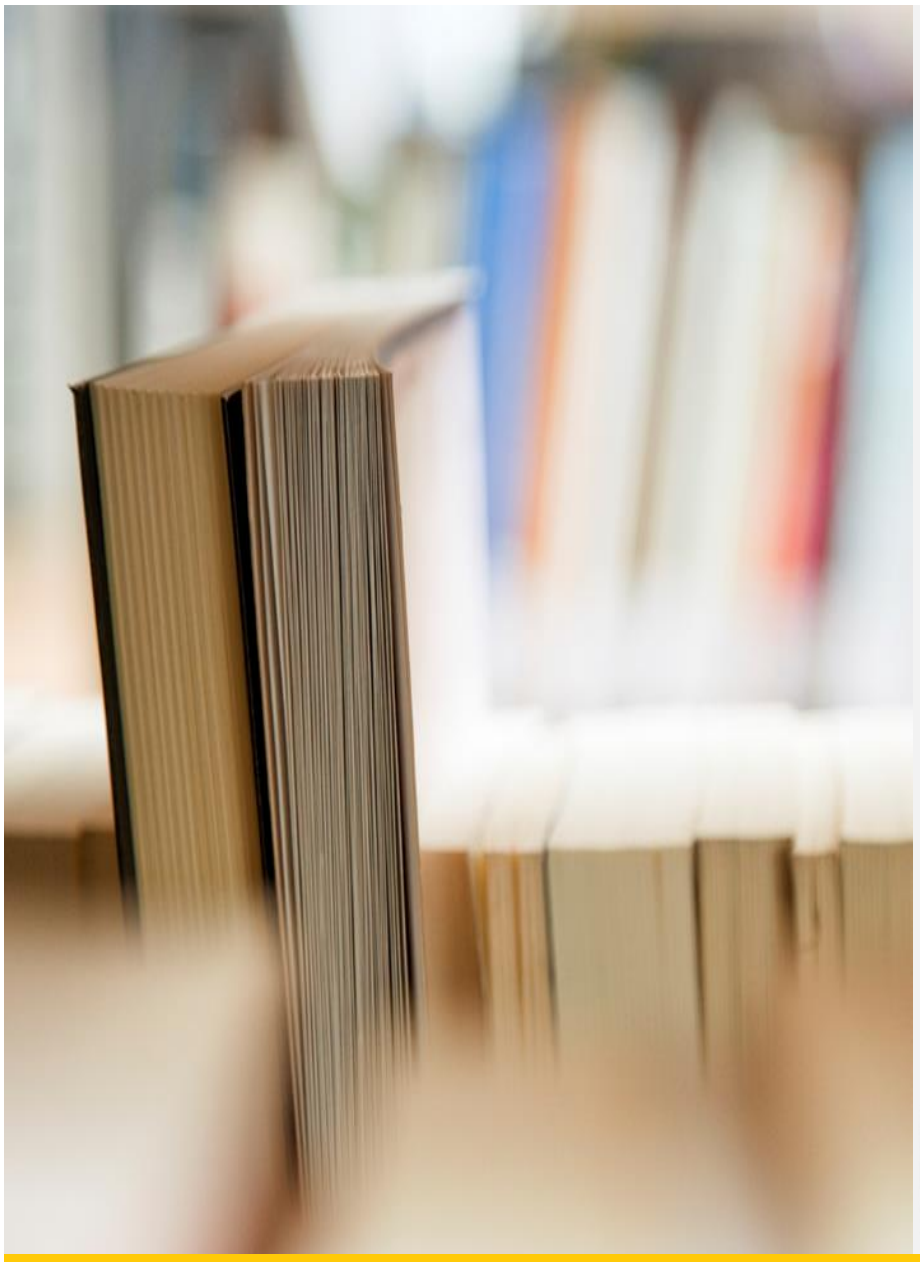

Quantitative Aptitude Module

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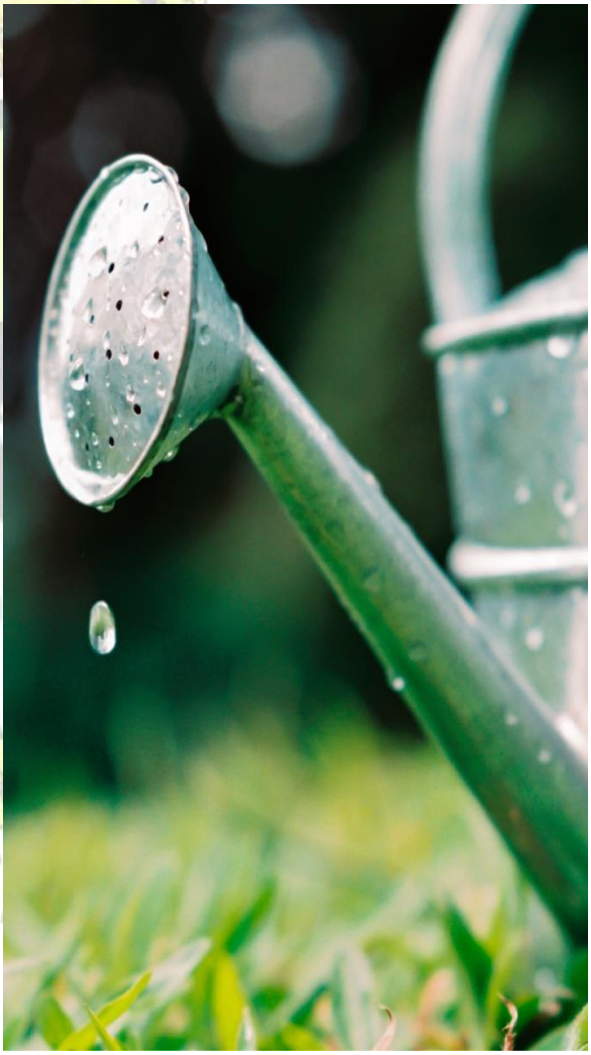
Objective

Aptitude tests are immensely popular and almost all recruiters/employers use them to choose the right candidate who fits their organization. Aptitude tests are designed to measure the intelligence and the potential of a candidate applying for a job.A high quantitative aptitude score confirms that the candidate can handle data with accuracy. This includes making sure that calculations are correct, payments are processed accurately, and all inputs are sound. This reduces the cost of future mistakes. The objective of this Module is to improve the numerical ability and problem-solving skills of the candidates by providing them with exposure to various topics and common questions, so that they can perform better in Aptitude Tests and apply the same in their job and career.



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1. Numbers System

Strategies to solve the Multiple-choice questions:

- Always Easy First
- Working Answers from Answers itself. Moving backwards from the options to the question
- Applying approximations
- Eliminate Choices
- Developing your own short-cuts
- Learn Tables, root's, reciprocals etc.
- Applying Thumb Rules

1. Types of Numbers:

Natural Numbers : **N** = { 1,2,3,4,5,6,7.....} Numbers existing in nature.

Whole Numbers : **W** = { 0,1,2,3,4,5.....} = { 0,N }

Integers :**I**= { .....-2,-1,0,1,2.....}

Rational Numbers : **Q** = { Numbers which can be expressed in the form of p/q where q = 0 }

Irrational Numbers : **Q'** = {Numbers which can't be expressed in the form of p/q}

Real Numbers : **R** = { **Q** + **Q'** }
Numbers which can represent actual physical quantities in a meaningful way like length, height, density.

Imaginary Numbers : Numbers which can be represented only on a specially designed plane called Argand plane. These numbers were created because in the real number system, there was no meaning of square root of a negative number. Thus by definition ***i*** = √-1 was created, (***i*** = iota).

Complex Numbers : Numbers which are in the form of (a + b***i***)
where a = real part & b***i*** = imaginary part

Prime No.: A natural no. which has no factor besides itself and unity. e.g. 2, 3, 5, 7, 11, 13, 17.....

Composite No.: A composite no. has other factors, besides itself and unity. e.g. 8, 72, 39 etc.

- Two numbers are called **co-prime** OR **relative prime** to each other when their HCF is 1. E.g. (i) 9 and 28, (ii) 3 and 5, (iii) 14 and 29 etc.
- If a no. has no factor equal to or less than its square root, then the no. is prime. This is a test to judge whether a no. is prime or not.
- The only even prime no. is 2
- There are 25 prime numbers between 0 & 100.
- 0 & 1 are neither prime nor composite

Q. Which of the following is a prime number?
(a) 119 (b) 115 (c) 127 (d) none

A. **(c) 127** check the divisibility by all prime numbers up to the square root of the number

Even Numbers	**Odd Numbers**	
2n	(2n + 1) or (2n – 1)	[where n is a natural number]

- 0 is neither even nor odd

Absolute value of a no.: |a| = a if a = + ve & |a| = -a if a = -ve

2. **Tests for Divisibility:**
   - By 2 if its unit digit is even or zero
   - By 3 if the sun of its digits is divisible by 3 e.g. 102, 192, 99 etc.
   - By 4 when the no. formed by last two right hand digits is divisible by 4 e.g. 576, 328
   - By 5, if units digit is 0 or 5
   - By 6, if divisible by 2 and 3 both
   - By 7, No test upto 3 digits; Group the no. into triplets from right side; add the odd group and even group separately; the difference of the odd group and even group should either be zero or divisible by 7. E.g. 85437954 three groups are 85, 437, 954 ⇒ 85 + 954 = 1039 – 437 = 602, which is divisible by 7
   - By 8, when no. formed by last three right hand digits is divisible by 8
   - By 9, when the sum of its digits is divisible by 9
   - By 10, when its unit digit is zero
   - By 11, when difference between the sums of digit in odd and even places is either zero or a multiple of 11. E.g. 17259, 62468252
   - By 12, when it is divisible by 3 and 4
   - By 25, when the no. formed by last two digit is divisible by 25
   - By 125, when no. formed by last three is divisible by 125

3. **HCF & LCM** : HCF is Highest or Greatest factor common to two or more given numbers
   Method: break the nos. in factors, choose common ones & multiply them

   LCM is Least Common Multiple, which is exactly divisible by all of them.

   LCM = Product of two No. / HCF
   HCF of Fraction = HCF of numerator / LCM of denominator
   LCM of Fraction = LCM of Numerator / HCF of denominator

   In case of Decimal multiply by 10 or 100 or 1000 to convert them into integer then find HCF or LCM & divide it again by that No. (10 or 100 or 1000)

   TIP: Remember LCM of given no. is always a no. greater than (or equal to) the given numbers. HCF of given nos. is always a no. smaller than (or equal to) the given nos. Hence when least number is asked you will find LCM and when greatest no. is asked, you will find the HCF.

4. **Simplification of a Division:** (Divisor x Quotient) + Remainder = Dividend

   - If a number n is divisible by two co-primes numbers a, b then n is divisible by ab.
   - $(a-b)$ always divides $(a^n - b^n)$ if n is a natural number.
   - $(a+b)$ always divides $(a^n - b^n)$ if n is an even number.
   - $(a+b)$ always divides $(a^n + b^n)$ if n is an odd number.
   - If a^n is divided by $(a-1)$, then remainder is always 1.
   - If a^n is divided by $(a+1)$ then reminder is 1 when n is even; and remainder is **a** when n is odd.

5. **Fractions:** Denotes parts or parts of a unit. Several types are

   Common fractions : Fractions whose Denominator is not 10 or its multiple. e.g. 2/3, 17/18 etc.
   Decimal Fraction : Denominator is 10 or its multiple
   Proper fraction : Value < 1; Numerator < Denominator
   Improper fraction : Value > 1; Numerator > Denominator

6. **Order of Simplification:** VBODMAS =

Vinculum Braces Of (multiplication) Division Multiplication Addition Subtraction

Q. Find the least number which when divided by 8, 12, 18 & 24 leaves remainders 6, 10, 16 & 22 respectively?

S. Since the difference between the nos. and the corresponding remainders is 2 in each case if we add 2 to the required no., the sum will be exactly divisible by 8, 12, 18 & 24. but LCM of 8, 12, 18 & 24 = 72 **the required number = 70**

Q. Find the least number which when divided by 35 leaves a remainder 25, when divided by 45 leaves the remainder 35 and when divided by 55 leaves 45?

S. (35 – 25) = (45 – 35) = (55-45) = 10
Now take LCM of 35, 45, 55 and subtract 10 from it => 3465 – 10 = **3455**

Q. The heights of A, B, C and D are 1.2, 2.1, 1.8 and 1.5 meters. Find the greatest possible length of the scale which will be able to measure their height

S. Just take HCF = **0.3 meters**

Q. Find the greatest number that will divide 2629 and 2483 leaving remainders 4 and 8 respectively

S. The required no. is the HCF of (2629 – 4) = 2625 & (2483 – 8) = 2475 which is **75**

Q. If a and b are positive integers and (a-b)/3.5 = 4/7, then
(a) b < a (b) b > a (c) b = a (d) b >= a

A. **(a)** b < a

7. Decimal Fractions:

Recurring: 2/3 = 0.6666; 22/7 = 3.142857142857
Pure recurring: Start recurring from decimal point i.e. all figures repeat
Mixed recurring: 9.1666666……

Method to convert pure recurring into fractions: Take recurring number one's in numerator / 9 (as many times as number of digits recurring)

e.g. 0.66666….. = 6 / 9 = 2 / 3
0.234234234……. = 234 / 999
2.035353535……. = $2\ ^{35}/_{99}$

Method for Mixed RD: In Numerator No. formed by all the digit – no. formed by digit not repeated / In denominator take as many nine as recurring digit & as many 0 as not recurring

e.g. 0.1777777777…….. = (17 – 1) / 90 = 16 / 90 = 8 / 45
0.1254545454…….. = (1254 – 12) / 9900 = 69 / 550

8. Multiplication Shortcuts:

- By 11, 101, 1001; add 1,2,3 zeros respectively then add the original number
- By 9, 99, 999: ad zeros & subtract original number
- By 5: add 0 and then divide it by 2
- By 25: add two zeros & divide by 4

9. Important Formulas:

- $(a + b)^2 = a^2 + 2ab + b^2$
- $(a - b)^2 = a^2 - 2ab + b^2$
- $(a + b)^2 - (a - b)^2 = 4ab$
- $(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$
- $a^2 - b^2 = (a+ b) (a – b)$
- $(a + b)^3 = a^3 + b^3 + 3ab (a + b)$
- $(a - b)^3 = a^3 – b^3 - 3ab (a – b)$
- $a^3 + b^3 = (a + b) (a^2 - ab + b^2)$
- $a^3 - b^3 = (a – b) (a^2 + ab + b^2)$
- $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ac$
- $a^3 + b^3 + c^3 – 3abc = (a + b + c) (a^2 + b^2 + c^2 - ab - bc – ac)$
  $\Rightarrow$ If $(a + b + c) = 0$ then $a^3 + b^3 + c^3 = 3abc$

10. Surds: Pure Surds: √6, √7
Mixed Surds: 3√3, 6√7

11. Indices:

- $a^m \times a^n = a^{m+n}$
- $a^m / a^n = a^{m-n}$
- $(a^m) n = a^{mn}$
- $a^{-m} = 1 / a^m$
- $(ab)^m = a^m \times b^m$
- $\sqrt[m]{a} = a^{1/m}$
- $a^{p/q} = \sqrt[q]{a^p}$
- $a^0 = 1$

12. Squares:

- Square of a natural number cannot end with 2,3,7,8 & odd no. of zeros.
- Square of a natural number cannot end with odd no. of zeros.
- Square of odd is odd and that of even is even.
- Every square is multiple of three or exceeds multiple of three by unity.
- Every square is multiple of four or exceeds multiple of four by unity.

Q. The value of $(23)^7$ is :
(a) 3404625432 (b) 3404825447 (c) 3404723493 (d) 3404523479

A. **(b)** 3404825447 [**Hint:** Unit digit = 7]

To find the unit digit of A^p

e.g. The unit digit of $(383)^{495} = (383)^{123 \times 4 + 3} \Rightarrow (\ldots 3)^3 = (\ldots\ldots 7)$

As we have $i = \sqrt{-1} \Rightarrow i^2 = -1$, $i^3 = -1 \times i = -i$, $i^4 = (i^2)^2 = (-1)^2 = 1$

If you have to find the value of any power of 'i' all you have to do is to remove all the powers which are multiples of 4.

e.g. (i) $i^{97} = i^{96} \times i = (i^4)^{24} \times i = 1 \times i = i = \sqrt{-1}$

Note: If a number is of the form $(a + ib)$ or $(a - \sqrt{b})$
then $(a – ib)$ or $(a + \sqrt{b})$ are respectively called their conjugates.
The use of conjugates is generally in rationalizing the complex numbers or mixed surds.

- If a number with unit digit 1 is raised to any power then unit digit of the answer is always 1.
- If a number with unit digit 5 is raised to any power then unit digit of the answer is always 5.
- If a number with unit digit 6 is raised to any power then unit digit of the answer is always 6.
- If a number with unit digit 4 is raised to **even power** then unit digit of the answer is always 4.
- If a number with unit digit 4 is raised to **odd power** then unit digit of the answer is always 6.
- If a number with unit digit 9 is raised to **even power** then unit digit of the answer is always 1.
- If a number with unit digit 9 is raised to **odd power** then unit digit of the answer is always 9.

Q. A boy was asked to multiply a certain number by 53. He multiplied it by 35 and got his answer less than the correct one by 1206. Find the number to be multiplied.
(a) 37 (b) 67 (c) 87 (d) 97 (e) 107

S. 53 – 35 = 18 ⇒ 1206 / 18 = **67** **A.** (b) 67

Q. A number when multiplied by 7/18 instead of 7/8 and got the result 770 less than the actual result, find the original number?

S. (7X / 8) + 770 = 7X / 18 ⇒ X = **1584**
Alternate method as above can be applied here also but it will be lengthy.

Methods to find square roots:
a) Factorization
b) Approximation
c) General Method: e.g. suppose we need to find the square root of 25932. Make pair from the unit digit 2, 59 & 32.

```
                161.03
              | 25932          no. of which root is required
    1         | 1                    greatest divisor of 2 (1 x 1)
  + 1         | ---------
    ____      | 159                  taking down next pair
26  | 156                      greatest (26 x 6)
    + 6       | ---------
    321       |   332
    +1        |   321
|   ---------
322 |     11
⇒
Put .   322   |      1100
Put 0   3220  |      110000
⇒

      32203   |      110000
+ 3   |       96609
                ------------
      32206   |      13391
```

13. Binary Operations: Operations other than four fundamental operations are called as binary operations, i.e. such operations don't precisely exist in mathematics but one can define these by assuming something e.g.

(1) If $A * B = A + B + A^2B^3 - A^3B^2$ find the value of 1 * 2
Sol: By definition $1 * 2 = 1 + 2 + 1^2 2^3 - 1^3 + 2^2 = 11 - 4 = 7$

14. Notes:

1. Sum of a positive number and its reciprocal is always greater than or equal to 2.
   $(a/b + b/a) >= 2$, $(a/b + b/c + c/d + d/a) >= 4$, $[X + 1/X] >= 2$

2. If product of two positive quantities is given, their sum is least when they are equal {try with XY = 100 ⇒ possible (X,Y) are (1,100), (2,50), (4,25) …min. will be (10,10)}

3. If sum of two positive quantities is given, their product is greatest when they are equal (try with X + Y = 30)

4. If $(X - a)(X - b) > 0$, X does not lie between a and B
   If $(X - a)(X - b) < 0$, X lie between a and B

5. If a > b then $a^n > b^n$ and $1/a^n < 1/b^n$ or $a^{-n} < b^{-n}$ where n is +ve

6. If a, b, c are all positive and not all equal, then
   $(a + b + c)(ab + bc + ac) > 9abc$
   $(a + b)(b + c)(c + a) > 8abc$

15. Roots of Quadratic equation: In the quadratic equation $\mathbf{ax^2 + bx + c = 0}$

$$\mathbf{x} = \frac{+\sqrt{b2 - 4ac}}{2a}$$

If $b2 - 4ac > 0$, then roots are real and distinct.
If $b2 - 4ac = 0$, then roots are real and equal.
If $b2 - 4ac < 0$, then roots are imaginary and distinct.

16. Factorization Method: e.g. $5x^2 - 17x - 12 = 0$

⇒ $5x^2 + 3x - 20x - 12 = 0$ [3 x (-20) = **-60** = 5 x (-12)]
⇒ $x(5x + 3) - 4(5x + 3) = 0$
⇒ $(5x + 3)(x - 4) = 0$

Q. Find the value of

$$2 + \cfrac{1}{2 + \cfrac{1}{2 + \cfrac{1}{2}}}$$

S. Starting from lowest stage answer is 12/29

Q. Find the value of

$$4 + \cfrac{1}{4 + \cfrac{1}{4 + \cfrac{1}{4 + \cdots}}}$$

S. The equation can be reduced to $X = 1 / (4 + X)$ where $X = \cfrac{1}{4 + \cfrac{1}{4 + \cfrac{1}{4 + \cdots}}}$

Solving the quadratic equation we get, X = 0.235

Q. Find the greatest no. and least no. of six digits which is exactly divisible by 1224

S. Greatest possible six digits no. is 999999.
On dividing it by 1224 it gives 1215 as remainder, so required no. is 999999 – 1215 = **998784**

Least possible no. is 100000.
On dividing it by 1224, it gives 856 as remainder
So add (1224 – 856) i.e. 368 to 100000 ⇒ Answer is 100368

Q. A no. X when divided by 289 leaves 18 as the remainder. The same no. when divided by 17 leaves Y as the remainder. Find Y.

S. Dividend = (Divisor x Quotient) + Remainder
⇒ X = (289 x K) + 18 = (17 x 17 x K) + 18
⇒ (17 x 17 x K) + (17 X 1) + 1 = 17 (17 X k + 1)
⇒ 17 (New Quotient) + 1 ⇒ Y = 1

Q. Find the value of:

$$\frac{1}{(216)^{-2/3}} + \frac{1}{(256)^{-3/4}} + \frac{1}{(243)^{-1/5}}$$

S. $216 = 6^3$, $256 = 4^4$, $243 = 3^5$; Solve to get 103

Q. Find the largest no. in $\sqrt[4]{4}$, $\sqrt[3]{3}$, $\sqrt[3]{3}$ and $\sqrt{2}$

S. Take LCM of the root i.e. of 4, 3, 3, 2 which is = 12

Q. Is 3001 a prime no.

S. $\sqrt{3001}$ is almost equal to 55; check divisibility up to 55. **A.** Yes

Q. The sum of two nos. is 144 and their HCF is 24. Find them?

S. Let the nos. be 24X and 24Y. Then 24X + 24Y = 24 (X + Y) = 144 or X + Y = 6
The possible pairs are (1, 5), (2, 4), (3, 3) But second and third one are rejected as they are not co-prime. So, the required numbers are 24 x 1 and 24 x 5 = 120. Answer 24 and 120

Q. Solve for X: $|3X - 6| < 9$

S. Since the absolute value of a no. denotes both +ve & -ve values, then either
(a) 3X – 6 < 9 or (b) –(3X -6) < 9 or -3X + 6 < 9 or -3X < 3

⇒ (a) 3X < 15 ⇒ X < 5
⇒ (b) -3X < 3 ⇒ X > -1
⇒ Combining, we get:: –1 < X < 5

1.1 Numbers System (Class Work)

1. Which one of the following is not a prime number?
   a. 31 b. 61 c. 71 d. 91
2. $(112 \times 5^4) = ?$
   a. 67000 b. 70000 c. 76500 d. 77200
3. It is being given that $(2^{32} + 1)$ is completely divisible by a whole number. Which of the following numbers is completely divisible by this number?
   a. $(2^{16} + 1)$ b. $(2^{16} - 1)$ c. (7×2^{23}) d. $(2^{96} + 1)$
4. What least number must be added to 1056, so that the sum is completely divisible by 23?
   a. 2 b. 3 c. 18 d. 21
5. 1397 x 1397 = ?
   a. 1951609 b. 1981709 c. 18362619 d. 2031719
6. How many numbers given in the bracket are divisible by 132? (264, 396, 462, 792, 968, 2178, 5184, 6336)
   a. 4 b. 5 c. 6 d. 7
7. (935421 x 625) = ?
   a. 575648125 b. 584638125 c. 584649125 d. 585628125
8. The largest 4 digit number exactly divisible by 88 is:
   a. 9944 b. 9768 c. 9988 d. 8888
9. Which of the following is a prime number?
   a. 33 b. 81 c. 91 d. 97
10. What is the unit digit in $\{(6374)^{1793} \times (625)^{317} \times (341^{491})\}$?
    a. 0 b. 2 c. 3 d. 5
11. 5358 x 51 = ?
    a. 273258 b. 273268 c. 273348 d. 273358
12. The sum of first five prime numbers is:
    a. 11 b. 18 c. 26 d. 28
13. The difference of two numbers is 1365. On dividing the larger number by the smaller, we get 6 as quotient and the 15 as remainder. What is the smaller number?
    a. 240 b. 270 c. 295 d. 360
14. $(12)^3 \times 6^4 \div 432 = ?$
    a. 5184 b. 5060 c. 5148 d. 5084
15. If the number 517_324 is completely divisible by 3, then the smallest whole number in the place of _ will be:
    a. 0 b. 1 c. 2 d. None of these
16. 72519 x 9999 = ?
    a. 725117481 b. 674217481 c. 685126481 d. 696217481
17. The smallest 3 digit prime number is:
    a. 101 b. 103 c. 109 d. 113
18. Which one of the following numbers is exactly divisible by 11?
    a. 235641 b. 245642 c. 315624 d. 415624
19. (?) - 19657 - 33994 = 9999
    a. 63650 b. 53760 c. 59640 d. 61560
20. The sum of first 45 natural numbers is:
    a. 1035 b. 1280 c. 2070 d. 2140

1.2 Numbers System (Home Assignment)

1. 7372 x 7372 + 7372 x 628 =?
   a. 58976000 b. 58967000 c. 5897600 d. None of these
2. 9999 + 8888 + 777 + ? = 19700
   a. 36 b. 16 c. 64 d. 26
3. 60? 6 x 111 = 666666
   a. 0 b. 2 c. 1 d. 6
4. 3149 x 1? 5 = 425115
   a. 3 b. 2 c. 4 d. 6
5. If the two digits of the age of Mayank are reversed then the new age so obtained is the age of his wife. 1/11th of the sum of their ages is equal to the difference between their ages. If Mayank is older than his wife the find the difference between their ages.
   a. 8 yrs b. 10 yrs c. 9 yrs d. 7 yrs
6. If in a long division sum, the dividend is 380606 and the successive remainders from the first to the last are 434, 125 and 413, then divisor is
   a. 451 b. 843 c. 4215 d. 3372
7. If $\frac{x}{y} = \frac{3}{4}$, then the value of $\frac{6}{7} + \frac{y-x}{y+x} = ?$
   a. 5/7 b. 8/7 c. 1 d. 2
8. The largest natural number by which the product of three consecutive even natural numbers is always divisible, is
   a. 16 b. 24 c. 48 d. 96
9. Which number should replace both the *'s in $\left(\frac{A}{21}\right) x \left(\frac{A}{189}\right) = 1$?
   a. 21 b. 63 c. 3969 d. 147
10. In a division sum, the divisor is 12 times the quotient and 5 time the remainder. If the remainder be 48, then the dividend is
   a. 240 b. 576 c. 4800 d. 4848
11. What least number must be subtracted from 1294 so that the remainder when divided by 9, 11, and 13 will leave in each case the same remainder 6?
   a. 0 b. 1 c. 2 d. 3
12. 24 is divided into two parts such that 7 times the first part added to 5 times the second part makes 146. The first part is
   a. 11 b. 13 c. 16 d. 17
13. 1/4th of a number subtracted from 1/3rd of the number gives 12. The number is
   a. 144 b. 120 c. 72 d. 63
14. 4/3rd of a certain number is 64. Half of that number is
   a. 32 b. 40 c. 80 d. 16
15. A fraction becomes 4 when 1 is added to both the numerator and denominator and it becomes 7 when 1 is subtracted from both the numerator and denominator. The denominator of the given fraction is
   a. 2 b. 3 c. 7 d. 15
16. Three numbers are in the ratio 3:4:5. The sum of the largest and the smallest equals the sum of the third and 52. The smallest number is
   a. 20 b. 27 c. 39 d. 52
17. The sum of three numbers is 68. If the ratio between first and second is 2:3 and that between second and third is 5:3, then the second number is
   a. 30 b. 20 c. 58 d. 48
18. If 1 is added to the denominator of a fraction, the fraction becomes ½. If 1 is added to the numerator, the fraction becomes 1. The fraction is
   a. 4/7 b. 5/9 c. 2/3 d. 10/11
19. 4/5th of a number exceeds its 2/3rd by 8. The number is
   a. 30 b. 60 c. 90 d. None of these
20. What is the sum of all the prime numbers from 60 to 80?
   a. 361 b. 341 c. 351 d. 349

1.3 Number System (Class Work)

1. Find the greatest number that will divide 43, 91 and 183 so as to leave the same remainder in each case.
a . 4 b. 7 c. 9 d. 13

2. The H.C.F. of two numbers is 23 and the other two factors of their L.C.M. are 13 and 14. The larger of the two numbers is:
a. 276 b. 299 c. 322 d. 345

3. Six bells commence tolling together and toll at intervals of 2, 4, 6, 8 10 and 12 seconds respectively. In 30 minutes, how many times do they toll together?
a. 4 b. 10 c.15 d. 16

4. Let N be the greatest number that will divide 1305, 4665 and 6905, leaving the same remainder in each case. Then sum of the digits in N is:
a. 4 b. 5 c. 6 d. 8

5. The greatest number of four digits which is divisible by 15, 25, 40 and 75 is:
a. 9000 b. 9400 c. 9600 d. 9800

6. The product of two numbers is 4107. If the H.C.F. of these numbers is 37, then the greater number is:
a. 101 b. 107 c. 111 d. 185

7. Three number are in the ratio of 3 : 4 : 5 and their L.C.M. is 2400. Their H.C.F. is:
a. 40 b. 80 c. 120 d. 200

8. The G.C.D. of 1.08, 0.36 and 0.9 is:
a. 0.03 b. 0.9 c. 0.18 d. 0.108

9. The product of two numbers is 2028 and their H.C.F. is 13. The number of such pairs is:
a. 1 b. 2 c. 3 d. 4

10. The least multiple of 7, which leaves a remainder of 4, when divided by 6, 9, 15 and 18 is:
a. 74 b. 94 c. 184 d. 364

11. Find the lowest common multiple of 24, 36 and 40.
a. 120 b. 240 c. 360 d. 480

12. The least number which should be added to 2497 so that the sum is exactly divisible by 5, 6, 4 and 3 is:
a. 3 b. 13 c. 23 d. 33

13. The value of (128352)/(238368) when reduced to lowest term is:
a. 3/4 b. 5/13 c. 7/13 d. 9/13

14. The least number which when divided by 5, 6 , 7 and 8 leaves a remainder 3, but when divided by 9 leaves no remainder, is:
a. 1677 b. 1683 c. 2523 d. 3363

15. A, B and C start at the same time in the same direction to run around a circular stadium. A completes a round in 252 seconds, B in 308 seconds and c in 198 seconds, all starting at the same point. After what time will they again at the starting point?
a. 26 min and 18 sec b. 42 min and 36 sec c. 45 min d. 46 min and 12 sec

16. The H.C.F. of two numbers is 11 and their L.C.M. is 7700. If one of the numbers is 275, then the other is:
a. 279 b. 283 c. 308 d. 318

17. What will be the least number which when doubled will be exactly divisible by 12, 18, 21 and 30?
a. 196 b. 630 c. 1260 d. 2520

18. The ratio of two numbers is 3 : 4 and their H.C.F. is 4. Their L.C.M. is:
a. 12 b. 16 c. 24 d. 48

19. The smallest number which when diminished by 7, is divisible 12, 16, 18, 21 and 28 is:
a. 1008 b. 1015 c. 1022 d. 1032

20. 252 can be expressed as a product of primes as:
a. 2 x 2 x 3 x 3 x 7 b. 2 x 2 x 2 x 3 x 7 c. 3 x 3 x 3 x 3 x 7 d. 2 x 3 x 3 x 3 x 7

1.4 Number System (Home Assignment)

1. What is the HCF of 27, 18 and 36?
   a. 7 b. 11 c. 9 d. None of these
2. Determine the LCM of 2/5, 3/10, 6/25.
   a. 6/5 b. 11/5 c. 9/5 d. None of these
3. What is the LCM of 25, 30, 35 and 40?
   a. 3800 b. 4200 c. 4400 d. None of these
4. What is the greatest number which divides 852, 1065 and 1491 exactly?
   a. 193 b. 183 c. 223 d. 213
5. What is the HCF of 4/9, 10/21 and 20/63?
   a. 4/189 b. 6/63 c. 2/63 d. None of these
6. Find the least number which when divided by 16, 18, 20 and 25 leaves 4 as remainder in each case but when divided by 7 leaves no remainder.
   a. 8004 b. 13004 c. 18004 d. 18014
7. Area of three fields is 165 sq. m, 195 sq. m, 85 sq. m respectively. In each of the fields a flower bed of equal length has to be made. If flower bed in each of the fields is 3 m wide then what is the maximum length of the flower bed in each of the fields?
   a. 7 m b. 9 m c. 5 m d. None of these
8. Find the greatest number which will divide 2112 and 2792 leaving the remainder 4 in each case.
   a. 78 b. 68 c. 65 d. 63
9. The HCF of two numbers is 12 and their difference is 12. The numbers are
   a. 66, 78 b. 70, 82 c. 94, 106 d. 84, 96
10. A merchant has three different kinds of milk – 435 litres, 493 litres and 551 litres. Find the least number of casks of equal size required to store all the milk without mixing.
   a. 51 b. 61 c. 47 d. 45
11. Find the greatest number which will divide 25, 73 and 97 so as to leave the same remainder in each case.
   a. 12 b. 18 c. 24 d. 32
12. The sum of two numbers is 216 and their HCF is 27. The numbers are
   a. 54, 162 b. 108, 118 c. 27, 189 d. None of these
13. How often will five bells toll together in one hour if they start together and toll at intervals of 5, 6, 8, 12, 20 seconds, respectively?
   a. 29 b. 30 c. 31 d. 120
14. Find the greatest number that will divide 964, 1238 and 1400 leaving remainders 41, 31 and 51 respectively.
   a. 71 b. 81 c. 61 d. 73
15. Find the side of the largest square slabs which can be paved on the floor of a room 5 m 44 cm long and 3 m 74 cm broad.
   a. 56 b. 42 c. 38 d. 34
16. The traffic lights at three different road crossings change after every 48 s, 72 s and 108 s, respectively. If they all change simultaneously at 8:20:00 hrs; then they will again change simultaneously at:
   a. 8:27:12 hrs b. 8:27:24 hrs c. 8:27:36 hrs d. 8:27:48 hrs
17. The product of two numbers is 6760 and their HCF is 13. How many such pairs can be formed?
   a. 2 b. 3 c. 4 d. Only one
18. Find the greatest number of four digits which when divided by 10, 15, 21 and 28 leaves 4, 9, 15 and 22 as remainders, respectively.
   a. 9654 b. 9666 c. 9664 d. 9864
19. The number of prime factors in the expression $(6)^{10} \times (7)^{17} \times (11)^{27}$ is
   a. 54 b. 64 c. 71 d. 81
20. Find the greatest number which will divide 3962, 4085 and 4167 leaving the same remainder in each case.
   a. 37 b. 36 c. 24 d. 12

2. Average, Time & Distance

Average is a central value around which a group of values shows a tendency to concentrate. The average is a single value that is in some way indicative of a group of values.

The average or arithmetic mean of a number of quantities of the same kind is equal to their sum divided by the number of those quantities.

1. Average = Sum of quantities/Number of quantities.
2. Sum of quantities = Average x Number of quantities.
3. Number of quantities = Sum of quantities / Average.
4. Weighted Average:The term 'weight' stands for the relative importance that is attached to the different values. If the values x_1, x_2, x_3,…,x_n are assigned weights w_1, w_2, w_3, …, w_n respectively, then the weighted average is = $(w_1x_1 + w_2x_2 + w_3x_3 + ...+ w_nx_n)/(x_1+x_2+x_3+...+x_n)$
5. If the number of quantities in two groups be n_1 and n_2 and their average is x and y respectively, the combined average is = $(n_1x + n_2y) / (n_1 + n_2)$.
6. If the average of n_1 quantities is x and the average of n_2 quantities out of them is y, the average of remaining group is = $(n_1x – n_2y) / (n_1 – n_2)$.
7. If each member of a group is added, subtracted, multiplied and divided by a fixed number then the average of the group is added, subtracted, multiplied and divided by the same fixed number.
8. The average of ***n*** quantities is equal to ***x***. if one of the given quantities whose value is ***p***, is replaced by a new quantity having value ***q***, the average becomes ***y***, then ***q = p + n(y – x)***.
9. The average of ***n*** quantities is equal to ***x***. When a quantity is removed, the average becomes ***y***. The value of the removed quantity = ***n(x – y) + y***.
10. The average of ***n*** quantities is equal to ***x***. When a quantity is added, the average becomes ***y***. The value of the quantity added = ***n(y – x) + y***.
11. The average of first *n* natural numbers = *(n+1)/2*.
12. The average of square of natural numbers till *n* is *(n+1)(2n+1)/6.*
13. The average of cubes of natural numbers till n is $n(n + 1)^2/4$.
14. The average of odd numbers from 1 to n is *(last odd number + 1)/2.*
15. The average of even numbers from 1 to n is *(last even number + 2)/2.*
16. Geometric Mean or Geometric Average of X_1, X_2, X_3, … X_n => n^{th} root of $X_1 \times X_2 \times X_3 \ldots \times X_n$
17. | Speed = Distance / Time | Distance = Speed x Time | Time = Distance / Speed |
    |---|---|---|
18. 1 km/h = (5/18) m/sec & 1 m/sec = (18/5) km/h
19. If a certain distance (A to B) is covered at a speed of x km/h and the same distance (B to A) is covered at a speed of y km/h, the average speed during the entire journey is = 2xy/(x + y) km/h.
20. If the total time (A to B & then B to A) taken in above case is T, the distance between A & B = Txy/(x + y) km.
21. In the formula 21, if the distance is d, and times are T_1 and T_2 then,

    Product of speeds (xy)/d = $x/T_2 = y/T_1$ = Difference of speed(x – y)/Difference of time $(T_1 – T_2)$
22. If a person or a motor car covers three equal distances at the speed of x km/h, y km/h and z km/h respectively, then for the entire journey average speed of the person or motor car is 3xyz/(xy+yz+zx) km/h.

23. If a person covers A km at a speed of x km/h, B km at a speed of y km/h and C km at a speed of z km/h, the average speed during the entire journey is (A + B + C)/{(A/x) + (B/y) + (C/z)} km/h.

24. If a person covers A^{th} part of the distance at x km/h, B^{th} part of the distance at y km/h and the remaining C^{th} part at z km/h, then the average speed during the entire journey is [1/{(A/x)+(B/y)+(C/z)}] km/h.

25. If two persons A and B start at the same time from two points P and Q towards each other and after crossing they take T_1 and T_2 hours in reaching Q and P respectively, then A's speed/B's speed = $(T_2/T_1)^{1/2}$.

26. If the new speed is a/b of the original speed, then the change in time taken to cover the same distance is given by, Change in time = {(b/a) – 1} x original time.

27. A train travels a certain distance at a speed of s_1 km/h without stoppages and with stoppages it covers the same distance at a speed of s_2 km/h. Then,

    The stoppage time per hour = $(s_1 – s_2)/s_1$ = Difference of speed/speed without stoppages.

28. If a train overtakes a pole or a man or a milestone, then the distance covered in overtaking is equal to the length of the train.

29. If a train overtakes a bridge or a tunnel or a platform or another train, then the distance covered is equal to the sum of the two lengths.

30. If two trains of lengths L_1 km and L_2 km are travelling in the same direction at s_1 km/h and s_2 km/h respectively such that $s_1 > s_2$, then $s_1 – s_2$ is their relative speed and the time taken by the faster train to cross the slower train is given by, $(L_1 + L_2)/(s_1 – s_2)$ h.

31. If two trains of lengths L_1 km and L_2 km are travelling in opposite directions at s_1 km/h and s_2 km/h respectively, then $s_1 + s_2$ is their relative speed and the time taken by the trains to cross each other is $(L_1 + L_2)/(s_1 + s_2)$ h.

32. Two trains of lengths L_1 m and L_2 m running in the same direction, the faster train passes the slower one in T_1 seconds, but while running in opposite directions with the same speeds, pass each other in T_2 seconds. Then,

    the speed of the faster train = $\{(L_1 + L_2)/2\}\ (1/T_1 + 1/T_2)$ m/s. and,

    the speed of the slower train = $\{(L_1 + L_2)/2\}\ (1/T_1 – 1/T_2)$ m/s.

33. A train starts from a place at s_1 km/h and another fast train starts from the same place after T hours at s_2 km/h in the same direction. Then, the distance from the starting place at which both the trains will meet is given by, $\mathbf{s_1 \times s_2 \times T/(s_2 – s_1)}$ km. Also the time after which they will meet is = $\mathbf{s_1 \times T/(s_2 – s_1)}$ h.

34. The distance between two stations A and B is *d* km. A train starts from A to B at s_1 km/h. *T* hours later another train starts from B to A at s_2 km/h. Then, the distance from A, at which both the trains meet is given by $\mathbf{s_1 \times (d + s_2T)/(s_1 + s_2)}$ km. Also, the time after which two trains meet = $\mathbf{(d + s_2T)/(s_1 + s_2)}$ h.

35. Two trains start simultaneously from the stations A & B towards each other with speeds s_1 km/h and s_2 km/h respectively. When they meet it is found that the second train had travelled **d** km more than the first. Then, the distance between the two stations is = $\mathbf{d \times (s_2 + s_1)/(s_2 – s_1)}$ km.

2.1 Average, Time & Distance (Class work)

1. The average of 10 numbers is 7. What will be the new average if each of the numbers is multiplied by 8?
   (a) 45 (b) 52 (c) 56 (d) 55
2. The average weight of 5 persons sitting in a boat is 38 kg. If the average weight of the boat and the persons sitting in the boat is 52 kg, the weight of the boat is
   (a) 228 kg (b) 122 kg (c) 232 kg (d) 242 kg
3. The average salary per head of all the workers in a workshop is Rs 850. If the average salary per head of 7 technicians is Rs 1000 and the average salary per head of the rest is Rs 780, the total no. of workers is
   (a) 26 (b) 24 (c) 28 (d) 22
4. The average age of 5 members is 21 years. If the age of the youngest member be 5 years, the average age of the family at the birth of the youngest member was
   (a) 24 years (b) 25 years (c) 20 years (d) 28 years
5. The average monthly salary of a staff of 9 persons is Rs 2450. One member of the staff whose monthly salary is Rs 2650 is transferred. The average salary of the remaining 8 persons of the staff is
   (a) Rs 2425 (b) Rs 2625 (c) Rs 3025 (d) Rs 2825
6. The mean marks of 10 boys in a class is 70% whereas the mean marks of 15 girls is 60%. The mean marks of all the 25 students is
   (a) 64% (b) 60% (c) 55% (d) 52%
7. The average of 17 numbers is 10.9. If the average of first nine numbers is 10.5 and that of the last nine numbers is 11.4, the middle number is
   (a) 11.8 (b) 11.4 (c) 10.9 (d) 11.7
8. The average speed of a train running at a speed of 30 km/h during the first 100 km, at 40 km/h during the second 100 km and at 50 km/h during the last 100 km is
   (a) 38.5 km/h (b) 38.3 km/h (c) 40.0 km/h (d) 39.2 km/h
9. Compare the speed of two trains, one moving at the speed of 80 km/h and the other at 10 m/s.
   (a) 30:9 (b) 40:9 (c) 20:9 (d) None of these
10. A train passes a railway bridge 150 m long in 18 seconds. If the train is running at a speed of 60 km/h, then the length of the train in metres is
    (a) 160 m (b) 150 m (c) 180 m (d) None of these
11. The wheel of an engine is $3^3/_4$ metres in circumference and makes 4 revolutions in 2 seconds. The speed of train is
    (a) 27 km/h (b) 31 km/h (c) 35 km/h (d) None of these
12. By walking 3/4th of his usual speed, a man reaches office 20 minutes later than usual. His usual time is
    (a) 65 minutes (b) 60 minutes (c) 70 minutes (d) None of these
13. Two men start together to walk a certain distance, one at 4 km/h and another at 3 km/h. The former arrives half an hour before the latter. Find the distance
    (a) 6 km (b) 9 km (c) 8 km (d) None of these
14. Krishna sets out to cycle from Delhi to Mathura and at the same time Sohan starts from Mathura to Delhi. After passing each other they complete their journey in 9 and 16 hours, respectively. At what speed does Sohan cycle if Krishna cycles at 16 km/h?
    (a) 12 km/h (b) 16 km/h (c) 14 km/h (d) None of these
15. Two trains, 130 m and 110 m long, while going in the same direction, the faster train takes one minute to pass the other completely. If they are moving in opposite directions, the speeds of the two trains are
    (a) 42 m/s, 38 m/s (b) 38 m/s, 36 m/s (c) 36 m/s, 42 m/s (d) None of these

2.2 Average, Time & Distance (Class Work)

1. A swimmer covers a distance of 28 km against the current and 40 km in the direction of the current. If in each case he takes 4 hours, then the speed of the current is

   (a) 3.5 km/h (b) 1.5 km/h (c) 2.5 km/h (d) None of these

2. A man can row at a speed of 10 km/h in still water to a certain upstream point and back to the starting point in a river which flows at 4 km/h. His average speed for total journey is

   (a) 9 and 2/5 km/h (b) 8 and 2/5 km/h (c) 11 and 2/5 km/h (d) None of these

3. A boat travels 2 km upstream in a stream flowing at 3 km/h and then returns downstream to the starting point in 30 minutes. The speed of the boat in still water is

   (a) 17 km/h (b) 9 km/h (c) 13 km/h (d) None of these

4. A man can swim 3 km/h in still water. If the velocity of the stream be 2 km/h, the time taken by him to swim to a place 10 km upstream and back, is

   (a) 8 and 1/3 h (b) 9 and 1/5 h (c) 10 h (d) 12 h

5. A man can row 30 km upstream and 44 km downstream in 10 h. Also, he can row 40 km upstream and 55 km downstream in 13 hours. The rate of the current and the speed of the man in still water is

   (a) 3 km/h, 8 km/h (b) 3.5 km/h, 7.5 km/h (c) 4 km/h, 7 km/h (d) 4.5 and 6.5 km/h

6. A man can row three-quarters of kilometer against the stream in 11 and ¼ minutes and returns in 7 and ½ minutes. The speed of the man in still water is

   (a) 2 km/h (b) 3 km/h (c) 4 km/h (d) 5 km/h

7. A boat goes 24 km upstream and 28 km downstream in 6 hours. If it goes 30 km upstream and 21 km downstream in 6 hours and 30 minutes, the speed of the stream is

   (a) 10 km/h (b) 5 km/h (c) 4 km/h (d) 6 km/h

8. At his usual rowing rate, Rahul can travel 12 miles downstream in a certain river in six hours less than it takes him to travel the same distance upstream. But if he could double his usual rowing rate for this 24 mile round trip, the downstream 12 miles would then take only one hour less than the upstream 12 miles. The speed of the current in miles per hour is

   (a) 7/3 (b) 4/3 (c) 5/3 (d) 8/3

9. Speed of a speed boat when moving in the direction perpendicular to the direction of the current is 16 km/h, speed of the current is 3 km/h. So the speed of the boat against the current will be

   (a) 22 km/h (b) 9.5 km/h (c) 10 km/h (d) None of these

10. A boat takes 90 minutes less to travel 36 miles downstream than to travel the same distance upstream. If the speed of the boat in still water is 10 mph, the speed of the stream is

    (a) 4 (b) 3 (c) 2.5 (d) 2

11. Ten years ago, Mohan was thrice as old as Ram was but 10 years hence, he will be only twice as old. Find Mohan's present age.

    (a) 60 years (b) 80 years (c) 70 years (d) 76 years

12. 15 years hence, Rohit will be just four times as old as he was 15 years ago. How old is Rohit at present?

    (a) 20 (b) 25 (c) 30 (d) 35

13. If twice the son's age in years be added to the father's age, the sum is 70 and if twice the father's age is added to the son's age, the sum is 95. Father's age is

(a) 40 years (b) 35 years (c) 42 years (d) 45 years

14. The ratio of A's and B's ages is 4 : 5. If the difference between the present age of A and the age of B 5 years hence is 3 years, then what is the total of present ages of A and B?

(a) 68 years (b) 72 years (c) 76 years (d) 64 years

15. One year ago the ratio between Samir's and Ashok's age was 4 : 3. One year hence the ratio of their ages will be 5 : 4. What is the sum of their present ages in years?

(a) 12 years (b) 15 years (c) 16 years (d) can't be made

16. Jayesh is as much younger to Anil as he is older to Prashant. If the sum of the ages of Anil and Prashant is 48 years, what is the age of Jayesh?

(a) 20 years (b) 24 years (c) 30 years (d) can't be made

17. Three times the present age of a father is equal to eight times the present age of his son. Eight years hence the father will be twice as old his son at that time. What are their present ages?

(a) 35, 15 (b) 32, 12 (c) 40, 15 (d) 27, 8

18. One year ago a father was four times as old as his son. In 6 years' time his age exceeds twice his son's age by 9 years. Ratio of their ages is

(a) 13 : 4 (b) 12 : 5 (c) 11 : 3 (d) 9 : 2

19. A's age is $1/6^{th}$ of B's age. B's age will be twice of C's age after 10 years. If C's eighth birthday was celebrated two years ago, then the present age of A must be

(a) 5 years (b) 10 years (c) 15 years (d) 20 years

20. If 10 years are subtracted from the present age of Ram and the remainder divided by 14, then you would get the present age of his grandson Shyam. If Shyam is 9 years younger to Sunder whose age is 14, then what is the present age of Ram?

(a) 80 years (b) 70 years (c) 60 years (d) none of these

21. A year ago, a father was four times his son's age. In six years, his age will be 9 more than twice his son's age. What is the present age of his son?

(a) 10 years (b) 9 years (c) 20 years (d) none of these

22. The average age of three boys is 16 years. If their ages are in the ratio 4 : 5 : 7, then the age of the youngest boy is

(a) 8 years (b) 9 years (c) 12 years (d) 16 years

23. My brother was 3 years of age when my sister was born, while my mother was 26 years of age when I was born. If my sister was 4 years of age when my brother was born, then what was the age of my father and mother respectively when my brother was born?

(a) 35 years, 33 years (b) 35 years, 29 years (c) 32 years, 23 years (d)32 yrs,29 years

24. A father is twice as old as his son. 20 years back, he was twelve times as old as the son. What are their present ages?

(a) 24, 12 (b) 44, 22 (c) 48, 24 (d) none of these

25. The average age of a class is 15.8 years. The average age of the boys in the class is 16.4 years and that of the girls is 15.4 years. What is the ratio of boys to girls in the class?

(a) 1 : 2 (b) 3 : 4 (c) 2 : 3 (d) none of these

2.3 Average, Time & Distance (Home Assignment)

1. There are 35 students in a hostel. If the number of students increased by 7, the expenses of the mess were increased by Rs 42 per day while the average expenditure per head diminished by Re 1. The original expenditure of the mess is

   (a) Rs 480 (b) Rs 440 (c) Rs 520 (d) Rs 420

2. The average weight of 24 students of section A of a class is 58 kg whereas the average weight of 26 students of section B of the same class is 60.5 kg. The average weight of all the 50 students of the class

   (a) 57.4 kg (b) 59.3 kg (c) 58.9 kg (d) 59.7 kg

3. Three years ago the average age of a family of 5 members was 27 years. On the addition of a child to the family, the present average age of the family is still 27 years. The present age of the child is

   (a) 16 years (b) 12 years (c) 24 years (d) 20 years

4. The average income of A for 15 days is Rs 70. The average for first five days is Rs 60 and that for the last nine days is Rs 80. The income for the sixth day is

   (a) Rs 80 (b) Rs 60 (c) Rs 40 (d) Rs 30

5. A batsman in his 17 innings makes a score of 85, and thereby increases his average by 3. What is his average after the 17^{th} innings? He had never been 'not out'?

   (a) 47 (b) 37 (c) 39 (d) 43

6. The average monthly expenditure of a family for the first four months is Rs 2750, for the next three months is Rs 2940 and for the last five months is Rs 3130. If the family save Rs 5330 during the whole year, the average monthly income of the family during the year.

   (a) Rs 3800 (b) Rs 3500 (c) R 3400 (d) Rs 4200

7. The average weight of 3 men A, B and C is 84 kg. Another man D joins the group and the average now becomes 80 kg. If another men E, whose weight is 3 kg more than that of D, replaces A, then average weight of B, C, D and E becomes 79 kg. The weight of A is

   (a) 70 kg (b) 72 kg (c) 75 kg (d) 80 kg

8. The average weight of 36 students is 50 kg. It was found later that the figure of 37 kg was misread as 73 kg. The correct average is

   (a) 49 kg (b) 51 kg (c) 50.5 kg (d) None of these

9. The average of marks obtained by 120 candidates was 35. If the average of marks of passed candidates was 39 and that of failed candidates was 15, the number of candidates who passed the examination is

   (a) 100 (b) 110 (c) 120 (d) 150

10. The average of two numbers is 62. If 2 is added to the smaller number, the ratio between the numbers becomes 1:2. The smaller number is

    (a) 60 (b) 30 (c) 84 (d) 40

11. The average age of students of a class is 15.8 years. The average age of boys in the class is 16.4 years and that of the girls is 15.4 years. The ratio of number of boys to the number of girls in the class is

    (a) 1:2 (b) 3:4 (c) 3:5 (d) 2:3

12. Neeta's attendance for the first two semesters out of four was 60% and 70% respectively. If there were equal number of days in each semester, what is the minimum attendance required in third semester so that her average attendance will be 80% throughout four semesters?

    (a) 70% (b) 80% (c) 90% (d) None of these

13. Average of n numbers is 36 where n is a multiple of 4. If $3/4^{th}$ of numbers are increased by 4 and the remaining decreased by 4, what is the new average?

    (a) 40 (b) 37.5 (c) 38 (d) None of these

14. There are twice the number of two wheelers as there are three wheelers and the number of 4 wheelers are equal to the number of two wheelers. The average number of wheels per vehicle is

(a) 3 (b) 4 (c) 5 (d) None of these

15. The average of any 5 consecutive odd natural numbers is k. If two more such numbers, just next to the previous 5 numbers are added, the new average becomes

(a) 2(k+1)/7 (b) 2k - 3 (c) 2k + 1 (d) k + 2

16. A train 100 metres long passes a bridge at the rate of 72 km/h in 25 seconds. The length of the bridge is

(a) 400 m (b) 17 m (c) 600 m (d) None of these

17. The distance of the sun from the earth is one hundred and forty three million four hundred thousand kilometers and light travels from the former to the latter in 7 minutes and fifty eight seconds. The velocity of light per second

(a) 3×10^5 km/s (b) 0.3×10^5 km/s (c) 3×10^5 km/s (d) None of these

18. A person covers half of his journey at 30 km/h and the remaining half at 20 km/h. The average speed for the whole journey is

(a) 25 km/h (b) 28 km/h (c) 32 km/h (d) None of these

19. A bicycle rider covers his onward journey from A to B at 10 km/h and during the return journey from B to A he covers the same distance at 8 km/h. If he finishes the onward and return journey in 4 and ½ hours, then the total distance covered by him during the entire journey is

(a) 30 km (b) 40 km (c) 50 km (d) None of these

20. A train travels 225 km in 3.5 hours and 370 km in 5 hours. The average speed of train is

(a) 80 km/h (b) 60 km/h (c) 70 km/h (d) None of these

21. A car during its journey travels 30 minutes at a speed of 40 km/h, another 45 minutes at a speed of 60 km/h, and 2 hours at a speed of 70 km/h. The average speed of the car is

(a) 63 km/h (b) 65 km/h (c) 70 km/h (d) None of these

22. A car starts from A for B travelling 20 km/h. $1^1/_2$ hours later another car starts from A and travelling at the rate of 30 km an hour reaches B $2^1/_2$ hours before the first car. The distance from A to B is

(a) 280 km (b) 260 km (c) 240 km (d) None of these

23. Monu walks from Tilak Nagar to Moti Nagar and back in a certain time at the rate of 3 and ½ km/h. But if he had walked from Tilak Nagar to Moti Nagar at the rate of 3 km/h and back from Moti Nagar to Tilak Nagar at the rate of 4 km/h, he would have taken 10 minutes longer. Distance between Tilak Nagar and Moti Nagar is

(a) 28 km (b) 32 km (c) 24 km (d) None of these

24. Without stoppage a person travels a certain distance at a n average speed of 42 km/h and with stoppages he covers the same distance at an average speed of 28 km/h. How many minutes per hour does he stop?

(a) 25 minutes (b) 30 minutes (c) 20 minutes (d) None of these

25. A train is running at a uniform speed of 60 km/h. It passes a railway platform in 15 seconds. If the length of the platform is 130 m, then the length of the train is

(a) 160 m (b) 120 m (c) 140 m (d) None of these

26. A train 160 metres long passes a standing man in 18 seconds. The speed of the train is

(a) 35 km/h (b) 45 km/h (c) 32 km/h (d) None of these

27. A train 100 metres long takes $3^3/_5$ seconds to cross a man walking at the rate of 6 km/h in a direction opposite to that of the train. The speed of the train is

(a) 76 km/h (b) 94 km/h (c) 86 km/h (d) None of these

28. Two trains are moving in the same direction at 50 km/h and 30 km/h. The faster train crosses a man in the slower train in 18 seconds. The length of the faster train is

(a) 120 m (b) 110 m (c) 100 m (d) None of these

29. A train leaves the station at 5 am at 60 km/h. Another train leaves the same station at 6.30 am at 75 km/h and travels in the direction of the first train. At what time and at what distance from the station will they meet?

(a) 12.30 pm, 450 km (b) 1.30 pm, 375 km (c) 11.30 am, 425 km (d) None of these

30. A train starts from station A at 9 am travels at 50 km/h towards station B, 210 km away. Another train starts from station B at 11 am and travels at 60 km/h towards station A. At what distance from A, will they meet?

(a) 150 km (b) 200 km (c) 250 km (d) None of these

31. Two men A and B walk from P to Q at a distance of 21 km at rates 3 and 4 km an hour, respectively. B reaches Q and returns immediately and meets A at R. The distance from P to R is

(a) 14 km (b) 20 km (c) 16 km (d) 18 km

32. Excluding stoppages, the speed of a bus is 54 km/h and including stoppages, it is 45 km/h. For how many minutes does the bust stop per hour?

(a) 9 (b) 10 (c) 12 (d) 20

33. Two boys begin together to write out a booklet containing 187 lines. The first boy starts with the first line, writing at the rate of 200 lines an hour and the second boy starts with the last line, then writes line 816 and so on, backwards proceeding at the rate of 150 lines an hour. They will meet on

(a) 467th line (b) 466th line (c) 460th line (d) 472th line

34. A train speeds past a pole in 15 seconds and speeds past a platform 100 metres long in 25 seconds. Its length in metres is

(a) 200 (b) 150 (c) 50 (d) Date inadequate

35. If a train 110 metres in length passes a man walking at the rate of 6 km/h against it in 6 seconds, it will pass another man walking at the same speed in the same direction in time of

(a) $9^1/_3$ s (b) $10^2/_3$ s (c) 8 s (d) $7^1/_3$ s

36. A student got down at a tram stop A and walked the remaining distance to school. If he had stayed in the tram until the next stop B and then walked to school he would have taken a minute longer. If he had walked the entire distance from A to school at twice his usual speed, he would have taken as much time as the tram would take for travelling from A to B. If the school is 300 m from A, and 100 m from B, the walking speed of the students in km/h is

(a) $2^1/_2$ (b) 3 (c) $3^1/_2$ (d) 4

37. In a shopping mall, Raju decided to walk down the escalator. He did some quick calculation in his mind. He found that if he walks down 30 steps, he requires 18 seconds to reach the bottom. However, if he is able to step down 34 stairs, he would only require 6 seconds to get to the bottom. If the time measured from the moment the top step begins to descend to the time he steps off the last step at the bottom, the height of the stair way in steps is

(a) 46 (b) 38 (c) 36 (d) 32

38. The distance of P from Q is 7 km. An aero plane flew from P to Q against the wind and then comes back in 22 minutes. If its speed was decreased by 12 and ½% flying against the wind and increased by 5% when flying with the wind, how long would the flight have taken, had there be no wind?

(a) 15 minutes (b) 21 minutes (c) 36 minutes (d) 60 minutes

39. Two trains A and B, 100 m long are moving on parallel tracks at speeds of 20 m/s and 30 m/s respectively. They are travelling in opposite directions. A boy in front of train A sees another boy in front of train B when he is closest to head. He throws a ball at a speed of 2 m/s which hits the tail of train B. What is the distance between the two trains?

(a) 0 m (b) 10 m (c) 4 m (d) 8 m

40. In the above question, if now the trains are travelling in the same direction and the boy repeats his action according to the previous question where will the ball hit?

(a) 10 m from the front of train B (b) 20 m from the front of train B

(c) at the front of train A (d) at the tail of train B

2.4 Average, Time & Distance (Home Assignment)

1. A man can row with the stream at 7 km/h and against the stream at 3 km/h. His speed in still water is
   (a) 6.5 km/h (b) 7 km/h (c) 5 km/h (d) None of these
2. A boat moves downstream at the rate of 1 km in 10 minutes and upstream at the rate of 4 km/h. The speed of current is
   (a) 5 km/h (b) 3 km/h (c) 1 km/h (d) None of these
3. A boatman can row 2 km against the stream in 20 minutes and return in 18 minutes. Find the rate of current.
   (a) 1/3 km/h (b) 2/3 km/h (c) 5/3 km/h (d) None of these
4. A man can row 6 km/h in still water. If the river is running at 2 km/h, it takes 3 hours more in upstream than to go downstream for the same distance. How far is the place?
   (a) 24 km (b) 28 km (c) 36 km (d) None of these
5. A boat travels upstream from B to A and downstream from A to B in 3 h. If the speed of the boat in still water is 9 km/h and the speed of the current is 3 km/h, the distance between A and B is
   (a) 8 km (b) 16 km (c) 12 km (d) None of these
6. A boat goes 40 km upstream in 8 hours and 36 km downstream in 6 hours. The speed of the boat in still water is
   (a) 5.5 km/h (b) 6.6 km/h (c) 4.5 km/h (d) None of these
7. Twice the speed downstream is equal to the thrice the speed upstream, the ratio of speed in still water to the speed of the current is
   (a) 1:5 (b) 5:1 (c) 1:3 (d) 2:3
8. A boat covers 24 km upstream and 36 km downstream in 6 h, while it covers 36 km upstream and 24 km downstream in 6 and ½ h. The velocity of the current is
   (a) 1.5 km/h (b) 1 km/h (c) 2 km/h (d) 2.5 km/h
9. P, Q, R are three towns on a river which flows uniformly. Q is equidistant from P and R. A man rows from P to Q and back in 10 h. He can row from P to R in 4 h. The ratio of speed of man in still water to the speed of the current is
   (a) 5:3 (b) 3:5 (c) 2:5 (d) 1:2
10. In a stream running at 2 km/h, a motor boat goes 10 km upstream and back again to the starting point in 55 min. The speed of motorboat in still water is
    (a) 20 km/h (b) 21 km/h (c) 22 km/h (d) 24 km/h
11. A motor boat whose speed is 15 km/h in still water goes 30 km downstream and comes back in four and a half hours. The speed of the stream is
    (a) 4 km/h (b) 6 km/h (c) 7 km/h (d) 5 km/h
12. A person can row with the stream at 8 km/h and against the stream at 6 km/h. The speed of the current is
    (a) 1 km/h (b) 2 km/h (c) 4 km/h (d) 5 km/h
13. Two boats, travelling at 5 and 10 km/h, head directly towards each other. They begin at a distance of 20 km from each other. How far apart are they just one minute before they collide?
    (a) 1/12 km (b) 1/6 km (c) ¼ km (d) 1/3 km
14. A boat, while going downstream in a river covered a distance of 50 miles at an average speed of 60 miles per hour. While returning because of the water resistance, it took one hour fifteen minutes to cover the same distance. What was the average speed during the whole journey?
    (a) 40 mph (b) 48 mph (c) 50 mph (d) 55 mph
15. The age of Ram and Shyam differ by 16 years. Six years ago, Mohan's age was thrice as that of Ram's, their present ages are
    (a) 14 and 30 years (b) 12 and 28 years (c) 16 and 34 years (d) 18 and 38 years
16. A man's age is 125 per cent of what it was 10 years ago, but $83^{1}/_{3}$ % of what it will be after 10 years. His present age is
    (a) 45 years (b) 50 years (c) 55 years (d) 60 years

17. Three years ago, the average age of a family of 5 members was 17. A baby having been born the average age of the family is the same today. The age of the child is
(a) 3 years (b) 5 years (c) 2 years (d) 1 year

18. The ages of A and B are in the ratio of 6 : 5 and sum of their ages is 44 years. The ratio of their ages after 8 years will be
(a) 4 : 5 (b) 3 : 4 (c) 3 : 7 (d) 8 : 7

19. Ratio of Ashok's age to Pradeeps's age is 4 : 3. Ashok will be 26 years old after 6 years. How old is Pradeep now?
(a) 18 years (b) 21 years (c) 15 years (d) 24 years

20. Five years ago Mr. Sohanlal was thrice as old as his son and ten years hence he will be twice as old as his son. Mr. Sohanlal's present age is
(a) 35 yrs (b) 45 yrs (c) 50 yrs (d) 55 yrs

21. The sum of ages of a father and son is 45 years. Five years ago, the product of their ages was four times the father's age at that time. The present age of the father is
(a) 39 yrs (b) 36 yrs (c) 25 yrs (d) none of these

22. The ages of A, B and C together total 185 years. B is twice as old as A and C is 17 years older than A. Then, the respective ages of A, B and C are
(a) 40, 86, 59 yrs (b) 42, 84, 59 yrs (c) 40, 80, 65 yrs (d) none of these

23. A father's age is three times the sum of the ages of his two children, but 20 years hence his age will be equal to the sum of their ages. Then the father's age is
(a) 30 yrs (b) 40 yrs (c) 35 yrs (d) 45 yrs

24. Sachin was twice as old as Ajay 10 years back. How old is Ajay today if Sachin will be 40 years old 10 years hence?
(a) 20 yrs (b) 10 yrs (c) 30 yrs (d) none of these

25. Two group of students, whose average ages are 20 years and 30 years, combine to form a third group whose average age is 23 years. What is the ratio of the number of students in the first group to the number of students in the second group?
(a) 5 : 2 (b) 2 : 5 (c) 7 : 3 (d) none of these

26. In 1932, I was as old as the number formed by the last two digits of my birth year. When I mentioned this interesting coincidence to my grandfather, he surprised me by saying that the same applied to him also. The year of birth of my grandfather is
(a) 1866 (b) 1886 (c) 1906 (d) 1916

27. "I am eight times as old as you were when I was as old as you are", said a man to his son. Find out their present ages if the sum of their ages is 75 years.
(a) 47, 28 yrs (b) 42, 33 yrs (c) 48, 27 yrs (d) 46, 26 yrs

28. Namrata's father is now four times her age. In five years, he will be three times her age. In how many years, will he be twice her age?
(a) 5 (b) 20 (c) 25 (d) 15

29. The present age of three persons are in the proportion of 4 : 7 : 9. Eight years ago, the sum of their ages was 56. Their present ages are
(a) 20, 35, 45 (b) 8, 20, 28 (c) 16, 28, 36 (d) none of these

30. Three years ago, X's age was double of Y's. Seven years hence, the sum of their united ages will be 83 years. The of X today is
(a) 47 yrs (b) 35 yrs (c) 45 yrs (d) 24 yrs

3. Ratio-proportion and Chain Rule

Ratio:

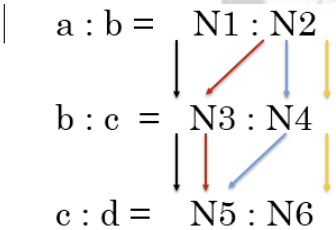
A ratio is the relation between two quantities which is expressed by a fraction.The ratio of number 'a' to the number 'b' is written as $\frac{a}{b}$ or a : b or a to b; e.g. the ratio of 5 hours to 3 hours can be written as $\frac{5}{3}$ (or) $5:3$.Ratio is always a comparison between the quantities of same kind or of same units; e.g. You cannot form the ratio between 5 hours and 3 days. Because, these two are expressed in different units.

- First convert days to hours, i.e. 3 days = 72 hours.Thus the ratio will be $\frac{5}{72}$ or 5 : 72.
- Two quantities that are being compared (a:b) are called terms.
- $\frac{a}{b} = \frac{antecedent}{consequent}$
- The ratio of two quantities is always an abstract number, without any units.
- The ratio $\frac{a}{b} = \frac{Ka}{Kb}$

Proportion:

Equality of two ratios is called proportion. Consider the two ratios, a:b and c:d, then proportion is written as, a:b :: c:d (or) a:b = c:d (or) $\frac{a}{b} = \frac{c}{d}$.

- a, b, c and d are called terms.
- a and d are called Extremes (end terms)
- b and c are called Means (middle terms)
- In a proportion, product of means (middle terms) is equal to product of extremes (end terms).
- ad = bc or $\frac{a}{b} = \frac{c}{d}$
- Duplicate ratio of a:b = $a^2 : b^2$
- Sub-duplicate ratio of a:b = $\sqrt{a}:\sqrt{b}$
- Triplicate ratio of a:b = $a^3 : b^3$
- Sub-triplicate ratio of a:b = $\sqrt[3]{a}:\sqrt[3]{b}$
- Inverse of reciprocal ratio of a:b = $\frac{1}{a}:\frac{1}{b}$
- Third proportional to a and b is $\frac{b^2}{a}$
- If a:b = x:y and b:c = p:q, then
- a:c = $\frac{xp}{yq}$ $and\ a:b:c = px:py:qy$
- Compound ratio of (a:b), (c:d), (e:f) is $\frac{a}{b} \times \frac{c}{d} \times \frac{e}{f}$



a:b:c:d = N1.N3.N5 : N2.N3.N5 : N2.N4.N5 : N2.N4.N6

Variations:

- **Direct Variation**
  - $\frac{x_1}{x_2} = \frac{y_1}{y_2}$

- **Indirect Variation**
  - $\frac{x_1}{x_2} = \frac{y_2}{y_1}$
- **Mixed Variation**
  - $\frac{x_1}{x_2} = \frac{y_1}{y_2} \times \frac{z_2}{z_1}$
- **Two groups:**
- M_1 persons can do W_1 work in D_1 time and M_2 person can do W_2 work in D_2 time, the relationship between the groups can be given by $\mathbf{M_1D_1W_2 = M_2D_2W_1}$
- M_1 persons can do W_1 work in D_1 time working t_1 hours a day and M_2 person can do W_2 work in D_2 time working t_2 hours a day. The relationship between the groups can be given by
  - $\mathbf{M_1D_1t_1W_2 = M_2D_2t_2W_1}$

3.1 Ratio-proportion and Chain Rule (Class Work)

Q1. Gold and brass are in the ratio 12:7. If the mixture weight is 38.19 gm, then what is the weight of brass?
a. 13.23 b. 14.07 c. 15.08 d. 18.08 e. 12.6

Q2. Length and breadth of a rectangle are in the ratio of 9:7. The circumference of the rectangle is 480 metres. Then the length of the rectangle is:
a. 180 b. 136 c. 135 d. 140 e. 132

Q3. A man earned Rs. 13.6 million. He distributed the money to his wife, son and daughter in the ratio of (5/2):(7/2):2. Then, the share of his son is:
a. 5.95 million b. 6.85 million c. 7.65 million d. 4.95 million e. 6.95 million

Q4. When distributed the amount Rs 125000 to A, B and C in the ratio 9:10:6, what is the amount that B gets more than C?
a. Rs20000 b. Rs18000 c.Rs25000 d. Rs22000 e. Rs24000

Q5. If x:y = 4:5, then the ratio of 2x +3y and 3x - 2y is:
a.24:5 b. 23:4 c. 23:2 d. 25:6 e. 23:5

Q6. The ratio of the marks of Ravi and Krishna is 7:8 and that of Krishna and Harish is 5:6. The marks obtained by Ravi is 350. Find the marks of Harish.
a.460 b. 480 c. 450 d. 520 e. 360

Q7. The ratio of two numbers is5:6. If 10 is added to both the numbers, the ratio of the numbers is 7:8, then the numbers are:
a. 30, 36 b. 20, 24 c. 15, 18 d. 30, 25 e.25, 30

Q8. In an office, they reduced the employees in the ratio of 25:18. They increased their wages in the ratio of 9:14. Then find the ratio of wages bill of previous salaries and present salaries of the employees.
a. 25:8 b. 25:28 c. 14:18 d. 9:12 e. 25:18

Q9. Monthly income of Raju and Rohit are in the ratio of 11:9. Their expenses are in the ratio of 7:5. They save Rs 5000 each. Find the monthly income of Rohit.
a. Rs11650 b. Rs1550 c. Rs12750 d. Rs11250 e. Rs9250

Q10. The investments of A, B and C in business are Rs 20000, Rs 30000, Rs 36000 respectively. They worked for the time period of 12, 8 and 9 months respectively. Their ratio of shares of business in the profit is:
a.15:16:18 b. 24:20:27 c. 20:24:27 d. 20:20:27 e. 20:21:25

Q11. An old woman distributes Rs 18 crore property to her three sones. First son gets 4/3 times the second son. Second son gets 3/2 times the third son. Find the share of the first son?
a. Rs 9 crore b. Rs 8.5 crore c. Rs 8 crore d. Rs 9.5 crore e. Rs 10 crore

Q12. Two bikes are bought for same price. After few years one bike is sold at 8% loss and the other bike is sold at 6% gain. Then find the ratio of their selling price?
a. 43:53 b. 44:51 c. 47:54 d. 45:52 e. 46:53

Q13. 10% of x = 25% of y. Then the ratio of x:y is
a. 2:5 b. 5:2 c. 3:4 d. 4:3 e. 5:7

Q14. In a mixture the ratio of milk and water is6:7. If 3/2 litre water is mixed, the ratio becomes 3:5. Then the quantities of milk and water in the mixture are:
a. 4 l and 4.5 l b. 5 l and 6 l c. 3 l and 3.5 l d. 6 l and 7 l e. 12 l and 14 l

Q15. If the salaries of Gopi, Vishnu and Anand are in the ratio of 7:5:8. After 6 months they got an increment of 20%, 25% and 18% respectively. Then find the ratio of new salaries of Gopi, Vishnu and Anand?

a. 840:625:944 b. 820:725:926 c. 835:720:938 d. 840:675:927 e. 725:638:943

Q16. The price of lady's watch and gent's watch are in the ratio of 15:16. If the lady's watch is Rs. 64 less than gent's watch, find the cost of gent's watch?

a. Rs 986 b. Rs 1012 c. Rs 998 d. Rs 1024 e. Rs 1036

Q17. In a mixture of 45 litres, the ratio of milk and water is 3:2. If we want to convert the ratio to 2:3, how much water should be added?

a. 13.5 litres b. 14 litres c. 15.5 litres d. 12 litres e. 22.5 litres

Q18. The average height of three girls is 15 cm. The ratio of their heights is 30:31:32. Their heights are respectively

a. 140 cm, 160 cm, 165 cm b. 145 cm, 160 cm, 165 cm
c. 150 cm, 160 cm, 165 cm d. 155 cm, 160 cm, 162 cm e. 150 cm, 155 cm, 160 cm

Q19. Mukesh had a piggy bank. In this piggy bank, one-rupee coins, two-rupee coins and five-rupees coins are in the ratio 15:23:16. The total value of the coins was Rs1128. Find the number of 5-rupee coins.

a. 128 b. 125 c. 129 d. 132 e. 135

Q20. The ratio of three numbers is 4:5:6. Sum of their cubes is 3240. Find the numbers?

a. 4, 5, 6 b. 8, 10, 12 c. 16, 20,24 d. 20, 25, 30 e. 12, 15, 18

Q21. Salaries of Niraj and Vijay are in the ratio of 4:7. If Niraj's salary is increased by Rs4000 and Vijay's salary increased by Rs 5000, the ratio of their salaries becomes 2:3. Find the previous salaries of Niraj and Vijay.

a. 16000, 28000 b. 2000, 3500 c. 8000, 14000 d. 4000, 7000 e. 6000, 10500

Q22. The ratio P:Q = 6:7, Q:R = 5:6. If Rs2140 is to be distributed among P, Q and R, then what is the share of R?

a. 825 b. 820 c. 840 d. 830 e. 780

Q23. If the ratio of seats of ME, EC and CS in an engineering college are in the ratio of 11:12:13.The seats increased by 10% in ME, 15% in EC and 20% in CS. The seats of EC became 276. Then find the seats of all the three branches available after increasing.

a. 830 b. 829 c. 828 d. 832 e. 834

Q24. Find which of the following ratio is the greatest?

a. 5:9 b. 13:17 c. 21:25 d. 3:7 e. 1:5

Q25. A, B and C started the business investing Rs21000, Rs 15000 and Rs 18000 respectively. B took the money from the business after 9 months and C took the money after 10 months. After one year, the business produced a profit of Rs 20400. Then find the profit of each.

a. 6800, 7200, 8400 b. 6400, 6000, 8000
c. 7200, 7500, 8400 d. 7600, 8400, 9000 e. 7000, 7500, 8000

Q26. If A:B= 3:7 and the sumof A and B is 45. find the value of B.

a. 28 b. 33.5 c. 31.5 d. 36

Q27. A fraction bears a sameratio to 3/7 as 1/27 does to 1/35. The fraction is:

a. 4/9 b. 1/3 c. 3/5 d. 5/9

Q28. Mean proportion between 8 and 72 is:

a. 24 b. 40 c. 16 d. 32

Q29. Fourth proportional to 3, 15 and 27 is

a. 39 b. 135 c. 81 d. 45

Q30. The ratio of daughter's age and mother's age is 2:9. If the actual age difference between them is 35 years, find the mother's age.

a. 30 yrs b. 40 yrs c. 45 yrs d. 50 yrs

Q31. What must be added to each term of 4:9 so that it becomes 2:3?

a. 1 b. 6 c. 11 d. 16

Q32. Two numbers bear a ratio of 2:7. If each of them is increased by 14, then their ratio becomes 4:7. Find the numbers.

a. 8, 28 b. 10, 35 c. 5, 18 d. 6, 21

Q33. What must be subtracted from each term of the ratio 68:49 so that it becomes 3:4?

a. -125 b. 0 c. 5 d. 125

Q34. Two numbers are in the ratio 5:3. If 9 is subtracted from both of them, their ratio becomes 23:12. The first number is:

a. 52 b. 53 c. 55 d. 54

Q35. If A's money to B's money is 4:5 and B's money to C's money is 2:3 and A has Rs 800, then total money among A, B and C is:

a. 2790 b. 3300 c. 3000 d. 3620

Q36. Rs 6800 has to be divided among A, B and C such that A gets 2/3 of what B gets, and B gets 1/4 of what C gets. Find B's share.

a. 1200 b. 800 c. 1000 d. 1600

Q37. The sum of Rs 530 is divided among A, B and C such that A gets Rs 70 more than B and B gets Rs 80 more than C. What is the ratio of A and C?

a. 25:18 b. 18:10 c. 9:5 d. 5:2

Q38. In a ratio equal to 4:9, the antecedent is 36, the consequent is:

a. 81 b. 16 c. 72 d. 76

Q39. A bag contains Rs 600 in the form of 1 rupee, 50 paise and 25 paise coins in the ratio 3:4:12. The number of 25 paise coins is:

a. 600 b. 800 c. 1200 d. 900

Q40. In a mixture of 180 litres, the ratio of milk and water is 2:1. If the ratio of milk and water is to be 1:2, the amount of water to be added is:

a. 80 litres b. 90 litres c. 120 litres d. 180 litres

3.2 Ratio-proportion and Chain Rule (Home Assignment)

Q1. If the cost of 46 apples is Rs 391. Then find the cost of 7 dozen of apples?
a. Rs 714 b. Rs 821 c. Rs 687 d. Rs 736 e. Rs 724

Q2. If 8 men working 9 hours per day can complete a work in 32 days. Then 12 men working 8 hours per day, require how many days to complete the work?
a. 18 b. 22 c. 36 d. 24 e. 28

Q3. 25 workers construct 25 houses in 25 days. Find one worker construct one house in how many days?
a. 12.5 b. 25 c. 5 d. 1 e. 50

Q4. 6 men or 9 women can do a piece of work in 30 days. Then find in how many days 10 men and 12 women can do the work?
a. 9 b. 16 c. 12 d. 15 e. 10

Q5. 12 clerks can clear 600 files in 20 days. Then how many clerks are required to complete 400 files in 10 days?
a. 14 b. 12 c. 16 d. 15 e. 18

Q6. The cost of 12 cartons of each weighs 4.5 kg of chocolates is Rs 10800. Then find the cost of 20 chocolate cartons weighing 5 kg each?
a. Rs 19600 b. Rs 18400 c. Rs 16800 d. Rs 20000 e. Rs 18000

Q7. 4 men can reap 40 hectares in 12 days, then how many hectares, 24 men reap in 20 days?
a. 400 b. 360 c. 320 d. 380 e. 420

Q8. 8 rail engines consume 12 tons of coal when each engine is running 6 hours a day. 12 rail engines running at 9 hours a day will consume how many tons of coal?
a. 27 b. 20 c. 25 d. 30 e. 50

Q9. 25 workers working 6 hours a day can finish the work in 20 days. If the workers went to work for 5 hours a day, how many more are required to complete the work in same 20 days?
a. 6 b. 5 c. 7 d. 9 e. 10

Q10. 16 plumbers working 6 hours a day will finish 1600 pipes work in 18 days. 12 plumbers working 5 hours will complete 1800 pipes work in how many days?
a. 162/5 days b. 158/5 days c. 166/5 days d. 171/5 days e. 172/5 days

Q11. Srinu can do a piece of work in 16 days. Kamalu is 20% more efficient than Srinu. Then in how many days Kamalu can finish the same piece of work?
a. 40/3 b. 38/3 c. 29/2 d. 41/3 e. 43/3

Q12. 'A' can complete a work in 15 days working 9 hours a day. 'B' can complete the same work in 12 days working 10 hours a day. If both of them work together for 8 hours a day, then approximately in how many days they can complete the work?
a. 6 days b. 9 days c. 8 days d. 5 days e. 10 days

Q13. 8 men and 10 women can do a piece of work in 12 days. Approximately in how many days 16 men and 14 women can finish the work if 3 men work done is equal to 4 women?
a. 7 b. 8 c. 6 d. 5 e. 9

Q14. Vinu starts a work and one extra man joins him every day. In this way they completed the work in 10 days. Then find in how many days, if 10 men are working together can finish the work?
a. 6 days b. 6.5 days c. 5.2 days d. 5.8 days e. 5.5 days

Q15. 300 men working 8 hours a day can complete 1/3 of the work in 15 days. Find in how many days 400 men working 9 hours a day can complete the remaining work?
a. 20 b. 25 c. 24 d. 18 e. 27

Q16. 5 men working 6 hours a day can complete a work in 15 days. But 2 men did not come into the work. How

many extra hours required to the remaining people to finish the work in same days?

a. 7/2 hours b. 4 hours c. 5 hours d. 11/2 hours e. 9/2 hours

Q17. The work efficiency of L and M are in the ratio 6:7. If L can finish a work in 42 days. Find in how many days both L and M can finish the work?

a. 23 & 5/13 days b. 26 & 7/13 days c. 22 & 8/13 days d. 21 & 7/13 dayse. 22 & 2/13 days

Q18. If a clock strikes 10 O'clock in 27 seconds. Then find the time to strike 6 O'clock?

a. 18 sec b. 15 sec c. 16 sec d. 12 sec e. 21 sec

Q19. If a car crosses 18 poles in 34 minutes, find the time to cross 25 poles, when the distance between any two poles is same?

a. 54 min b. 36 min c. 42 min d. 48 min e. 46 min

Q20. P can complete 1/5 of the work in 3 days. Q can complete 1/4 of the work in 4 days. If the same work is given to both P and Q, find in how many days they can finish?

a. 7 & 13/31 days b. 7 & 15/31 days c. 6 & 2/7 days d. 8 & 1/3 days e. 7 & 23/31 days

Q21. Running at same constant rate, 4 identical machines can produce a total of 140 bottles per minute. At this rate, how many bottles can 9 such machines produce in 4 minutes?

a. 1260 b. 960 c. 3600 d. 3260

Q22. It takes 15 days for 12 pumps of equal capacity to fill a tank. Instead of 15 days if the same job is to be done in 9 days how many extra pumps are needed?

a. 20 b. 22 c. 8 d. 4

Q23. If 8 men working together can finish a work in 11 days, then number of days taken by 11 men for the same work is ___.

a. 8 b. 11 c. 14 d. Can't be determined

Q24. If 2 kg of onion costs Rs 80, how many paise will 750 gm costs?

a. Rs 30 b. Rs 35 c. Rs 42 d. Rs 38

Q25. A building 12.5 metres high cast shadow of 28.75 metres. Under similar conditions, what will be the height of a flagstaff if it casts a shadow of length 40.25 metres?

a. 17.5 m b. 20.4 m c. 22 m d. 25.6 m

Q26. If 3/4 of work is completed in 6 days, then how many more days are required for completion of work?

a. 2 b. 3 c. 4 d. 6

Q27. In a camp, there is a meal for 60 women or 100 children. If 75 children have taken the meal, how many women will be catered with the remaining meal?

a. 10 b. 15 c. 20 d. None

Q28. If 6 metres of rod weighs 22.8 kg, then what will be the weight of 11.25 metres of rod?

a. 42.25 b. 42.5 c. 42.75 d. Cannot be determined

Q29. If certain number of men can complete 50% of work in 13 days. Can adding 50% of more men be able to complete the remaining work in 7 days?

a. Yes b. No c. Cannot be determined d. None of these

Q30. In a poultry farm, 5 hens eat 4 packets of grains in 20 days. In how many days will one hen eat 1 packet of grains?

a. 22 b. 25 c. 44 d. 50

4. Percentage

Percent is the abbreviation of the Latin phrase *per centum.* It means per hundred or for every hundred. The symbols used for it is %. It is sometimes abbreviated as p.c.

Earning 35% profit means out of every 100 rupees invested the profit earned is 35 rupees.

A fraction whose denominator is 100 is called a *percentage* and the numerator of the fraction is called *rate per cent.* For example, 9/100 and 9 per cent mean the same thing, that is, 9 parts out of every hundred parts.

1. To convert a fraction *p/q* to rate per cent, multiply it by 100 and put % symbol. For example, 2/5 in per cent is equivalent to => 2/5 x 100 = 40%.
2. To convert a per cent into a fraction, remove the per cent sign and divide the numerator by 100. For example, 15% = 15/100 = 3/20.
3. X% of a given number (N) = X/100 x N. For example, 30% of 5000 = 30/100 x 5000 = 1500.
4. If A is X% more than that of B, then B is less than that of A by **100X /(100+X)%**.
5. If A is X% less than that of B, then B is more than that of A by **100X /(100-X)%**.
6. If two numbers are respectively x% and y% more than a third number, then the first number = **(100+x) / (100+y) X 100%** of the second and the second number = **(100+y) / (100 + x) X 100%** of the first.
7. If two numbers are respectively x% and y% less than a third number, then the first number = **(100-x) / (100-y) X 100%** of the second and the second number = **(100-y) / (100-x) X 100%** of the first.
8. Per cent increase = (actual increase / Original Value) x 100.
9. Per cent decrease = (actual decrease / Original Value) x 100.
10. If the price of a commodity increases by R%, the reduction in consumption so as not the increase the expenditure = 100R **/ (100+R) %**.
11. If the price of a commodity decreases by S%, the increase in consumption so as not the decrease the expenditure = **100S / (100-S) %**.
12. If a number is increased or decreased successively by x% and y%, then net % change = **x+y+(xy/100) %**. If there is an increase then x and y are positive and if there is a decrease then x and y are negative.
13. If two parameters A and B are multiplied to get a product and if A is changed by x% and B is changed by y%, then the net change in the product (A x B) =>**x+y+(xy/100) %.** If there is an increase then x and y are positive and if there is a decrease then x and y are negative.
14. If the present population of a place or value of an item be P and the population or value changes at r% per annum, thenPopulation or Value after n years = **P. [1 + (r/100)]^n**. *(*r is positive or negative as per the change in the value)*
15. In the above condition, Population or Value n years ago = **P / [1 + (r/100)]^n**.
16. If a number N is increased successively by x% followed by y% and then by z%, then the final value = **N (1+x/100) (1+y/100) (1+z/100)**. (**Use negative sign with x, y or z, if there is a decrease.*)
17. If in an examination, the minimum pass percentage is x%. If a student secures y marks and fails by z marks, then the maximum marks in the examination = **100 (y+z)/x**.
18. If in an examination x% and y% students respectively fail in two different subjects while z% students fail in both the subjects, then the percentage of students who pass in both the subjects = **[100- (x+y-z)]%**.

4.1 Percentage (Class Work)

1. What percentage is equivalent to $5^1/_4$?
   (a) 525% (b) 425 (c) 625% (d) None of these
2. $37^1/_2$ % of Rs 48 is
   (a) Rs 20 (b) Rs 16 (c) Rs 18 (d) None of these
3. What per cent of 2/7 is 1/35?
   (a) 15% (b) 18% (c) 10% (d) None of these
4. If 200% of a number is 90, then what is the 80% of that number?
   (a) 48 (b) 36 (c) 24 (d) None of these
5. A number x is 125% of y. To compute y, the number x has to be multiplied by
   (a) 0.08 (b) 0.4 (c) 0.8 (d) None of these
6. 20% of 30% of 20% of Rs 850 is
   (a) Rs 9.5 (b) Rs 10.2 (c) Rs 10.5 (d) None of these
7. If A's income is 25% less than that of B, then how much per cent is B's income more than that of A?
   (a) $33^1/_3$% (b) $66^2/_3$% (c) $11^2/_3$% (d) None of these
8. Two numbers are less than a third number by 30% and 37% respectively. How much per cent is the second number less than the first?
   (a) 15% (b) 10% (c) 20% (d) None of these
9. Two numbers are respectively 20% and 10% more than a third number. How much per cent is the first number more than the second?
   (a) $9^1/_{11}$% (b) $7^1/_{11}$% (c) $11^1/_{11}$% (d) None of these
10. The price of cooking oil has increased by 15%. The percentage of reduction that a family should effect in the use of cooking oil so as not to increase the expenditure on this account is
    (a) $15^2/_{23}$% (b) $13^1/_{23}$% (c) $17^1/_{23}$% (d) None of these
11. If the price of apples goes down by 10%, the percentage of increase that a family should effect in its consumption so as not to increase expenditure on this account is
    (a) $13^1/_9$% (b) $15^1/_9$% (c) $11^1/_9$% (d) None of these
12. A number is increased by 20% and then decreased by 20%, the final value of the number.
    (a) doesn't change (b) decreases by 2% (c) increases by 4% (d) decrease by 4%
13. The population of a town is decreased by 20% and 25% in two successive years. What per cent population is decreased after two years?
    (a) 50% (b) 40% (c) 60% (d) None of these
14. The difference between a discount of 35% and two successive discounts of 20% and 20% on a certain bill was Rs 22. The amount of bill is
    (a) Rs 3200 (b) Rs 2200 (c) Rs 1800 (d) None of these
15. Two shopkeepers sell a radio of similar brand and type at the same list price of Rs 1000. The first allows two successive discounts of 20% and 10% and the second allows the successive discounts of 15% and 15%. The difference in discounts offered by the two shopkeepers is
    (a) Rs 3.5 (b) Rs 1.5 (c) Rs 2.5 (d) None of these
16. The radius of a sphere is increased by 10%. The surface area increases by
    (a) 21% (b) 31% (c) 41% (d) None of these
17. In measuring the sides of a rectangle, one side is taken 10% in excess and the other 20% in deficit. The error per cent in area calculated from the measurement
    (a) 12% deficit (b) 10% deficit (c) 12% excess (d) None of these
18. The value of a machine is Rs 6250. It decreases by 10% during the first year, 20% during the second year and 30% during the third year. The value of machine after 3 years is
    (a) Rs 2650 (b) Rs 3050 (c) Rs 3150 (d) None of these
19. A student has to secure 15% marks to get through. If he gets 80 marks and fails by 70 marks, the maximum marks set for the examination
    (a) 900 (b) 1000 (c) 1200 (d) None of these
20. In an examination, 30% and 35% students respectively failed in History and Geography while 27% students failed in both the subjects. If the number of students passing the examination is 248, the total number of students who appeared in the examination is

    (a) 425 (b) 380 (c) 400 (d) None of these

4.2 Percentage (Home Assignment)

1. $6^2/_3$% expressed as a fraction in its lowest form is
   (a) 2/15 (b) 1/15 (c) 3/20 (d) None of these
2. 7/8 as percentage is equal to
   (a) $67^1/_2$% (b) $87^1/_2$% (c) $97^1/_4$% (d) None of these
3. $8^1/_3$% as a fraction is equal to
   (a) 1/12 (b) 1/16 (c) 1/18 (d) None of these
4. If $37^1/_2$% of a number is 45, then $87^1/_2$% of the number will be
   (a) 115 (b) 135 (c) 105 (d) None of these
5. If 8% of x = 4% of y, then 20% of x is
   (a) 15% of y (b) 10% of y (c) 20% of y (d) None of these
6. 40% of 20% + 30% of 25% + 50% of 28% is equal to
   (a) 29.5% (b) 28.5% (c) 30.5% (d) None of these
7. If a number is 20% more than the other, the second number is less than the first by
   (a) $12^1/_3$% (b) $16^2/_3$% (c) $16^1/_3$% (d) None of these
8. If the given two numbers are respectively 7% and 28% of a third number, then what percentage is the first of the second?
   (a) 20% (b) 25% (c) 18% (d) None of these
9. Two numbers are respectively 60% and 20% more than a third number. Second number expressed as a percentage of first is
   (a) 75% (b) 90% (c) 80% (d) None of these
10. A clerk's salary was decreased by 50%. Again, the reduced salary was increased by 50%. He has a loss of
    (a) 35% (b) 25% (c) 20% (d) None of these
11. A shopkeeper marks the prices of his goods at 25% higher than the original price. After that, he allows a discount of 12%. He gets
    (a) 10% profit (b) 15% profit (c) 10% loss (d) 15% loss
12. The tax on a commodity is diminished by 10% and its consumption increases by 10%. The effect on revenue is
    (a) 1% (b) 2% (c) 3% (d) None of these
13. When the price of an article is reduced by 15%, the sales increases by 35%. The percentage change in the total amount of receipts is
    (a) $14^3/_4$% decrease (b) $14^3/_4$% increase (c) $13^3/_4$% decrease (d) None of these
14. The length and breadth of a square are increased by 30% and 20% respectively. The area of the rectangle so formed exceeds the area of the square by
    (a) 56% (b) 46% (c) 66% (d) None of these
15. For a rectangle, the length and breadth are increased by 10% and 20% respectively. The percentage increase in area is
    (a) 24% (b) 48% (c) 32% (d) None of these
16. Water tax is increased by 20% but its consumption is decreased by 20%. The increase or decrease in the expenditure is
    (a) 4% decrease (b) 4% increase (c) 8% decrease (d) 8% increase
17. The population of a city increases at the rate of 10% annually. Its present population I 90.51 lacs. The population 3 years ago was nearly
    (a) 72 lacs (b) 68 lacs (c) 80 lacs (d) None of these
18. The income of a company increase 20% per annum. If its income is Rs 26,64,000 in the year 2009, what was its income in the year 2007?
    (a) Rs 17,50,000 (b) Rs 16,50,000 (c) Rs 18,50,000 (d) None of these
19. Ram loses 20% of his pocket money. After spending 25% of the remainder he has Rs 480 left. His pocket money was
    (a) Rs 600 (b) Rs 800 (c) Rs 900 (d) None of these
20. An army lost 10% of its men in war, 10% of the remaining due to diseases and 10% of the rest were disabled. Thus, the strength was reduced 7,29,000 active men. The original strength was
    (a) 10,00,000 (b) 12,00,000 (c) 15,00,000 (d) None of these

21. From the salary of an officer, 10% is deducted as house rent, 15% of the rest he spends on children's education and 10% of the balance, he spends on clothes. After this expenditure he is left with Rs 1377. His salary is
    (a) Rs 2000 (b) Rs 2040 (c) Rs 2100 (d) Rs 2200
22. If the price of gold increases by 30%, find by how much the quantity of ornaments must be reduced so that the expenditure may remain the same as before?
    (a) $27^{2}/_{13}\%$ (b) $23^{1}/_{13}\%$ (c) 30% (d) 19%
23. In an examination, there are 1000 boys and 800 girls, 60% boys and 40% girls passed. The percentage of candidates that failed is
    (a) 48.88 (b) 45.88 (c) 50.00 (d) 49.88
24. The price of an article is cut by 20%. To restore it to its original price, the new price must be increased by
    (a) 20% (b) $22^{1}/_{2}\%$ (c) 25% (d) 40%
25. In a fraction, numerator is increased by 25% and the denominator is diminished by 10%. The new fraction obtained is 5/9. The original fraction was
    (a) 2/5 (b) 5/9 (c) 3/5 (d) None of these
26. One side of a square is increased by 30%. To maintain the same area the other side will have to be decreased by
    (a) $23^{1}/_{13}\%$ (b) $76^{12}/_{13}\%$ (c) 30% (d) 15%
27. A person has some amount with him. 25% of it is taken in a bus, 10% is lost through a hole in the pocket, 50% of remainder is spent on food. He then purchases a book worth Rs 26 from the remainder. He walks back home because all his money is over. The initial amount he had
    (a) Rs 160 (b) Rs 1230 (c) Rs 90 (d) Rs 80
28. Three papers were set in an examination and the maximum marks per paper were in the ratio of 1:2:2 respectively. If a student obtained 50% in the first paper, 60% in the second, and 65% in the third, his overall percentage was
    (a) 58.3% (b) 66.66% (c) 33.33% (d) 60%
29. A businessman's earning increases by 25% in one year but decreases by 4% in the next. After 5 years his total earnings would be Rs 72,000. His present earning is
    (a) Rs 10,000 (b) Rs 80,000 (c) Rs 40,000 (d) Rs 54,000
30. A family's ratio of savings to expenditure for last month was 2:13. This month, due to unforeseen expenditure, savings fell to 50% of the amount saved last month. Salary, last month was Rs 10,000. This month there was an increase of 15% in the salary. How much did the family spend this month?
    (a) Rs 667 (b) Rs 11,167 (c) Rs 10,833 (d) Rs 9,833
31. A trader sells soaps in economy packs of four soaps per pack, each pack being charged at the listed price of three soaps. For every set of five such packs bought by a customer, the trader gives him one extra soap as a free gift. If a customer buys 12 economy packs, the effective percentage of discount that he gets
    (a) 28% (b) $28^{4}/_{7}\%$ (c) 4% (d) $35^{5}/_{7}\%$
32. If the charges per hour of internet surfing are increased by 25%, then find the percentage decrease in the time period of surfing of a user who can afford only a 10% increase in expenditure
    (a) 22% (b) 12% (c) 15% (d) 9.09%
33. In my office there are 30% female employees and of these earn greater than Rs 8000 per month and 80% of male employees earn less than Rs 8000 per month. What is the percentage of employees who earn more than Rs 8000 per month?
    (a) 30% (b) 23% (c) 60% (d) can't be made
34. In an examination a candidate got 30% marks and failed by 30 marks. If the passing marks are 60% of the total marks, then the maximum marks will be
    (a) 450 (b) 600 (c) 300 (d) 100
35. In a city, 35% of the population is composed of migrants, 20% of whom are from rural areas. Of the local population, 48% is female while this figure for rural and urban migrants is 30% and 40% respectively. If the total population of the city is 7,28,400, what is its female population?
    (a) 5,09,940 (b) 3,49,680 (c) 3,24,138 (d) None of these
36. A clothing supplier stores 800 clothes in a warehouse, of which 15 per cent are full-length coats. If 500 of the shorter length coats are removed from the warehouse, what per cent of the remaining coats is full-length?
    (a) 35% (b) 9.37% (c) 5.62% (d) 40%

37. A company received two shipments of ball bearings. In the first shipment, 1 per cent of the ball bearings were defective. In the second shipment, which was twice as large as the first, 4.5 per cent of the ball bearings were defective. If the company received a total of 100 defective ball bearings. The no. of ball bearings in first shipment
    (a) 2000 (b) 1000 (c) 990 (d) 3000
38. In a company there are 75% skilled workers and remaining are unskilled. 80% of skilled workers and 20% of unskilled workers are permanent. If the number of temporary workers is 126, then the total no. of workers is
    (a) 480 (b) 510 (c) 360 (d) 377
39. A man spends 60% of his monthly salary on consumable items and 50% of the remaining on clothes and transport. He saves the remaining amount. If his savings at the end of the year were Rs 48,456, the amount he spent on clothes and transport?
    (a) Rs 8076 (b) Rs 4038 (c) Rs 9691.20 (d) Rs 4845.60
40. A scooter costs Rs 25,000 when it is brand new. At the end of each year, its value is only 80% of what it was at the beginning of the year. What is the value of the scooter at the end of the 3 years?
    (a) Rs 12,500 (b) Rs 10,000 (c) Rs 12,800 (d) Rs 12,000
41. 40% of the students in a college play basketball, 34%of the students play tennis and the number of students who play both the games 234. The number of students who play neither basketball nor tennis is 52%. The no. of students in the collage.
    (a) 800 (b) 1050 (c) 900 (d) 850
42. There are five boxes in a cargo hold. The weight of the first box is 200 kg and the weight of the second box is 20% higher than the weight of the third box, whose weight is 25% higher than the first box. The fourth box at 350 kg is 30% higher than the fifth box. The difference in average weight of the four heaviest boxes and the four lightest boxes is
    (a) 51.5 kg (b) 75 kg (c) 37.5 kg (d) 112.5 kg
43. In a class 40% of the boys is same as ½ of the girls and there are 20 girls. Total no. of students in the class is
    (a) 70 (b) 45 (c) 35 (d) 25
44. Peter got 30% of the maximum marks in an examination and failed by 10 marks. However, Paul who took the same examination got 40% of the total marks and got 15 more than the passing marks in the examination. The passing marks in the examination were
    (a) 35 (b) 250 (c) 75 (d) 85
45. Village A has a population of 6,800, which is decreasing at the rate of 120 per year. Village B has a population of 4200, which is increasing at the rate of 80 per year. The population of both the villages will be same in
    (a) 9 years (b) 11 years (c) 13 years (d) 16 years
46. Of the 1000 inhabitants of a town, 60% are males of whom 20% are literate. If, of all the inhabitants, 25% are literate, then what per cent of the females of the town is literate?
    (a) 22.5% (b) 27.5% (c) 32.5% (d) 37.5%
47. Two-third of one-seventh of a number is 87.5% of 240. The number is
    (a) 2670 (b) 2450 (c) 2205 (d) 1470
48. The digit at unit's place of a two-digit number is increased by 100% and the ten's digit of the same number is increased by 50%. The new number thus formed is 19 more than the original number. The original number is
    (a) 22 (b) 63 (c) 24 (d) None of these
49. A person who has a certain amount with him goes to market. He can buy 50 oranges or 40 mangoes. He retains 10% o the amount for taxi fares and buys 20 mangoes and of the balance, he purchases oranges. Number of oranges he can purchase is
    (a) 36 (b) 40 (c) 15 (d) 20
50. $2/5^{th}$ of voters promise to vote for A and the rest promised to vote for B. Of these, on the last day 15% of the voters went back on their promise to vote for A and 25% of voters went back on their promise to vote for B, and A lost by 2 votes. Then the total number of voters is
    100 (b) 110 (c) 90 (d) 95

5. Mixtures and Alligations

Alligation:

- It's the rule which enables us to find the ratio in which two or more ingredients at the given price must be mixed to produce a mixture of a specified price.
- Mean Price: It's the Cost Price of a unit quantity of mixture.

Rule of Alligation:

- $\frac{Quantity\ of\ Cheaper}{Quantity\ of\ Dearer} = \frac{CP\ of\ Dearer - Mean\ Price}{Mean\ Price - CP\ of\ Cheaper}$
- CP of cheaper (P_c) CP of Dearer (P_d)

Removal and Replacement – 1:

- Suppose a container has Q units of mixture of ingredients A and B. From this P units of Mixture is taken out and replaced by an equal amount of ingredient-B. If this process is repeated 'n' times, then after 'n' operations
- $\frac{Quantity\ of\ A\ left}{Quantity\ of\ A\ originally\ present} = (1 - \frac{P}{Q})^n$
- Quantity of B left = Q – (Quantity of A left)

Removal and Replacement – 2:

- Suppose a container has Q units of liquid A only. From which P units of liquid-A are taken out and replaced by an equal amount of ingredient-B. If this process is repeated 'n' times, then after 'n' operations
- Quantity of A left = $Q(1 - \frac{P}{Q})^n$
- Quantity of B left = Q – (Quantity of A left)

5.1 Mixtures & Alligations (Class Work)

Q1. A person covers 800 km partly at a speed of 50 km/h and partly at a speed of 150 km/h, in 10 hours over all. What is the distance covered at the speed of 150 km/h?

a. 450 km b. 400 km c. 350 km d. 300 km

Q2. The cost of oil is Rs. 100 per kg. After adulteration with another oil, which costs Rs 50 per kg, Raju sells the mixture at Rs. 96 per kg making a profit of 20%. In what ratio does he mix the two kinds of oil?

a. 4:5 b. 3:5 c. 3:2 d. 6:7

Q3. Two solutions of milk and water are combined in the ratio 2:3 by volume. The resultant solution is a 40% milk solution. Find the milk concentration in the first solution if the concentration of milk in the second is 60%?

a. 20% b. 30% c. 15% d. 10%

Q4. A shopkeeper sold 45 kg of goods. If he sells some quantity at a loss of 3% and rest at 17% profit, making 5% profit on the whole, find the quantity sold at profit.

a. 14 kg b. 15 kg c. 18 kg d. 21 kg

Q5. A man purchased a horse and a cow for Rs. 5000. He sells the horse at 20% profit and the cow at 10% loss. If he gains 2% on the whole transaction, the cost of the horse is:

a. Rs. 1500 b. Rs. 1600 c. Rs. 1800 d. Rs. 2000

Q6. In a classroom of 142 children, boys have 1-rupee coins and girls have 25-paise coins and together possess a sum of Rs 58. Then find the number of girls in the class room.

a. 30 b. 84 c. 112 d. 118

Q7. In a mixture of milk and water in the ratio of 9:5, how much mixture should be withdrawn and water should be substituted in its place, so that in the resulting mixture, there may be half milk and half water?

a. $1/3^{rd}$ b. $2/9^{th}$ c. $5/9^{th}$ d. $1/9^{th}$

Q8. One vessel contains a mixture of 3 parts milk and 1 part of water, whereas the other vessel contains a mixture of 7 parts milk and 5 parts water. Compare the strength of the milk.

a. 7:9 b. 11:7 c. 9:7 d. 7:11

Q9. A merchant has 50 kgs of sugar, part of which he sells at 15% profit and the rest at 20% profit. He gains 17% on the whole. Find how much sugar is sold at 15% profit?

a. 30 kg b. 40 kg c. 70 kg d. 50 kg

Q10. In what ratio must a grocer mix two varieties of pulses costing Rs 25 and Rs 30 per kg respectively so as to get a mixture worth Rs 28.5 per kg.

a. 4:5 b. 3:7 c. 2:5 d. 6:7

Q11. The cost of Type-I wheat is Rs 20 per kg and Type-II wheat is Rs 30 per kg. If both Type-I and Type-II are mixed in the ratio of 2:3, then price per kg of mixed variety of rice is.

a. Rs 24 b. Rs 26 c. Rs 26.5 d. Rs 28.25

Q12. A mixture of a certain quantity of milk with 10 litres of water is worth Rs 5.5 a litres. If pure milk be worth Rs 10.5 a litres, how much milk is there in the mixture?

a. 10 litres b. 11 litres c. 12 litres d. 13 litres

Q13. 100 litres of mixture of milk and water contains 35% of water. How much water must be added to make 40% of water in new mixture?

a. 6 litres b. 8.33 litres c. 7.66 litres d. 9.33 litres

Q14. Solution A of 90% and solution B of 97% are mixed resulting in 21 litres of 94%. What is the quantity of first solution in resulting mixture?

a. 8 litres b. 9 litres c. 10 litres d. None of these

Q15. Two types of rice pricing Rs 23 and Rs 29 are mixed. The average price was Rs 25. Another x% and y% of respective rice is mixed but the price was same i.e. Rs 25 what will be the possible scenario?

a. x = y b. x < y c. x > y d. Can't be said

Directions (Q16-18): Answer the following questions using the below data:

Type-I Rice = Rs 15 Type-II Rice = Rs 20 Type-III Rice = Rs 25

Q16. In what ratio Type-II and Type-III Rice should be mixed so as to get the average price of Rs 24?

a. 4:1 b. 2:3 c. 1:4 d. 3:2

Q17. If Type-I and Type-III Rice are mixed and sold at Rs 18. So, for 100 kg of Type-III Rice, how much kg of Type-I Rice should be mixed?

a. 200 kg b. 233 kg c. 266 kg d. 300 kg

Q18. What will be the per kg price of 20 kg of Type-I and 60 kg of Type-II Rice mixture.

a. Rs. 18 b. Rs. 18.25 c. Rs. 18.50 d. Rs. 18.75

Q19. A jar contains 10 litres of alcohol with 90% concentration. If 1 litre of this solution is replaced with water 3 times, then find the final concentration of alcohol.

a. 45.61 b. 55.71 c. 65.61 d. 75.61

Q20. A cask contains spirit with 60% concentration. Find the amount of this mixture has to be replaced with water so that the concentration reduces to 48% if volume of the cask is 60 litres.

a. 12 litres b. 15 litres c. 18 litres d. 30 litres

5.2 Mixtures & Alligations (Home Assignment)

Q1. Two kinds of rice are mixed in the ratio 2:3 and sold at Rs 44 per kg, resulting in a profit of 10%. If the cost price per kg of smaller quantity be Rs 25, then what is the cost per kg of the larger quantity?

a. Rs 42 b. Rs 44 c. Rs 45 d. Rs 50

Q2. A milkman mixed 1:4 solution of milk and water with another 1:2 solution of milk and water in the volume in the ratio of 3:2. The profit earned by selling the first solutions was 20%. If the mixture was sold at the same price as that of first solution, what is the profit or loss percentage assuming water comes free of cost?

a. 5.26% profit b. 5.26% loss c. 6.25% loss d. None of these

Q3. If certain quantity of water, which equals to 10% of the volume of the solution, is added to a solution of milk and water, and then 10% of the solution is removed, the ratio of milk to water becomes 2:5. Find the ratio of milk and water in the original solution.

a. 11:14 b. 14:11 c. 3:8 d. 2:7

Q4. In a cask, whose capacity is 100 litres, water and alcohol are filled to the brim in the ratio of 1:4. This mixture is poured into a bigger cask. How much water should be added to make their ratio 1:1?

a. 48 litres b. 60 litres c. 65 litres d. 72 litres

Q5. To 15 litres of water containing 20% wine, we add 5 litres of pure eater. What is the percentage of wine?

a. 15% b. 16% c. 17.4% d. 17.94%

Q6. 6 litres of 20% strength and 4 litres of 60% strength solution are mixed. What is the strength of the resultant solutions?

a. 28% b. 32% c. 36% d. 42%

Q7. A man buys 12 litres of a solution, which contains 20% milk and the rest is water. He then mixes it with 10 litre of another mixture with 30% milk. What is the percentage of water in the new solution?

a. 27.5% b. 72.5% c. 24.6% d. 75.6%

Q8. There are two jars. In the first jar there is 25% milk and in another 50% milk. In what ratio should they be mixed to get a solution with 42.5% milk?

a. 1:2 b. 2:3 c. 3:7 d. 4:5

Q9. In a mixture of 3 litres, R is 2 parts and S is 1 part. In order to make S to 25% of the mixture, how much R should be added?

a. 1 litre b. 1.2 litres c. 1.4 litres d. 1.5 litres

Q10. A 64-pound mixture of sand and gravel is having 25% sand. How much pounds of sand must be added to produce a mixture that contains 40% gravel?

a. 50 pounds b. 56 pounds c. 45 pounds d. 48 pounds

Q11. A tea merchant buys two kinds of tea, the price of the first being twice that of the second. He sells the mixture at Rs 14 per kg, thereby making a profit of 20%. If the ratio of the first and second kind of tea in the mixture be 2:3, find the cost price of second kid of tea.

a. Rs 15 b. Rs 16 c. Rs 16.66 d. Rs 17.25

Q12. A cup of milk contains 3 parts of pure milk and 1 part of water. How much of the mixture must be withdrawn and water substituted in order that the resulting mixture may be half milk and half water?

a. ¼ b. 1/5 c. ½ d. 1/3

Q13. A mixture contains wine and water in the ratio 3:2. Another contains wine and water in the ratio 4:5. How many gallons of the later must be mixed with 3 gallons of the former so that the resulting mixture may contain equal quantities of wine and water?

a. 5 b. 5.4 c. 5.8 d. 6

Q14. One alloy of metal contains 90% copper and 10% tin. Another alloy contains 93% copper 4% tin. If they are mixed so that the mixture may contain 9% of tin, find the ratio in which these two alloys are to be mixed.

a. 6:1 b. 5:2 c. 5:1 d. 2:1

Q15. One alloy contains silver and copper in the ratio of 5:1 and the other contains them in the ratio of 7:2 respectively. What weights of the two must be melted together so as to make a 5 pound mass with 80% silver?

a. 2:3 b. 2:5 c. 1:3 d. 1:4

Q16. 9 litres are drawn from a cask full of wine and it is then filled with water. 9 litres of the mixture are drawn and the cask is again filled with water. The quantity of the wine now left in the cast is to that of the water in it as 16:9. How much does the cask hold?

a. 40 b. 45 c. 50 d. 55

Q17. A vessel contains mixture of spirit and water. Spirit is 18%. 8 litres of mixture is taken out of the vessel which is again filled with water. If the present percentage of spirit is 15%, find the quantity in litres of the mixture in the vessel.

a. 33 b. 42 c. 45 d. 48

Q18. Gold is 19 times as heavy as water and copper 9 times. In what ratio should these metals be mixed that the mixture may be 15 times as heavy as water?

a. 1:3 b. 1:4 c. 3:2 d. 2:3

Q19. A man buys milk at 85 rupees per litre and mixes water in it. He sells the mixture at the same rate and thus gains 11.11%. Find the quantity of water per litre of the mixture?

a. 1/10 b. 1/12 c. 1/6 d. 1/9

Q20. Two liquids are mixed in the ratio 5:3 and by selling the mixture at Rs 12.25 per litre, a profit of 16.66% is made. If the first liquid costs Rs 4 per litre more than the second, find the price per lire of first liquid.

a. 8 b. 6 c. 10 d. 12

6. Time & Work and Pipes & Cisterns

1. If A can do a piece of work in *n* days, then at a uniform rate of working A will finish *1/n*th part of work in one day.
2. If *1/n*th part of work is done by A in one day, then A will take *n* days to complete the full work.
3. If A does two times faster work than B, then ratio of work done by A and B is 2 : 1 and ratio of time taken by A and B is 1 : 2.
4. A, B and C do a piece of work in T_1, T_2 and T_3 days, respectively. If they have worked for D_1, D_2 and D_3 days respectively,
   - then Amount of work done by A = D_1/T_1,
   - Work done by B = D_2/T_2 and
   - Work done by C = D_3/T_3.
   - Also, the work done by A, B and C together = $\left(\frac{D_1}{T_1}+\frac{D_2}{T_2}+\frac{D_3}{T_3}\right)$.
5. If A can do a piece of work in X days and B can do the same piece of work in Y days, then both of them working together will do the same work in $\frac{XY}{X+Y}$days.
6. If A, B and C, while working alone, can complete a piece of work in X, Y and Z days respectively, then they will together complete the work in $\frac{XYZ}{XY+YZ+ZX}$ days.
7. Two persons, A and B, working together, can complete a piece of work in X days. If A, working alone, can complete the work in Y days, then B working alone, will complete the work in$\frac{XY}{Y-X}$ days.
8. If A and B, working together, can finish a piece of work in X days, B and C in Y days, C and A in Z days,
   - then A, B and C working together, will finish the job in $\frac{2XYZ}{XY+YZ+ZX}$ days.
   - A alone can finish the job in$\frac{2XYZ}{Y(X+Z)-ZX}$days
   - B alone in $\frac{2XYZ}{Z(X+Y)-XY}$ days and,
   - C alone in $\frac{2XYZ}{X(Y+Z)-YZ}$ days.
9. If A can finish the work in X days and B is *k* times faster than A, then the time taken by both A and B working together to complete the work is $\frac{X}{(1+k)}$ days.
10. If A and B working together can finish a work in X days and B is *m* times faster than A,
    - then the time taken by A, working alone, to complete the work is X(*m* + 1) days, and
    - the time taken by B, working alone is $\frac{X(m+1)}{m}$days.
11. If A working alone takes *a* days more than A and B working together; and B working alone takes *b* days more than A and B working together,
    - then the number of days taken by A and B, working together, to finish the job is $\sqrt{ab}$.
12. If A can complete *a/b* part of work in X days, then *c/d* part of the work will be done in $\frac{bcX}{ad}$ days.
13. If one group of M_1 people can do W_1 work in D_1 time and other group of M_2 people can do W_2 work in D_2 time and if efficiency of both the groups is same,
    - then $M_1 D_1 W_2 = M_2 D_2 W_1$.
    - if working hours per day of both the groups be T_1 and T_2 respectively, and efficiencies of both the groups is same then, $M_1 D_1 T_1 W_2 = M_2 D_2 T_2 W_1$.
14. If *a* men or *b* women can do a piece of work in *n* days, then *c* men and *d* women can do the work in$\frac{nab}{(bc+ad)}$days.
15. If an inlet can completely fill the empty tank in X hours, the part of the tank filled in 1 hr = 1/X part.
16. If an outlet can empty the full tank in Y hours, the part of the tank emptied in 1 hr = 1/Y part.

17. If both inlet and outlet are open, net part of the tank filled in 1 hr = $\frac{1}{X} - \frac{1}{Y}$.

18. Two pipes A and B can fill (or empty) a cistern in X and Y hours respectively, while working alone. If both the pipes are opened together, then the time taken to fill (or empty) the cistern is given by $\frac{XY}{(X+Y)}$ hours.

19. Three pipes A, B and C can fill a cistern in X, Y and Z hours respectively, while working alone. If all the three pipes are opened together, the time taken to fill the cistern is $\frac{XYZ}{XY+YZ+ZX}$ hours.

20. Two pipes A and B can fill a cistern in X hours and Y hours, respectively. There is also an outlet C. If all the three pipes are opened together, the tank is full in Z hours. The time taken by C to empty the full tank is $\frac{XYZ}{Z(X+Y)-XY}$ hours.

21. A tank takes X hours to be filled by a pipe. But due to a leak, it is filled in Y hours. The time taken by leak to empty the full tank = $\frac{XY}{Y-X}$ hours.

22. A cistern has a leak which can empty it in X hours. A pipe which admits *y*litres/hour into the cistern is turned on and now the cistern is emptied in Z hours. The capacity of the cistern is $\frac{XyZ}{Z-X}$ litres.

23. One fill pipe A is *k* times faster than the other fill pipe B. If B can fill the cistern in X hours,

    - then the time in which the cistern will be full, if both the fill pipes are opened together, is $\frac{X}{k+1}$ hours.
    - if A can fill the cistern in Y hours, then the time in which the cistern will be full, if both the fill pipes are opened together, is $\frac{Yk}{k+1}$ hours.

24. If one fill pipe A is *k* times faster and take *m* hours less time than the other fill pipe B,

    - then the time taken to fill a cistern, if both the pipes are opened together is $\frac{km}{(k-1)^2}$ hours.
    - A will fill the cistern in $m/(k-1)$ hours.
    - B will fill the cistern in $km/(k-1)$ hours.

6.1 Time & Work and Pipes & Cisterns (Class Work)

1. 10 men can complete a piece of work in 15 days and 15 women can complete the same work in 12 days, if all the 10 men and 15 women work together, in how many days will the work get completed?
   (a) $6^2/_3$ days (b) $8^1/_3$ days (c) $7^2/_3$ days (d) None of these
2. Ramesh takes twice as much time as Mahesh and thrice as much time as Suresh to complete a job. If working together, they can complete the job in 4 days, then the time taken by each of them separately to complete the work is
   (a) 36, 24 and 16 days (b) 20, 16 and 12 days (c) 24, 12 and 8 days (d) None of these
3. A and B can do a piece of work in 18 days, B and C in 24 days, C and A in 36 days. A alone can do the work in
   (a) 48 days (b) 56 days (c) 40 days (d) None of these
4. Nikita, Nitisha and Kavita can complete a work in $2\frac{2}{3}2^2/_3$ days. If Nitisha and Kavita can do it in 4 days and Nitisha alone can do it in 6 days, then Nikita and Nitisha can complete the work in
   (a) $5^4/_7$ days (b) $4^2/_7$ days (c) $3^3/_7$ days (d) None of these
5. Working 7 hours daily 24 men complete a piece of work in 27 days. In how many days would 14 men complete the same piece of work working 9 hours daily?
   (a) 36 days (b) 30 days (c) 32 days (d) None of these
6. A can do a piece of work in 10 days, while B alone can do it in 15 days. They together for 5 days and the rest of the work is done by C in 2 days. If they get Rs 450 for the whole work, hoe should they divided the money?
   (a) Rs 250, Rs 100, Rs 100 (b) Rs 225, Rs 150, Rs 75 (c) Rs 200 Rs 150, Rs 100 (d)Rs 175, 175, 100
7. A and B working together can complete a piece of work in 12 days and B and C working together can complete the same work in 16 days. A worked at it for 5 days and B worked at in for 7 day. C finished the remaining work in 13 days. How many days would C alone take to complete it?
   (a) 10 days (b) 24 days (c) 32 days (d) 12 days
8. One tap can fill a cistern in 2 hours and another can empty the cistern in 3 hours. How long will they take to fill the cistern if both taps are opened?
   (a) 6 hours (b) 7 hours (c) 6.30 hours (d) None of these
9. Two taps A and B can fill a tan in 10 hours and 15 hours, respectively. If both the taps are opened together the tank will be fill in
   (a) 8 hours (b) 6 hours (c) 5 hours (d) None of these
10. A cistern is normally filled in 8 hours but takes 2 hours longer to fill because of a leak in its bottom if the cistern is full, the leak will empty it in
    (a) 35 hours (b) 45 hours (c) 40 hours (d) None of these
11. Two pipes A and B can fill a cistern in 4 minutes and 6 minutes respectively. If these pipes are turned on alternately for 1 minutes each how long will it take for the cistern to fill?
    (a) 4 min 40 sec (b) 3 min 20 sec (c) 4 min 50 sec (d) 3 min 30 sec
12. A reservoir is provided by two pipes A and B. A can fill the reservoir 5 hours faster than B. If both together fill the reservoir in 6 hours, the reservoir will be filled by A alone in
    (a) 10 hours (b) 8 hours (c) 12 hours (d) 11 hours
13. Two pipes A and B can separately fill a thin in 6 hours and 8 hours, respectively. Both the pipes are opened together but $1^1/_2$ hours after the start, the pipe A is turned off. How much time will it take to fill the tank?
    (a) $4\frac{1}{2}$ $hours$ $4^1/_2$ hours (b) 6 hours (c) 5 hours (d) $5\frac{1}{2}$ $hours 5^1/_2$ hours
14. Two taps can separately fill a cistern in 10 minutes and 15 minutes, respectively and when the waste pipe is open, they can together fill in 18 minutes. The waste pipe can empty the full cistern in
    (a) 7 minutes (b) 9 minutes (c) 13 minutes (d) 23 minutes
15. Pipe A can fill a tank in 3 hours and 45 min. 2 hours after the pipe started filling the empty tank the motor stopped working. What percent of the tank was left empty?
    (a) 58% (b) $46^2/_3$% (c) $33^1/_3$% (d) $53^1/_3$%

6.2Time & Work and Pipes & Cisterns (Home Assignment)

1. A can do 1/3rd of a work in 5 days and B can do 2/5 of the work in 10 days. In how many days both A and B together can do work?
   (a) $13^2/_3$ days (b) $9^3/_8$ days (c) $7^2/_3$ days (d) None of these
2. Sita takes twice as much time as Gita to complete a work and Rita does it in the same time as Sita and Gita together. If all three working together can finish the work in 6 days, then the time taken each of them to finish the work is
   (a) 18, 36 and 12 days (b) 20, 38 and 14 days (c) 24, 42 and 18 days (d) None of these
3. Ajay and Sunil can do a piece of work in 10 days, Sunil and Sanjay in 15 days and Sanjay and Ajay in 20 days. They together work at it for 6 days and then Ajay leaves and Sunil and Sanjay go on together for 4 days more. If Sunil then leaves, how long will Sanjay take to complete the work?
   (a) 12 days (b) 10 days (c) 16 days (d) None of these
4. A is twice as good a work man as B and together they finish a piece of work in 14 day. A alone can finish work in
   (a) 28days (b) 21days (c) 24days (d) None of these
5. A alone would take 27 days more to complete the job than if both A and B would together. If B worked alone, he took 3 days more to complete the job than A and B worked together. What time would they take if both A and B worked together?
   (a) 7 days (b) 9 days (c) 11 days (d) None of these
6. 10 men can cut 15 trees in 2 hours. If 2 men leave the job how many trees will they cut in 3 hours?
   (a) 20 trees (b) 18 trees (c) 24 trees (d) None of these
7. 4 men or 6 women can finish a piece of work in 20 days. 6 men and 11 women can finish the same work in
   (a) 9 days (b) 6 days (c) 7 days (d) None of these
8. Two men A and B working together complete a piece of work, which would have taken them 30 and 40 days respectively to complete if they worked separately. If they received a payment of Rs 2100, B's share is
   (a) Rs 900 (b) Rs 1200 (c) Rs 800 (d) Rs 1300
9. 5 men and 2 boys working together can do four times as much work per hour as a man and a boy together. The work done by a man and a boy should be in the ratio
   (a) 1 : 2 (b) 2 : 1 (c) 1 : 3 (d) 4 : 1
10. A, B and C can do a piece of work in 16, 32, 48 days respectively. They started working together but C left working 4 days and B and 2 days before the completion of work. Total number of days taken for completion of work was
    (a) 8 days (b) $9^1/_9$ days (c) 11 days (d) $10^4/_9$ days
11. A and B can do a piece of work in 45 and 40 days, respectively. They began the work together, but A leaves after some days and B finished the remaining work in 23 days. After many days did A leave?
    (a) 6 days (b) 8 days (c) 9 days (d) 12 days
12. A can do a piece of work in 90 days. He starts working, but having some other engagements he drops out after 5 days. Therefore, B completes this work in 21 days. A and B would complete this work working together in
    (a) 15 days (b) 16 days (c) 17 days (d) 11 days
13. A can do a piece of work in 40 days and B in 60 days. Both of them start working together and 4 days before the schedule completion, A drops out. By how many days is the work extends beyond the normal schedule?
    (a) 10 days (b) 8 days (c) 8.33 days (d) 6 days
14. A man can do a job in 5 hours. After 2h 20 minutes, the man stops working. He is replaced by a woman to complete the job. She does the remainder of the work in 1h 40 minutes. If the woman works alone, how much faster will she be than the man?
    (a) 1 h 25 min. (b) 1 h 55 min. (c) 2 hours (d) 1 h 17 min.
15. 16 men and 12 women can complete a work in 20 days. 18 women can complete the same work in 40 days. In how many days will 12 men and 27 women complete the same work?
    (a) 12 (b) 16 (c) 13 (d) 24

16. Rakesh, Shiv and Vijay working alone can complete fencing a wall in 12, 18 and 27 hours respectively. All of them started fencing the wall together as a team and after 2 hours, Rakesh left the team. Shiv and Vijay continued to fence until Vijay fell ill and hence, he had to leave the team. Then, Shiv finished fencing the wall in the last 5 hours. How many hours did it take for the team to finish fencing the wall in the last 5 hours?
(a) 11 hours (b) 13 hours (c) 15.66 hours (d) None of these
17. Which pair among the following will be able to finish fencing the all in the least time?
(a) Rakesh and Shiv (b) Shiv and Vijay (c) Rakesh and Vijay (d) either (b) or (c)
18. A team of 30 men is supposed to do a work in 38 days. After 25 days, 5 more men were employed and the work was finished one day earlier. How many days would it have been delayed if 5 more men were not employed?
(a) 1 day (b) 4 days (c) 3 days (d) 5 days
19. A contractor undertook a work to complete in 60 days. But just after 20 days he observed that only 1/5th of the project work had been completed. To complete the work in time (i.e., in rest days) minimum how many workers he had to increases, if there were initially 75 workers were deployed for the task?
(a) 25 (b) 50 (c) 75 (d) can't be made
20. A, B and C working together complete a job in 18 days. A and B together work twice as C, A, and C, together work thrice as much as B, A, alone can finish the work in
(a) 18 days (b) 43.2 days (c) 54 days (d) 72 days
21. A tap can fill a tank in 25 minutes and another can empty it in 50 minutes. Find whether the tank will be filled up or emptied and in how many minutes?
(a) Tank is filled up in 50 minutes (b) Tank is emptied up in 25 minutes
(c) Tank is filled up in 25 minutes (d) None of these
22. Two pipes can fill a tan in 10 hours and 12 hours, respectively. While a third pipe emptied the full tank in 20 hours. If all the three pipe operators simultaneously, in how much time the tank will be filled?
(a) 7 h 30 min (b) 6 h 40 min (c) 8 h 30 min (d) None of these
23. A water tank is /2/5th full. Pipe A can fill the tank in 10 minutes and the pipe B can empty it in 6 minutes. If both the pipes are open, how long will it take to empty or fill the tank to empty?
(a) 6 min to fill (b) 6 min to empty (c) 8 min to fill (d) None of these
24. Two pipes A and B can fill a cistern in 24 minutes and 30 minutes, respectively. There is also an outlet C. If all the three pipes are opened together, the cistern is full in 20 minutes. How much time will be taken by C to empty the full cistern?
(a) 30 min (b) 40 min (c) 45 min (d) None of these
25. A cistern has a leak which would empty in 8 hours. A tap is turned on which admits 6 liters a minutes into the cistern and it is now emptied in 12 hours. The cistern can hold
(a) 6840 litres (b) 7860 litres (c) 8640 litres (d) None of these
26. One fill pipe A is 3 times faster than second fill pipe B and takes 32 minutes less than the fill pipe B. When will the cistern be full if both pipes are opened together?
(a) 28 min (b) 24 min (c) 30 min (d) data inadequate
27. There are two taps to fill a tank, while a third to empty it. When the third tap is closed, they can fill the tank in 10 minutes and 12 minutes respectively. If all the three taps be opened, the tank is filled in 15 minutes. If the first two taps are closed, in what time can the third tap empty the tank when it is full?
(a) 7 min (b) 9 min 32 sec (c) 8 min 34 sec (d) 6 min
28. Two pipe A and B can separately fill a cistern in 15 minutes and 18 minutes, respectively, while a third pipe C can empty it in 6 minutes. Two pipes A and B are kept open for 6 minutes in the beginning and then the third pipe is also opened. In what time will the cistern be emptied?
(a) 16 $^1/_2$ min (b) 15 min (c) 15 $^1/_2$ min (d) 16 min
29. A cistern is provided by tow taps A and B. A can fill it in 20 minutes and B in 25 minutes If both the taps are kept open for 5 minutes and then the second is turned off. The cistern will be completely filled in another
(a) 11 min (b) 10 min (c) 15 min (d) 12 min
30. A cistern has two taps which fill it in 12 minutes and 15 minutes respectively. There is also a waste pipe in the cistern. When all the pipes are opened, the empty cistern is full in 20 minutes. How long will the waste pipe take to empty a full cistern?
(a) 8 min (b) 10 min (c) 12 min (d) 16 min

31. A tank is filled with water through five pipes. The first pipe can fill it in 40 minutes. The second, third and the fourth together can fill it in 10 minutes, the second the third and the fifth fill it in 20 minutes, the fourth and the fifth together 30 minutes. In what time will the tank be filled if all the five pipes work simultaneously
(a) $8\,{}^{2}/_{5}$ min (b) $7\,{}^{3}/_{4}$ min (c) $8\,{}^{4}/_{7}$ min (d) $8\,{}^{1}/_{7}$ min
32. A steady stream flows into a cistern partly full which has a number of equal holes at the bottom. If 12 holes are opened, the cistern is emptied in4 hours and if 10 holes are opened the cistern is emptied in 8 hours. How many holes should be opened so as to empty the cistern in 2 hours?
(a) 14 (b) 16 (c) 15 (d) 12
33. Two taps can fill a tank in 12 min and 18 min respectively. Both the taps are kept open for 2 min and then the tap that fills the tank in 12 min is turned off. In how many more minutes will tank be filled?
(a) 9 (b) 10 (c) 12 (d) 13
34. Pipe A and B can completely fill a cistern in 8 hours 12 h respectively. The two pipes are simultaneously opened but due to a leak at the bottom of the cistern it takes 6 h extra to fill the cistern. The time in which leak can empty the full cistern is
(a) 10 h (b) 120/13 h (c) 123/15 h (d) None of these
35. A tank is connected with four pipes A, B, C and d of which two are filling the tank and other two are emptying it. The time taken by A, B, C and D to finish their jobs are 10 hours, 15 hours, 20 hours and 30 hours respectively. All four pipes are opened. When the tank was empty, it took 12 hours to fill it completely. The outlet pipes are
(a) A and B (b) C and D (c) A and C (d) B and D
36. One filling pipe A is 6 times faster than second filling pipe B. If B can fill a cistern in 28 minutes, then find the time when the cistern will be full both the pipes are opened together
(a) 6 min (b) 8 min (c) 4 min (d) 7 min
37. A, B, C are pipes attached to a cistern. A and B can fill it in 20 and 30 minutes respectively, while C can empty it in 15 minutes. If A, B and C are kept in operation successively for one minute each, the cistern will be filled in
(a) 167 min (b) 160 min (c) 166 min (d) 164 min
38. Pipe A can fill an empty tank in 30 hours while B can fill it in 45 hours. Pipe A and B are opened and closed alternatively i.e., first pipe A is opened then B, again A and then B and so on for 1 hours each time without any time laps. In how many hours the tank will be filled when it was empty, initially
(a) 36 (b) 54 (c) 48 (d) 60
39. An inlet pipe can fill a tank in 5 hours and an outlet pipe can empty the same tank in 36 hours, working individually. How many additional number of outlet pipes of the same capacity are required to be opened so that the tank never over flows?
(a) 3 (b) 6 (c) 8 (d) 7
40. Three pipes A, B and C are attached to a cistern. A can fill in 10 minutes B in 15 minutes, C is a waste pipe for emptying it. After opening both the pipes A and B, a man leaves the cistern and returns when the cistern should have been just full. Finding however, that the waste pipe had been left open, he close it and the cistern now gets, filled in 2 minutes. In how much time the pipe C, if opened alone, empty the full cistern.
(a) 12 min (b) 16 min (c) 18 min (d) 15 min

7. Profit, Loss & Discount

Cost Price: It is the price at which an article has been purchased. It is abbreviated as CP.
Selling Price: It is the price at which an article has been sold. It is abbreviated as SP.
Profit or Gain: If SP is more than CP, then Profit or Gain = SP – CP.
Loss: If CP is more than SP, then Loss = CP – SP.
Overheads: Some additional expenses on transportation, labour, commission etc. are added to the cost price.
Marked Price: The price on the label is called the marked price or list price.
Discount: The reduction made on the marked price of an article is called discount. Discount is expressed as a percentage of the marked price. When no discount is given, selling price is the same a marked price.

Note: Profit and loss are always calculated with respect to CP unless otherwise mentioned in the problem.

1. Gain% = $\frac{Gain}{CP} x100$.
2. Loss% = $\frac{Loss}{CP} x100$.
3. 100 x SP = (100 + Gain%) x CP
4. 100 x SP = (100 – Loss%) x CP
5. Selling Price = Marked Price (MP) – d% discount on MP.
   - SP = MP x $\left(1 - \frac{d}{100}\right)$
6. Discount per cent d% = $\frac{(MP-SP)}{MP} x100$.
7. If a person buys **x** items for Rs. **y** and sells **z** items for Rs. **w**,
   - then gain% or loss% = $\left(\frac{xw}{zy} - 1\right) x100$
8. If the CP of **m** articles is equal to the SP of **n** articles,
   - then Gain% or Loss % = $\frac{(m-n)}{n} x100$
9. If an article is sold at SP_1 and corresponding % gain or % loss be **x**, and if it is sold at SP_2 and corresponding % gain or % loss be **y**,
   - then, $\frac{SP_1}{(100+x)} = \frac{SP_2}{(100+y)} = \frac{CP}{100} = \frac{SP_1 - SP_2}{(x-y)}$

   Note: Take**x** and **y** negative, if there is a loss.
10. If A sells an item to B at a gain or loss of **x**% and B sells it to C at a gain or loss of **y**%. If C pays Rs. **R** for it to B,
    - then, $CP\ for\ A = \frac{100^2 R}{(100+x)(100+y)} Overall\ \%Gain\ or\ \%Loss = x + y + \frac{xy}{100}$

    Note: Take **x** and **y** negative, if there is a loss.
11. If two different items are sold at the same SP, getting gain or loss of **x**% on the first and gain or loss of **y**% on the second,
    - then, $Overall\ \%Gain\ or\ \%Loss = \frac{100(x+y)+2xy}{(100+x)+(100+y)}$

    Note: Take **x** and **y** negative, if there is a loss.
12. If two different items are sold at the same SP getting a gain of **x**% on first and a loss of **x**% on second,
    - then there is **always a loss** = $\left(\frac{x}{10}\right)^2\%$
13. If a trader sells his goods at gain or loss of **x**%. And apart from this, he uses faulty measures. The overall % gain or % loss **G** is expressed as,
    - $\frac{(100+G)}{(100+x)} = \frac{True\ Measure}{Faulty\ Measure}$
14. If a trader uses **e**% error, and apart from this, sells his goods at %gain or % loss of **x**%,
    - the overall % gain or % loss = $\frac{(e+x)}{(100-e)}\ x\ 100\ \%$

15. A person buys two items for total Rs*A* and sells one at a loss of *l%* and other at a gain of *g%*. If the SP of the two items is equal, then
    - The CP of the item sold at loss = $\frac{A\,x\,(100+g)}{(200+g-l)}$
    - The CP of the item sold at gain = $\frac{A\,x\,(100-l)}{(200+g-l)}$
16. If two successive discounts on an article are *m%* and *n%* respectively,
    - then, a single discount equivalent to the two successive discounts =$m+n-\frac{mn}{100}\ \%$
17. If three successive discounts on an article are *l%, m% & n%* respectively,
    - then, a single equivalent discount = $l+m+n-\frac{lm+ln+mn}{100}+\frac{lmn}{100^2}$
18. A shopkeeper sells an item at Rs. *z* after giving a discount of *d%* on labeled price. Had he not given the discount; he would have earned a profit of p% on the cost price.
    - then, CP =$\frac{100^2 z}{(100-d)(100+p)}$

7.1 Profit, Loss & Discount (Class Work)

1. A tooth paste marked at Rs 80 is sold for Rs 68. The rate of discount is
   (a) 12 % (b) 14% (c) 15% (d) None of these
2. Hemant purchased 120 reams of paper at Rs 80 per ream. He spent Rs 280 on transportation, paid octroi at the rate of 40 paise per ream and paid Rs 72 to the coolie. If he wants to have a gain of 8%, the selling price per ream must be
   (a) Rs 89 (b) Rs 90 (c) Rs 95 (d) None of these
3. A shopkeeper loses 7% by selling a cricket ball for Rs 31. For how much should he sell the ball so as to gain 5%
   (a) Rs 50 (b) Rs 65 (c) Rs 35 (d) None of these
4. A man bought apples at the rate of 6 for Rs 20 and sold them at 4 for Rs 16. His estimated profit per cent is
   (a) 23% (b) 18% (c) 20% (d) None of these
5. If the selling price of 2/3rd of a certain quantity of milk be equal to the cost price of whole milk, the gain per cent in this transaction is
   (a) 50% (b) 48% (c) 53% (d) None of these
6. A shopkeeper sells an article at a gain of 10%. Had he sold it at a loss of 20%, its selling price would have been Rs 180 less. What is the cost price of the article?
   (a) Rs 630 (b) Rs 600 (c) Rs 580 (d) None of these
7. Amit sells an article to Basant at a gain of 20% and Basant sells it to Chandan at a gain of 10% and Chandan sells it to Dhiru at a gain of $12^1/_2$%. If Dhiru pays Rs 29.70, what did it cost Amit?
   (a) Rs 20 (b) Rs 24 (c) Rs 18 (d) None of these
8. A manufacturer sells an article to a wholesaler at a profit of 20% and the wholesaler sells it to a retailer at a loss of 5%. The resultant of profit or loss is
   (a) 14% loss (b) 14% gain (c) 12% gain (d) None of these
9. A man sold two watches for Rs 3750 each; on one he gained 5% and on the other he lost 5%. His total gain or loss as a percentage is
   (a) $1^1/_4$% (b) ½ % (c) ¼% (d) None of these
10. A man sells two articles, each for the same price of Rs 640. He earns 20% profit on the first and 40% profit on the second. His overall per cent profit is
    (a) $29^1/_2$% (b) $28^1/_2$% (c) $29^3/_{13}$% (d) None of these
11. A grocer sells rice at a profit of 20% and uses a weight which is 25% less. His overall percentage gain is
    (a) 60% (b) 65% (c) 58% (d) None of these
12. A cloth merchant says that due to slump in the market, he sells the cloth at 10% loss but he uses a false metre scale and actually gains 15%. The actual length of the scale is
    (a) 72.4 cm (b) 71.34 cm (c) 78.25 cm (d) None of these
13. An article is listed at Rs 65. A customer bought this article for Rs 56.16 and got two successive discounts of which one is 10%. The other discount of this discount scheme that was allowed by the shopkeeper was
    (a) 4% (b) 3% (c) 6% (d) None of these
14. A shopkeeper sells the goods at 10% loss on cost price but uses 20% less weight. His percentage profit or loss
    (a) 2% gain (b) $2^1/_2$% loss (c) $12^1/_2$% (d) None of these
15. A person sells CD players at Rs 1134 each after giving a discount of 19% on the marked price. Had he not given the discount, he would have earned a profit of 40% on the cost price. The cost price of each CD player is
    (a) Rs 1000 (b) Rs 1200 (c) Rs 1400 (d) None of these

7.2 Profit, Loss & Discount (Home Assignment)

1. Ramesh purchased a bicycle for Rs 5200 and spent Rs 800 on its repairs. He had to sell it for Rs 800. His profit or loss % is
   (a) $8^1/_3$% loss (b) $7^1/_2$% loss (c) 9% (d) None of these
2. A man buys 10 articles for Rs 8ans sells them at the rate of Rs 1.25 per article. His gain per cent is
   (a) 55% (b) $56^1/_4$% (c) 40% (d) None of these
3. Mr. Verma sold hold scooter for Rs 10500 at a gain of 5%. Find the cost price of the scooter
   (a) Rs 10300 (b) Rs 10700 (c) Rs 10000 (d) None of these
4. Ramdeen bought 200 dozen oranges at Rs 10 a dozen. He spends Rs 500 on transportation. He sold them at Re 1 each. His profit or loss per cent is
   (a) 4% (b) 6% (c) 5% (d) None of these
5. A shopkeeper sold some articles at Rs 35 per articles and gained 40% on it. What would be the selling price of each article to get 60% profit?
   (a) Rs 40 (b) Rs 45 (c) Rs 50 (d) None of these
6. A fruitseller buys 10 bananas for Rs 14 and sells 12 for Rs 15. Find his percentage gain or loss
   (a) $10^5/_7$% loss (b) $10^5/_9$% gain (c) 9% gain (d) None of these
7. If the cost price of 21 watches is equal to the selling price of 18 of them, what will be the gain per cent in this transaction?
   (a) $6^1/_2$% (b) 7% (c) $16^2/_3$% (d) None of these
8. A shopkeeper sells 20 pencils for the same money as he paid for 25. His gain per cent is
   (a) 20% (b) 25% (c) 24% (d) None of these
9. A person sells 36 oranges per rupee and suffers a loss of 4%. How many oranges per rupee to be sold to have a gain of 8%
   (a) 1/32 (b) 5 (c) 1/16 (d) None of these
10. Ravi sold a watch at a gain of 5%. Had he sold it for Rs 72 more, he would have gained 13%. CP of the watch is
    (a) Rs 900 (b) Rs 910 (c) Rs 870 (d) None of these
11. A buys an article and sells it to B at a profit of 10%, B sells it to C gaining 20%. If C gives Rs 924, A gave
    (a) Rs 700 (b) Rs 724 (c) Rs 780 (d) None of these
12. A man sold two plots at the rate of Rs 300000 each. He thereby incurred a loss of 20% on one of the flats and a gain of 20% on the other. What was the overall profit or loss he incurred in the entire transaction?
    (a) no gain, no loss (b) Rs 25000 profit (c) Rs 25000 loss (d) Rs 10000loss
13. A shopkeeper is giving 6 kg of price of Rs 5 per kg. What should be the markup on cost price if he wants to make a profit of 20%?
    (a) 25% (b) 50% (c) 44% (d) 20%
14. The amount of wheat at the rate of Rs 610 per quintal which should be added to 126 quintals of wheat costing Rs 285 per quintal so that 20% may be gained by selling the mixture at Rs 480 per quintal will be
    (a) 38 quintal (b) 49 quintal (c) 69 quintal (d) None of these
15. Amit went to Mumbai and bought a pair of watches costing Rs 360 at 25% discount on them but on the way back he loses one of these watches and had to buy the pair again home. He totally spent on the watches
    (a) Rs 620 (b) Rs 720 (c) Rs 540 (d) None of these

16. The market price of an article is Rs 100. If it is sold at a discount of 10%, a profit of 35% is made. How much loss of profit will be made if it is sold for Rs 30 less than the market price

(a) 5% loss (b) 8% gain (c) 5% gain (d) 8% loss

17. The cost price of three varieties of apples namely A, B and C is Rs 20/kg, 40/kg and 50/kg. Find the selling price of one kg of apple in which these three varieties of apples are mixed in the ratio of 2:3:5 such that there is a net profit of 20%?

(a) Rs 48 (b) Rs 48.6 (c) Rs 49.2 (d) Rs 49.8

18. A sweet seller sells $3/5^{th}$ part of sweets at a profit of 10% and remaining at a loss of 5%. If the total profit is Rs 1500, then what is the total cost price of sweets?

(a) Rs 36500 (b) Rs 37000 (c) Rs 37500 (d) None of these

19. A sold an article to B at a profit of 20%. B sold the same articles to C at a loss of 25% and C sold the same article to D at a profit of 40%. If D paid Rs 252 for the article, then find how much did A pay for it?

(a) Rs 175 (b) Rs 200 (c) Rs 180 (d) Rs 210

20. If the absolute difference between the selling price of the article when there is 15% loss and 15% gain in selling an article is Rs 450, then what is the cost price of the article?

(a) Rs 1200 (b) Rs 1500 (c) Rs 2000 (d) Rs 2200

21. On selling an article at successive discounts of 20% and 25% a dealer makes a net profit of 20%. Find the net profit per cent if the dealer sells the same article at a discount of 25%.

(a) 50% (b) 40% (c) 66.66% (d) 60%

22. If the selling price of a mat is five times the discount offered and if the percentage of discount is equal to the percentage profit, find the ratio of the discount offered to the cost price

(a) 11:30 (b) 1:5 (c) 1:6 (d) 7:30

23. A sells his house to B at a profit of 10% who in turn sells it to C at a profit of 15% who in turn sells it to D at a profit of 25% and D sells it to E at 35% profit. If cost price of E's house is Rs 3500000. Approx cost price for A is

(a) Rs 1540000 (b) Rs 1510000 (c) Rs 1500000 (d) Rs 1640000

24. A shopkeeper buys a toy at Rs 100 and sells it at Rs 120. Another shopkeeper buys the same toy at Rs 120 but sells it at Rs 100. What are the respective profit/loss per cent for the two shopkeepers?

(a) 20%, 20% (b) 20%, 16.7% (c) 16.7%, 16.7% (d) 16.7%, 10%

25. A book vendor sold a book at a loss of 10%. Had he sold it for Rs 108 more, he would have earned a profit of 10%. The cost price of the book is

(a) Rs 432 (b) Rs 540 (c) Rs 648 (d) Rs 740

26. Cost price of 12 oranges is equal to the selling price of 9 oranges and the discount on 10 oranges is equal to the profit on 5 oranges. The percentage point difference between the profit % and discount % is

(a) 20 (b) 22.22 (c) 16.66 (d) 15

27. If books bought at prices ranging from Rs 200 to Rs 350 are sold at prices ranging from Rs 300 to Rs 425. What is the greatest possible profit that might be made in selling 8 books?

(a) Rs 800 (b) Rs 1800 (c) Rs 1600 (d) None of these

28. A dishonest dealer marks up the price of his goods by 20% and gives a discount of 10% to the customer. He also uses a 900 g weight instead of 1 kg weight. His percentage profit is

(a) 8% (b) 12% (c) 20% (d) None of these

29. A businessman marked the price of his goods 30% more than its CP. He then sells $1/4^{th}$ of his stock at a discount of 15%, and half of the stock at the market price, and the rest at a discount of 30%. His gain %

(a) 16.5% (b) 15.375% (c) 14.20% (d) 13.37%

30. When a bicycle manufacturer reduced its selling price by 50%, the number of bicycles sold radically increased by 600%. Initially the manufacturer was getting only 140% profit. The percentage increase of his profit is

(a) 10% (b) 14% (c) 0% (d) None of these

31. The marked price of a watch is Rs 1600. The shopkeeper gives successive discount of 10%, r% to the customer. If the customer pays Rs 1224 for the watch, the value of r is

(a) 10% (b) 20% (c) 25% (d) 15%

32. A trader sells goods to a customer at a profit of k% over the cost pirce, besides it he cheats his customer by giving 880 g only instead of 1 kg. Thus his overall profit percentage is 25%. The value of k is
(a) 8.33% (b) 8.25% (c) 10% (d) 12.5%
33. On selling a pen at 5% loss and a book at 15% gain, Monu gains Rs 7. If he sells the pen at 5% gain and the book at 10% gain, then he gains Rs 13. The actual price of the book is
(a) Rs 100 (b) Rs 80 (c) Rs 10 (d) Rs 400
34. By selling 33 metres of cloth, a shopkeeper gains the price of 11 metres of cloth. His gain per cent is
(a) 7% (b) 50% (c) 20% (d) 22%
35. There would be 10% loss if a toy is sold at Rs 10.80 per piece. To earn a profit of 20%, it should be sold at
(a) Rs 12 (b) Rs 1296 (c) Rs 14.4 (d) None of these
36. If selling price is doubled, the profit triples. Find the profit per cent.
(a) $66^{2}/_{3}$ (b) 100 (c) $105^{1}/_{3}$ (d) 120
37. What is the percentage profit made by selling an umbrella at a certain price, if by selling at $2/3^{rd}$ of that price, there would be a loss of 10%
(a) 25% (b) 30% (c) 35% (d) None of these
38. A tradesman by means of false balance defrauds to the extent of 8% in buying goods and also defrauds to the extent of 8% in selling. His gain per cent is
(a) 16% (b) 15.48% (c) 16.64% (d) 36%
39. If 7 kg of tea of price Rs 72/kg is blended with 33 kg of tea of Rs 87/kg and 35 kg of Rs 87/kg and the mixture is sold at 15% profit, then what is the selling price of the mixture?
(a) Rs 80.66/kg (b) Rs 102.33/kg (c) Rs 91.22/kg (d) Rs 97.37/kg
40. A dealer offers a cash discount of 20% and still makes a profit of 20% when he further allows 16 articles to a dozen to a particularly sticky bargainer. How much per cent above the CP were his wares listed?
(a) 100% (b) 80% (c) 75% (d) $66^{2}/_{3}$ %

8. Simple and Compound Interest

Simple Interest:

When a person X borrows some money from another person Y, then X has to pay certain amount to Y for the use of this money. This amount paid by X is called **Interest**. The total amount of money borrowed by X to Y is called the **Principal**. The money paid back to Y, which comprises of the principal and the interest is called the **Amount**. In other words,

Amount = Principal + Interest

1. **Simple Interest:** When the interest is payable on the principal only, it is called Simple Interest. For example, simple interest on Rs 100 at 10% per annum will be Rs 10 each year, that is, at the end of one year, total amount will be Rs 110. At the end of second year, it will be Rs 120 and so on.
2. If P stands for Principal, R for the rate per annum, T for the number of years, I for the simple interest and A for the amount, then

   Simple Interest =(Principal x Rate x Time) /100

   Or, **I x 100 = P x R x T**
3. Amount = Principal + Interest.
   - then, $A = P\ (1 + \frac{RT}{100})$
4. If a certain sum in T years at R% per annum amounts to Rs A,
   - then the sum will be $P = \frac{100A}{100+RT}$
5. If a certain sum is invested in 3 types of investments in such a manner that equal amount is obtained on different rates and for different time periods,
   - the ratio in which amounts are invested, $P_1:P_2:P_3 = \frac{1}{100+R_1T_1} : \frac{1}{100+R_2T_2} : \frac{1}{100+R_3T_3}$

   This formula can be generalized for n investments.
6. If a certain sum of money becomes n times itself in T years, at R% per annum at simple interest,
   - then, Rate of Interest R = $\frac{100(n-1)}{T}\%$
7. If a certain sum of money becomes n times itself in T years at a simple interest,
   - then the time T in which it will become m times itself, T' = $\frac{T(m-1)}{(n-1)}$
8. Effect of change of P, R and T on simple interest is given by
   - $\Delta I = PT \times (R_1 - R_2)/100$
   - $\Delta I = RT \times (P_1 - P_2)/100$
   - $\Delta I = P \times (R_1T_1 - R_2T_2)/100$

Compound Interest

1. When the interest for each period is added to the principal before interest is calculated for the next period, then it is called Compound Interest. This method is used in investments such as savings account and bonds.
2. The amount A due after t years, when a principal P is given on compound interest at the rate R% per annum is given by,

$$A = P\left(1 + \frac{R}{100}\right)^T$$

3. Compound Interest, CI = A – P

$$= P\left[\left(1 + \frac{R}{100}\right)^T - 1\right]$$

4. Rate of interest, $R = \left(\sqrt[T]{\frac{A}{P}} - 1\right)\%$

5. Calculation of R and T

Mode	Rate	Time
Yearly	R	T
Half-yearly	R/2	2T
Quarterly	R/4	4T
Monthly	R/12	12T

6. Depreciation: Assets like machines, vehicles and electronic items etc. decrease in value year by year due to wear and tear. This decrease in value is called depreciation. If the rate of depreciation is R% per year of an article worth Rs P,

- then the value of the article at the end of n years= $P\left(1 - \frac{R}{100}\right)^n$

7. Population Formula: If the population of a town is P and the annual increase is R%, then the population in n years is= $P\left(1 + \frac{R}{100}\right)^n$

If the annual decrease is R%, then the population in n years= $P\left(1 - \frac{R}{100}\right)^n$

8. When the rate of interest are different for different years, say R_1, R_2, R_3 per cent for first, second and third year respectively,

- then, Amount $= P\left(1 + \frac{R_1}{100}\right)\left(1 + \frac{R_2}{100}\right)\left(1 + \frac{R_3}{100}\right)$

9. If a certain sum becomes **n** times in **t** years at compound interest, then the same sum becomes $\mathbf{n^m}$ in **mt** years.

10. If a certain sum becomes n times in t years, then the rate of compound interest $R = 100\left(\sqrt[t]{n} - 1\right)$

11. When the time is given in the form of fraction, say $3^4/_5$ years, then $A = P\left(1 + \frac{R}{100}\right)^3\left(1 + \frac{4R}{500}\right)$

12. A loan of Rs P at R% compound interest per annum can be repaid in n equal yearly instalments of

- $$\frac{P}{\left(\frac{100}{100+R}\right) + \left(\frac{100}{100+R}\right)^2 + \left(\frac{100}{100+R}\right)^3 + \cdots + \left(\frac{100}{100+R}\right)^n}$$

8.1 Simple & Compound Interest (Class Work)

1. Mahesh borrowed Rs 3000 from his friend Suresh at 15% per annum for 3 years. The interest and amount returned by Mahesh are
   (a) 1350, 4250 (b) 1350, 4350 (c) 1250, 4350 (d) 1250, 4250
2. What principal will amount to Rs 570 at 4% per annum in 3 and ½ years?
   (a) Rs 450 (b) Rs 300 (c) Rs 500 (d) Rs 510
3. A sum of Rs 1586 is divided among three such parts that amount obtained on these three parts of money after 2, 3 and 4 years, respectively at the rate of 5% per annum remains equal. The three parts are
   (a) 552, 528, 506 (b) 552, 555, 516 (c) 525, 535, 516 (d) 552, 562, 515
4. A certain sum of money triples itself in 5 years simple interest. The rate per cent per annum is
   (a) 35% (b) 44% (c) 25% (d) 40%
5. In what time a sum of money will double it at a rate of simple interest of 8% p. a.?
   (a) 8 years (b) 10 years (c) $12^1/_2$ years (d) 12 years
6. A sum of money put out on simple interest doubles itself in $12^1/_2$ years. It would triple itself in
   (a) 23 years (b) 24 years (c) 25 years (d) 30 years
7. If simple interest on Rs 600 increases by Rs 30, when the rate % increases by 4% per annum then time is
   (a) $1^1/_8$ years (b) $1^1/_5$ years (c) $1^1/_4$ years (d) 1/3 year
8. If the simple interest on Rs 1400 be more than the interest on Rs 100 by Rs 60 in 5 years, the rate % p. a. is
   (a) 3% (b) 4% (c) 5% (d) 5.5%
9. If the simple interest on a certain sum at 4% per annum for 4 years is Rs 80 more than the interest on the same sum for 3 years at 5% per annum, the sum is
   (a) Rs 7500 (b) Rs 8000 (c) Rs 6500 (d) Rs 7000
10. The simple interest on Rs 500 at 6% per annum from May 3rd to July 15th in the same year is
    (a) Rs 9 (b) Rs 6 (c) Rs 4 (d) None of these
11. The principal that will yield Rs 60 as simple interest at 6% per annum in 5 years is
    (a) Rs 175 (b) Rs 350 (c) Rs 200 (d) None of these
12. If the simple interest on a certain sum of money is 4/25th of the sum and the rate per cent equals the number of years, then the rate of interest per annum is
    (a) 2% (b) 3% (c) 4% (d) None of these
13. A sum was put at simple interest at a certain rate for 4 years. Had it been put at 2% higher rate, it would have fetched Rs 56 more. The sum is
    (a) Rs 680 (b) Rs 700 (c) Rs 720 (d) None of these
14. Mr. Lala invested an amount of Rs 12000 at the simple interest rate of 10% per annum and another amount at the simple interest rate of 20% per annum. The total interest earned at the end of one year on the total amount invested became 14% per annum. The total amount invested is
    (a) Rs 20000 (b) Rs 20800 (c) Rs 21000 (d) None of these
15. A person invested 2/3rd of his capital at 3%, 1/6th at 6% and the remainder at 12%. If his annual income is Rs 25, then the capital invested is
    (a) Rs 490 (b) Rs 510 (c) Rs 500 (d) None of these
16. Mohan invested an amount of Rs 15000 at compound interest rate 5% p.a. for a period of 2 years. What amount will he receive at the end of 2 years?
    (a) 16537.5 (b) 20215.5 (c) 16000 (d) 19000
17. Compound interest on Rs 5000 for 2 years at 4% p.a. will be
    (a)Rs 450 (b) Rs 300 (c) Rs 408 (d) Rs 510
18. Ravi invested Rs 16000 for two years at compound interest and received an amount of Rs 17640 on maturity. The rate of interest is
    (a) 4.5% p.a. (b) 4.0% p.a. (c) 5.5% p.a. (d) 5% p.a.
19. The amount of Rs 8000 in $1^1/_2$ years at 5% per annum compound interest payable half-yearly is.
    (a) Rs 8509.25 (b) Rs 8995.13 (c) Rs 8615.13 (d) Rs 8315.13
20. The compound interest on Rs 1000 at 40% per annum compounded quarterly for 1 year.
    (a) Rs 365 (b) Rs 464.10 (c) Rs 400 (d) Rs 425.2
21. The compound interest on Rs 4000 at 24% per annum for 3 months, compounded monthly.
    (a) Rs 200 (b) Rs 430.44 (c) Rs 244.83 (d) Rs 495.5

22. Nitin purchased a car 4 years ago for Rs 2 lakh. Its value depreciated each year at the rate of 25% p.a. The present value of the car is
    (a) Rs 80550 (b) Rs 83375 (c) Rs 84375 (d) Rs 88675
23. The population of a city increases at the rate of 12% per annum and 3 years ago its population was 1 million. Its present population is
    (a) 1360000 (b) 1554100 (c) 1647120 (d) 1404928
24. Isha invests Rs 5000 in a bond which gives interest at 4% per annum during the first year, 5% during the second year and 10% during the third year. The amount she gets at the end of the third year is
    (a) Rs 6006 (b) Rs 7007 (c) Rs 8008 (d) Rs 5567
25. A sum of money place at compound interest doubles itself in 3 years. It will amount to four times itself in
    (a) $4^1/_2$ years (b) 5 years (c) $5^1/_2$ years (d) 6 years
26. At what rate per cent compound interest does a sum of money become four-fold in 2 years?
    (a) 5% (b) 50% (c) 75% (d) 100%
27. What will be the compound interest on Rs 15625 for $2^1/_2$ years at 4% per annum?
    (a) Rs 1613 (b) Rs 1717 (c) Rs 1814 (d) Rs 1859
28. If a sum of Rs 13040 is to be paid back in two equal annual instalments at $3^3/_4$% per annum, the instalment is
    (a) Rs 6889 (b) Rs 7760 (c) Rs 7209 (d) Rs 6520
29. What annual payment will discharge a debt of Rs 7620 due in 3 years at $16^2/_3$% p. a. compound interest?
    (a) Rs 3430 (b) Rs 2540 (c) Rs 2150 (d) None of these
30. The difference between the compound interest and simple interest on a certain sum at 10% per annum for 2 years is Rs 631. The sum is
    (a) Rs 65400 (b) Rs 64500 (c) Rs 63100 (d) None of these

8.2 Simple & Compound Interest (Home Assignment)

1. A person gets 5% interest per annum for first 3 years, 8% for next 3 years and 9% beyond that by depositing certain sum in the bank. If he gets Rs. 32250 as simple interest for 10 years, then how much money did he deposit in the bank?
   (a) 43000 (b) 34000 (c) 28000 (d) None of these
2. A sum of money doubles itself in 4 years. In how many years with the amount become thrice the principal at the same rate of simple interest?
   (a) 2 (b) 4 (c) 8 (d) 16
3. Divide Rs. 13000 into two parts in such a manner that the simple interest on the first part for 3 years at 5% per annum remains equal to two time the simple interest on the second part for 4 years at 3% per annum. Then the second part of amount after 2 years is.
   (a) 5300 (b) 5600 (c) 5800 (d) 5900
4. If the difference between the simple interest on a certain sum for 4 years at 3% per annum (p.a.) and the simple interest on the same sum for the same period at $5^1/_2$% per annum is Rs. 200. Find the sum
   (a) 2820 (b) 2000 (c) 980 (d) 840
5. A person borrowed Rs. 2000 at some rate of simple interest and Rs. 3000 at 1% higher rate of interest. If after 5 years he had to pay Rs. 3500 as total interest on the sum of money borrowed by him in both cases, find the former rate of interest.
   (a) $13^1/_5$% (b) $12^7/_5$% (c) $12^1/_4$% (d) None of these
6. Ali borrowed Rs. 8000 at 5% per annum simple interest. If each year she pays Rs. 800 for interest and part of debt, find the amount that will be left to be paid back at the end of 3 years.
   (a) 9282 (b) 8448 (c) 7539 (d) 6899
7. Ayush borrowed a sum of money at the rate of 5% p.a. simple interest. If after 6 years the interest is Rs. 2352 less than the sum of money borrowed, find the money borrowed by Ayush.
   (a) 2890 (b) 3360 (c) 4534 (d) None
8. The simple interest on a certain sum of money is 16/25 of the sum and the number of years equals the rate percent p.a., then the rate percent p.a. will be?
   (a) 8% (b) 61/2% (c) 51/2% (d) 41/2%
9. A person borrowed Rs 18500 at a certain rate of simple interest and Rs. 15000 at 1% higher rate of interest. If after 4 years the interest paid by him in both cases is Rs. 2000, the former rate of interest was
   (a) 22/63% (b) 13/67% (c) 13/14% (d) None
10. A certain sum of money placed at compound interest amounts to Rs. 4410 in 2 years. The rate of interest per annum is
    (a) 5% (b) 10% (c) 8% (d) 4%
11. A certain sum of money doubles itself in 4 years. In how many years will it become 16 times at the same rate of compound interest.
    (a) 8 yrs (b) 16 yrs (c) 24 yrs (d) None
12. A sum of money placed at compound interest amounts to Rs. 10000 in 4 years and to Rs.12000 in 5 yrs. Find the amount that the sum will yield in 6 years.
    (a) 21820 (b) 14400 (c) 12320 (d) None
13. x and y together borrowed a total sum of Rs. 12000 from a money lender at 5% per annum compound interest in such a proportion that to settle his loan after 2 years, x paid as much amount as y paid after 3 years from the date of borrowing. Find the part of money borrowed by y?
    (a) 6146.34 (b) 5853.66 (c) 5000 (d) 7000
14. In what time Rs.10000 invested at 10% per annum will yield Rs. 3310 as compound interest?
    (a) 1 (b) 2 (c) 3 (d) 4
15. Two partners A and B jointly lent out a sum of Rs. 12600 at 10% per annum compound interest, interest being compounded annually. If after 4 years A obtain as much amount as was obtained by B after 5 years. Then the part of money invested by A is
    (a) 5700 (b) 6600 (c) 7000 (d) 7800
16. A borrowed some amount from B at 5% per annum compound interest. If within two years A cleared his debt by paying two equal annual installments of Rs. 1260, what sum did A borrow?

(a) 2845 (b) 2343 (c) 2120 (d) 1945

17. If a sum of Rs. 48000 is to be paid back in two equal annual installments at 51/2% per annum, what is the amount for each installment?
(a) 40123 (b) 50157 (c) 62345 (d) 78456
18. The simple interest on a certain sum of money at 5% per annum for 4 years is Rs. 200 more than the interest on the sum for 3 years at 6% per annum. Find the sum.
(a) 20000 (b) 10000 (c) 5000 (d) 2500
19. In how many years does a sum of money become 4 times at the simple interest rate of 10% p.a.?
(a) 30 (b) 45 (c) 60 (d) 90
20. The rate of interest for the first 3 years is 5% p.a. for the next 3 years is 8% and beyond this, it is10%. If the simple interest for 10 years is Rs. 4977 then find out the principal.
(a) 8485 (b) 7435 (c) 6845 (d) 6300
21. A sum of money put out on simple interest double itself in 221/2 years. In how many years would it triple itself?
(a) 25 years (b) 45 years (c) 65 years (d) None
22. Simple interest on a sum of money is 1/16th of the principal, and rate percent per annum is equal to the number of years. Then the rate per cent is.
(a) 21/2 (b) 5 (c) 51/2 (d) 7
23. A sum was put at simple interest at a certain rate for 4 years. Had it been put at 2% higher rate, it would have fetched RS. 200 more. Find the sum.
(a) 5800 (b) 4500 (c) 2500 (d) 1200
24. The annual payment that will discharge a debt of Rs. 1200 in 3 years at 10% per annum is
(a) 252.5 (b) 377.5 (c) 433.85 (d) 486.74
25. After what time will the sum of Rs 10000 become Rs 12000 in 3 years at 10% per annum is:
(a) 3 yrs (b) 2 yrs (c) 5 yrs (d) 4 yrs

9. Basic Geometry

Basic Concepts

Line: A line is a set of infinite points extending in two opposite direction

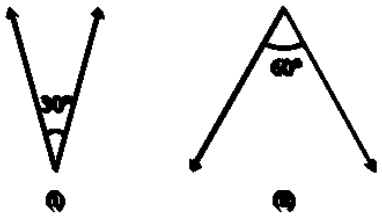
Ray: A ray is a part of line, having initial point but no end point

Line Segment: A Line segment is a part of line, having initial point as well as end point.

Related Angles

Complementary Angles: If the sum of the measures of two angles is 90°, the angles are called **complementary angles.**

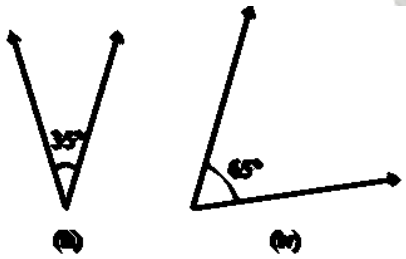
Example: Two angle of 30° and 60° are complementary angles



Supplementary Angles: If the sum of two angles is 180°, the angles are called supplementary angles.

When two angles are supplementary, each angle is called supplement of each other.

Example: Two angles 60° and 120° are supplementary angles

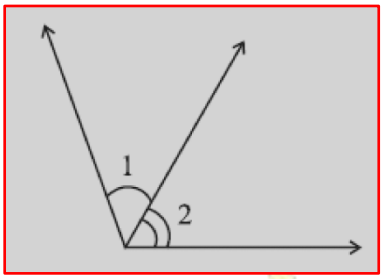


Adjacent Angles: Two angles are called Adjacent angles, if

(i) they have a common vertex;

(ii) they have a common arm; and

(iii) the non-common arms are on either side of the common arm.

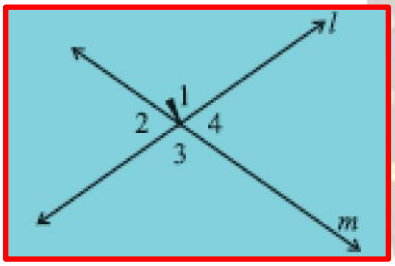


Linear Pair

A linear pair is a pair of adjacent angles whose non-common sides are opposite rays.

Vertically Opposite Angles:

Two angles are said to be a pair of vertically opposite angles if they have a common vertex and their arms are making a pair of two lines.



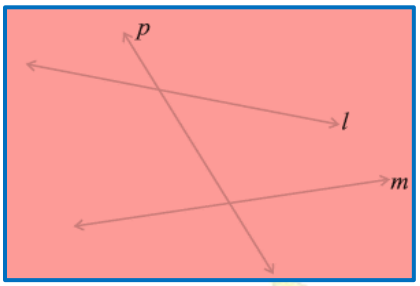
Pairs of Lines

Intersecting Lines

Two lines *l* and m intersect if they have a point in common. This common point O is their **point of intersection**.

Transversal

A line that intersects two or more lines at **distinct** points is called a **transversal**.

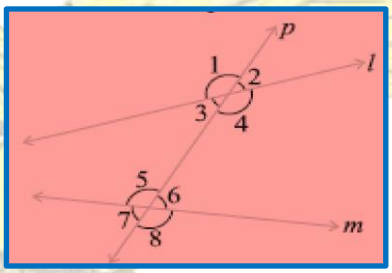


Angles made by a Transversal

In Fig. You lines *l* and *m* cut by transversal *p*. The eight angles marked 1 to 8 have their special names:

Interior angles (∠3, ∠4, ∠5, ∠6)

Exterior angles (∠1, ∠2, ∠7, ∠8)



Pairs of Corresponding angles

(∠1 and ∠5, ∠2 and ∠6, ∠3 and ∠7, ∠4 and ∠8)

Pairs of Alternate interior angles

(∠3 and ∠6, ∠4 and ∠5)

Pairs of Alternate exterior angles

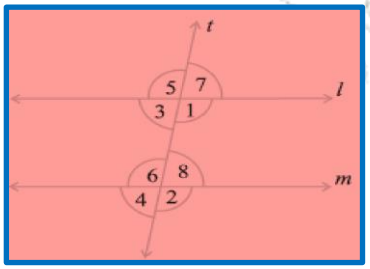
(∠1 and ∠8, ∠2 and ∠7)

Pairs of interior angles on the same side of the transversal

(∠3 and ∠5, ∠4 and ∠6)

Properties of Parallel Lines

- ☒ If two parallel lines are cut by a transversal, each pair of **corresponding angles are equal** in measure.
- ☒ If two parallel lines are cut by a transversal, each pair of **alternate interior angles are equal**.
- ☒ If two parallel lines are cut by a transversal, then each pair of interior angles on the same side of the transversal are **supplementary**.



Checking for Parallel Lines

- ☒ When a transversal cuts two lines, such that pairs of corresponding angles are equal, then the lines have to be parallel.
- ☒ When a transversal cuts two lines, such that pairs of alternate interior angles are equal, the lines have to be parallel.
- ☒ When a transversal cuts two lines, such that pairs of interior angles on the same side of the transversal are supplementary, the lines have to be parallel.

Polygons

- ☒ A closed plane figure made up of several line segments that are joined together is called a Polygon.
- ☒ If all the sides of a polygon are equal then it is called Regular Polygon.
- ☒ Regular Polygons are both equilateral and equiangular.

Exterior Angle: The angle subtended by a side of the regular polygon at the vertex outside.

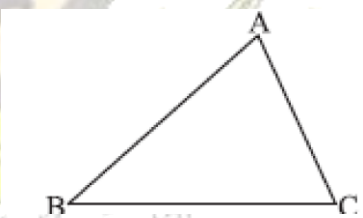
- ☒ Sum of the exterior angles of any polygon = 360 degrees.
- ☒ Each exterior angle (Regular Polygon) = $\frac{360}{n}$
- ☒ here, n = no. of sides in the polygon

Interior Angle: Sum of the interior angles of a polygon = (n – 2) x 180^o

- ☒ Each interior angle of a regular polygon = $\frac{180\ (n-2)}{n}$
- ☒ The number of diagonals in a polygon = $\frac{n\ (n-3)}{2}$
- ☒ The number of triangles (when you draw all the diagonals from one vertex) in a polygon = (n – 2).

Triangle

- When three non collinear points are joined by three line-segments the figure obtained is called a triangle.
- It has three vertices, three sides and three angles.
- **Sides**: AB, BC , CA
- **Angles**: ∠BAC, ∠ABC, ∠BCA
- **Vertices**: A, B, C

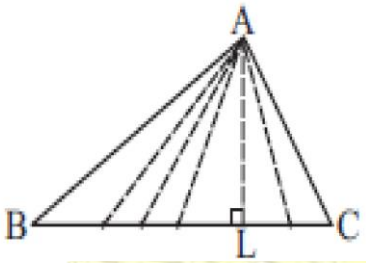


Triangles can be classified on the basis of the (i) sides (ii) angles.

- (i) Based on Sides: Scalene, Isosceles and Equilateral triangles.
- (ii) Based on Angles: Acute-angled, Obtuse-angled and Right-angled triangles.

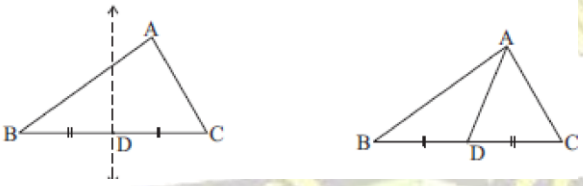
Altitudes of a Triangle

- The **height** is given by the line segment that starts from A, comes straight down to BC, and is perpendicular to BC. This line segment AL is an **altitude** of the triangle.
- **An altitude has one end point at a vertex of the triangle and the other on the line containing the opposite side.**



Median of a Triangle

Median: Median of a triangle is a line segment joining a vertex of triangle to the mid-point of the opposite side.

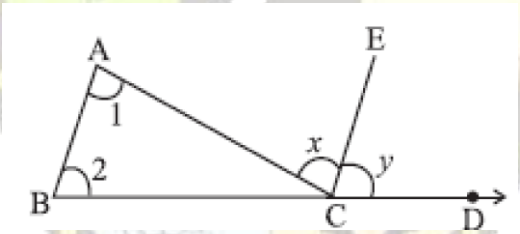


In triangle ABC, if D is the midpoint of side BC, then AD is the median. There can be three medians from three vertices.

Exterior Angle of a Triangle and its Property

Theorem: An exterior angle of a triangle is equal to the sum of its interior opposite angles.

Given Consider ΔABC.



∠ACD is an exterior angle.

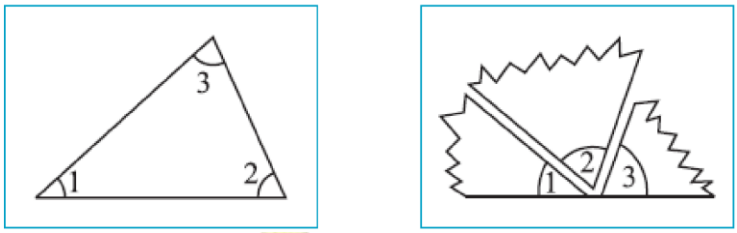
$m\angle ACD = m\angle A + m\angle B$

$\angle 1 = \angle x$ (Alternate angles)

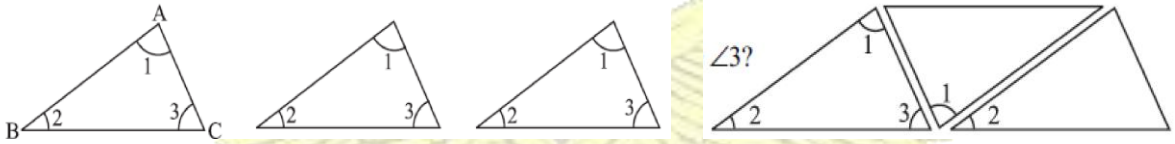
$\angle 2 = \angle y$ (Corresponding angles)

Therefore $\angle 1 + \angle 2 = \angle x + \angle y = \angle ACD$

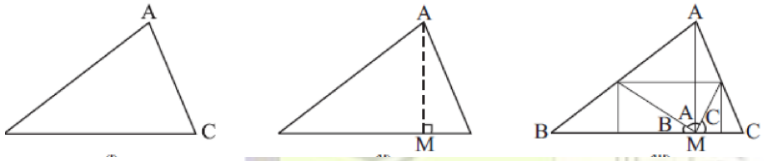
Angle Sum Property of a Triangle



1. The total measure of the three angles of a triangle is 180°.
2. The same fact you can observe in a different way also. Take three copies of any triangle, say ΔABC. Arrange them as in Fig. What do you observe about ∠1 + ∠2 + ∠3?



3. Take a piece of paper and cut out a triangle, say, ΔABC. Make the altitude AM by folding ΔABC such that it passes through A. Fold now the three corners such that all the three vertices A, B and C touch at M. You find that all the three angles form together a straight angle. This again shows that the sum of the measures of the three angles of a triangle is 180°.



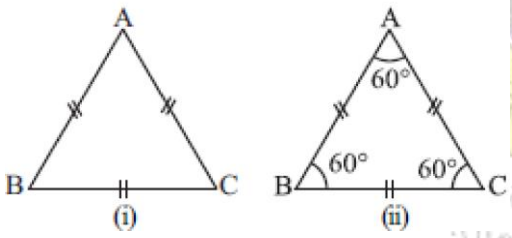
Two Special Triangles

Equilateral Triangle: A triangle in which all the three sides are of equal lengths is called an equilateral triangle.

We conclude that in an equilateral triangle:

(i) all sides have same length.

(ii) each angle has measure 60°.

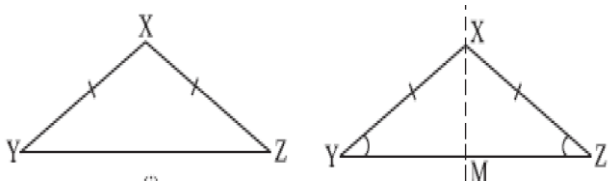


Isosceles Triangle: A triangle in which two sides are of equal lengths is called an isosceles triangle.

In an isosceles triangle:

(i) two sides have same length.

(ii) base angles opposite to the equal sides are equal.

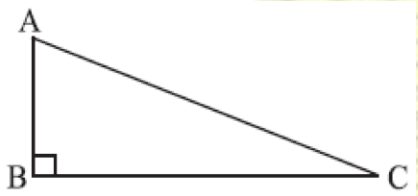


Property of a triangle: The sum of the lengths of any two sides of a triangle is greater than the third side.

Right angled Triangle: A triangle in which one angle is a right angle is called a right angled triangle.

The side opposite to the right angle is called the **hypotenuse**; the other two sides are known as the **legs** of the right-angled triangle.

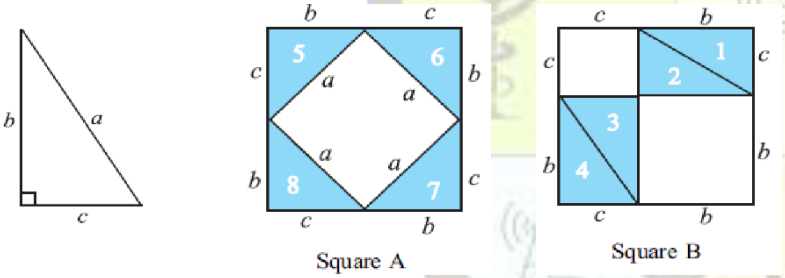
In ΔABC, the right-angle is at B. So, AC is the hypotenuse. AB and BC are the legs of ΔABC.

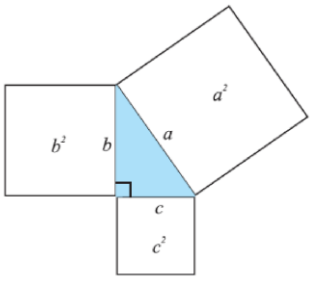


Pythagoras Theorem: In a right angled triangle the square on the hypotenuse is equal to the sum of the squares on the legs.

Make eight identical copies of right angled triangle of any size you prefer. Draw two identical squares on a sheet with sides of lengths $b + c$.

You are to place four triangles in one square and the remaining four triangles in the other square. Uncovered area of square A = uncovered area of square B. Therefore $a^2 = b^2 + c^2$



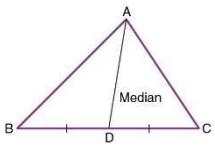


Basic Proportionality Theorem

- If a line is drawn parallel to one side of a triangle, then it divides other two sides in the same ratio.
- If DE||BC then $\frac{AD}{BD} = \frac{AE}{EC}$
- The line joining midpoint of two sides of a triangle is always parallel to the 3rd side and it is half of the 3rd side.

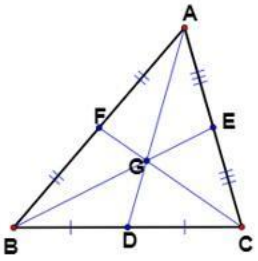
Median of Triangle

A line joining the midpoint of a side to the opposite vertex is called Median of a triangle. In a triangle ABC, if AD is the median then it divides triangle ABC into two equal parts, i.e. $\Delta ADB = \Delta ADC$.



Centroid

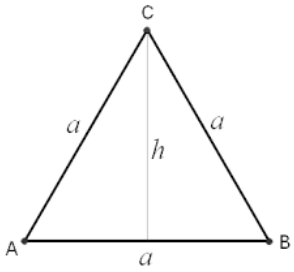
- The point of concurrence of the median of a triangle is called Centroid and is denoted by G.
- If G is one of its median then G divides AD in the ratio 2:1.
- $AB^2 + BC^2 + CA^2 = 3(AG^2 + BG^2 + CG^2)$
- $\Delta ABG = \Delta BCG = \Delta ACG = \frac{1}{3}\Delta ABC$.



- In a triangle ABC if D, E, F are the mid points of the sides BC, CA and AB respectively then, $\Delta AEF = \Delta BDF = \Delta CDE = \Delta DEF = \frac{1}{4}\Delta ABC$ also, $3(AB^2 + BC^2 + CA^2) = 4(AD^2 + BE^2 + CF^2)$

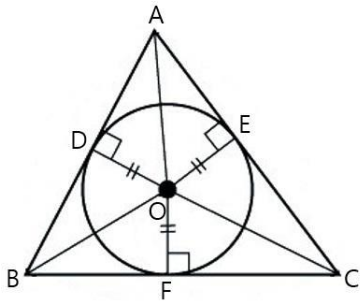
Altitude of an Equilateral Triangle:

In an equilateral triangle with side 'a' and altitude 'h', we have $h = \frac{\sqrt{3}}{2}a$ and Area = $\frac{\sqrt{3}}{4}a^2$ or $\frac{h^2}{\sqrt{3}}$



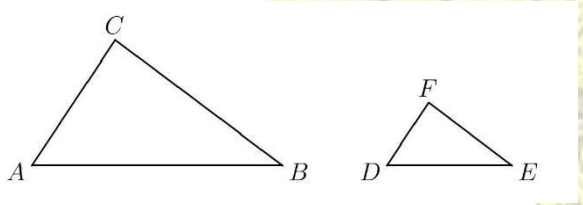
In-circle:

- If in a triangle ABC, a circle is inscribed by touching the sides at D, E, F respectively then,
- $DB + FC + EA = \frac{1}{2}(AB + BC + CA)$



Similar Triangles:

Two triangles ABC and DEF are said to be similar if their corresponding angles are equal or the ratio of their corresponding sides are equal i.e. $\Delta ABC \sim \Delta DEF \leftrightarrow \frac{AB}{DE} = \frac{BC}{EF} = \frac{AC}{DF}$

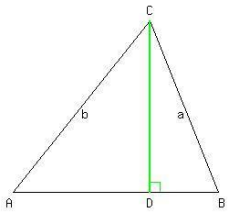


- AAA: If the corresponding angle of two triangles are equal then they are similar.
- SSS: If the ratio of the corresponding sides of two triangles are equal then they are similar.
- SAS: If the ratio of two corresponding sides of two triangles are equal and their included angles are equal then they are similar.

Similarity in Right Angled Triangle

If ABC is a triangle such that $angle\ C = 90°\ and\ CD\ is\ perpendicular\ to\ AB\ then,$

- $\Delta ACD \sim \Delta CBD \sim \Delta ABC$.
- $CD^2 = AD.DB$, $AC^2 = AD.AB$, $BC^2 = BD.AB$
- $\frac{1}{CD^2} = \frac{1}{BC^2} + \frac{1}{AC^2}$

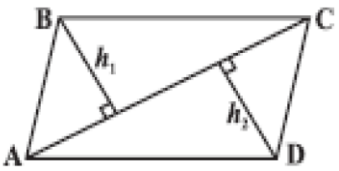


The ratio of the areas of two similar triangles is equal to ratio of the square of their corresponding sides.

In two similar triangles, the ratio of the altitudes is same as the ratio of their corresponding sides.

Quadrilaterals:

A Quadrilateral is a plane figure bounded by four straight lines called sides. The sum of four angles of a quadrilateral is 360^o.



Area of a General Quadrilateral

Area of quadrilateral ABCD = (area of ABC) + (area of ADC)

$$= (\frac{1}{2} \text{ x AC x } h_1) + (\frac{1}{2} \text{ x AC x } h_2)$$

$$= \frac{1}{2} \text{ x AC x } (h_1 + h_2)$$

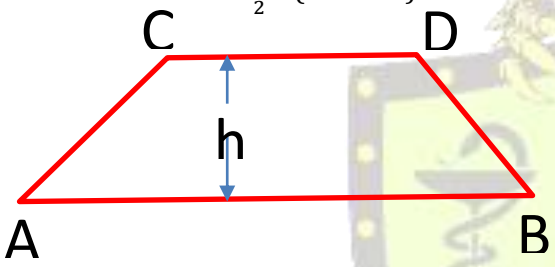
$$= \frac{1}{2} \text{ x d x } (h_1 + h_2)$$

Area of a Quadrilateral = $\frac{1}{2}$ x Diagonal x Sum of perpendiculars on diagonals

Area of Trapezium:

Trapezium: Area = $\frac{1}{2}$ x Sum of Parallel side x height

Area = $\frac{1}{2}$ x (AB + CD) x h



Parallelogram:

- two pairs of parallel opposite sides
- two pairs of equal opposite sides
- two pairs of equal opposite angles.
- Perimeter = 2(a+b)
- Area = a x h

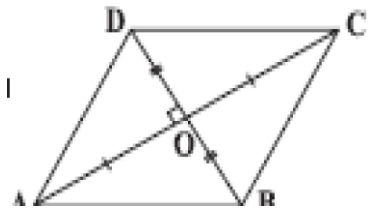
Rhombus:

- Area of rhombus ABCD = (area of ACD) + (area of ABC)

  $= (\frac{1}{2} \text{ x AC x OD}) + (\frac{1}{2} \text{ x AC x OB}) = \frac{1}{2} \text{ x AC x (OD + OB)} = \frac{1}{2} \text{ x AC x BD}$

- Area of Rhombus = $\frac{1}{2}$ x Product of diagonals

- In a Rhombus, $d_1^2 + d_2^2 = 4(\text{side})^2$.



Square: A square is a rhombus with

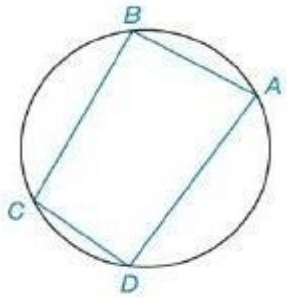
- 2 pairs of parallel lines
- 4 equal sides
- 4 equal internal right angles
- Perimeter = 4a
- Area = a^2
- Diagonal = $\sqrt{2}.a$

Rectangle: A rectangle is a parallelogram with

- 2 pairs of parallel opposite sides
- 2 pairs of equal opposite sides
- 4 equal internal right angles
- Perimeter = 2(a+b)
- Area = a x b
- Diagonal = $\sqrt{a^2 + b^2}$

Cyclic Quadrilateral: A quadrilateral inscribed in a circle is called cyclic quadrilateral. In a cyclic quadrilateral ABCD,

- A+C = 180^o = B+D
- A cyclic trapezium is a parallelogram.
- A cyclic parallelogram is a rectangle.

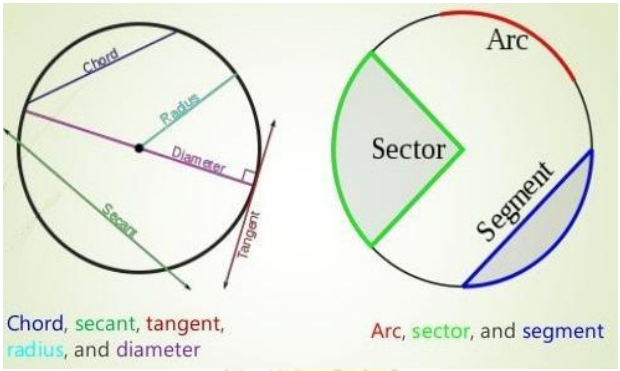


Circle:

A circle is defined as the collection of all the points on a plane that are at equal distance from a given fixed point. This fixed point is called the centre of the circle and the fixed distance is called the radius.

Area of Circle = πr^2

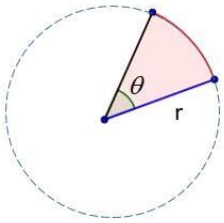
Circumference of Circle = $2\pi r$



Sector:

A Sector is a part of a circle enclosed between two radii.

- Area of Sector = $\frac{\theta}{360}$ x πr^2
- Length of an arc = $\frac{\theta}{360}$ x $2\pi r$



Chord: A line which cuts a circle at two distinct points is called a chord.

- The length of the chord = $2\sqrt{r^2 - d^2}$
- Two chords AB, CD of a circle intersect at E, then AE.EB = CE.ED

Tangent: A line which touches a circle at a single point 'P' is called the tangent to the circle.

- The tangent and radius of the circle are perpendicular to each other at the point of contact.
- The length of the tangent from 'Q' to a circle of a radius 'r' and centre 'C' such that CQ = d is CQ = $\sqrt{d^2 - r^2}$

Concentric Circles:

Two circles having same centres with different radii are called Concentric Circles.

Segment of a Circle:

The **segment of a circle** is the region bounded by a chord and the arc subtended by the chord.

- The angles on the same segment of a circle are equal.
- The angle subtended by an arc of a circle at the centre is double the angle subtended by the same arc at any point on the circumference of the circle.

9.1 Basic Geometry (Class Work)

EXERCISE

1) If $d = 5$ cm, $r_1 = 2.5$, $r_2 = 1.5$ cm; then the length of the direct common tangent is?

a) 3 b) 4 c) $2\sqrt{6}$ d) $3\sqrt{2}$

2) In the diagram, $\angle x = 20^\circ$, $\angle C = ?$

a) 70° b) 40° c) 60° d) 80°

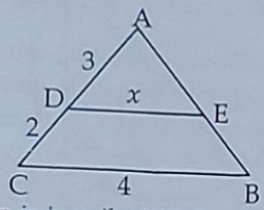
3) ABC is an isosceles right angled triangle, $\angle C = 90^\circ$ then $AB^2 =$

a) $2AC^2$ b) AC^2 c) BC^2 d) $3AC^2$

4) The corresponding sides of two similar triangles are in the ratio 2 : 3. Then the ratio of their areas is?

a) 9 : 4 b) 3 : 2 c) $\sqrt{2}:\sqrt{3}$ d) 4 : 9

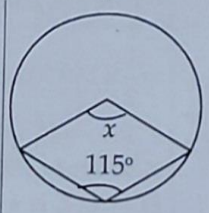
5) From the figure the value of $x =$



6) If a hexagon is inscribed in the circle of radius 6 cm. Then the area of hexagon is _____ *(sq.cm)*.

a) 36 b) 54 c) $54\sqrt{3}$ d) $\frac{54}{\sqrt{3}}$

7) The value of angle 'x' from the given figure is?



a) 65° b) 130° c) 115° d) 50°

8) P is a point 9 cm from the center of a circle. Radius of the circle is 4 cm. Then length of the tangent is ____ cm.

a) $\sqrt{81}$ b) $\sqrt{56}$ c) $\sqrt{65}$ d) $\sqrt{169}$

9) If the angles of the triangle are in the ratio 1:2:3 then the sides of the triangle are in the ratio of?

a) $1:\sqrt{3}:2$ b) $1:\sqrt{2}:2$ c) $\sqrt{3}:2:1$ d) $1:2:\sqrt{3}$

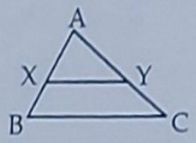
10) The height of an equilateral triangle is $\sqrt{3}$. Then area of the triangle is?

a) $3\sqrt{3}$ b) $\sqrt{3}$ c) $2\sqrt{3}$ d) 3

11) Side of a regular hexagon is $4\sqrt{3}$. Then the area o it will be?

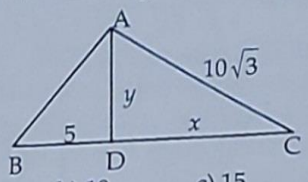
a) $\frac{72}{\sqrt{3}}$ b) 72 c) $72\sqrt{3}$ d) $24\sqrt{3}$

12) In a ΔABC, $XY \| BC$, $AX : XB = 2 : 1$, then $\Delta AXY : \Delta ABC = ?$



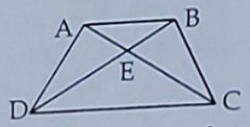
a) 2 : 3 b) 4 : 9 c) 4 : 1 d) 3 : 2

13) In the below figure $AD \perp BC$. If $BD = 5$, $AD = y$, $AC = 10\sqrt{3}$ and angle $A = 90^0$ then $DC = ?$



a) 20 b) 10 c) 15 d) $5\sqrt{3}$

14) ABCD is a trapezium where $AB \| CD$ and $CE = 6$, and $AE = 4$, then $\frac{AB}{CD}$ is.



a) $\frac{3}{5}$ b) $\frac{2}{3}$ c) $\frac{1}{2}$ d) can't be found

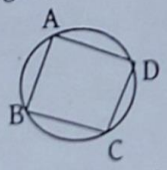
15) Find the number of sides of a polygon if its diagonals are 14.

a) 4 b) 7 c) 8 d) 28

16) Find the interior angle of a regular polygon with 6 sides.

a) 120^0 b) 60^0 c) 80^0 d) 180^0

17) In the below figure, find $\angle D$ if $\angle B = 70^0$.



a) 180^0 b) 110^0 c) 90^0 d) 70^0

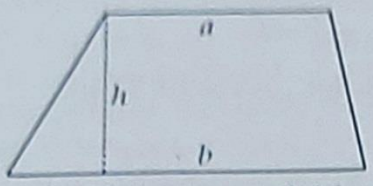
18) Find the length of diagonal of rhombus if area of rhombus is 32 *sq cm* and both diagonals are of same length.

a) 4 *cm* b) 6 *cm* c) 8 *cm* d) 10 *cm*

19) Find the radius of in-circle of a triangle of area 50 *sq.cm* and perimeter 60 *cm*.

a) 5 *cm* b) 3 *cm* c) $\frac{3}{5}$ *cm* d) $\frac{5}{3}$ *cm*

20) Find the area of the below trapezium if $a = 10\ cm$, $b = 8\ cm$ and height is $\left(\frac{1}{5}\right)^{th}$ of side 'a'.

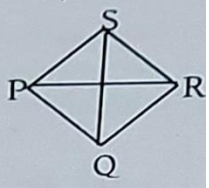


a) 18 $sq.cm$ b) 20 $sq.cm$ c) 16 $sq.cm$ d) 24 $sq.cm$

21) Find height of equilateral triangle if side is $4\sqrt{3}$.

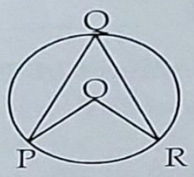
a) $\sqrt{3}$ b) 3 c) $\sqrt{6}$ d) 6

22) In the below rhombus PQRS, find the side of the rhombus if, $PR^2 = 9$ and $QS = 5$.



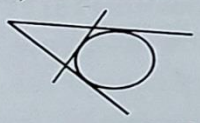
a) $\frac{34}{\sqrt{2}}$ b) $34\sqrt{2}$ c) $\frac{\sqrt{34}}{2}$ d) 17

23) In the below fig, O is the center of circle. Find $\angle PQR$ if $\angle PQR + \angle POR = 120^0$.



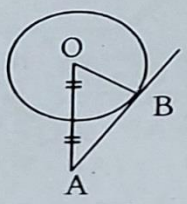
a) 30^0 b) 40^0 c) 60^0 d) 110^0

24) AB, AC, PQ are tangents of a circle as shown in the figure and AB = 5 cm, then find the perimeter of ΔAPQ.



a) 5 cm b) 10 cm c) 15 cm d) 20 cm

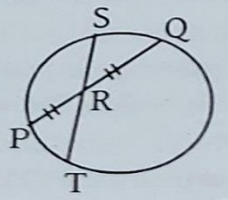
25) In the below figure find the length of the tangent AB if radius = 8 cm.



a) $2\sqrt{48}$ b) $\sqrt{48}$ c) $4\sqrt{20}$ d)Cannot be determined

d

26) In the below figure find PR if SR=5 cm and RT=6 cm.



a) $\sqrt{27}\ cm$ b) 36 cm c) $\sqrt{30}\ cm$ d) 5.5 cm

9.2 Basic Geometry (Home Assignment)

1. A line has

(a) one end point (b). two end points (c) three end points (d) no end points

2. A line segment has

(a) one end point (b). two end points (c) three end points (d) no end points

3. A ray has

(a) one end point (b). two end points (c) three end points (d) no end points

4. An angle which is greater than 180 degrees but less than 360 degrees is called

(a) acute angle (b) obtuse angle (c) straight angle (d) reflex angle

5. The complement of 62 degrees is

(a) 118 degrees (b) 28 degrees (c) 38 degrees (d) 48 degrees

6. The supplement of 60 degrees is

(a) 30 degrees (b) 40 degrees (c) 120 degree (d) 300 degrees

7. The complement of 72 degrees 40 minutes is

(a) 107 deg 20 min (b) 27 deg 20 min (c) 17 deg 20 min (d) 12 deg 40 min

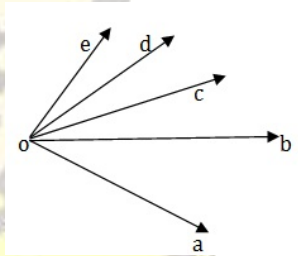
8. An angle is one fifth of its supplement. The measure of the angle is

(a) 15 deg (b) 30 deg (c) 75 deg (d) 150 deg

9. If an angle is its own complementary angle, then its measure is

(a) 30 deg (b) 45 deg (c) 60 deg (d) 90 deg

10. How many angles are made by rays shown in the figure?



(a) 5 (b) 6

(c) 8 (d) 10

11. If an angle is 24 deg more than its complement, the measure of the angle is

(a) 57 deg (b) 47 deg (c) 53 deg (d) 66 deg

12. An angle is 32 degree less than its supplement; the measure of the angle is

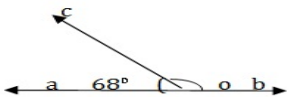
(a) 37 deg (b) 74 deg (c) 48 deg (d) 66 deg

13. Two supplementary angles are in the ratio 3:2; the smaller angle measure is

(a) 108 deg (b) 81 deg (c) 72 deg (d) 66 deg

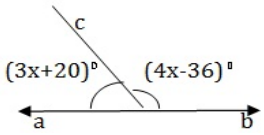
14. In the given figures, AOB is a straight line, angle AOC = 68 degrees and angle BOC = x degrees. The value of the x is

(a) 120 deg (b) 22 deg



(c) 112 deg (d) 132 deg

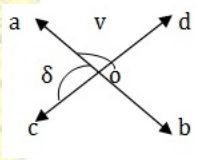
15. In the given figure, AOB is a straight line, angle AOC = (3x + 20) deg and



Angle BOC = (4x – 36) degrees. The value of x is

(a) 32 deg (b) 22 deg (c) 26 deg (d) 24 deg

16. In the given figure, straight line AB and CD intersect at O. IF ∠δ =3∠v, then ∠v = ?



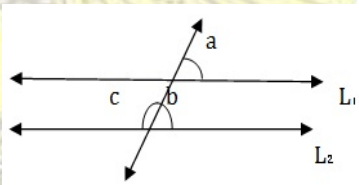
(a) 40 deg (b) 45 deg

(c) 50 deg (d) 55 deg

17. Two lines intersect

(a) at a point (b) in a line (c) at infinite no. of points (d) at two points

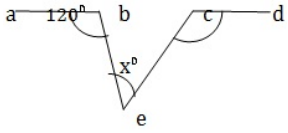
18. In the given figure L_1 || L_2 and ∠A = 65°. Then ∠C= ?



(a) 110 deg (b) 115 deg

(c) 120 deg (d) 135 deg

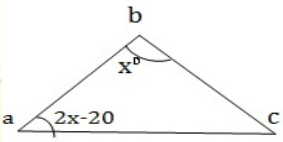
19. In the given figure , AB ll CD, ∠ABE =120°, ∠DCE = 100° and ∠BEC =x°. Then, x= ?



(a) 60 deg (b) 50 deg

(c) 40 deg (d) 70 deg

20. In a Δ ABC, AB= BC,∠ B= x° and ∠A = (2x-20)°. Then, ∠ B= ?



(a) 30 deg (b) 40 deg

(c) 44 deg (d) 64 deg

21. A ladder is placed in such a way that its foot is 15m away from a wall and its top reaches a window 20m above the ground. The length of the ladder is:

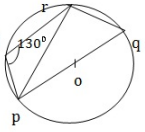
(a) 35 m (b) 17.5 m (c) 25 m (d) 18 m

22. A chord of length 30 cm is at a distance of 8 cm from the centre of a circle. The radius of the circle is:

(a) 11 cm (b) 13 cm (c) 15 cm (d) 17 cm

23. In the given figure , POQ is a diameter and PQRS is a cyclic quadrilateral. If ∠PSR =130°, Then ∠ RPQ =?

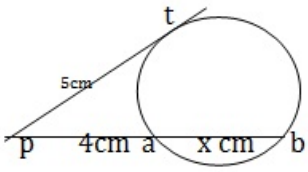
(a) 40 deg (b) 50 deg



(c) 60 deg (d) 70 deg

24. In the given fig. PAB is a secant and PT is a tangent to the circle from P. If PT = 4cm and AB = xcm , Then PB = ?

(a) 2.5 cm (b) 2.6 cm (c) 2.25 cm (d) 2.75 cm



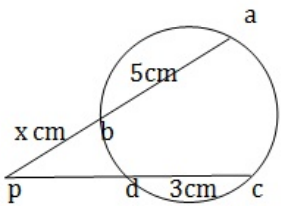
25. The lengths of the diagonals of a rhombus are 24cm and 18cm respectively. The length of each side of the rhombus is

(a) 12 cm (b) 9 cm (c) 15 cm (d) 8 cm

26. If Δ ABC is an isosceles triangle with ∠ C = 90^o and AC = 5cm , Then AB =?

(a) 2.5 cm (b) 5 cm (c) 10 cm (d) 5√2 cm

27. In the given figure, chords AB and CD of a circle intersect externally at P. If AB =6cm, CD = 3cm and PD= 5cm then PB= ?



(a) 5 cm (b) 6.25 cm

(c) 6 cm (d) 4 cm

28. The angle in a semi circle is

(a) an acute angle (b) an obtuse angle (c) a right angle (d) a reflex angle

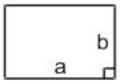
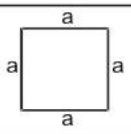
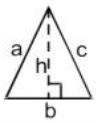
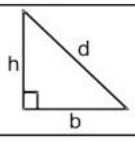
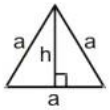
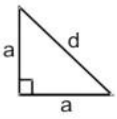
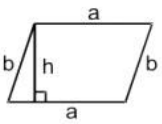
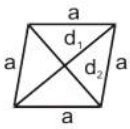
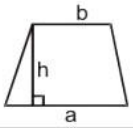
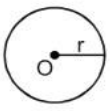
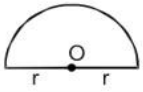
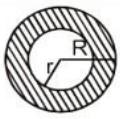
29. The lengths of the diagonals of a rhombus are 24cm and 18cm respectively. The length of each side of the rhombus is

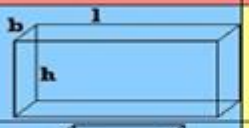
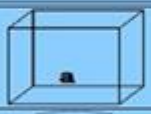
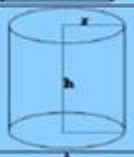
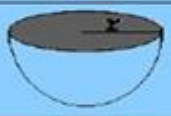
(a) 12cm (b) 9 cm (c) 15 cm (d) 8 cm

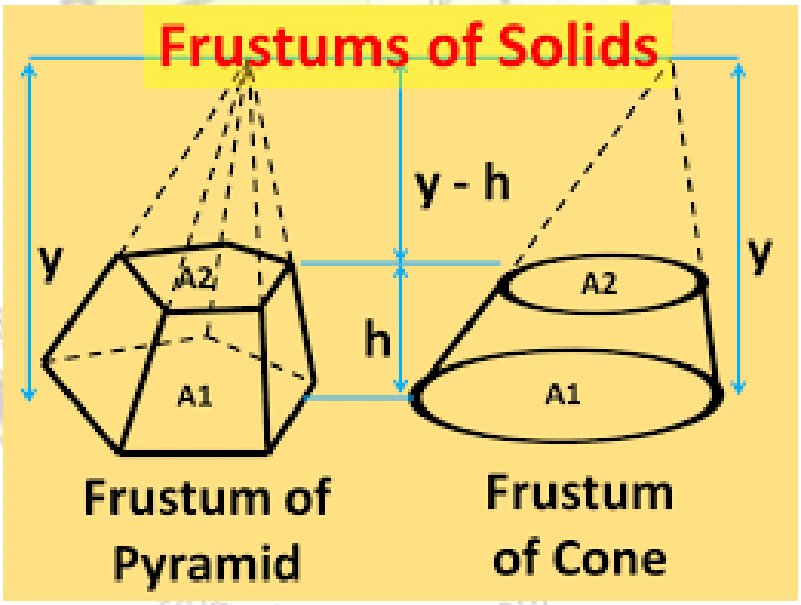
30. The bases of a parallelogram and a triangle are equal. If their altitudes are in the ratios of 3:4, then the ratio of their areas is?

(a) 4:3 (b) 2:3 (c) 3:2 (d) 3:4

10. Mensuration

Name	Figure	Perimeter	Area
Rectangle		2 (a + b)	ab
Square		4a	a^2
Triangle		a + b + c = 2s	1 = $\frac{1}{2} \times b \times h$ 2 = $\sqrt{s(s-a)(s-b)(s-c)}$
Right triangle		b + h + d	$\frac{1}{2}$ bh
Equilateral triangle		3a	1. $\frac{1}{2}$ ah 2. $\frac{\sqrt{3}}{4} a^2$
Isosceles right triangle		2a + d	$\frac{1}{2} a^2$
Parallelogram		2 (a + b)	ah
Rhombus		4a	$\frac{1}{2} d_1 d_2$
Trapezium		Sum of its four sides	$\frac{1}{2}$ h (a + b)
Circle		$2\pi r$	πr^2
Semicircle		$\pi r + 2r$	$\frac{1}{2} \pi r^2$
Ring (shaded region)		----	$\pi (R^2 - r^2)$
Sector of a circle		l + 2r where l = $(\theta/360) \times 2\pi r$	$\theta/360° \times \pi r^2$

Name	Figure	Curved Surface Area	Total Surface Area	Volume
Cuboid		$2(l+b)h$	$2(lb+bh+hl)$	lbh
Cube		$4a^2$	$6a^2$	a^2
Right Circular Cylinder		$2\pi rh$	$2\pi r(h+r)$	$\pi r^2 h$
Right Circular Cone		πrl	$\pi r(l+r)$	$\frac{1}{3}\pi r^2 h$
Sphere		$4\pi r^2$	$4\pi r^2$	$\frac{4}{3}\pi r^3$
Solid Hemisphere		$2\pi r^2$	$3\pi r^2$	$\frac{2}{3}\pi r^3$
Hollow Hemisphere		$2\pi r^2$	$2\pi r^2$	$\frac{2}{3}\pi r^3$



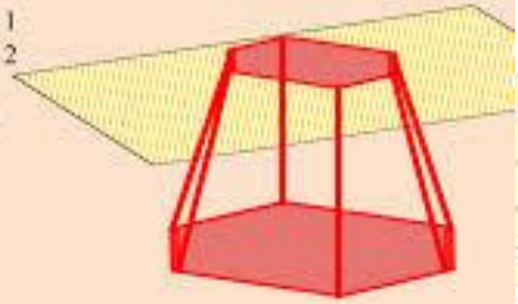
Total Surface Area

$$TSA = [\frac{1}{2}(P_1 + P_2)\, l] + B_1 + B_2$$

Total Volume

$$V = \frac{1}{3} h (B_1 + B_2 + \sqrt{B_1 B_2})$$

where:
P_1 = perimeter of base 1
P_2 = perimeter of base 2
l = slant height
h = altitude of frustum
B_1 = base area 1
B_2 = base area 2



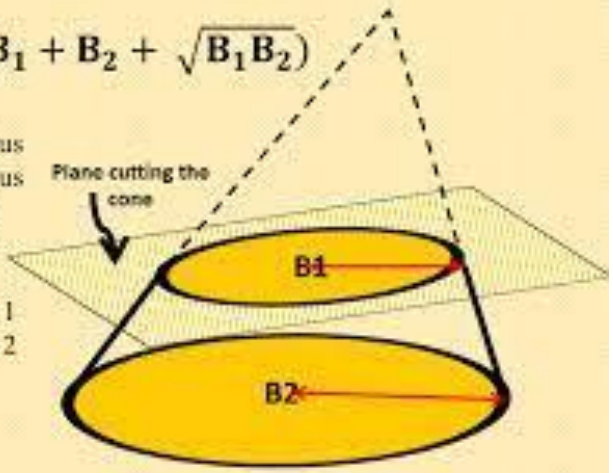
Total Surface Area

$$TSA = \pi (r_1 + r_2)\, l + \pi r_1^2 + \pi r_2^2$$

Total Volume

$$V = \frac{1}{3} h (B_1 + B_2 + \sqrt{B_1 B_2})$$

where:
r_1 = upper radius
r_2 = lower radius
l = slant height
h = altitude of frustum
B_1 = base area 1
B_2 = base area 2



10.1 Mensuration (Class Work)

1. If the side of an equilateral triangle is4 cm, find its area and perimeter.
   (a) 6.928 sq cm, 12 cm (b) 6 sq cm, 12 cm (c) 6.928 sq cm, 5 cm (d) None

2. If three sides of a triangle are 5, 6 and 7 cm respectively, find the area of triangle
   (a) 6√3 sq cm (b) 6√6 sq cm (c) 3√6 sq cm (d) 3√2 sq cm

3. If a triangular paper of length 6 cm and width 3 cm is rolled to form a cylinder with height equal to the width of the paper, then its base radius is
   (a) 3/π (b) 5/π (c) 7/π (d) 9/π

4. The sides of a triangle are in the ratio of 5:4:3. If its perimeter is 24 cm, what is the area of the triangle?
   (a) 22 sq cm (b) 24 sq cm (c) 26 sq cm (d) 28 sq cm

5. The two adjacent sides of a parallelogram are 12 and 14 metres respectively, and if the diagonal connecting the ends is 22 metres, find the area of the parallelogram.
   (a) 150 sq cm (b) 145 sq cm (c) 151.78 sq cm (d) None

6. The length of a rectangle is increased by 30% and its breadth is decreased by 20%. What is the percentage change in the area?
   (a) 4 (b) 6 (c) 8 (d) 10

7. The diameter of a circle is doubled. Its area becomes ____ times.
   (a) 4 (b) 2 (c) 6 (d) 8

8. There is a path of 1 m width, around a circular part of 10 m radius. What is the area of the path?
   (a) 66 sq cm (b) 55 sq cm (c) 45 sq cm (d) 68 sq cm

9. A rope, by which a horse istied, is increased from 12 to 23 m. How much additional ground with it be able to graze?
   (a) 1020 sq m (b) 1210 sq m (c) 1120 sq m (d) None

10. A sphere has the same curved surface as a cone of height 12 cm and base radius 5 cm. Find the radius to the nearest cm.
    (a) 4 cm (b) 5 cm (c) 6 cm (d) 7 cm

11. The surface area of hemisphere is 462 sq cm. What is its curved surface area?
    (a) 300 sq cm (b) 308 sq cm (c) 306 sq cm (d) 302 sq cm

12. The height of a cylinder is halved and its radius is increased to three times the initial radius. What is the ratio between the initial volume and new volume?
    (a) 2:7 (b) 2:5 (c) 2:3 (d) 2:9

13. If 12000 copies of a newspaper are issued daily in a town, each copy consisting of 4 sheets and each sheet measuring 75cm x 50 cm, how many hectares will be covered by these copies?
    (a) 45 hectares (b) 54 hectares (c) 43 hectares (d) 18 hectares

14. A reservoir is supplied water by a pipe 6 cm in diameter. How many pipes of 3 cm diameter would discharge the same quantity, supposing the velocity of water is same?
    (a) 1 (b) 3 (c) 4 (d) 5

15. Find area of a right-angled triangle whose base is 5 units and hypotenuse is 13 units.
    (a) 60 sq unit (b) 15 sq unit (c) 8 sq unit (d) 30 sq unit

16. Find the side of the equilateral triangle if the area is √3 sq cm.
    (a) √2 cm (b) 2 cm (c) √3 cm (d) 2√3 cm

17. Find the perimeter of an isosceles triangle, whose base of 8 cm is formed by the third unequal side and the height of the triangle from the unequal side is 3 cm.
    (a) 9 cm (b) 18 cm (c) 27 cm (d) None

18. In a quadrilateral ABCD, the angles made on each vertex are in the ratio 1:2:3:4. Find the measure of angle made at vertex B.
(a) 72 degrees (b) 84 degree (c) 96 degrees (d) 108 degrees

19. Find the area of a circular pathway, where inner radius is 3 cm and it is 6 times the width of the pathway.
(a) 4π sq cm (b) 19 sq cm (c) 2.41π sq cm (d) None

20. Find the length of diagonal of a cuboid if length of cuboid = 8 cm, breadth of cuboid = 11 cm and height of cuboid is half of length of cuboid.
(a) 201 cm (b) √201 cm (c) 2√101 cm (d) √(201/2) cm

21. Find the percentage increase in the surface of a cube if the edge of the cube is increased by 20%?
(a) 20% (b) 22% (c) 40% (d) 44%

22. Find the ratio of volume of cylinders whose height are equal and radii are in the ratio of 2:5.
(a) 2:5 (b) 5:2 (c) 4:25 (d) 1:16

23. Find the total surface area of the right circular cone if slant height is equal to radius and radius equal to π.
(a) $4\pi^2$ (b) $2\pi^3$ (c) $4\pi^4$ (d) $4\pi^3$

24. If the sphere of radius 16 cm is melted to form smaller spheres of diameter 4 cm, then find how many smaller spheres can be formed?
(a) 8 (b) 64 (c) 512 (d) Infinite

25. Find the coloring cost of the sphere if the radius of sphere is 6 cm and cost per sq cm for color is Rs 3.
(a) 170 (b) 150 (c) 120 (d) 80

10.1 Mensuration (Home Assignment)

1. The area of a triangle having sides 3, 4 and 5 m is
   (a) 6 m^2 (b) 7.5 m^2 (c) 4.5 m^2 (d) 6.5 m^2

2. The area of a triangle whose base is 4.6 m and height is 67 cm is
   (a) 16410 cm^2 (b) 15410 cm^2 (c) 941 cm^2 (d) 17410 cm^2

3. The length of the side of an equilateral triangle is $4/\sqrt{3}$ cm. Its height is
   (a) 2 cm (b) 3 cm (c) 4 cm (d) 5 cm

4. The height of an equilateral triangle is $4\sqrt{3}$ cm. Its area is
   (a) $14\sqrt{3}$ cm^2 (b) $15\sqrt{3}$ cm^2 (c) $16\sqrt{3}$ cm^2 (d) $17\sqrt{3}$ cm^2

5. The perimeter of an isosceles triangle is 42 cm. If the base is 16 cm, the length of equal sides is
   (a) 14 cm (b) 12 cm (c) 16 cm (d) 13 cm

6. If the base of an isosceles triangle is 10 cm and the length of equal sides is 13 cm, its area is
   (a) 60 cm^2 (b) 55 cm^2 (c) 28 cm^2 (d) 75 cm^2

7. In a parallelogram, the lengths of adjacent sides are 11 cm and 13 cm, respectively. If the length of one diagonal is 20 cm, the length of the other diagonal is approximately
   (a) 14.5 m (b) 13.4 m (c) 16.8 m (d) 18.7 m

8. The area of a quadrilateral, whose diagonal is 38 cm long and the lengths of perpendiculars from the other two vertices are 31 cm and 19 cm respectively, is
   (a) 950 cm^2 (b) 810 cm^2 (c) 780 cm^2 (d) 885 cm^2

9. The area of a parallelogram whose adjacent sides are 130 m and 140 m and one of the diagonals connecting them is 150 m long.
   (a) 18900 m^2 (b) 17750 m^2 (c) 16800 m^2 (d) 15500 m^2

10. The area of a rectangular field whose one side is 16 cm and the diagonal is 20 cm is
    (a) 184 cm^2 (b) 192 cm^2 (c) 224 cm^2 (d) None of these

11. A rectangular carpet has an area of 120 m^2 and perimeter of 46 m. The length of its diagonal is
    (a) 15 m (b) 16 m (c) 17 m (d) None of these

12. The perimeter of a rectangle is 82 cm and its area is 400 sq. m. The length and breadth respectively are
    (a) 16 m, 25 m (b) 25 m, 16 m (c) 27 m, 24 m (d) 22 m, 19 m

13. If the area of a square field be 6050 m^2, the length of its diagonal is
    (a) 120 m (b) 105 m (c) 115 m (d) 110 m

14. In order to fence a square Ram fixed 36 poles. If the distance between two poles is 6 m, the area of square is
    (a) 1216 m^2 (b) 2516 m^2 (c) 2916 m^2 (d) 3125 m^2

15. The perimeter of a square field is $16\sqrt{2}$ cm. The length of its diagonal is
    (a) 7 cm (b) 7.5 cm (c) $7\sqrt{2}$ cm (d) 8 cm

16. The area of a rhombus is 156 cm^2. If one of its diagonals is 13 m, the length of the other diagonal is
    (a) 24 m (b) 25 m (c) 26 m (d) 28 m

17. In a rhombus, the lengths of two diagonals are 18 m and 24 m. Its perimeter is
    (a) 50 m (b) 60 m (c) 70 m (d) 75 m

18. The side of a rhombus, one of whose diagonals measures 4 m and the other 3 m, is

(a) 2.5 m (b) 3.0 m (c) 4.5 m (d) 5.5 m

19. The parallel sides of a trapezium are 24 m and 52 m. If its other two sides are 26 m and 30 m, its area is
(a) 912 m^2 (b) 896 m^2 (c) 729 m^2 (d) 1028 m^2

20. The two parallel sides of a trapezium of area 180 sq cm measure 28 cm and 12 cm. Its height is
(a) 7 cm (b) 8 cm (c) 9 cm (d) 10 cm

21. The volume and the total surface area of a cuboid whose dimensions are 25 m, 10 m and 2m are respectively
(a) 400 m^2, 640 m^3 (b) 500 m^2, 640 m^3 (c) 500 m^2, 540 m^3 (d) 500 m^2, 740 m^3

22. The length of the longest bamboo that can be placed in a room 12 m long, 9 m broad and 8 m high is
(a) 15 m (b) 16 m (c) 17 m (d) 18 m

23. The area of a side of a box is 120 cm^2. The area of the other side of the box is 27 cm^2. If the area of the upper surface of the box is 60 cm^2, then the volume of the box is
(a) 720 cm^3 (b) 620 cm^3 (c) 729 cm^3 (d) 848 cm^3

24. The sum of length, breadth and height of a cuboid is 12 cm long. The total surface area of the cuboid is
(a) 70 cm^2 (b) 75 cm^2 (c) 80 cm^2 (d) 85 cm^2

25. The volume and the length of diagonal of a cube, each of whose sides measures 4 cm are
(a) 64 cm^3, 4√3 cm (b) 16 cm^3, 4√3 cm (c) 64 cm^3, 3√3 cm (d) 64 cm^3, 5√3 cm

26. The surface area of a cube is 216 cm^2, its volume is
(a) 216 cm3 (b) 256 cm3 (c) 326 cm3 (d) 569 cm3

27. The diagonal of a cube is 8√3 cm. Its total surface area and volume are respectively
(a) 256 cm^2, 512 cm^3 (b) 384 cm^2, 576 cm^3 (c) 384 cm^2, 512 cm^3(d) 384 cm^2, 712 cm^3

28. If the volume of two cubical blocks are in the ratio of 8:1, the ratio of their edges is
(a) 3 : 1 (b) 1 : 3 (c) 2 : 1 (d) 1 : 2

29. Volumes of the two cubes are in the ratio of 1 : 9. The ratio of their surface areas is
(a) 1 : $3(2)^{1/3}$ (b) 1 : $3(3)^{1/3}$ (c) (b) 2 : $3(3)^{1/3}$ (d) (b) 2 : $3(2)^{1/3}$

30. Sides of two cubes are in the ratio of 2 : 3. The ratios of their surface areas is
(a) 4 : 9 (b) 5 : 9 (c) 5 : 7 (d) 4 : 7

31. The diameter of the base of a right circular cylinder is 28 cm and its height is 10 cm. The volume and area of the curved surface of the cylinder is
(a) 770 cm^2 (b) 880 cm^2 (c) 676 cm^2 (d) 729 cm^2

32. A cylinder of height 21 cm has base of radius 4 cm. The total surface area of the cylinder is
(a) $628^4/_7$ cm^2 (b) $625^4/_7$ cm^2 (c) $576^4/_7$ cm^2 (d) $512^4/_7$ cm^2

33. A rectangular piece of paper is 71 cm long and 10 cm wide. A cylinder is formed by rolling the paper along its breadth. Taking ∏ = 355/113, the volume of the cylinder is
(a) 455 cm^3 (b) 465 cm^3 (c) 565 cm^3 (d) 575 cm^3

34. Two circular cylinders of equal volume have their heights in the ratio of 9 : 16. The ratio of their radii is
(a) 2 : 3 (b) 4 : 3 (c) 5 : 2 (d) 5 : 3

35. Two circular cylinders of equal volume have their height in the ratio of 16 : 25. The ratio of their curved surface areas is
(a) 3 : 5 (b) 5 : 3 (c) 4 : 5 (d) 5 : 4

36. Two circular cylinders of equal volume have their radii in the ratio of 4 : 9. The ratio of curved surface areas is
(a) 9 : 4 (b) 4 : 9 (c) 5 : 9 (d) 9 : 5

37. Two circular cylinders of equal heights have their radii in the ratio of 2 : 5. The ratio of their volumes is
(a) 4 : 5 (b) 4 : 25 (c) 2 : 5 (d) 2 : 25

38. Two circular cylinders of equal heights have their curved surface areas in the ratio of 3 : 5. The ratio of their volumes is
(a) 9 : 25 (b) 3 : 25 (c) 3 : 5 (d) 9 : 5

39. Two circular cylinders of equal curved surface areas have their heights in the ratio of 4 : 7. The ratio of their volumes
(a) 4 : 5 (b) 5 : 4 (c) 4 : 7 (d) 7 : 4

40. Two circular cylinders of equal curved surface areas have their heights in the ratio of 4 : 5. The ratio of their volumes is
(a) 5 : 4 (b) 4 : 5 (c) 3 : 5 (d) 5 : 3

41. The slant height of a cone whose volume is 1232 cm^3 and radius of the base is 7 cm
(a) 15 cm (b) 20 cm (c) 25 cm (d) 35 cm

42. A tent is of diameter 12 m at the base and its height is 8 m. How many persons can the tent accommodate, at the most, if each person requires 18 m^3 of air?
(a) 15 (b) 16 (c) 17 (d) 18

43. The height of a cone is 21 cm and radius of its base is 28 cm. Its total surface area is
(a) 4544 cm^2 (b) 4954 cm^2 (c) 5544 cm^2 (d) 6644 cm^2

44. Two right circular cones of equal curved surface areas have their slant heights in the ratio of 3 : 5. The ratio of their radii is
(a) 5 : 3 (b) 4 : 5 (c) 3 : 5 (d) 5 : 4

45. Two right circular cones of equal volumes have their heights in the ratio of 4 : 9. The ratio of their radii is
(a) 3 : 2 (b) 4 : 5 (c) 3 : 5 (d) 2 : 3

46. Two right circular cones of equal heights have their radii in the ratio of 1 : 3. The ratio of their volumes is
(a) 1 : 8 (b) 8 : 3 (c) 9 : 1 (d) 1 : 9

47. The volumes of two cones are in the ratio of 1 : 4 and their diameters are in the ratio of 4 : 5. The ratio of their heights is
(a) 25 : 49 (b) 16 : 25 (c) 25 : 56 (d) 25 : 64

48. A reservoir is in the shape of a frustum of a right circular cone. It is 8 m across the top and 4 m across the bottom. It is 6 m deep. The area of its volume is
(a) 126 m^3 (b) 176 m^3 (c) 225 m^3 (d) 369 m^3

49. Diameter of a sphere is 28 cm. Its surface area is
(a) 1464 cm^2 (b) 1764 cm^2 (c) 2464 cm^2 (d) 3464 cm^2

50. The curved surface area and the total surface area of a hemisphere of radius 21 cm are (in cm^2)
(a) 2772, 4158 (b) 3765, 5479 (c) 1578, 4236 (d) 2994, 4236

51. The radii of two spheres are in the ratio of 2 : 3. The ratio of their surface areas is
(a) 3 : 4 (b) 4 : 9 (c) 9 : 4 (d) 3 : 2

52. The radii of two spheres are in the ratio of 2 : 5. The ratio of their volumes is
(a) 5 : 16 (b) 8 : 64 (c) 8 : 25 (d) 8 : 125

53. The volume and the total surface area of a triangular prism whose height is 30 m and the sides of whose base are 21 m, 20 m and 13 m respectively are
(a) 6804 m^3, 1872 m^2 (b) 6304 m^3, 1572 m^2 (c) 7804 m^3, 2872 m^2 (d) 5804 m^3, 1872 m^2

11. Equations

Linear Equation in One Variable:

A linear equation in one variable is an equation of the type ax + b = 0 or ax = c, where a, b, c are constants (real numbers), a ≠ 0 and x is an unknown variable.

The solution of the linear equation ax + b = 0 is x = -b/a. We also say that -b/a is the root of the linear equation ax + b = 0.

For example, the equation 2x + 5 = 0 is a linear equation in one unknown variable x. Its solution or root is -3/2.

Linear Equation in Two Variables:

A linear equation in two variables is an equation of the type ax + by + c = 0 or ax + by = d, where a, b, c and d are constants, a ≠ 0, b ≠ 0 and x and y are two unknown variables.

For example, 4x + 7y + 3 = 0 and 2x – 5y = 9 are linear equations in two variable x and y.

Methods of Solving Two Simultaneous Linear Equations:

1. Method of substitution:

We find the value of one variable in terms of another variable and substitute the value-obtained in other equation.

2. Method of Elimination:

We multiply both the equation by suitable numbers so that the coefficient of one of the variables becomes numerically same.

3. Short-cut Method:

Let the two equations be

$a_1x + b_1y = c_1$

$a_2x + b_2y = c_2$

The solution is written as

$$\frac{x}{b_1c_2 - b_2c_1} = \frac{y}{c_1a_2 - c_2a_1} = \frac{-1}{a_1b_2 - a_2b_1}$$

i.e. $x = \frac{b_1c_2 - b_2c_1}{a_1b_2 - a_2b_1}$ and $y = -\frac{c_1a_2 - c_2a_1}{a_1b_2 - a_2b_1}$

Consistent and Inconsistent Equations:

When a system of equations has a solution, the system is called consistent. When a system of equations has no solution, the system is called inconsistent.

Test of Consistency:

If we are given two equations $a_1x + b_1y = c_1$ and $a_2x + b_2y = c_2$. Then,

a) If $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$, the system will have exactly one solution and will be consistent. The graph of such equations will have intersecting lines.

b) If $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$, the system is consistent and has infinitely many solutions. The graph of such equations will have coincident lines.

c) If $\frac{a_1}{a_2} = \frac{b_1}{b2} \neq \frac{c_1}{c_2}$, the system has no solution and is inconsistent. The graphs of such equations will have parallel lines.

Quadratic Equations:

An equation of the form: $ax^2 + bx + c = 0$, where a (≠ 0), b and c are real numbers is called a Quadratic Equation.

The numbers a, b and c are coefficients of the quadratic equation.

The expression $b^2 - c$ is called the Discriminant. It is generally denoted by D.

Roots of the Quadratic Equation:

The roots of the quadratic equation $ax^2 + bx + c = 0$, are given by $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Nature of Roots of the Quadratic Equation

1. If D < 0, then roots α and β are imaginary.

2. If D > 0, then roots α and β are real and distinct.

3. If D = 0, then roots α and β are real and equal.

Sum and Product of the Roots

If α and β are roots of $ax^2 + bx + c = 0$, then

Sum of roots = $\alpha + \beta = \frac{-b}{a}$

Product of roots = $\alpha\beta = \frac{c}{a}$

Symmetric Functions of the Roots:

In a symmetric function remains unchanged when its roots are interchanged. In order to find the value of a symmetric function, express the given function in terms of $\alpha + \beta$ and $\alpha\beta$. The following results will be useful.

1. $\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$

2. $\alpha^3 + \beta^3 = (\alpha + \beta)^3 - 3\alpha\beta(\alpha + \beta)$

3. $\alpha^4 + \beta^4 = (\alpha^3 + \beta^3)(\alpha + \beta) - \alpha\beta(\alpha^2 + \beta^2)$

4. $\alpha^5 + \beta^5 = (\alpha^3 + \beta^3)(\alpha^2 + \beta^2) - \alpha^2\beta^2(\alpha + \beta)$

5. $|\alpha - \beta| = \sqrt{(\alpha + \beta)^2 - 4\alpha\beta}$

6. $\alpha^2 - \beta^2 = (\alpha + \beta)(\alpha - \beta)$

7. $\alpha^3 - \beta^3 = (\alpha - \beta)\{(\alpha + \beta)^2 - \alpha\beta\}$

8. $\alpha^4 - \beta^4 = (\alpha + \beta)(\alpha - \beta)(\alpha^2 + \beta^2)$

Key Points on Quadratic Equations:

1. Roots are rational; it means D is a perfect square.

2. Roots are irrational; it means D is positive but not a perfect square.

3. If a + b + c = 0, then 1 is a root of the equation $ax^2 + bx + c = 0$.

4. If a andc are of opposite signs, the roots must be of opposite sign.

5. If the roots are equal in magnitude but opposite in sign, then b = 0, ac > 0.

6. If the roots are reciprocal of each other, then c = a.

7. If $ax^2 + bx + c = 0$ is satisfied by more than two values, it is an identity and a = b = c = 0 and vice-versa.

8. If $ax^2 + bx + c = 0$, where a, b and c are real numbers, and has one root p + *i*q, then the other root will be p – *i*q. Hence imaginary roots occur in a conjugate pair.

9. If $ax^2 + bx + c = 0$, where a, b and c are rational, and has one root $p + \sqrt{q}$ then the other root will be $p - \sqrt{q}$. Hence irrational roots occur in conjugate pair if the coefficients are rational.

10. The quadratic function $ax^2 + 2hxy + by^2 + 2gx + 2fy + c$ is resolvable into linear rational factors if and only if $D = abc + 2fgh - af^2 - bg^2 - ch^2 = 0$.

Polynomial Function:

If $a_0, a_1, a_2, \ldots a_n$, are real and 'n' is a positive integer, then $f(x) = a_0 + a_1x + a_2x^2 + \ldots + a_nx^n$ is called a polynomial function in x.

Polynomial Equation:

If $a_0, a_1, a_2, \ldots a_n$, are real and 'n' is a positive integer, then $f(x) = a_0 + a_1x + a_2x^2 + \ldots + a_nx^n = 0$ is called a polynomial equation in x with real coefficients. If $a_n \neq 0$, then f(x) = 0 is an equation of degree 'n'.

Root of a Polynomial Equation:

The value of x which satisfies f(x) = 0 is called root of the equation f(x) = 0. If f(a), then x = a is a root of equation f(x) = 0. Also (x – a) is a factor of the polynomial f(x).

11.1 Equations (Class Work)

1. Which of the following, for which the system of equations kx + 2y = 5 and 3x + y = 1, has a unique solution
   (a) $k \neq 5$ (b) $k = 5$ (c) $k = 6$ (d) $k \neq 6$

2. For what value of k, the system of equations 3x + 4y = 6 and 6x + 8y = k represent, coincident lines?
   (a) k = 10 (b) k = 11 (c) k = 12 (d) k = 12.5

3. The value of k for which the equations 9x + 4y = 9 and 7x + ky = 5 have no solution
   (a) k = 23/9 (b) k = 28/9 (c) k = 25/7 (d) k = 34/13

4. If 2/x + 3/y = 9/xy and 4/x + 9/y = 21/xy, where $x \neq 0$ and $y \neq 0$, the values of x and y are respectively
   (a) 0, 1 (b) 1,2 (c) 2, 3 (d) 1, 3

5. The solution to the system of equations Ix + yI = 1 and x – y = 0 is given by
   (a) x = y = 1/2 (b) x = y = –1/2 (c) x = 1 , y = 0 (d) both (a) & (b)

6. A man has some hens and cows. If the number of heads be 48 and number of feet equals 140, the number of hens will be
   (a) 26 (b) 24 (c) 23 (d) 22

7. Rs 49 were divided among 150 children. Each girl got 50 paise and a boy, 25 paise. The number of boys was
   (a) 100 (b) 102 (c) 104 (d) 105

8. The value of c for which the system of equations cx + 3y = c – 3, 12x + cy = c has infinitely many solutions
   (a) 6 (b) 8 (c) 4 (d) None of these

9. The value of k for which the system of equations 2x + ky = 1, 3x – y = 7 has a unique solutions
   (a) k = -2/3 (b) $k \neq 2/3$ (c) $k \neq -2/3$ (d) k = 2/3

10. There are 190 chairs; they are to be arranged in rectangular manner. Initially, when the chairs are arranged 5 more chairs are needed. When number of rows is increased by 2, 35 more chairs are needed, initially the rows were
    (a) 17 (b) 13 (c) 15 (d) None of these

11. The set of values of P for which the quadratic equation $Px^2 + 4x + 1 = 0$ has real roots.
    (a) $P < 4$ (b) $P \geq 4$ (c) $P \leq 4$ (d) None of these

12. If one root of the quadratic equation $2x^2 + Px + 4 = 0$ is 2, the second root and value of P respectively will be
    (a) 1, -6 (b) 1, 6 (c) -1, 6 (d) -1, -6

13. The roots of the equation $3a^2x^2 – 3abx + 2b^2 = 0$ are
    (a) 2b/a, -b/a (b) 2b/a, b/a (c) -2b/a, b/a (d) None of these

14. The quadratic equation whose roots are $\sqrt{2}$ and $2\sqrt{2}$ is
    (a) $x^2 - 3\sqrt{2}x – 4 = 0$ (b) $x^2 - 3\sqrt{2}x + 4 = 0$ (c) $x^2 + 3\sqrt{2}x – 4 = 0$ (d) $x^2 + 3\sqrt{2}x + 4 = 0$

15. The value of P so that the equation $3x^2 - 5x + P = 0$, has equal roots
    (a) -25/12 (b) 25/6 (c) 25/12 (d) -25/6

16. If α and β are the roots of the equation $ax^2 + bx + c = 0$, then the value of $\alpha^2+\beta^2$ is
    (a) $(b^2 – 2ac)/2a^2$ (b) $(b^2 + 2ac)/a^2$ (c) $(b^2 + 2ac)/2a^2$ (d) $(b^2 – 2ac)/a^2$

17. If α and β are the roots of the equation $ax^2 + bx + c = 0$, then the value of $(\alpha/\beta) + (\beta/\alpha)$ is
(a) $(b^2 - 2ac)/ac$ (b) $(b^2 - 2ac)/2ac$ (c) $(b^2 - ac)/2ac$ (d) $(b^2 + 2ac)/ac$

18. The value of p so that the equation $x^2 + 5px + 16 = 0$ has no real root, is
(a) $-4/5 < p < 4/5$ (b) $-8/5 < p < 8/5$ (c) $P < -4/5$ or $p > 4/5$ (d) None of these

19. The expression $x^4 + 7x^2 + 16$ can be factored as
(a) $(x^2 + x + 1)(x^2 + x + 16)$ (b) $(x^2 + x + 1)(x^2 - x + 16)$ (c) $(x^2 + x + 4)(x^2 - x + 4)$ (d) $(x^2 + x - 4)(x^2 - x - 4)$

20. The positive value of m for which the roots of the equation $12x^2 + mx + 5 = 0$ are in the ratio 3:2 is
(a) $5\sqrt{10}$ (b) $(5/2)\sqrt{10}$ (c) $5/12$ (d) $12/5$

12. Permutations & Combinations

1. The continued product of first n natural numbers is called n factorial or factorial n and is denoted by n! Thus, n! = 1.2.3.4…(n-1).n or, n! = n.(n-1).(n-2)...3.2.1
2. 0! = 1 and n! = n.(n-1)!
3. **Multiplication Principle:** If an operation can be performed in m different ways; following which a second operation can be performed in n different ways, then the two operations in succession can be performed in m x n different ways. For example: If Monu wishes to go from Delhi to Mumbai by train and return from Mumbai to Delhi by air. There are six different trains from Delhi to Mumbai and five different flights from Mumbai to Delhi. In how many ways can he perform the journey? Solution: Since he can choose any one of the six trains for going to Mumbai, and for each such choice he has five choices for returning to Delhi, he can perform the journey in 6 x 5 ways, that is, 30 ways.
4. **Addition Principle:** If an operation can be performed in m different ways and another operation, which is independent of the first operation, can be performed in n different ways, then either of the two operations can be performed in m+n ways. For example: Suppose there are 7 gates to a stadium, 3 on one side and 4 on the other. Sonu has to go out of the stadium. He can go out from any one of the 7 gates. Thus, the number of ways in which he can go out is 7. Hence, the work of going out through the gates on one side will be done in 3 ways and that through the gates on the other side will be done in 4 ways. The work of going out will be done when Sonu goes out from side I or side II. Thus, the work of going out can be done in 3 + 4 = 7 ways.
5. **Permutation:** Each of the different arrangements which can be made by taking some or all of given number of things or objects at a time is called a *permutation*. Permutation of things means arrangement of things. The word arrangement is used if order of things is taken into account. Thus, if order of different things changes, then their arrangement also changes.

   Let r and n be positive integers such that the value of r lies between 1 and n. Then, the number of permutations of n different things, taken r at a time, is denoted by the symbol ${}^{n}P_{r}$ or P(n, r).
6. ${}^{n}P_{r}$ or P(n, r) = n!/(n-r)! = n.(n-1).(n-2)…{n-(r-1)}
7. The number of permutations of n things, taken all at a time, out of which p are alike and are of one type, q are alike and are of second type and rest are all different = n!/(p!.q!)
8. The number of permutations of n different things taken r at a time when each thing may be repeated any number of times is n^{r}.
9. **Permutations under Restrictions:**
   a. Number of permutations of n different things, taken r at a time, when a particular thing is to be always included in each arrangement = $r.{}^{n-1}P_{r-1}$
   b. Number of permutations of n different things, taken r at a time, when s particular things are to be always included in each arrangement = $s!.\{r-(s-1)\}.{}^{n-s}P_{r-s}$.
   c. Number of permutations of n different things, taken r at a time, when a particular thing is never taken in each arrangement = ${}^{n-1}P_{r}$.
   d. Number of permutations of n different things, taken all at a time, when m specified things always come together = m! x (n-m+1)!
   e. Number of permutations of n different things, taken all at a time, when m specified things never come together = n! – {m! x (n-m+1)!}
10. **Circular Permutations:**
    a. Number of circular arrangements (permutations) of n different things = (n-1)!
    b. Number of circular arrangements (permutations) of n different things when clockwise and anticlockwise arrangements are not different, that is when observation can be made from both sides = (1/2) x (n-1)!

Combination: Each of the different groups or selections which can be made by taking some or all of a number of things (irrespective of order) is called a *combination*.

Combination of things means selection of things. Obviously, in selection of thins order of things has no importance. Thus, with the change of order of things selection of things does not change. The number of combinations of n different things taken r at a time is denoted by ${}^{n}C_{r}$ or C(n, r).

11. ${}^{n}C_{r}$ or C(n, r) = n!/{n!.(n-r)!} = ${}^{n}P_{r}$/r!

12. ${}^{n}C_{r}$= ${}^{n}C_{n-r}$, ${}^{n}C_{0}$ = ${}^{n}C_{n}$, ${}^{n}C_{1}$ = n

13. If ${}^{n}C_{x}$ = ${}^{n}C_{y}$ then either x = y or y = n – x.

14. ${}^{n}C_{r}$ + ${}^{n}C_{r-1}$ = ${}^{n+1}C_{r}$.

15. ${}^{n}C_{0}$+ ${}^{n}C_{1}$+ ${}^{n}C_{2}$ + … + ${}^{n}C_{n}$= 2^{n}.

16. ${}^{n}C_{0}$+ ${}^{n}C_{2}$+ ${}^{n}C_{4}$ + … = ${}^{n}C_{1}$+ ${}^{n}C_{3}$+ ${}^{n}C_{5}$ + … = 2^{n-1}.

17. Number of combinations of n different things taken r at a time

a. When p particular things are always included = ${}^{n-p}C_{r-p}$.
b. When p particular things are never included = ${}^{n-p}C_{r}$.
c. When p particular things are not together in any selection = ${}^{n}C_{r}$ – ${}^{n-p}C_{r-p}$.

18. If out of (p+q+r+t) things, p are alike of one kind, q are alike of second kind, r are alike of third kind and t are different, then the total number of selections is {(p+1).(q+1).(r+1).2^{t}} – 1.

19. The number of ways of selecting some of all out of p+q+r items where p are alike of one kind, q are alike of second kind and rest are alike of third kind = {(p+1).(q+1).(r+1).} – 1.

20. Number of ways of dividing m+n different things in two groups containing m and n things respectively (m ≠ n) = (m+n)!/(m!xn!)

21. Number of ways of dividing m+n+p different things in three groups containing m, n and p things respectively (m ≠ n ≠ p) = (m+n+p)!/(m!xn!xp!)

22. The number of triangles which can be formed by joining the angular points of a polygon of n sides as vertices = {n(n-1)(n-2)}/6

23. The number of diagonals which can be formed by joining the vertices of a polygon of n sides = n(n-3)/2

24. If there are m horizontal lines and n vertical lines then the number of different rectangles formed = ${}^{m}C_{2}$x ${}^{n}C_{2}$

25. There are n points in a plane out of which m points are collinear. The number of triangles formed by the points as vertices = ${}^{n}C_{3}$– ${}^{m}C_{3}$

26. There are n points in a plane out of which m points are collinear. The number of straight lines formed by joining them = ${}^{n}C_{2}$– ${}^{m}C_{2}$ + 1

27. If there are n points in a plane and no three points are collinear, then the number of triangles formed with n points = {n(n-1)(n-2)}/6

28. The number of quadrilaterals that can be formed by joining the vertices of a polygon of n sides = {n(n-1)(n-2)(n-3)}/24, where n>3

29. There are n points in a plane and no points are collinear, then the number of straight lines that can be drawn using these n points = n(n-1)/2

30. There are n persons in a party and every person shakes hands with other persons. Total no. of handshakes H = n(n-1)/2.

12.1 Permutations & Combinations (Class Work)

1. There are 6 candidates for 3 posts. In how many ways can the posts be filled?
   (a) 120 (b) 130 (c) 100 (d) 110

2. There are 15 buses running between Delhi and Mumbai. In how many ways can a man go to Mumbai and return by a different bus?
   (a) 280 (b) 310 (c) 240 (d) 210

3. For a set of five true-or-false questions, no student has written all the correct answers, and no two students have given the same sequence of answers. The maximum number of students in the class, for this to be possible, is
   (a) 31 (b) 21 (c) 51 (d) 41

4. A code word is to consist of two English alphabets followed by two distinct numbers between 1 and 9. For example, CA23 is a code word. How many such code words are there?
   (a) 615800 (b) 46800 (c) 719500 (d) 410800

5. There are 5 letters and 5 directed envelopes. Find the number of ways in which the letters can be put into the envelopes so that all are not put in directed envelopes?
   (a) 129 (b) 119 (c) 109 (d) 139

6. How many three-digit odd numbers can be formed from the digits 1, 2, 3, 4, 5, 6 when i. repetition of digits is not allowed and ii. When repetition of digits is allowed
   (a) 60, 108 (b) 50, 98 (c) 70, 118 (d) 80,128

7. How many odd numbers less than 1000 can be formed using the digits 0, 2, 5, 7? (repetition of digits is allowed)
   (a) 52 (b) 32 (c) 22 (d) 42

8. How many words (with or without meaning) of three distinct English alphabets are there?
   (a) 15600 (b) 14650 (c) 12800 (d) 13700

9. How many integers between 1000 and 10000 have no digits other than 4, 5 or 6?
   (a) 91 (b) 51 (c) 81 (d) 71

10. A customer forgets a four-digit code for an ATM in a bank. However, he remembers that this code consists of digits 3, 5, 6 and 9. Find the largest possible number of trials necessary to obtain the correct code.
    (a) 12 (b) 24 (c) 48 (d) 36

11. Find n if ${}^{n}P_4 = 18.\ {}^{n-1}P_2$
    (a) 4 (b) 8 (c) 6 (d) 12

12. How many words, with or without meaning, can be formed using all letters of the word EQUATION, using each letter exactly one?
    (a) 38320 (b) 39320 (c) 40320 (d) 38400

13. Find how many words can be formed out of the letters of the word ORIENTAL so that vowels always occupy the odd places.
    (a) 576 (b) 578 (c) 767 (d) none of these

14. How many three-digit numbers can be formed by using the digits 1, 3, 6 and 8, when the digits may be repeated any number of times?
    (a) 48 (b) 64 (c) 80 (d) 32

15. How many different signals can be transmitted by arranging 3 red, 2 yellow and 2 green flags on a pole? (Assume that all the 7 flags are used to transmit a signal.)

(a) 220 (b) 240 (c) 200 (d) 210

16. There are 5 gentlemen and 4 ladies to dine at a round table. In how many ways can they seat themselves so that no two ladies are together?
(a) 3280 (b) 2880 (c) 2080 (d) 2480

17. How many different necklaces can be formed with 6 white and 5 red beads?
(a) 18 (b) 24 (c) 21 (d) 27

18. If C(n, 8) = C(n, 6), then the value of C(n, 2) is
(a) 91 (b) 81 (c) 61 (d) 71

19. If C(18, r) = C(18, r+2); then r is equal to
(a) 56 (b) 63 (c) 49 (d) 0

20. The value of $\sum$ C(5, r) from r = 1 to 5 is
(a) 41 (b) 31 (c) 51 (d) 61

21. In how many ways can a cricket team of 11 players be selected out of 16 players if two particular players are to be included and one particular player is to be rejected?
(a) 715 (b) 615 (c) 915 (d) 515

22. How many words, each of 3 vowels and 2 consonants, can be formed from the letters of the word INVOLUTE?
(a) 2280 (b) 2480 (c) 2880 (d) 2680

23. How many lines can be drawn through 21 points on a circle?
(a) 310 (b) 210 (c) 410 (d) 570

24. There are 40 students in a class. A student is allowed to shake hand only once with a student who is taller than him or equal in height to him. He can't shake hand with somebody who is shorter than him. Average height of the class is 5 feet. What is the difference between the maximum and minimum number of handshakes that can happen in such a case?
(a) $\{(^{40}C_2)/2\} - 1$ (b) 361 (c) $^{40}C_2 - 40$ (d) $^{40}C_2$

25. What is the number of ways in which triangles are formed in a octagon with each triangle having the centre point of the octagon as one vertex and vertices of octagon as the other?
(a) 25 (b) 28 (c) 30 (d) 32

13. Probability

1. **Consider these sentences:** i) she may come today. ii) Probably it may rain in the evening. iii) Most probably Raj may get through the examination.

   All the three sentences involve an element of uncertainty and probability is a concept which measures this uncertainty. The Probability is the chance of occurring of a certain event when expressed quantitatively; in other words, Probability is a quantitative measure of the certainty.

2. **Random Experiment or Trial**: If in an experiment all the possible outcomes are known in advance and none of the outcomes can be predicted with certainty, then such an experiment is called a Random Experiment. For example, tossing a coin, throwing a die or drawing a card from a pack of playing cards are Random Experiments.

3. **Sample Space**: The set of all possible outcomes of an experiment is called a Sample Space. We generally denote it by S. For example, When a coin is tossed, S = {H, T}; When a die is thrown S = {1, 2, 3, 4, 5, 6}.

4. **Equally Likely Events**: Events are said to be equally likely if there is no reason to expect any one in preference to other. Thus, equally likely events mean outcome is as likely to occur as any other outcome. For example, in throwing a die, all the six faces (1, 2, 3, 4, 5, 6) are equally likely to occur.

5. **Simple and Compound Events**: If we consider the probability of happening or non-happening of a single event then it is called a Simple Event. For example, finding out the probability of drawing an ace from a pack of cards.

   If we consider the probability of joint occurrence of two or more events then it is called Compound Event. For example, if from a bag, containing 6 red and 4 green balls, two successive draws of a ball are made, then finding out the probability of getting a red ball in the first draw and a green ball in the second draw, will be compound event.

6. **Exhaustive Events:** The total number of all possible outcomes of any trial is called Exhaustive Events. For example, when a coin is tossed, either head or tail may turn up so there are two exhaustive cases. If a die is thrown, then there are six exhaustive cases or events.

7. **Mutually Exclusive Events:** In an experiment, if the occurrence of an even rules out the happening of other event in the same experiment, then these two events are called Mutually Exclusive Events. For example, when a coin is tossed either Head or Tail will appear. Head and Tail cannot appear simultaneously. Therefore, occurrence of a Head or a Tail are two Mutually Exclusive events.

8. **Calculation of Probability:** Probability of occurring of an event A, is given by the ratio of *the no. of cases in favour of A to the no. of possible outcomes.*

   If an even A can happen in a ways and fails in b ways and each of a+b ways is equally likely to occur then the probability of occurrence of event A,

   $P(A) = a/(a+b)$

   Probability of non-occurrence of A,

   $P(\text{not } A) = b/(a+b)$

   $P(A) + P(\text{not } A) = 1$

9. **Odds of an Event:** Let, there are m outcomes favorable to a certain event and n outcomes unfavorable to the event in a sample space, then

   Odds in favour of the event = m/n

   Odds against the event = n/m

   $P(A) = m/(m+n)$

   $P(\text{not } A) = n/(m+n)$

10. In a random experiment, if S is the sample space and E is an event, then

$P(E) \geq 0$, $P(\phi) = 0$ and $P(S) = 1$.

11. For any two event A and B,

$P(A \cup B) = P(A) + P(B) - P(A \cap B)$

12. If A and B are two mutually exclusive events, $(A \cap B) = \phi$ and $P(A \cap B) = 0$, so

$P(A \cup B) = P(A) + P(B)$

13. For any three events A, B and C;

$P(A \cup B \cup C) = P(A) + P(B) + P(C) - P(A \cap B) - P(B \cap C) - P(C \cap A) + P(A \cap B \cap C)$

14. Independent Events: Two events A and B are said to be independent if the occurrence or non-occurrence of one does not affect the probability of the occurrence (and non-occurrence) of the other. For example, if two coins are thrown simultaneously, then the occurrence or non-occurrence of Head on one does not affect the occurrence or non-occurrence of Head on the other.

15. For two independent events A and B,

$P(A \text{ and } B) = P(A).P(B)$

16. Dependent Events: Two events A and B are said to be dependent if the occurrence of one, say B, is influenced by the occurrence of another event A. For example, if two cards are drawn from a pack one by one without replacement then the chances of getting a King in the second draw will be affected by the first draw.

17. Conditional Probability: The probability of the even B given that event A has already occurred,

$P(B/A) = P(A \cap B) / P(A)$

18. $P(A \cap B) = P(A) \times P(B/A)$

19. $P(A \cap B \cap C) = P(A) \times P(B/A) \times P(C/ (A \cap B))$

20. De-Morgan's Laws:

$P(A \cup B)' = P(A' \cap B')$ and $P(A \cap B)' = P(A' \cup B')$

13.1 Probability (Class Work)

1. Rupesh is known to hit a target in 5 out of 9 shots whereas David is known to hit the same target in 6 out of 11 shots. What is the probability that the target would be hit once they both try?
   (a) 76/99 (b) 79/99 (c) 10/33 (d) 20/99
2. A pair of dice is thrown together and the sum of points of the two dice is noted to be 10. The probability that one of the two dice has shown the point 4?
   (a) 1/2 (b) 1/3 (c) 2/3 (d) 3/4
3. In a group of 20 males and 15 females, 12 males and 8 females are service holders. The probability that a person selected at random from the group is a service holder given that the selected person is a male?
   (a) 0.60 (b) 0.70 (c) 0.75 (d) 0.50
4. In connection with a random experiment, it is found that P(A) = 2/3, P(B) = 3/5 and P(A∪B) = 5/6. The values of P(B/A) and P(A'/B) are respectively
   (a) 13/20, 5/18 (b) 11/20, 7/18 (c) 7/18, 11/20 (d) 13/20, 7/18
5. Odds in favour of an event is 2:3 and the odds against another event is 3:7. The probability that only one of the two events occurs is
   (a) 43/50 (b) 19/50 (c) 21/50 (d) 27/50
6. Mr. Roy is invited for interviews for three separate posts. For the first post, there are three candidates, for the second, there are five candidates and for the third, there are 10 candidates. The probability that Mr. Roy would be selected is
   (a) 12/25 (b) 13/25 (c) 14/25 (d) 11/25
7. If an unbiased coin is tossed three times, what is the probability of getting more than one head?
   (a) 1/8 (b) 3/8 (c) 1/2 (d) 1/3
8. The wages of 8 workers in rupees are 50, 62, 40, 70, 45, 56, 32 and 45. If one of the workers is selected at random, the probability that his wage would be lower than the average wage is
   (a) 0.625 (b) 0.500 (c) 0.375 (d) 0.450
9. What is the chance that a leap year, selected at random will contain 53 Sundays?
   (a) 1/7 (b) 2/7 (c) 3/7 (d) 7/4
10. The letters of word SOCIETY are placed in a row. What is the probability three vowels come together?
    (a) 3/7 (b) 2/7 (c) 1/7 (d) None of these
11. Two dice are thrown. The odds against getting the sum 6 are
    (a) 5:31 (b) 6:31 (c) 31:5 (d) 31:6
12. An integer is chosen at random from first two hundred natural numbers. What is the probability that the integer chosen is divisible by 6 or 8?
    (a) 1/4 (b) 3/4 (c) 1/2 (d) None of these
13. Two unbiased dice are thrown. The probability that neither a doublet nor a total of 10 will appear is
    (a) 7/9 (b) 4/9 (c) 2/9 (d) 1/3
14. The probability that a contractor will get a plumbing contract is 2/3 and the probability that he will not get an electricity contract is 5/9. If the probability of getting at least one contract is 4/5, probability he will get both
    (a) 8/45 (b) 31/45 (c) 14/45 (d) None of these
15. Two persons A and B throw a die alternately till one of them gets a 6 and wins the game. If the game starts with A, the probability of winning of B is
    (a) 5/11 (b) 6/11 (c) 4/11 (d) 3/11

14. Clocks Test

Q1. How many times in a day hour hand and minute hand are at 180 degrees?

a. 24 b. 22 c. 12 d. 11

Q2. How many times in a day hour hand and minute hand are at 90 degrees?

a. 40 b. 42 c. 22 d. 44

Q3. What is the angle between the hands of a clock at 25 minutes past 8 O'clock?

a. 110 degrees b. 102.5 degrees c. 90 degrees d. 115.5 degrees

Q4. A person observes the reflection of a wall clock in a mirror. The time observed by the person in the mirror is 4 hours 20 minutes. What is the actual time shown in the clock?

a. 7:40 b. 8:40 c. 7:35 d. 7:40

Q5. The time in a clock is 20 minutes past 2. Find the angle between the hands of the clock.

a. 60 degrees b. 120 degrees c. 45 degrees d. 50 degrees

Q6. At how many points between 10 O'clock and 11 O'clock are the minute hand and hour hand of a clock at an angle of 30 degrees to each other?

a. 2 b. 1 c. 4 d. 3

Q7. What is the angle between the minute hand and the hour hand when the time is 16:40 hours?

a. 150 b. 160 c. 100 d. 90

Q8. The minute hand of a clock overtakes the hour hand at intervals of 64 minutes of correct time. How much does the clock gain or lose per day?

a. 96 min b. 34 min c. 26 and (2/11) min d. 32 and (8/11) min

Q9. A watch which gains time uniformly is 5 minutes slow at 8 O'clock in the morning on Sunday and is 5 minutes 48 seconds fast at 8 pm the following Sunday. When was it correct?

a. Wednesday, 7:20 pm b. Tuesday, 8:45 am c. Friday, 12:00 noon d. Tuesday, 4:40 pm

Q10. If the minutes hand and hour hand coincide every 84 minutes, find how much time the clock gains or loses everyday (approximately in minutes).

a. 144 b. 152 c. 161 d. 318

Q11. A clock loses 3% time during the first week and then gains 2% time during the next one week. If the clock was set right at 12 noon on a Sunday, what will be the time that the clock will show exactly 14 days from the time it was set right?

a. 1:36:48 b. 1:40:48 c. 1:41:24 d. 10:19:12

Directions (Q12-13): A 12 dial clock has its minute hand defective. Whenever it touches dial 12, it immediately falls down to 6 instead of running smoothly (the hour hand remains unaffected during that fall). It was set right at 12 O'clock in the noon.

Q12. What was the actual time when the minute hand of the clock touched dial 9 for the 5th time?

a. 2.15 b. 3:00 c. 5:15 d. 6:45

Q13. If the actual time is 10:10, what is the position of the hour hand in that defective clock?

a. between 2 and 3 b. between 4 and 5 c. between 10 and 11 d. None of these

Q14. If the lengths of the hour and minute hands of a clock are 2 cm and 4 cm respectively, then what is the difference between the distance travelled by the tip of the hour and minute hands in 15 minutes?

a. (23/12) pi b. 12 pi c. 24 pi d. 2 pi

Q15. A clock loses 36 minutes in 24 hours. If it is corrected at 4:45 pm, then what will be the time shown at 11:25 am the next day?

a. 10:58 am b. 10:59 am c. 10:57 am d. 11:00 am

Q16. At what time between 5 O'clock and 6 O'clock do the hands of a clock be opposite to each other?

a. 5.50 b. 5.55 c. 6.00 d. 6.05

Q17. Give the angle made by the hands of the clock at 20 minutes past 8 O'clock?

a. 120 degrees b. 125 degrees c. 130 degrees d. 145 degrees

Q18. The angle between the hands of the clock when the time is 30 minutes past 7 is?

a. 150 degrees b. 100 degrees c. 45 degrees d. 30 degrees

Q19. The angle between the hands of the clock when the time is 25 minutes past 5 is?

a. 45.5 degrees b. 32.5 degrees c. 24.5 degrees d. 12.5 degrees

Q20. My watch gains 5 minutes every hour. How many degrees does the seconds hand move in every minute?

a. 375 degrees b. 380 degrees c. 390 degrees d. 365 degrees

15. Progressions

Progressions

We have already studied about the progressions in our earlier years. Though, the problems given in the competitive exams are a bit twisted and need careful applications. Study the formulas and solved examples so that you can easily answer the questions given in this chapter.

Arithmetic progression

A series in which each term (except first term) differs from its preceding term by a fixed quantity is called an Arithmetic progression (A.P.) and the fixed quantity is called the common difference. If a is the first term and d is the common difference of an A.P. then that A.P is a + (a + d) + (a + 2d) +..... . If the same quantity is added (multiplied) to each term of an A.P. then the resulting series is also an A.P.

Arithmetic Progression formulas:

1. n^{th} term of an A.P = $T_n = a + (n-1)d$
2. Sum of first n terms of an A.P. = S_n = $\frac{n}{2}[2a+(n-1)d]$

(or)

$\frac{n}{2}(a+l)$ where 'l' is the last term.

3. Number of terms in an A.P = $n = \frac{l-a}{d}+1$ (inclusive of first and last terms)

$= \frac{l-a}{d}-1$ (exclusive of first and last terms)

4. The arithmetic mean between a and b is $\frac{a+b}{2}$.
5. If three numbers are in A.P., then they can be taken as a – d, a, a + d.
6. If four numbers are in A.P., then they can be taken as a – 3d, a – d, a + d, a + 3d.
7. If five numbers are in A.P., then they can be taken as a – 2d, a – d, a, a + d, a + 2d.

Geometric progression

A series in which each term (except first term) is obtained by multiplying the preceding term by a fixed quantity is called a Geometric progression (G.P) and the fixed quantity is called the common ratio. If 'a' is the first term and r is the common ratio of a G.P. then that G.P is $a + ar + ar^2 + \ldots\ldots$. If every term of a G.P. is multiplied by a fixed real number, then the resulting series is also a G.P. If every term of a G.P is raised to the same power, then the resulting series is also a G.P. The reciprocals of the terms of a G.P. is also a G.P.

Geometric Progression formulas:

1. nth term of a G.P : ar^{n-1}
2. The sum of first n terms of a G.P = $\frac{a(r^n-1)}{r-1}$ if r>1;

$= \frac{a(1-r^n)}{1-r}$ if r<1

3. The sum of infinite G.P. = $\frac{a}{1-r}$ when |r| <1
4. If three positive numbers a,x,b are in G.P. then x is called the Geometric Mean (G.M) between a and b. The G.M. between two positive numbers a and b is $\sqrt{ab}$
5. If three numbers are in G.P., then they can be taken $\frac{a}{r}$, a, ar.
6. If four numbers are in G.P., then they can be taken as $\frac{a}{r^3}, \frac{a}{r}, ar, ar^3$
7. If five number are in G.P., then they can be taken as $\frac{a}{r^2}, \frac{a}{r}, a, ar, ar^2$

Harmonic progression

If the reciprocals of the terms of a series form an A.P., then the series is called a Harmonic progression (H.P.). If a, x, b are in H.P., then x is called Harmonic Mean between a and b.

a, b, c, d, ... are in H.P then $\frac{1}{a}, \frac{1}{b}, \frac{1}{c}, \frac{1}{d}$ . . . are in A.P

Therefore, we will rewrite the sequence as, $\frac{1}{a}, \frac{1}{a+d}, \frac{1}{a+2d}, \frac{1}{a+3d}, \ldots$

Note: To solve questions involving H.P, we take reciprocals of the numbers so that the given series is now in A.P.

Harmonic Mean: The harmonic mean between two non zero numbers a and b is $\frac{2ab}{a+b}$.

Important:
If A, G, H are the arithmetic mean, geometric mean, harmonic mean between two positive numbers then $A \geq G \geq H$ and $G^2 = AH$

Key formulas:

1. The sum of first n natural numbers = $\sum n = \frac{n(n+1)}{2}$

2. The sum of first n natural numbers = $\sum n^2 = \frac{n(n+1)(2n+1)}{6}$

3. The sum of cubes of first n natural numbers = $\sum n^3 = \frac{n^2(n+1)^2}{4}$

4. The sum of first n even integers = $n(n + 1)$

5. The sum of first n odd integers = n^2.

15.1 Progressions (Class Work)

1. The 25th of an AP whose 9th term is – 6 and common difference is 5/4 is
   (a) 16 (b) 18 (c) 12 (d) 14
2. The nth term of the series {1/n}+{(n+1)/n}+{(2n+1)/n}+… is
   (a) $(3+n+n^2)/n$ (b) $(1+n^2-n)/n$ (c) $(2+n^2-n)/n$ (d) None of these
3. If the *p*th term of an AP is q and *q*th term is p, then its *r*th term is
   (a) p + q – r (b) p – q – r (c) r + q + p (d) None of these
4. The value of k, so that k+2, 4k–6 and 3k–2 are three consecutive terms of an AP, is
   (a) 5 (b) 7 (c) 9 (d) 3
5. The ratio of the 7th to the 3rd term of an AP is 12:5. The ratio of 13th to the 4th term is
   (a) 8:5 (b) 9:4 (c) 7:3 (d) 10:3
6. The 4th term of an AP is equal to 3 times the first term and the seventh term exceeds twice the third term by 1. The common difference is
   (a) 3 (b) 5 (c) 7 (d) 9
7. A body falls 16 metres in the first second of its motion, 48 metres in the second, 80metres in the third, and 112 metres in the fourth and so on. How far does it fall during the 11th second of its motion?
   (a) 338 m (b) 340 m (c) 334 m (d) 336 m
8. The sum of the first 35 terms of an AP, if $t_2 = 2$ and $t_7 = 22$
   (a) 2510 (b) 2310 (c) 2710 (d) 2910
9. The sum of a series in AP is 525. Its first term is 3 and last term is 39. The common difference is
   (a) 3/2 (b) 3/3 (c) 2/3 (d) 1/3
10. Sum the series 51+50+49+…+21
    (a) 1116 (b) 1122 (c) 1128 (d) 1124
11. The sum of P terms of an AP is $3p^2 + 4p$. The nth term is
    (a) 5n+2 (b) 6n+1 (c) 8n+3 (d) 7n+3
12. The sum of the first hundred even natural numbers divisible by 5 is
    (a) 50575 (b) 50560 (c) 50500 (d) 50505
13. The sum of all integers of between 50 and 500 which are divisible by 7 is
    (a) 17966 (b) 1177996 (c) 17766 (d) 17696
14. The 10th term of the GP 5+25+125+…, is
    (a) 5^{10} (b) 5^9 (c) 5^{11} (d) 5^8
15. The 5th term of the GP, ¼, -1/2, +1,… is
    (a) 6 (b) 8 (c) 4 (d) 10
16. What term of the progression 18, -12, 8,… is 512/729?
    (a) 15 (b) 18 (c) 9 (d) 12
17. A person has two parents (father and mother), four grandparents, eight great grandparents and so on. The number of ancestors the person has up to the 10th generation
    (a) 1028 (b) 1024 (c) 1030 (d) 1026
18. Sum the series to infinity $(3/4) - (5/4^2) + (3/4^3) - (5/4^4) + (3/4^5) - (5/4^6) + \ldots$
    (a) 8/15 (b) 7/17 (c) 7/15 (d) 8/17
19. The product $(32)\,(32)^{1/6}\,(32)^{1/36}\ldots$ upto infinity is equal to
    (a) 16 (b) 64 (c) 32 (d) 0
20. The 9th term of the HP, 6, 4, 3, …

(a) 7/5 (b) 6/5 (c) 5/6 (d) None of these

16. ANSWERS

1.1 Number System (Class work)

1	D	2	B	3	D	4	A	5	A
6	A	7	B	8	A	9	D	10	A
11	A	12	D	13	B	14	A	15	C
16	A	17	A	18	D	19	A	20	A

1.2 Numbers System (Home Assignment)

1	A	2	A	3	A	4	A	5	C
6	B	7	C	8	C	9	B	10	D
11	B	12	B	13	A	14	B	15	D
16	C	17	A	18	C	19	B	20	

1.3 Number System (Class Work)

1	A	2	C	3	D	4	A	5	C
6	C	7	A	8	C	9	B	10	D
11	C	12	C	13	C	14	B	15	D
16	B	17	C	18	D	19	B	20	A

1.4 Number System (Home Assignment)

1	C	2	A	3	B	4	D	5	C
6	C	7	C	8	B	9	D	10	A
11	C	12	C	13	C	14	A	15	D
16	A	17	A	18	A	19	B	20	C

2.1 Average, Time & Distance (Class work)

1	C	2	B	3	D	4	C	5	A
6	A	7	A	8	C	9	B	10	A
11	B	12	A	13	A	14	A	15	A

2.2 Average, Time & Distance (Class Work)

1	B	2	B	3	B	4	D	5	A
6	D	7	C	8	D	9	C	10	D
11	C	12	B	13	A	14	B	15	C
16	B	17	C	18	C	19	A	20	A
21	B	22	C	23	A	24	B	25	C

2.3 Average, Time & Distance (Home Assignment)

1	D	2	B	3	B	4	D	5	B
6	C	7	C	8	A	9	A	10	D
11	D	12	C	13	C	14	A	15	D
16	A	17	A	18	A	19	B	20	C
21	A	22	C	23	A	24	C	25	B
26	C	27	B	28	C	29	A	30	A
31	D	32	B	33	A	34	B	35	D
36	B	37	C	38	B	39	C	40	B

2.4 Average, Time & Distance (Home Assignment)

1	C	2	C	3	A	4	A	5	C
6	A	7	B	8	C	9	A	10	C
11	D	12	A	13	C	14	B	15	A
16	B	17	C	18	D	19	C	20	C
21	B	22	B	23	A	24	A	25	C
26	A	27	C	28	B	29	C	30	C

3.1 Ratio-proportion and Chain Rule

1	B	2	C	3	A	4	A	5	C
6	B	7	E	8	A	9	D	10	D
11	C	12	E	13	B	14	C	15	A
16	D	17	E	18	E	19	A	20	B
21	D	22	C	23	A	24	C	25	B
26	C	27	D	28	A	29	B	30	C
31	B	32	D	33	A	34	C	35	B
36	A	37	D	38	A	39	D	40	D

3.2 Ratio-proportion and Chain Rule (Home Assignment)

1	A	2	D	3	C	4	E	5	C
6	D	7	A	8	A	9	B	10	A
11	A	12	C	13	A	14	E	15	A
16	B	17	C	18	B	19	D	20	E
21	A	22	C	23	A	24	A	25	A
26	A	27	B	28	C	29	B	30	B

4.1 Percentage (Class Work)

1	A	2	C	3	C	4	B	5	C
6	B	7	A	8	B	9	A	10	B
11	C	12	D	13	B	14	B	15	C
16	A	17	A	18	C	19	B	20	C

4.2 Percentage (Home Assignment)

1	B	2	B	3	A	4	C	5	B
6	A	7	B	8	B	9	A	10	B
11	A	12	A	13	B	14	A	15	C
16	A	17	B	18	C	19	B	20	A
21	A	22	B	23	A	24	C	25	A
26	A	27	D	28	D	29	C	30	C
31	A	32	B	33	D	34	D	35	C
36	D	37	B	38	C	39	B	40	C
41	C	42	B	43	B	44	D	45	C
46	C	47	C	48	D	49	D	50	A

5.1 Mixtures & Alligations (Class Work)

1	A	2	C	3	D	4	C	5	D
6	C	7	B	8	C	9	A	10	B
11	B	12	B	13	B	14	B	15	C
16	C	17	B	18	D	19	C	20	A

5.2 Mixtures & Alligations (Home Assignment)

1	D	2	B	3	A	4	B	5	A
6	C	7	D	8	C	9	A	10	B
11	C	12	D	13	B	14	C	15	A
16	B	17	D	18	C	19	A	20	D

6.1 Time & Work and Pipes & Cisterns (Class Work)

1	A	2	C	3	A	4	C	5	A
6	B	7	B	8	A	9	B	10	C
11	A	12	A	13	B	14	B	15	B

6.2 Time & Work and Pipes & Cisterns (Home Assignment)

1	B	2	A	3	B	4	B	5	B
6	B	7	B	8	A	9	B	10	D
11	C	12	A	13	D	14	B	15	B
16	A	17	A	18	A	19	C	20	B
21	A	22	A	23	B	24	B	25	C
26	B	27	C	28	A	29	A	30	B
31	A	32	B	33	D	34	D	35	B
36	C	37	A	38	A	39	D	40	C

7.1 Profit, Loss & Discount (Class Work)

1	C	2	B	3	C	4	C	5	A
6	B	7	A	8	B	9	C	10	C
11	A	12	C	13	A	14	C	15	A

7.2 Profit, Loss & Discount (Home Assignment)

1	A	2	B	3	C	4	A	5	A
6	A	7	C	8	B	9	A	10	A
11	A	12	C	13	C	14	C	15	C
16	C	17	C	18	C	19	B	20	B
21	A	22	D	23	D	24	B	25	B
26	B	27	B	28	C	29	B	30	C
31	D	32	C	33	B	34	B	35	C
36	B	37	C	38	C	39	D	40	A

8.1 Simple and Compound Interest (Class Work)

1	B	2	C	3	A	4	D	5	C
6	C	7	C	8	A	9	B	10	B
11	C	12	C	13	B	14	A	15	C
16	A	17	C	18	D	19	C	20	B
21	C	22	C	23	D	24	A	25	D
26	D	27	A	28	A	29	A	30	C

8.2Simple&Compound Interest (Home Assignment)

1	A	2	C	3	A	4	B	5	B
6	C	7	B	8	A	9	B	10	A
11	B	12	B	13	B	14	C	15	B
16	B	17	B	18	B	19	A	20	D
21	B	22	A	23	C	24	B	25	D

9.1 Basic Geometry (Class Work)

1	C	2	D	3	A	4	D	5	
6	C	7	B	8	C	9	A	10	B
11	C	12	B	13	C	14	B	15	B
16	A	17	B	18	C	19	D	20	A
21	D	22	C	23	B	24	B	25	A
26	C								

9.2 Basic Geometry (Home Assignment)

1	D	2	B	3	A	4	B	5	B
6	B	7	C	8	B	9	B	10	D
11	A	12	A	13	C	14	A	15	B
16	B	17	A	18	B	19	C	20	C
21	C	22	D	23	A	24	C	25	C
26	D	27	D	28	C	29	C	30	C

10.1 Mensuration (Class Work)

1	A	2	B	3	A	4	B	5	C
6	A	7	A	8	A	9	B	10	A
11	B	12	D	13	D	14	C	15	D
16	B	17	B	18	A	19	D	20	B
21	D	22	C	23	B	24	C	25	B

10.1 Mensuration (Home Assignment)

1	A	2	B	3	A	4	C	5	D
6	A	7	B	8	A	9	C	10	B
11	C	12	B	13	D	14	C	15	D
16	A	17	B	18	A	19	A	20	C
21	B	22	C	23	A	24	C	25	A
26	A	27	C	28	C	29	B	30	A
31	B	32	A	33	C	34	B	35	C
36	A	37	B	38	A	39	D	40	A
41	C	42	B	43	C	44	A	45	A
46	D	47	D	48	B	49	C	50	A
51	B	52	D	53	A				

11.1 Equations (Class Work)

1	D	2	C	3	B	4	D	5	D
6	A	7	C	8	A	9	C	10	B
11	C	12	A	13	B	14	B	15	C
16	D	17	A	18	B	19	C	20	A

12.1 Permutations & Combinations (Class Work)

1	A	2	D	3	A	4	B	5	B
6	A	7	B	8	A	9	C	10	B
11	C	12	C	13	A	14	B	15	D
16	B	17	C	18	A	19	A	20	B
21	A	22	C	23	B	24	D	25	B

13.1 Probability (Class Work)

1	B	2	C	3	A	4	A	5	D
6	B	7	C	8	B	9	B	10	C
11	C	12	A	13	A	14	C	15	A

14.1 Clock Test (Class Work)

1	B	2	D	3	B	4	B	5	D
6	B	7	C	8	D	9	A	10	D
11	D	12	A	13	C	14	A	15	C
16	C	17	C	18	C	19	D	20	C

15.1 Progressions (Class Work)

1	D	2	B	3	A	4	D	5	D
6	A	7	D	8	B	9	A	10	A
11	B	12	C	13	D	14	A	15	C
16	C	17	B	18	C	19	B	20	B