BANKING
QUANTITATIVE APTITUDE
FORMULA BOOK

Quick Revision of
Quantitative Aptitude for Banking Exams

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Vedic Maths (Calculation Techniques)

1. METHOD TO MULTIPLY 2-DIGIT NUMBER.

(i) $AB \times CD = AC / AD + BC / BD$

$35 \times 47 = 12 / 21 + 20 / 35 = 12 / 41 / 35 = 1645$

(ii) $AB \times AC = A^2 / A(B + C) / BC$ $74 \times 76 = 7^2 / 7(4 + 6) / 4 \times 6$

$= 49 / 70 / 24 = 49 / 70 / 24 = 5624$

(iii) $AB \times CC = AC / (A + B)C / BC$

$= 35 \times 44 = 3 \times 4 / (3 + 5) \times 4 / 5 \times 4$

$= 12 / 32 / 20 = 1^2 / 3^2 / 2^0 = 1540$

2. SQUARE OF NUMBERS

$1^2 = 1$	$11^2 = 121$	$21^2 = 441$
$2^2 = 4$	$12^2 = 144$	$22^2 = 484$
$3^2 = 9$	$13^2 = 169$	$23^2 = 529$
$4^2 = 16$	$14^2 = 196$	$24^2 = 576$
$5^2 = 25$	$15^2 = 225$	$25^2 = 625$
$6^2 = 36$	$16^2 = 256$	$26^2 = 676$
$7^2 = 49$	$17^2 = 289$	$27^2 = 729$
$8^2 = 64$	$18^2 = 324$	$28^2 = 784$
$9^2 = 81$	$19^2 = 361$	$29^2 = 841$
$10^2 = 100$	$20^2 = 400$	$30^2 = 900$

3. SOME PROPERTIES OF SQUARE AND SQUARE ROOT:

(i) Complete square of a no. is possible if its last digit is 0, 1, 4, 5, 6 & 9. If last digit of a no. is 2, 3, 7, 8 then complete square root of this no. is not possible.

(*ii*) If last digit of a no. is 1, then last digit of its complete square root is either 1 or 9.

(*iii*) If last digit of a no. is 4, then last digit of its complete square root is either 2 or 8.

(*iv*) If last digit of a no. is 5 or 0, then last digit of its complete square root is either 5 or 0.

(*v*) If last digit of a no. is 6, then last digit of its complete square root is either 4 or 6.

(*vi*) If last digit of a no. is 9, then last digit of its complete square root is either 3 or 7.

Method to find square of two digit number:

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

Add carry to the left terms.

For ex, $(36)^2 = 9/2 \times 3 \times 6/36 = 9/(36 + 3)/6$

$= (9 + 3)/9/6 = 1296$

Cube of numbers:

$1^3 = 1$	$7^3 = 343$	$14^3 = 2744$
$2^3 = 8$	$8^3 = 512$	$15^3 = 3375$
$3^3 = 27$	$9^3 = 729$	$16^3 = 4096$
$4^3 = 64$	$11^3 = 1331$	$17^3 = 4913$
$5^3 = 125$	$12^3 = 1728$	$18^3 = 5832$
$6^3 = 216$	$13^3 = 2197$	$19^3 = 6859$

4. THOSE NUMBERS WHOSE ALL DIGITS ARE 3.

$(33)^2 = \underline{10}8\underline{9}$ Those number in which all digits are number is 3 two or more than 2 times repeated, to find the square of these number, we repeat 1 and 8 by (n – 1) time. Where n ® Number of times 3 repeated.

$(333)^2 = \underline{110}889$ $(3333)^2 = \underline{1110}8889$

5. THOSE NUMBERS WHOSE ALL DIGITS ARE 9.

$(99)^2 = 9801$ $(9999)^2 = 99980001$
$(999)^2 = 998001$ $(99999)^2 = 9999800001$

6. THOSE NUMBER WHOSE ALL DIGITS ARE 1.

A number whose one's, ten's, hundred's digit is 1 i.e., 11, 111, 1111, ...

In this we count number of digits. We write 1, 2, 3, ... in their square the digit in the number, then write in decreasing order up to 1. $11^2 = 121$

$111^2 = 12321$ $1111^2 = 1234321$

Number System

1. If the prime factorization of a natural number N is given by

   $N = p_1{}^{q_1} p_2{}^{q_2} p_3{}^{q_3} \ldots$

   Then, the number of factors of $N = (1 + q_1)(1 + q_2)(1 + q_3) \ldots$

2. If the prime factorization of a natural number N is given by

   $N = p_1{}^{q_1} p_2{}^{q_2} p_3{}^{q_3} \ldots$

   Then, the sum of all the factors of N $= (1 + p_1{}^1 + p_1{}^2 + \ldots + p_1{}^{q_3})(1 + p_2{}^1 + p_2{}^2 + \ldots + p_2{}^{q_2})(1 + p_3{}^1 + p_3{}^2 + \ldots + p_3{}^{q_3}) \ldots$

3. The factorial of a natural number is equal to the product of the first n natural numbers and it is denoted by N!.

   $N! = 1 \times 2 \times 3 \times \ldots \times N$

4. Let p be a prime number. Then, the maximum value of m for which p^m

   divides $N!$ completely $= \left[\dfrac{N}{p}\right] + \left[\dfrac{N}{p^2}\right] + \left[\dfrac{N}{p^3}\right] + \ldots$

   where [x] denotes the greatest integer less than equal to x.

5. HCF × LCM = Product of two numbers

   Note: This formula is applicable only for two numbers

6. If $P = n(n + 1)(n + 2)(n + 3) + 1$, then P is a perfect square number and $P = (n^2 + 3n + 1)^2$

7. The number added to $x(x + a)(x + 2a)(x + 3a)$ to make it a perfect square $= a^4$

DIVISIBILITY (IMPORTANT TO ENHANCE CALCULATION SPEED)

(*i*) A no. of 3-digits which is formed by repeating a digit 3-times, then this no. is divisible by 3 and 37. e.g., 111, 222, 333, ...

(*ii*) A no. of 6-digit which is formed by repeating a digit 6-times then this no. is divisible by 3, 7, 11, 13 and 37. e.g., 111111, 222222, 333333, 444444, ...

1. **Divisibility by '2':** A number will be divisible by 2 if its last digit is an even number.

2. **Divisible by 3:** A number will be divisible by 3 if sum of its all digits is divisible by 3.

   For example, 2352 is divisible by 3 because sum of digits (2 + 3 + 5 + 2 = 12) is also divisible by 3.

3. **Divisible by 9:** A number will be divisible by 9 if sum of its all digits is also divisible by 9.

   For example, 23526 is divisible by 9 because the sum of digits (2 + 3 + 5 + 2 + 6 = 18) is also divisible by 9.

4. **Divisible by 4:** A number will be divisible by 4 if its last two digits are divisible by 4.

   For example, 561224 is divisible by 4 because the last two digits i.e. 24 are divisible by 4.

5. **Divisible by 8:** A number will be divisible by 8 if its last three digits are divisible by 8.

   For example, 521224 is divisible by 8 because the last three digits i.e. 224 are divisible by 8.

6. **Divisible by 16:** A number will be divisible by 16 if its last four digits are divisible by 16.

   For example, 521632 is divisible by 16 because the last four digits i.e. 1632 are divisible by 16.

7. **Divisible by 7:** We use osculator (– 2) for divisibility test.

   99995 : 9999 – 2 × 5 = 9989

   9989 : 998 – 2 × 9 = 980

   980 : 98 – 2 × 0 = 98

   Now 98 is divisible by 7, so 99995 is also divisible by 7.

8. **Divisible by 11:** In a number, if difference of sum of digit at even places and sum of digit at odd places is either 0 or multiple of 11, then no. is divisible by 11. For example, 12342 ¸ 11

   Sum of even place digit = 2 + 4 = 6

   Sum of odd place digit = 1 + 3 + 2 = 6 Difference = 6 – 6 = 0

   12342 is divisible by 11.

9. **Divisible by 13:** We use (+ 4) as osculator.

e.g., 876538 ¸ 13

876538: $8 \times 4 + 3 = 35$

$5 \times 4 + 3 + 5 = 28$

$8 \times 4 + 2 + 6 = 40$

$0 \times 4 + 4 + 7 = 11$

$1 \times 4 + 1 + 8 = 13$

13 is divisible by 13.

∴ 876538 is also divisible by 13.

10. **Divisible by 17:** We use (– 5) as osculator.

e.g., 294678: $29467 – 5 \times 8 = 29427$

27427: $2942 – 5 \times 7 = 2907$

2907: $290 – 5 \times 7 = 255$

255: $25 – 5 \times 5 = 0$

294678 is completely divisible by 17.

11. **Divisible by 19:** We use (+ 2) as osculator.

e.g: 149264: $4 \times 2 + 6 = 14$

$4 \times 2 + 1 + 2 = 11$

$1 \times 2 + 1 + 9 = 12$

$2 \times 2 + 1 + 4 = 9$

$9 \times 2 + 1 = 19$

19 is divisible by 19.

149264 is divisible by 19.

12. **Divisibility by 5:** Any number will be divisible by 5 if its last digit is either '0' or '5'.

Mix Divisibility :

13. **Divisibility by 6:** A number will be divisible by 6 if and only if it is divisible by both 2 and 3.

For example : 2454 is divisible by 6 because it is divisible by 2 (last digit even number) and 3 (sum of digits = 15 also divisible by 3).

14. **Divisibility by 12:** A number will be divisible by 12 if and only if it is divisible by both 4 and 3.

For example : 24564 is divisible by 12 because it is divisible by 4 (last two digits are divisible by 4) and 3 (sum of digits = 21 also divisible by 3).

15. **Divisibility by 72:** A number will be divisible by 72 if and only if it is divisible by both 8 and 9.

   Ramban : Any number will be divisible by a given number if it is divisible by co-prime factors of the given number.

16. Dividend = Divisor × Quotient + Remainder

Remainder Theorem

1. **When divided by '2':** If an odd number is divided by 2, it always gives 1 as remainder.

   When divided by '4':

   (*a*) When unit digit of a number is either 3 or 7 and also preceded by an even number, then remainder will always be 3 else remainder will be 1.

   (*b*) When unit digit of a number is either 1 or 5 and also preceded by an even number then remainder always will be 1 elese remainder will be 3.

   (*c*) When unit digit is '9', remainder always will be 1.

   When divided by 5: When the unit digit is < 5, then remainder will be unit digit and when unit digit is > 5, then remainder will be (unit digit - 5).

Sequences and Series

1. The sum of the first n natural numbers $= 1 + 2 + 3 + ... + n = \dfrac{n(n+1)}{2}$

2. The sum of the first n even natural numbers $= 2 + 4 + 6 + ... + 2n$
   $= n(n+1)$

3. The sum of the first n odd natural numbers $= 1 + 3 + 5 + ... + 2n - 1 = n^2$

4. The sum of squares of the first n natural numbers $= 1^2 + 2^2 + 3^2 + ... + n^2$
   $= \dfrac{n(n+1)\,(2n+1)}{6}$

5. The sum of squares of the first n even natural numbers
   $= 2^2 + 4^2 + 6^2 + ... + (2n)^2 = \dfrac{2n(n+1)\,(2n+1)}{3}$

6. The sum of squares of the first n odd natural numbers $= 1^2 + 3^2 + 5^2 + ...$
   $+ (2n-1)^2 = \dfrac{n(2n-1)\,(2n+1)}{3}$

7. The sum of cubes of the first n natural numbers $= 1^3 + 2^3 + 3^3 + ... + n^3$
   $= \left[\dfrac{n(n+1)}{2}\right]^2$

8. The sum of cubes of the first n even natural numbers
   $= 2^3 + 4^3 + 6^3 + ... + (2n)^3 = 2[n(n+1)]^2$

9. The sum of cubes of the first n odd natural numbers
   $= 1^3 + 3^3 + 5^3 + ... + (2n-1)^3 = n^2\,(2n^2 - 1)$

10. Let a be the first term and d be the common difference of an Arithmetic Progression (AP). Then, the nth term of this AP is given by

$T_n = a + (n - 1)\, d$

11. Let a be the first term and d be the common difference of an Arithmetic Progression (AP). Then, the sum of the first n terms of this AP is given by

$$S_n = \frac{n}{2}[2a + (n-1)d]$$

Or $S_n = \frac{n}{2}[a+l]$, where l is the last term of the given AP.

12. Let a be the first term and r be the common ratio of a Geometric Progression (GP). Then, the nth term of this GP is given by

$T_n = a_r^{(n-1)}$

13. Let a be the first term and r be the common ratio of a Geometric Progression (GP). Then, the sum of the first n terms of this GP is given by

$$S_n = a_r = \frac{a(r^{n-1})}{(r-1)},$$

14. Let a be the first term and r be the common ratio of a Geometric Progression (GP). If $|r| < 1$, then the sum of infinite terms of this GP is given by

$$S_\infty = \frac{a}{(1-r)}$$

15. Arithmetic mean (AM) of two numbers a and b = (a+b)/2

16. Arithmetic mean (AM) of n numbers $a_1, a_2, a_3, ..., a_n = \dfrac{(a_1 + a_2 + a_3 + ... a_n)}{n}$

17. Geometric mean (GM) of two numbers a and $b = \sqrt{ab}$

18. Geometric mean (GM) of n numbers $a_1, a_2, a_3, ... , a_n$

= $(a_1 . a_2 . a_3 ... an)^{(1/n)}$

19. For n positive numbers, AM $\geq$ GM

20. For n negative numbers, AM $\leq$ GM

Algebra

1. Formulae and Identities
   I. $a^2 - b^2 = (a + b)(a - b)$
   II. $(a + b)^2 = a^2 + b^2 + 2ab$
   III. $(a - b)^2 = a^2 + b^2 - 2ab$
   IV. $(a + b)^2 + (a - b)^2 = 2(a^2 + b^2)$
   V. $(a + b)^2 - (a - b)^2 = 4ab$
   VI. $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$
   VII. $(a + b)^3 = a^3 + b^3 + 3ab(a + b)$
   VIII. $(a - b)^3 = a^3 - b^3 - 3ab(a - b)$
   IX. $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$
   X. $a^3 + b^3 = (a + b)^3 - 3ab(a + b)$
   XI. $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$
   XII. $a^3 - b^3 = (a - b)^3 + 3ab(a - b)$

2. Formulae and Identities: $\left(x + \dfrac{1}{x} \right)$ form

   I. $\left(x + \dfrac{1}{x} \right)^2 = x^2 + \dfrac{1}{x^2} + 2$

   II. $\left(x - \dfrac{1}{x} \right)^2 = x^2 + \dfrac{1}{x^2} - 2$

   III. If $x^2 + \dfrac{1}{x^2} = k$, then $x + \dfrac{1}{x} = \sqrt{k + 2}$ and $x - \dfrac{1}{x} = \sqrt{k - 2}$

   IV. If $x + \dfrac{1}{x} = k$, then $x^2 + \dfrac{1}{x^2} = k^2 - 2$

V. If $x - \dfrac{1}{x} = k$, then $x^2 + \dfrac{1}{x^2} = k^2 + 2$

VI. If $x + \dfrac{1}{x} = k$, then $x - \dfrac{1}{x} = \sqrt{k^2 - 4}$

VII. If $x - \dfrac{1}{x} = k$, then $x + \dfrac{1}{x} = \sqrt{k^2 + 4}$

VIII. $\left(x + \dfrac{1}{x} \right)^3 = x^3 + \dfrac{1}{x^3} + 3\left(x + \dfrac{1}{x} \right)$

IX. $\left(x - \dfrac{1}{x} \right)^3 = x^3 - \dfrac{1}{x^3} - 3\left(x - \dfrac{1}{x} \right)$

3. Some Other Important formulae
   I. If $x^2 + x + 1 = 0$, then $x^3 = 1$
   II. If $x^2 - x + 1 = 0$, then $x^3 = -1$

4. **Factor Theorem:** Let $p(x)$ be a polynomial of degree greater than equal to 1. Then, $(x - a)$ is a factor of $p(x)$ if and only if $p(a) = 0$.

5. **Relation between zeros and coefficient of a polynomial:**
   I. If α and β are the zeros of the quadratic polynomial $ax^2 + bx + c$ then,

   $\alpha + \beta = -\dfrac{b}{a}$ [Sum of the roots]

   $\alpha\beta = \dfrac{c}{a}$ [Product of the roots]

   II. If α, β and γ are the zeros of the cubic polynomial, then $ax^3 + bx^2 + cx + d$ then,

   $\alpha + \beta + \gamma = -\dfrac{b}{a}$ [Sum of the roots]

   $\alpha\beta + \beta\gamma + \gamma\alpha = \dfrac{c}{a}$ [Sum of the roots taken one at a time]

   $\alpha\beta\gamma = -\dfrac{d}{a}$ [Product of roots]

6. **Quadratic Formula:** The roots of the quadratic equation $ax^2 + bx + c = 0$ are:

   $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

7. **Discriminant of a Quadratic equation:** The discriminant of the quadratic equation $ax^2 + bx + c = 0$ is:

$D = b^2 - 4ac$

8. **Nature of Roots:** The roots of the quadratic equation $ax^2 + bx + c = 0$ are:

   I.   **Real and Unequal:** If $D > 0$

  II.   **Real and Equal:** If $D = 0$

 III.   **Imaginary:** If $D < 0$

Mensuration (Area and Perimeter)

1. **Triangle:**

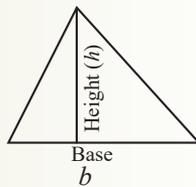   (i) Let the length of the sides of a triangle be a, b, and c. Then,
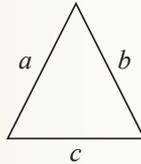
   (a) Perimetre of the triangle $= a + b + c$

   (b) Semi-perimetre, $s = \dfrac{(a+b+c)}{2}$

   (c) Area of the triangle, $\Delta = \sqrt{(s(s-a)\,(s-b)\,(s-c))}$

   (ii) Let the base of a triangle be b and let the length of the altitude from the opposite vertex to the base be h. Then,

   Area of the triangle, $\Delta = \dfrac{1}{2} \times$ base $\times$ height $= \dfrac{1}{2} \times b \times h$

   (iii) Let a and b be the length of the two sides of a triangle and let θ be the angle between the two lines. Then,
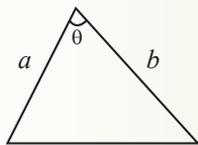
Area of the triangle, $\Delta = \dfrac{1}{2} \times a \times b \times \sin\theta$

(*iv*) Right Angle Triangle: Let ABC be a right triangle, right angled at B. Then,

Area of $\triangle ABC = \dfrac{1}{2} \times$ base $\times$ perpendicular $= \dfrac{1}{2} \times AB \times BC$

PYTHAGORAS THEOREM EQUATION
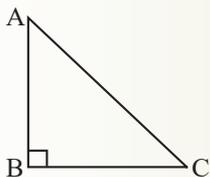
$(\text{Hypotenuse})^2 = (\text{Base})^2 + (\text{Perpendicular})^2$

Hypotenuse is the side in front of 90 degree angle.

In triangle ABC, AC is the hypotenuse.

If AB is base then BC will be perpendicular and vice versa.

$(AC)^2 = (BC)^2 + (AB)^2$

(*v*) Equilateral Triangle: Let the length of each side of an equilateral triangle be *a*. Then,
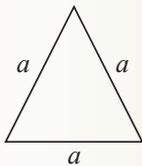
(*a*) Perimeter of Equilateral Triangle = 3*a*

(*b*) Area of Equilateral Triangle = $\dfrac{\sqrt{3}}{4} a^2$

2. **Circle:** Let the radius of the circle be *r*. Then,
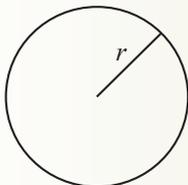
(*i*) Diameter of the circle, $d = 2r$

(*ii*) Circumference of the circle $= 2\pi r$

(*iii*) Area of the circle $= \pi r^2$

(*iv*) Length of the arc which subtends an angle θ at the center of the circle

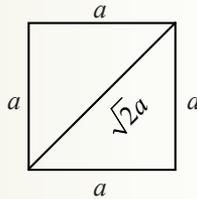$l = r\,\theta$, if θ is in radian $l = 2\pi r \times \dfrac{\theta}{360°}$, if θ is in degree
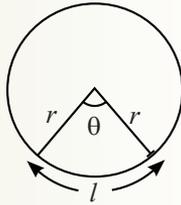
(*v*) Area of the sector of central angle $\theta = \pi r^2 \times \dfrac{\theta}{360°}$
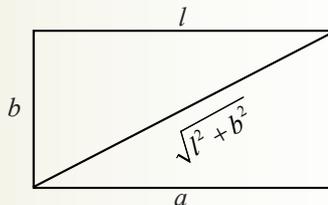
(*vi*) Perimeter of semi-circle $= \pi r + 2r = r(2 + \pi)$
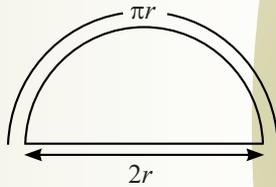
3. **Square:** Let the length of the side of a square be a. Then,

(*i*) Perimeter of the square $= 4a$

(*ii*) Area of the square $= a^2$
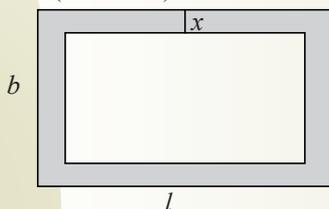
(*iii*) Diagonal of the square $= \sqrt{2}a$

4. **Rectangle:**

(i) Perimetre of the rectangle $= 2(l + b)$

(ii) Area of the rectangle $= l \times b$

(iii) Diagonal of the rectangle $= \sqrt{l^2 + b^2}$

(iv) Area of the path of uniform width x on the outer side along the boundary of the rectangle $= 2x\,(l + b + 2x)$
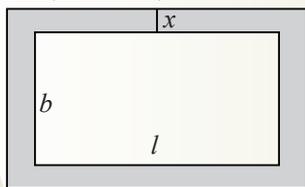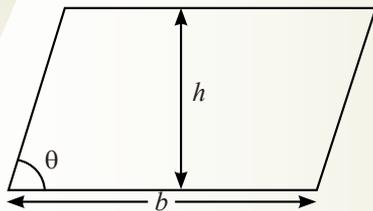

(v) Area of the path of uniform width x on the inner side along the boundary of the rectangle $= 2x(l + b - 2x)$

(vi) Area of the path of uniform width x in the middle of the rectangle along its length and breadth $= x(l + b - x)$
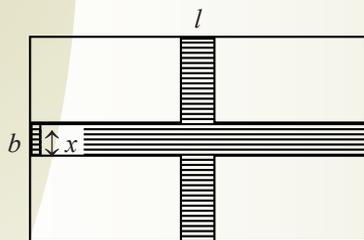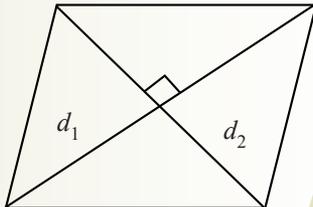

5. Parallelogram:

(i) Area of the parallelogram of base b and height $h =$ base $\times$ height
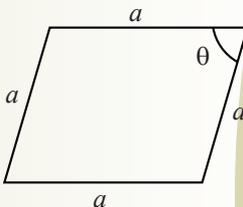$= b \times h$

(*ii*) Area of the parallelogram of the length of the sides a and b and one interior angle $\theta = ab \sin \theta$
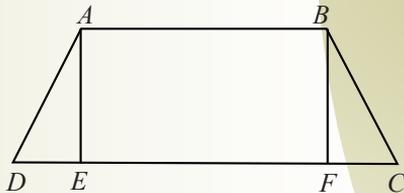
6. Rhombus:

(*i*) Area of the rhombus of diagonals d_1 and $d_2 = \dfrac{1}{2} \times d_1 \times d_2$

(*ii*) Area of the rhombus of the length of the side a and one interior angle $\theta = a^2 \sin \theta$

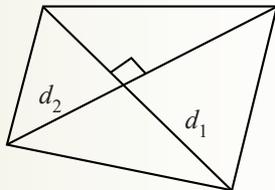## 7. Trapezium: Let ABCD be a trapezium with AB || CD and let AE ⊥ DC and BF ⊥ DC. Then,

Area of the trapezium = $\dfrac{1}{2} \times$ (AB + CD) × AE

8. Quadrilateral: Let the diagonals of the quadrilateral are d_1 and d_2 and intersect each other at 90°. Then,

Area of the quadrilateral $= \dfrac{1}{2} \times d_1 \times d_2$

9. **Regular Hexagon:** Let the length of the side of a regular hexagon be a. Then,
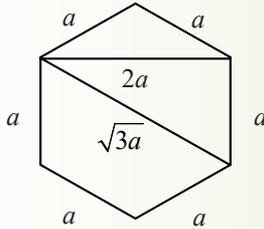
  (*i*) Perimetre of the Regular Hexagon $= 6a$

 (*ii*) Area of the Regular Hexagon $= \dfrac{2\sqrt{3}a^2}{3}$

(*iii*) Length of the longest Diagonal $= 2a$

(*iv*) Length of the smaller diagonal $= \sqrt{3}a$

Mensuration (Volume and surface areas)

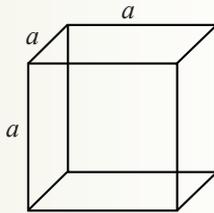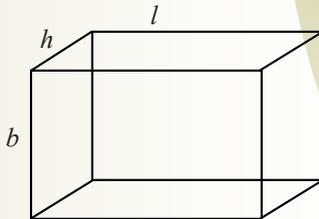1. **Cube:** Let the edge of the cube be a. Then,

  (*i*) Volume of the cube = a^3

 (ii) Lateral surface area of the cube = $4a^2$

(iii) Total surface area of the cube = $6a^2$

(iv) Length of the longest diagonal of the cube = $\sqrt{3}a$

2. **Cuboid:** Let the length, breadth had height of a cuboid be l, b and h respectively. Then,

  (*i*) Volume of the cuboid = $l \times b \times h$

 (*ii*) Lateral surface area of the cuboid = $2(l + b) \times h$

(*iii*) Total surface area of the cuboid = $2(lb + bh + hl)$

(*iv*) Length of the longest diagonal of the cube = $\sqrt{l^2 + b^2 + h^2}$

3. **Cylinder:** Let the radius of base and height of the cylinder be r and h respectively. Then,
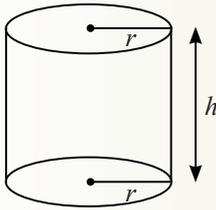
Volume of the cylinder = $\pi r^2 h$

Curved Surface Area of the cylinder = $2\pi r h$

Total Surface Area of the cylinder = $2\pi r h + 2\pi r^2 = 2\pi r(h + r)$

4. **Cone:** Let the radius of base and height of the cone be r and h respectively. Then,
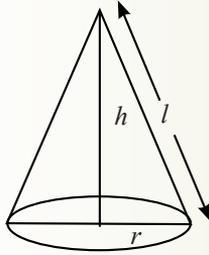
(i) Volume of the cone = $\dfrac{1}{3}\pi r^2\, h$

(ii) Slant Height of the cone, $l = \sqrt{r^2 + h^2}$

(iii) Curved Surface Area of the cone = $\pi r l$

(iv) Total Surface Area of the cone = $\pi r l + \pi r^2 = \pi r(l + r)$

5. **Sphere:** Let the radius of the sphere be r. Then,
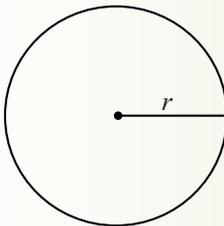
(i) Volume of the sphere = $\dfrac{4}{3}\,\pi r^3$

(ii) Total Surface Area of the sphere = $4\pi r^2$

6. **Hemisphere:** Let the radius of the sphere be r. Then,
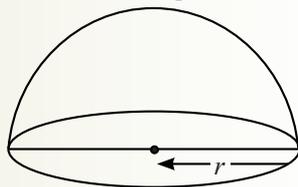
(i) Volume of the hemisphere = $\dfrac{2}{3}\pi r^3$

(ii) Curved Surface Area of the hemisphere = $2\pi r^2$

(iii) Total Surface Area of the hemisphere = $3\pi r^2$

7. **Frustum of Cone:** Let the radii of the frustum are r and R and the height of the frustum be h. Then,
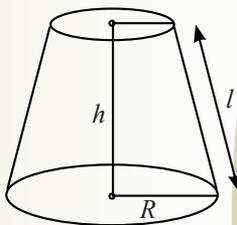
(i) Volume of the frustum of the cone = $\dfrac{1}{3}\pi h(R^2 + r^2 + Rr)$

(ii) Slant Height of the cone, $l = \sqrt{h^2 + (R-r)^2}$

(iii) Curved Surface Area of the cylinder = $\pi l(R + r)$

Total Surface Area of the cylinder = $\pi l(R + r) + \pi R^2 + \pi r^2$

8. **Prism:** A prism is a solid whose cross-sectional area is uniform.
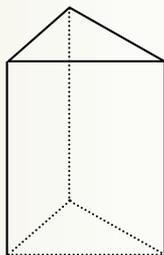
(i) Volume of the prism = Area of the base × Height of the prism

(ii) The curved surface area of the prism

= Perimetre of the base × Height of the prism

(*iii*) The total surface area of the prism

= Curved Surface Area + 2 × Area of the base.

9. Pyramid:
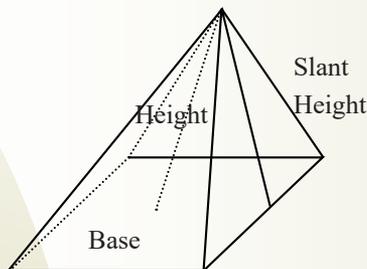
(*i*) Volume of the pyramid = $\dfrac{1}{3}$ × Area of the base × Height of the pyramid

(*ii*) Lateral surface area of the prism

= $\dfrac{1}{2}$ × Perimetre of the base × Slant Height of the pyramid

(*iii*) Total surface area of the prism = Curved Surface Area + Area of the base

10. Regular Tetrahedron: A regular tetrahedron is a tetrahedron whose all four faces are equilateral triangles of equal size. Let the side of each equilateral triangle be *a*. Then,
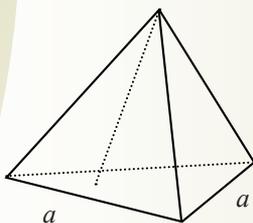
(*i*) Volume of the regular tetrahedron = $\dfrac{\sqrt{2}\, a^3}{12}$

(*ii*) Lateral Surface Area = $\dfrac{3\sqrt{3}}{4} a^2$

(*iii*) Total Surface Area = $\sqrt{3}\, a^2$

Geometry

GEOMETRY

   (*i*) The complementary angle of $\theta = 90° - \theta$.

  (*ii*) The supplementary angle of $\theta = 180° - \theta$.

1. Triangle:

   (*i*) The sum of all the angles of a triangle is180°.

      i.e. $\angle BAC + \angle ABC + \angle ACB = 180°$
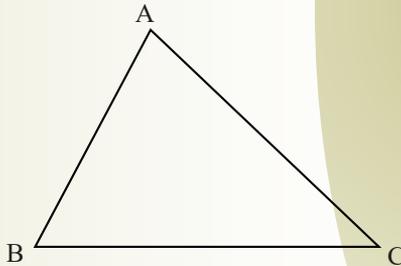
2. Square: Let *ABCD* be a square and let the diagonals *AC* and *BD* intersect at point *O*. Then,
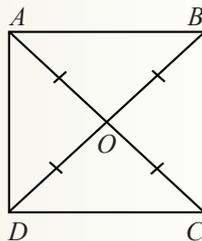
   (*i*) $AC = BD$

  (*ii*) $OA = OB = OC = OD$

(*iii*) $\angle AOB = \angle BOC = \angle COD = \angle DOA = 90°$

(*iv*) $\angle BAC = 45°$

3. **Rectangle:** Let *ABCD* be a rectangle and let the diagonals *AC* and *BD* intersect each other at point *O*. Then,
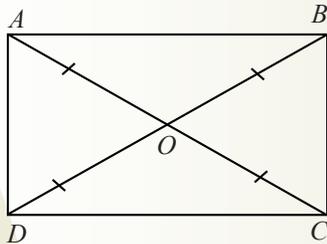
(*v*) $AC = BD$

(*vi*) $OA = OB = OC = OD$

4. **Polygon**

(*i*) The sum of all interior angles of a polygon of *n* sides = $(n - 2) \times 180°$

(*ii*) The measure of each interior angle of a regular polygon of *n* sides

$$= \frac{(n-2) \times 180°}{n}$$

(*iii*) The sum of all exterior angles of a polygon of *n* sides = 360°

(*iv*) The measure of each exterior angle of a regular polygon of *n* sides

$$= \frac{360°}{n}$$

(*v*) Number of diagonals in a polygon of *n* sides $\dfrac{n(n-3)}{2}$

Averages

1. Average $= \dfrac{\text{Sum of observations}}{\text{Number of observations}}$

2. Sum of numbers = Average × number of observations

3. If the average of n_1 numbers is a_1 and the average of n_2 numbers is a_2, then the combined average of all the numbers $\dfrac{a_1 n_1 + a_2 n_2}{n_1 + n_2}$

4. Let x_1 be n observations and w_i be their respective weights, then the weighted average $= \dfrac{x_1 w_1 + x_2 w_2 + ... + x_n w_n}{w_1 + w_2 + ... + w_n}$

5. **Average of numbers:**

   (*i*) The average of the first n natural numbers $= n(n + 1)$

   (*ii*) The average of the first n even natural numbers $(n + 1)$

   (*iii*) The average of the first n odd natural numbers $= n$

   (*iv*) The average of squares of the first n natural numbers $= \dfrac{(n+1)\,(2n+1)}{6}$

   (*v*) The average of squares of the first n even natural numbers $= \dfrac{2(n+1)\,(2n+1)}{3}$

   (*vi*) The average of squares of the first n odd natural numbers $= \dfrac{(2n-1)\,(2n+1)}{3}$

   (*vii*) The sum of cubes of the first n natural numbers $= n\left[\dfrac{(n+1)}{2}\right]^2$

(*viii*) The sum of cubes of the first n even natural numbers $= 2n[(n + 1)]^2$

  (*ix*) The sum of cubes of the first n odd natural numbers $= n(2n^2 - 1)$

   (*x*) Let a be the first term and l be the last term of an Arithmetic Progression (AP). Then, the average of all the numbers $= \dfrac{a+l}{2}$

Ratio and Proportion

1. **Ratio:** Ratio The ratio of two numbers a and b is written as $a : b$ and is equivalent to $\dfrac{a}{b}$ i.e. $a : b = \dfrac{a}{b}$

2. **Proportion:**

   I. If $a, b, c,$ and d are in proportion then we write $a : b :: c : d$

   $a : b :: c : d = a \times d = b \times c$

   II. **Continued Proportion:** If a, b and c are in continued proportion, then

   $\dfrac{a}{b} = \dfrac{b}{c}$

   III. **Third proportion:** The third proportion of a and b $= \sqrt{ab}$

   IV. **Fourth proportion:** The fourth proportion of a, b and c $= \dfrac{bc}{a}$

   V. **Mean proportion:** The mean proportion of a and b $= \sqrt{ab}$

3. **Directly and Indirectly Proportional:**

   I. **Directly Proportional:** If X is directly proportional to Y, then we write $X \propto Y$.

   $X \propto Y \Rightarrow X = kY$, where k is a constant

   Also, $X \propto Y \Rightarrow \dfrac{X_1}{X_2} = \dfrac{Y_1}{Y_2}$

   II. **Indirectly Proportional:** If X is indirectly proportional to Y, then we write $X \propto \dfrac{1}{Y}$.

$$X \propto \frac{1}{Y} \Rightarrow XY = k \text{, where } k \text{ is a constant}$$

Also, $X \propto \dfrac{1}{Y} \Rightarrow X_1Y_1 = X_2Y_2$

4. **Partnership:**

I. If A invests ₹ x for t_1 time and B invests ₹ y for t_2 time, then the ratio of their profits $(xt_1) : (yt_2)$

II. If A invests ₹ x for t_1 time, B invests ₹ y for t_2 time and C invests ₹ z for t_3 then the ratio of their profits $= (xt_1) : (yt_2) : (zt_3)$

5. **Mixture and Alligation:**

I. A container contains x litres of milk. From this container y litres of milk was taken out and replaced by water. If this process was repeated n times, then the quantity of milk in the final mixture $= x\left(1 - \dfrac{y}{x}\right)^n$

II. The cost price of 1 unit of cheaper ingredient is c and the cost price of 1 unit of dearer ingredient is d. If these two ingredients are mixed together such that the cost price of 1 unit of mixture is m, then the ratio in which these two ingredients are mixed $= (d - m) : (m - c)$

CP of 1 unit of cheaper   CP of 1 unit of dearer

c d

Mean Price

m
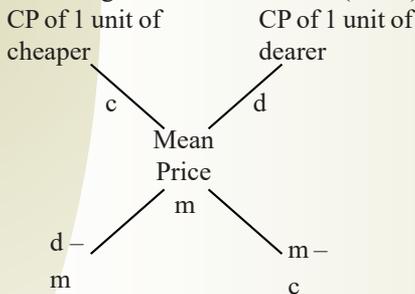
$d - m$ $m - c$

Ratio of Quantity of cheaper to dearer $= (d - m) : (m - c)$

Percentage

1. Conversion of percentage into fraction and vice versa

   $$x\% = \frac{x}{100}$$

   $$\frac{x}{y} = \left(\frac{x}{y} \times 100\right)\%$$

   I. $ab.ab\% = \dfrac{ab}{99}$

2. If A is $x\%$ more than B, then $A = (100 + x)\%$

3. If A is $y\%$ less than B, then $A = (100 - y)\%$

4. If A is $x\%$ more than B, then B is $\dfrac{x}{100 + x}\%$ less than A

5. If A is $y\%$ less than B, then B is $\dfrac{y}{100 - y}\%$ more than A

6. If A is $x\%$ more than B and B is $y\%$ more than C, then A is $\left(x + y + \dfrac{xy}{100}\right)\%$ more than C.

7. If the price of a commodity increased by $x\%$, then the reduction in consumption so that the expenditure remains same $= \dfrac{x}{100 + x}\%$

8. Let the population of a town increases $R\%$ every year. If the present population of a town is P, then

   I. n years ago, the population of the town n years ago $= \dfrac{P}{\left(1 + \dfrac{R}{100}\right)^n}$

II. n years hence, the population of the town $= P\left(1+\dfrac{R}{100}\right)^{n}$

9. Let the value of an item depreciates $R\%$ every year. If the present value of the item is P, then

III. n years ago, the value of the item $= \dfrac{P}{\left(1+\dfrac{R}{100}\right)^{n}}$

IV. n years hence, the value of the item $= P\left(1+\dfrac{R}{100}\right)^{n}$

10. Let the population of a town decreases $R\%$ every year. If the present population of a town is P, then

V. n years ago, the population of the town n years ago $= \dfrac{P}{\left(1-\dfrac{R}{100}\right)^{n}}$

VI. n years hence, the population of the town $= P\left(1-\dfrac{R}{100}\right)^{n}$

10. Let the value of an item depreciates   every year. If the present value of the item is , then

VII. n years ago, the value of the item

VIII. n years hence, the value of the item

IX. Percentage to Fraction Conversion and Vice Versa

$1 = 100\%$	$1/11 = 9\dfrac{1}{11}\% = 9.09\%$	$3/8 = 37.5\%$
$\frac{1}{2} = 50\%$	$1/12 = 8\dfrac{1}{3}\% = 7.69$	$5/8 = 62.5\%$
$1/3 = 33\dfrac{1}{3}\% = 33.33\%$	$1/13 = 7\dfrac{9}{13}\% = 7.69$	$7/8 = 87.5\%$
$1/4 = 25$	$1/14 = 7\dfrac{1}{7}\% = 7.14$	$2/3 = 66.66\%$
$1/5 = 20\%$	$1/15 = 6\dfrac{2}{3}\% = 6.66$	$7/16 = 43.75\%$

$1/6 = 16\dfrac{2}{2}\% = 16.66\%$	$1/16 = 6\dfrac{1}{4}\% = 6.25\%$	$9/16 = 56.25\%$
$1/7 = 14\dfrac{2}{7}\% = 14.28\%$	$1/17 = 5\dfrac{15}{17}\% = 5.88\%$	$2/7 = 28\dfrac{4}{7}\% =$
$1/8 = 12\dfrac{1}{8}\% = 12.5\%$	$1/18 = 5\dfrac{15}{9}\% = 5.55$	28.57%
$1/9 = 11\dfrac{1}{9}\% = 11.11\%$	$1/19 = 5\dfrac{5}{19}\% = 526$	$4/7 = 57\dfrac{1}{7}\% = 57.14$
$1/10 = 10\%$	$1/20 = 5\%$	$5/6 = 83\dfrac{1}{3}\% = 83.33\%$

$$58.33\% = 58\dfrac{1}{3}\% = \dfrac{7}{12}$$

$$45.45\% = 45\dfrac{5}{11}\% = \dfrac{5}{11}$$

$$31.25\% = 31\dfrac{1}{4}\% = \dfrac{5}{16}$$

$$18.18\% = 18\dfrac{2}{11}\% = \dfrac{2}{11}$$

$$44.44\% = 44\dfrac{4}{9}\% = \dfrac{4}{9}$$

$$22.22\% = 22\dfrac{2}{9}\% = \dfrac{2}{9}$$

$$18.75\% = 18\dfrac{3}{4}\% = \dfrac{3}{16}$$

$$26.66\% = 26\dfrac{2}{3}\% = \dfrac{4}{15}$$

Profit and Loss

1. **Some basic formulae:**
   I. When SP > CP, then profit = SP – CP
   II. When CP > SP, then loss = CP – SP
   III. SP = CP + Profit
   IV. SP = CP – Loss
   V. Profit % $= \dfrac{SP - CP}{CP} \times 100 = \dfrac{Profit}{CP} \times 100$
   VI. Loss % $= \dfrac{CP - SP}{CP} \times 100 = \dfrac{Loss}{CP} \times 100$

2. **If profit % = P, then**
   $$SP = \dfrac{100 + P}{100} \times CP$$
   $$CP = \dfrac{100}{100 + P} \times SP$$

3. **If loss % = L, then**
   $$SP = \dfrac{100 - L}{100} \times CP$$
   $$CP = \dfrac{100}{100 - L} \times SP$$

4. A person sells two articles at the same price. If he incurs x% loss on one item and x% profit on another item, then he incurs a loss of $\dfrac{x^2}{100}$% on the whole transaction.

5. If a shopkeeper sells his goods at cost price but uses false weight, then his

profit% $= \dfrac{True\,weight - false\,weight}{False\,weight} \times 100$

6. If a shopkeeper sells his goods at x% profit and uses y% less weight, then

his profit % $= \dfrac{x+y}{100-y}$

7. If a shopkeeper sells his goods at x%loss and uses y% less weight, then

his profit% or loss % $= \dfrac{y-x}{100-y}$

DISCOUNT

1. Discount = MP – SP

2. Discount% $= \dfrac{Discount}{MP} \times 100 = \dfrac{MP-SP}{MP} \times 100$

3. If discount % $=d$, then $SP = \dfrac{100-d}{100} \times MP$ $MP = \dfrac{100}{100-d} \times SP$

4. When there are two successive discounts of d_1 % and d_2%, then

$SP = \dfrac{(100-d_1)}{100} \times \dfrac{(100-d_2)}{100} \times MP$

5. A single discount equivalent to two successive discounts of x% and y%

$= \left(x+y - \dfrac{xy}{100} \right)\%$

6. If there is a profit of P% after giving D % discount, then $\dfrac{MP}{CP} = \dfrac{100+P}{100-D}$

CHAPTER **12**

Simple Interest and Compound Interest

1. If Principal $= P$, Rate of interest $= R$ % per annum and Time $= T$ years. Then,

   I. Simple Interest, $SI = \dfrac{P \times R \times T}{100}$

   II. Amount, $A = P + SI$

   III. If simple interest for n years is 'X', then simple interest for one year will be (X/n)

2. If an amount of $= P$ at a certain rate of interest becomes n_1 times in t years, then it will become n_2 times in $= \dfrac{(n_2 - 1) \times t}{n_1}$

3. If the Principal $= P$, Rate of interest $= R$ % per annum and Time $= T$ years and the interest is compounded annually, then,

   I. Amount, $A = P\left(1 + \dfrac{R}{100}\right)^T$

   II. Compound Interest, $CI = A - P = P\left[\left(1 + \dfrac{R}{100}\right)^T - 1\right]$

4. If the Principal $= P$, Rate of interest $= R$ % per annum and Time $= T$ years and the interest is compounded half-yearly, then,

   I. Amount, $A = P\left(1 + \dfrac{R}{4 \times 100}\right)^{4T}$

   II. Compound Interest, $CI = A - P = P\left[\left(1 + \dfrac{R}{4 \times 100}\right)^{4T} - 1\right]$

5. If the Principal $= P$, Rate of interest $= R\%$ per annum and Time $= T$ years and the interest is compounded quarterly, then,

I. Amount, $A = P\left(1 + \dfrac{R}{4 \times 100}\right)^{4T}$

II. Compound Interest, $CI = A - P = P\left[\left(1 + \dfrac{R}{4 \times 100}\right)^{4T} - 1\right]$

6. If the interest is compounded annually and the rate of interest is R_1 % for the first year, R_2 % for the second year and R_3 % for the third year, then

$$A = P\left(1 + \dfrac{R_1}{100}\right)\left(1 + \dfrac{R_2}{100}\right)\left(1 + \dfrac{R_3}{100}\right)$$

7. If the interest is compounded annually, the rate of interest is $R\%$ per annum and the time is in fractions say $t\dfrac{n}{m}$ years, then $A = P\left(1 + \dfrac{R}{100}\right)^t\left(1 + \dfrac{nR}{m \times 100}\right)$

8. If an amount P at a certain rate of interest becomes n_1 times in t_1 years, and n_2 times in t_2 years, and the interest is compounded annually, then $(n_2)^{t_1} = (n_1)^{t_2}$

9. If Principal $= P$, Rate of interest $= R$ % per annum and Time $= 2$ years. Then,

$$CI - SI = P\left(\dfrac{R}{100}\right)^2 \qquad CI - SI = \dfrac{SI \times R}{100}$$

10. If Principal $= P$, Rate of interest $= R$ % per annum and Time 3 years. Then,

$$CI - SI = \dfrac{PR^2(300 + R)}{100^3}$$

10. If Principal , Rate of interest % per annum and Time years. Then,

$$CI - SI = P\left[\left(\dfrac{R}{100}\right)^2 + 3\left(\dfrac{R}{100}\right)^2\right]$$

11. If an amount of C is to be returned in n equal installments and the value of each installment is I, then

$$P = \dfrac{I}{\left(1 + \dfrac{R}{100}\right)} + \dfrac{I}{\left(1 + \dfrac{R}{100}\right)^2} + \dfrac{I}{\left(1 + \dfrac{R}{100}\right)^3} + \dots + \dfrac{I}{\left(1 + \dfrac{R}{100}\right)^n}$$

Speed, Time and Distance

1. **Basic Formulae:**

   I.   Distance = Speed × Time

   II. Time $= \dfrac{Distance}{Speed}$

   III. Speed $= \dfrac{Distance}{Time}$

2. **Conversion of km/hr to m/s and vice-versa**

   I. x km/hr $= x \times \dfrac{5}{18}$ m/s

   II. x m/s $= x \times \dfrac{18}{5}$ km/ph

3. **Average Speed:**

   I.   Average Speed $= \dfrac{\text{Total distance traveled}}{\text{Total time taken}}$

   II. If a person covers a certain distance at x kmph and the same distance at y kmph then the average speed during the whole journey $= \dfrac{2xy}{x+y}$ kmph.

4. **Same Distance is covered at two Different Speeds:**

   I.   If a person covers a distance from A to B at x kmph and returns back to A at y kmph and the total time of the journey is t hours then the distance between A and B $= \left(\dfrac{xy}{x+y} \times t \right)$ kmph.

II. If a person covers the same distance at two different speeds kmph and kmph and the difference in time taken is hours then the distance between A and B kmph.

5. **Relative Speed:**

   I. When two persons are moving in the same direction at x kmph and y kmph (where $x > y$), then the relative speed of A with respect to B $= (x - y)$ kmph

   II. When two persons A and B are moving in the opposite direction at x kmph and y kmph, then the relative speed of A with respect to B $= (x + y)$ kmph

6. If two vehicles A and B start at the same time towards each other from two fixed points and after passing each other they complete their journey in X and Y hours respectively, then

$$\frac{Speed\ of\ A}{Speed\ of\ B} = \frac{\sqrt{X}}{\sqrt{Y}}$$

7. **Trains:**

   I. If the length of the train $= L$ m and the speed of the train $= S$ m/s, then the time taken (in seconds) by the train to cross a pole, tree etc. is $t = \dfrac{L}{S}$

   II. If the length of the train $= L_1$ m, the speed of the train $= S_1$ m/s, and the length of the platform or bridge $= L_2$ m, then the time taken (in seconds) by the train the platform is $t = \dfrac{L_1 + L_2}{S}$

   III. If the length of the train $= L$ m, the speed of the train $= S_1$ m/s, and the speed of the man $= S_2$ m/s, then the time taken (in seconds) by the train to cross the man moving in the same direction as of the train is $t = \dfrac{L}{S_1 - S_2}$

   IV. If the length of the train $= L$ m, the speed of the train $= S_1$ m/s, and the speed of the man $= S_2$ m/s, then the time taken (in seconds) by the train to cross the man moving in the opposite direction as of the train is $t = \dfrac{L}{S_1 + S_2}$

   V. If the length of the train A $= L_1$ m, the speed of the train A $= S_1$ m/s, the length of the train B $= L_2$ m, and the speed of the train B $= S_2$ m/s, and the trains are running on parallel tracks in the same direction, then

the time taken (in seconds) by the faster train to cross the slower train

is $t = \dfrac{L_1 + L_2}{S_1 - S_2}$

VI. If the length of the train A $= L_1$ m, the speed of the train A $= S_1$ m/s, the length of the train B $= L_2$ m, and the speed of the train B $= S_2$ m/s, and the trains are running on parallel tracks in the opposite direction, then the time taken (in seconds) by the trains to cross each other is

$t = \dfrac{L_1 + L_2}{S_1 + S_2}$

VII. If a train covers a certain distance 'd' out of total distance D with its original speed and after that get accidented and completes the remaining distance (D - d) at reduced speed due to which it late by 't' hours, then

$\dfrac{(D - d)}{\text{reduced speed}} - \dfrac{(D - d)}{\text{Original speed}} = t$

BOATS AND STREAMS

1. If the speed of a boat in still water is x kmph and the speed of the stream is y kmph, then

    I. Speed downstream $= (x + y)$ kmph

    II. Speed upstream $= (x - y)$ kmph

2. If the speed downstream is x kmph and the speed upstream is y kmph, then

    I. Speed of the boat in still water $= \dfrac{1}{2}(x + y)$ kmph

    II. Speed of the stream $= \dfrac{1}{2}(x - y)$ kmph

3. If the speed of the boat in still water is x kmph and the speed of the stream is y kmph and it takes t hours to row from A to B and come back, then the

    distance between A and B $= \dfrac{t(x^2 - y^2)}{2x}$

4. If the speed of a boat in still water is x kmph and the speed of the stream is y kmph, let the boat covers the same distance upstream and downstream, then the ratio of time taken downstream and upstream

5. If the speed of a boat in still water is x kmph and the speed of the stream is y kmph, let the boat takes n times as long to row up as to row down,

    then $x = y\left(\dfrac{n+1}{n-1}\right)$

Time and Work

1. If A can do a work in m days and B can do the same work in n days, then A and B together can do the same work in $= \dfrac{mn}{m+n}$ days

2. If A can do a work in m days and A and B together can do the same work in n days, then B can do the same work in $= \dfrac{mn}{m-n}$ days

3. If A takes x days more than A and B together to do a work and B takes days more than A and B together to do a work then, A and B together complete the work in $= \sqrt{xy}$ days.

4. If M_1 men can do W_1 work in D_1 days working H_1 hours per day and M_2 men can do W_2 work in D_2 days working H_2 hours per day then,
$$\dfrac{M_1 D_1 H_1}{W_1} = \dfrac{M_2 D_2 H_2}{W_2}$$

5. A and B together complete a work. If A can do the same wok in m days and B can do the same work in n days, then the ratio of their wages $= n : m$

6. If A can do a work in m days, B can do the same work in n days, C can do the same work in p days, then ratio of their efficiencies $= \dfrac{1}{m} : \dfrac{1}{n} : \dfrac{1}{p}$

   and so on.

7. If A can do a work in m days, B can do the same work in n days, C can do the same work in p days, then total work = LCM of (m,n,p) units

8. A and B can complete a work in 'n' days working alternatively while A can complete the work in x days alone and B can complete the work in y days alone.

I.   If n = even, then the last working person will be B if A starts the work.

II. If n = odd, then last working parson will be A if A starts the work

III. Work done in n time = $\dfrac{n}{2}\left(\text{First two days work of } A \text{ and } B\right)$

Note : Same formulas are applicable for Pipe and Cistern topics.

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