and five consonants (G, N, R, T and S). When the four vowels are considered as one letter, we have six letters which can be arranged in ${}^{6}P_6$ ways ie 6! ways. Note that the four vowels can be arranged in 4! ways.

Hence required number of words
$= 6! \times 4!$
$= 720 \times 24 = 17280$

10. (c) Here, 5 men out of 8 men and 6 women out of 10 women can be chosen in
${}^{8}C_5 \times {}^{10}C_6$ ways, i.e., 11760 ways.

11. (b) Total possible ways of selecting 4 students out of 15 students $= {}^{15}C_4 = \frac{15\times14\times13\times12}{1\times2\times3\times4} = 1365$

The no. of ways of selecting 4 students in which no student belongs to Karnataka $= {}^{10}C_4$

$\therefore$ Hence no. of ways of selecting at least one student from Karnataka $= {}^{15}C_4 - {}^{10}C_4 = 1155$

$\therefore$ Probability $= \frac{1155}{1365} = \frac{77}{91} = \frac{11}{13}$

12. (d) Assume the 2 given students to be together (i.e one]. Now there are five students.
Possible ways of arranging them are = 5! = 120
Now, they (two girls) can arrange themselves in 2! ways.
Hence total ways = 120 × 2 = 240

13. (e) 3 vowels can be arranged in three odd places in 3!ways. Similarly, 3 consonants can be arranged in three even places in 3! ways. Hence, the total number of words in which vowels occupy odd positions = 3! × 3! = 6 × 6 = 36 ways.

14. (b) $n(S) = {}^{12}c_3 = \frac{12\times11\times10}{3\times2} = 2\times11\times10 = 220$

No. of selection of 3 oranges out of the total 12 oranges
$= {}^{12}c_3 = 2\times11\times10 = 220$.

No. of selection of 3 bad oranges out of the total 4 bad oranges $= {}^{4}c_3 = 4$

$\therefore$ $n(E)$ = no. of desired selection of oranges
$= 220 - 4 = 216$

$\therefore$ $P(E) = \frac{n(E)}{n(S)} = \frac{216}{220} = \frac{54}{55}$

15. (c) Taking all vowels (IEO) as a single letter (since they come together) there are six letters

Hence no. of arrangements $= \frac{6!}{2!} \times 3! = 2160$

[Three vowels can be arranged 3! ways among themselves, hence multiplied with 3!.]

16. (b) Total no. of ways of drawing 3 marbles

$= {}^{12}C_3 = \frac{12\times11\times10}{1\times2\times3} = 220$

Total no. of ways of drawing marbles, which are of same colour = ${}^5C_3 + {}^4C_3 + {}^3C_3 = 10 + 4 + 1 = 15$

$\therefore$ Probability of same colour = $\frac{15}{220} = \frac{3}{44}$

$\therefore$ Probalitity of not same colour = $1 - \frac{3}{44} = \frac{41}{42}$

17. (c) Possible arrangements are :

$\frac{7!}{2!2!} = 1260$

[division by 2 times 2! is because of the repetition of E and R]

18. (b) When 0 is the repeated digit like

100, 200, ..., 9 in number

When 0 occurs only once like

110, 220, ..., 9 in number

When 0 does not occur like

112, 211, ..., $2 \times (8 \times 9) = 144$ in number.

Hence, total = 9 + 9 + 144 = 162.

19. (b) Suppose $x_1\ x_2\ x_3\ x_4\ x_5\ x_6\ x_7$ represents a seven digit number. Then x_1 takes the value 1, 2, 3, ..., 9 and x_2, x_3, ..., x_7 all take values 0, 1, 2, 3, ..., 9.

If we keep $x_1, x_2, ..., x_6$ fixed, then the sum $x_1 + x_2 + ... + x_6$ is either even or odd. Since x_7 takes 10 values 0, 1, 2, ..., 9, five of the numbers so formed will have sum of digits even and 5 have sum odd.

Hence the required number of numbers

$= 9 \,.\, 10 \,.\, 10 \,.\, 10 \,.\, 10 \,.\, 10 \,.\, 5 = 4500000.$

20. (a) Number of single digit numbers = 5

Number of two digits numbers = 4×5

[$\because$ 0 cannot occur at first place and repetition is allowed]

Number of three digits numbers

$= 4 \times 5 \times 5 = \quad 4 \times 5^2$

....

....

Number of 20 digits numbers = 4×5^{19}

$\therefore$ Total number of numbers

$= 5 + 4.5 + 4.5^2 + 4.5^3 \ .....4.5^{19}$

$= 5 + 4.\frac{5(5^{19} - 1)}{5 - 1} = 5 + 5^{20} - 5 = 5^{20}$

21. (d) The first and the last (terminal) digits are even and there are three even digits. This arrangement can be done in ${}^3P_2$ ways. For any one of these arrangements, two even digits are used; and the remaining digits are 5 (4 odd and 1 even) and the four digits in the six digits (leaving out the terminal digits) may be arranged using these 5 digits in ${}^5P_4$ ways. The required number of numbers is ${}^3P_2 \times {}^5P_4 = 6 \times 120 = 720$.

22. (d) Required number of possible outcomes

= Total number of possible outcomes –

Number of possible outcomes in which 5 does not appear on any dice. (hence 5 possibilities in each throw)

$= 6^3 - 5^3 = 216 - 125 = 91$

23. (a) Ten candidates can be ranked in 10! ways. In half of these ways A_1 is above A_2 and in another half A_2 is above A_1. So, required number of ways is $\frac{10!}{2}$.

24. (b) Let the two boxes be B_1 and B_2. There are two choices for each of the n objects. So, the total number of ways is $\underset{n-\text{times}}{2\times2\times....\times2} = 2^n$.

25. (b) Required number of possible outcomes

= Total number of possible outcomes –

Number of possible outcomes in which all vowels are together

$= 6\,! - 4\,! \times 3\,! = 576$

26. (a) Task 1 can not be assigned to either person 1 or 2 i.e. there are 4 options.

Task 2 can be assigned to 3 or 4

So, there are only 2 options for task 2.

So required no. of ways = 2 options for task 2 × 3 options for task 1 × 4 options for task 3 × 3 options for task 4 × 2 options for task 5 × 1 option for task 6.

$= 2 \times 3 \times 4 \times 3 \times 2 \times 1 = 144$

27. (d) The required number of ways

$= (10+1)(9+1)(7+1) - 1 = 879$.

28. (c) The number of ways of selecting 3 persons from 12 people under the given conditon :

Number of ways of arranging 3 people among 9 people seated in a row, so that no two of them are consecutive

= Number of ways of choosing 3 places out of the 10 [8 in between and 2 extremes]

$= {}^{10}C_3 = \frac{10\times9\times8}{3\times2\times1} = 5\times3\times8 = 120$

29. (c) Since each question can be selected in 3 ways, by selecting it or by selecting its alternative or by rejecting it. Thus, the total number of ways of dealing with 10 given questions is 3^{10} including a way in which we reject all the questions.

Hence, the number of all possible selections is $3^{10} - 1$.

30. (c) Number of ways of selecting 5 guests from nine friends $= {}^9C_5$

Out of these, ${}^7C_3$ ways are those in which two of the friends occur together [3 more persons to be selected out of remaining 7]

$\therefore$ Number of ways, in which two of the friends will not attend the party together = ${}^9C_5 - {}^7C_3 = 91$.

31. (b) The total number of two factor products = $^{200}C_2$. The number of numbers from 1 to 200 which are not multiples of 5 is 160. Therefore the total number of two factor products which are not multiple of 5 is $^{160}C_2$. Hence, the required number of factors which are multiples of 5 = $^{200}C_2 - {}^{160}C_2 = 7180$.

32. (c) Reqd. no. of ways

$$= {}^4C_1 \times {}^6C_3 + {}^4C_2 \times {}^6C_2 + {}^4C_3 \times {}^6C_1 + {}^4C_4$$

$$= 4 \times \frac{6 \times 5 \times 4}{1 \times 2 \times 3} + \frac{4 \times 3}{1 \times 2} \times \frac{6 \times 5}{1 \times 2} + \frac{4 \times 3 \times 2}{1 \times 2 \times 3} \times 6 + 1$$

$$= 80 + 90 + 24 + 1 = 195$$

33. (d) Reqd. no. of ways

$$= {}^6C_2 \times {}^4C_2 + {}^6C_3 \times {}^4C_1 + {}^6C_4$$

$$= \frac{6 \times 5}{1 \times 2} \times \frac{4 \times 3}{1 \times 2} + \frac{6 \times 5 \times 4}{1 \times 2 \times 3} \times 4 + \frac{6 \times 5 \times 4 \times 3}{1 \times 2 \times 3 \times 4}$$

$$= 90 + 80 + 15 = 185.$$

34. (b) The word ORGANISE has 4 vowels and 4 consonants. Now, both groups (vowels and consonants) can be treated as two letters.This can be arranged in 2! ways. Now, the 4 letters of each group can be arranged.in 4! ways.

So, total possible ways of arrangement

$$= 2! \times 4! \times 4!$$

$$= 2 \times 24 \times 24 = 1152.$$

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