Quantitative Aptitude

Formula Booklet

Corporate & International Relations

1. Averages

Simple averages = $\frac{x_1+x_2+x_3+\cdots+x_n}{n}$

Weighted Average = $\frac{w_1x_1+w_2x_2+w_3x_3+\cdots+w_nx_n}{w_1+w_2+w_3+\cdots+w_n}$

Geometric Mean = $\sqrt[n]{x_1 \times x_2 \times x_3 \times \ldots\ldots\ldots \times x_n}$

Harmonic Mean = $\frac{n}{\left(\frac{1}{x_1}+\frac{1}{x_2}+\frac{1}{x_3}+\cdots+\frac{1}{x_n}\right)}$

For two numbers, Harmonic Mean = $\frac{2ab}{a+b}$

2. Percentage Change

Change % = $\frac{Final\ Value-Initial\ Value}{Initial\ Value} \times 100\ \%$

Total Successive Change% = $(a+b+\frac{ab}{100})\ \%$

3. Interest

Simple Interest = $\frac{P\times R\times T}{100}$

Compound Interest = $P \times (1+\frac{R}{100})^n - P$

Population after n years P' = $P \times (1 \pm \frac{R}{100})^n$

4. Growth

Growth% = $\frac{final\ value-Initial\ Value}{Initial\ Value} \times 100\%$

SAGR or AAGR = $\frac{Growth\ Rate}{Number\ of\ Years} \times 100\%$

CAGR = $\left[\left(\frac{Final\ Value}{Initial\ Value}\right)^{\frac{1}{Number\ of\ Years}} - 1\right] \times 100\%$

[Here, S. A. G. R. = Simple Annual Growth Rate, A. A. G. R. = Average Annual Growth Rate and C. A. G. R. = Compound Annual Growth Rate]

5. Profit and Loss

Profit = SP – CP

Loss = CP – SP

Percentage Profit = $\frac{Profit}{CP} \times 100\% = \frac{SP-CP}{CP} \times 100\%$

Percentage Loss = $\frac{Loss}{CP} \times 100\% = \frac{CP-SP}{CP} \times 100\%$

6. False Weights

If an item is claimed to be sold at cost price, using false weights, then the overall percentage profit is given by

Percentage Profit = $\left(\frac{\text{Claimed Weight of Item}}{\text{Actual Weight of Item}} - 1\right) \times 100\%$

7. Discount

Discount = Marked Price − Selling Price

Discount Percentage = $\frac{Discount}{Marked\ Price} \times 100\%$

8. Buy *x* and Get *y* Free

If articles worth Rs. *x* are bought and articles worth Rs. *y* are obtained free along with *x* articles, then the discount is equal to *y* and discount percentage is given by

Percentage discount = $\frac{y}{x+y} \times 100\%$

9. Successive Discounts

When a discount of *a*% is followed by another discount of *b*%, then

Total discount = $\left(a + b - \frac{ab}{100}\right)\%$

10. Ratios

If *a: b = c: d*, then *a: b = c: d = (a + c): (b + d)* If 0<*a* < *b*, then for a positive quantity *x*,

$\frac{a+x}{b+x} > \frac{a}{b}\ and\ \frac{a-x}{b-x} < \frac{a}{b}$

If *a* > *b>0*, then for a positive quantity *x*,

$\frac{a+x}{b+x} < \frac{a}{b}\ and\ \frac{a-x}{b-x} > \frac{a}{b}$

11. Proportions

If a: b:: c:d or $\frac{a}{b} = \frac{c}{d}$, then

$\frac{a}{c} = \frac{b}{d}$	Alternendo Law
$\frac{b}{a} = \frac{d}{c}$	Invertendo Law
$\frac{a+b}{b} = \frac{c+d}{d}$	Componendo Law
$\frac{a-b}{b} = \frac{c-d}{d}$	Dividendo Law
$\frac{a+b}{a-b} = \frac{c+d}{c-d}$	Componendo and Dividendo Law

If $\frac{a}{b} = \frac{c}{d} = \frac{e}{f} = \cdots \ldots \ldots .. = k$, then $\frac{a+c+e+\cdots \ldots}{b+d+f+\cdots \ldots} = k$

$\frac{a}{b} = \frac{c}{d} = \frac{e}{f} = \cdots \ldots \ldots .. = k$ and p, q, r are real numbers, then $\frac{pa^n+qc^n+re^n+\cdots \ldots}{pb^n+qd^n+rf^n+\cdots \ldots} = k^n$

12. Successive Replacement

$$\frac{Quantity\ of\ milk\ remaining\ after\ n^{th}\ replacement}{Quantity\ of\ total\ mixture} = \left(\frac{x-y}{x}\right)^n$$

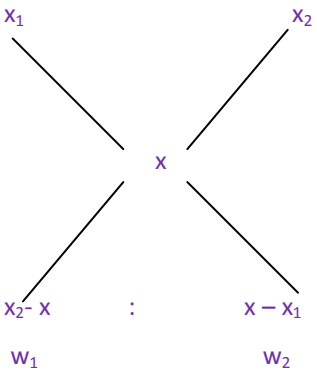
Where *x* is the original quantity, *y* is the quantity that is replaced and *n* is the number of times the replacement process is carried out.

13. Alligation Rule

The ratio of the weights of the two items mixed will be inversely proportional to the deviation of attributes of these two items from the average attribute of the resultant mixture.

$$\frac{w_1}{w_2} = \frac{(x_2 - x)}{(x - x_1)}$$

Alligation Cross:



14. Time, Speed and Distance

Speed = Distance / Time

Important Conversion Factors:

1 km/hr = $\frac{5}{18}$ m/s and 1 m/s = $\frac{18}{5}$ km/hr

15. Average Speed

Average = $\frac{\text{Total Distance travelled}}{\text{Total time taken}} = \frac{d_1 + d_2 + d_3 + \ldots.}{t_1 + t_2 + t_3 + \ldots..}$

A man travels first half of the distance at a speed s_1, second half of the distance at a speed s_2 then, Average Speed [Average speed is given by harmonic mean of two speeds] $S_{avg} = \frac{2s_1 s_2}{s_1 + s_2}$

If the time is constant, then average speed is given by arithmetic mean of two speeds: $S_{avg} = \frac{s_1 + s_2}{2}$

16. Relative Speed

For Trains

Time = $\frac{Sum\ of\ the\ lengths}{Relative\ Speed} = \frac{l_1 + l_2}{s_1 \pm s_2}$

For Boats and Streams

$S_{downstream} = S_{boat} + S_{stream}$

$S_{upstream} = S_{boat} - S_{stream}$

$S_{boat} = \frac{S_{downstream} + S_{upstream}}{2}$

$S_{stream} = \frac{S_{downstream} - S_{upstream}}{2}$

17. Time and Work/Pipes and Cisterns

Number of days to complete the work = $\frac{1}{Work\ done\ in\ one\ day}$

$\frac{M_1 D_1 H_1}{W_1} = \frac{M_2 D_2 H_2}{W_2}$

[This is our general formula to solve time & work problems. It is also known as **Work Equivalence Method]**

18. Application of H.C.F.

The greatest natural number that will divide *x*, *y* and *z* leaving remainders *r*1, *r*2 and *r*3, respectively, is the H.C.F. of $(x - r_1)$, $(y - r_2)$ and $(z - r_3)$

19. Application of L.C.M.

The smallest natural number that is divisible by *x*, *y* and *z* leaving the same remainder *r* in each case is the L.C.M. of (*x*, *y* and *z*) + *r*

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

H.C.F of fractions = $\frac{H.C.F\ of\ numerators\ of\ all\ fractions}{L.C.M\ of\ denominators\ of\ all\ fractions}$

L.C.M of fractions = $\frac{L.C.M\ of\ numerators\ of\ all\ fractions}{H.C.F\ of\ denominators\ of\ all\ fractions}$

[Express all numbers as fractions in its simplest form]

21. Properties of Surds

$\left[\sqrt[n]{a}\right]^n = a$

$\sqrt[n]{a}\sqrt[n]{b} = \sqrt[n]{ab}$

$\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$

22. Law of Indices

If a and b are non – zero rational numbers and m and n are rational numbers, the

$a^0 = 1$

$a^{-m} = \frac{1}{a^m}$

$\sqrt[m]{a} = a^{\frac{1}{m}}$

$a^{\frac{m}{n}} = \sqrt[n]{a^m}$

$a^m \times a^n = a^{m+n}$

$a^m \div a^n = a^{m-n}$

$(a^m)^n = a^{mn}$

$(ab)^m = a^m b^m$

If$a^m = a^n$, then m = n

If $a^m = b^n$ and m≠0, then a = b if m is odd and a = $\pm$ b if m is even

23. Laws of Logarithms

$\log_b 1 = 0$

$\log_a a = 1$

$\log_a b \times \log_b a = 1$

$\log_a(m \times n) = \log_a m \times \log_a n$

$\log_a \frac{m}{n} = \log_a m - \log_a n$

$\log_a m^n = n \log_a m$

$\frac{\log_a m}{\log_a b} = \log_a m \times \log_b a$

$b \log_b n = n$

If $\log_a m = \log_b n \; and \; if \; m = n, then \; a \; will \; be \; equal \; to \; b$

If $\log_a m = \log_b n \; and \; if \; a = b, then \; m \; will \; be \; equal \; to \; n$

24. Binomial Theorem

If n is a natural number that is greater than or equal to 2, then according to the binomial theorem:

$(x+a)^n = {}^nc_o x^n a^0 + {}^nc_1 x^{n-1} a^1 + {}^nc_2 x^{n-2} a^2 + \ldots\ldots\ldots + {}^nc_n x^0 a^n$

Here, ${}^nC_r = \frac{n!}{(n-r)!r!}$

25. Roots of Quadratic Equation

The two roots of the equation, $ax^2+bx+c=0$ are given by:

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

26. Algebraic Formulae

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

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

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

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

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

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

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

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

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

27. Arithmetic Progression

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

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

28. Geometric Progression

$$T_n = ar^{n-1}$$

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

$$S_\infty = \frac{a}{1-r}, for\ r < 1$$

29. Harmonic Progression

$$T_n = \frac{1}{a + (n-1)d}$$

30. Sum of Important Series

Sum of first *n* natural numbers

$$\sum n = 1 + 2 + 3 + \cdots n = \frac{n(n+1)}{2}$$

Sum of the squares of the first *n* natural numbers

$$\sum n^2 = 1^2 + 2^2 + 3^2 + \ldots . n^2 = \frac{n(n+1)(2n+1)}{6}$$

Sum of the cubes of the first *n* natural numbers

$$\sum n^3 = 1^3 + 2^3 + 3^3 + \cdots n^3 = \left(\frac{n(n+1)}{2}\right)^2$$

31. Factorial

$n! = 1 \times 2 \times 3 \times \ldots \times (n-1) \times n$

$n! = n \times (n-1)!$

32. Permutations

$$n_{P_r} = \frac{n!}{(n-r)!}$$

33. Combinations

$$n_{C_r} = \frac{n!}{(n-r)!\,r!}$$

Important Properties:

$$n_{C_r} = n_{C_{n-r}}$$

$$n_{C_0} + n_{C_1} + n_{C_2} + \cdots + n_{C_n} = 2^n$$

$$n_{C_0} + n_{C_2} + \cdots = n_{C_1} + n_{C_3} + \cdots = 2^{n-1}$$

$$n_{C_r} + n_{C_{r+1}} = (n+1)_{C_{(r+1)}}$$

$$n_{C_r} = n_{C_k} \Longrightarrow r = k \; or \; r + k = n$$

34. Partition Rule

Number of ways of distributing *n* identical things among *r* persons when each person may get any number of things

$= (n + r - 1)\, C_{(r-1)}$

35. Probability

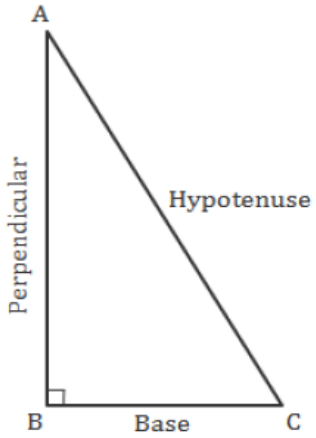
Probability of an event = $\frac{Number\ of\ favourable\ outcomes}{Number\ of\ total\ outcomes}$

Odds in favour = $\frac{Number\ of\ favourable\ outcomes}{Number\ of\ unfavourable\ outcomes}$

Odds against = $\frac{Number\ of\ unfavourable\ outcomes}{Number\ of\ favourable\ outcomes}$

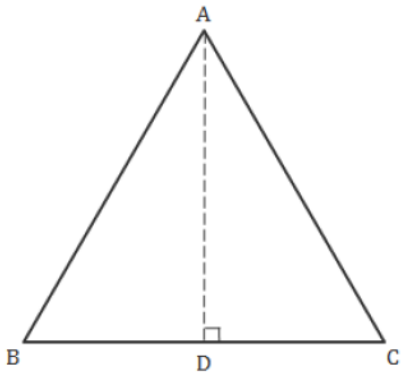
36. Pythagoras Theorem

For right triangle ABC



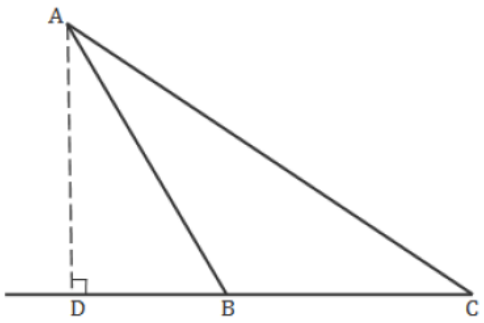
$AC^2 = AB^2 + BC^2$

For acute triangle ABC



$AC^2 = AB^2 + BC^2 - 2\,(BC)\,(BD)$

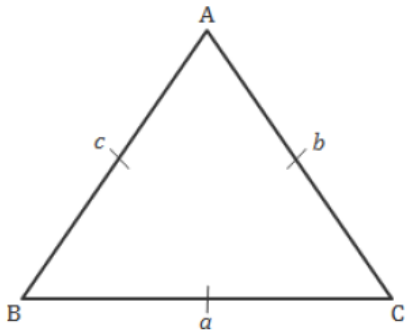
For obtuse triangle ABC



$AC^2 = AB^2 + BC^2 + 2*BC*BD$

37. Area of Triangle

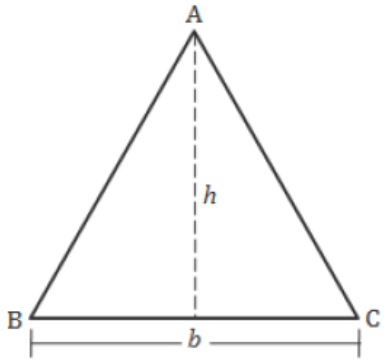
When lengths of the sides are given



Area = $\sqrt{s\,(s-a)(s-b)(s-c)}$

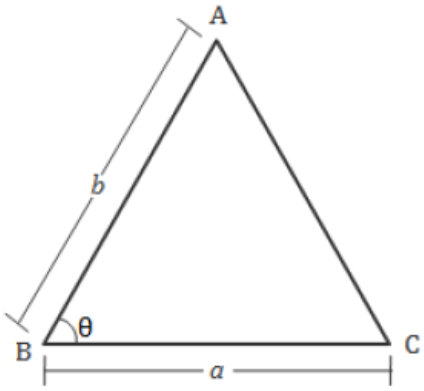
Where, semi perimeter (s) = $\frac{a+b+c}{2}$

When lengths of the base and altitude are given



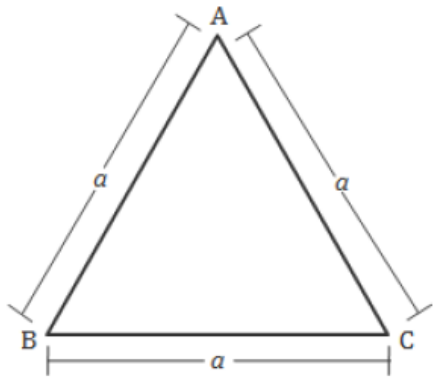
Area = $\frac{1}{2}\ bh$

When lengths of two sides and the included angle are given



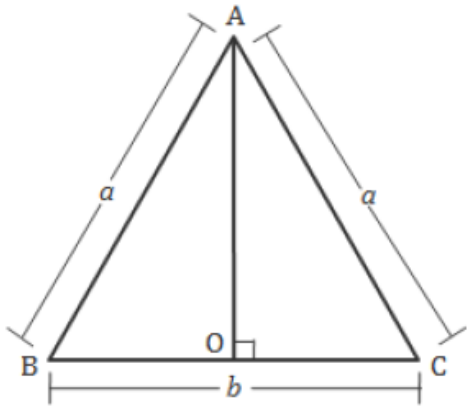
Area = $\frac{1}{2}\ ab\ \sin\theta$

For Equilateral Triangle



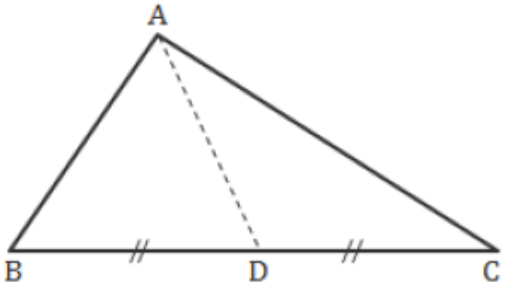
Area = $\frac{\sqrt{3}}{4}a^2$

For Isosceles Triangle



Area = $\frac{b}{4} \times \sqrt{4a^2 - b^2}$

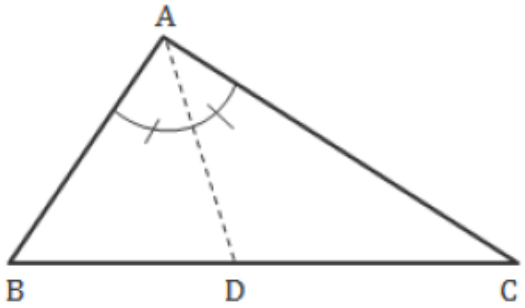
38. Apollonius Theorem



If AD is the median, then:

$AB^2 + AC^2 = 2(AD^2 + BD^2)$

39. Angle Bisector Theorem



If AD is the angle bisector for angle A, then:

$$\frac{AB}{BD} = \frac{AC}{CD}$$

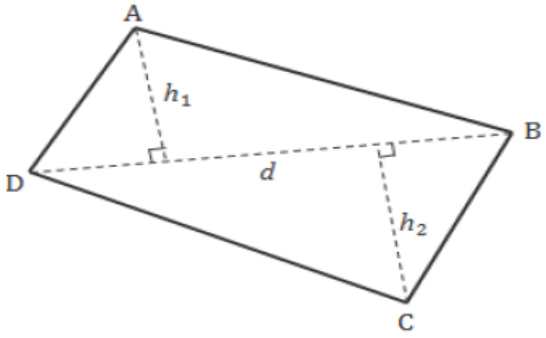
40. Area of Quadrilateral

For Cyclic Quadrilateral

Area = $\sqrt{(S-a)(S-b)(S-c)(S-d)}$

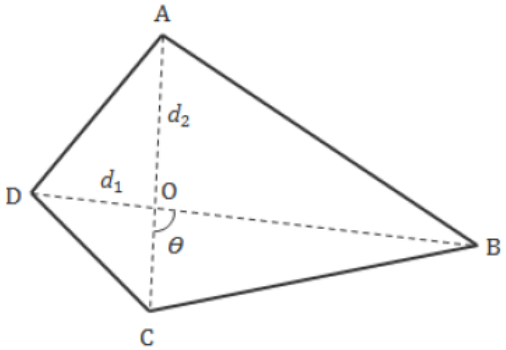
Where, semi perimeter (s) = $\frac{a+b+c+d}{2}$

If lengths of one diagonal and two offsets are given



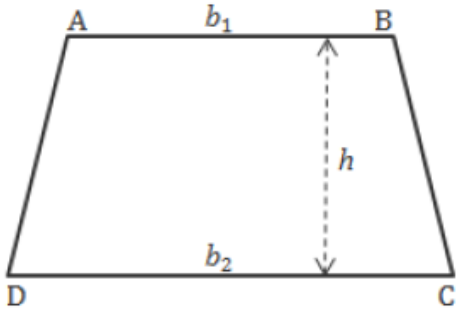
Area = $\frac{1}{2}d(h_1 + h_2)$

If lengths of two diagonals and included angle are given



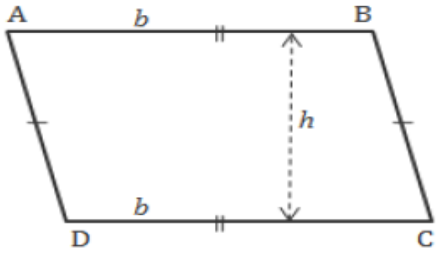
Area = $\frac{1}{2}d_1 d_2 sin\theta$

For Trapezium



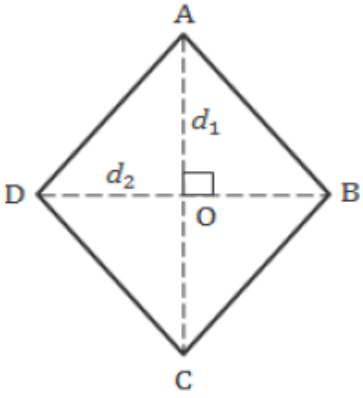
Area = $\frac{1}{2}(b_1 + b_2)h$

For Parallelogram



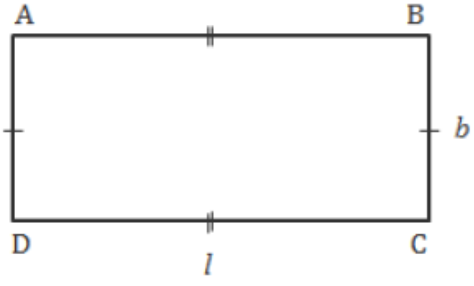
Area = bh

For Rhombus



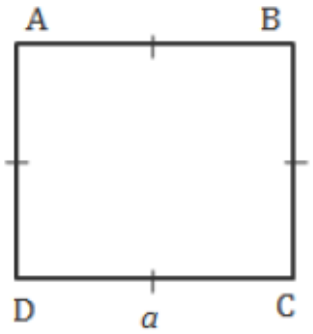
Area = $\frac{1}{2}\ d_1\ d_2$

For Rectangle



Area = lb

For Square



Area = a^2

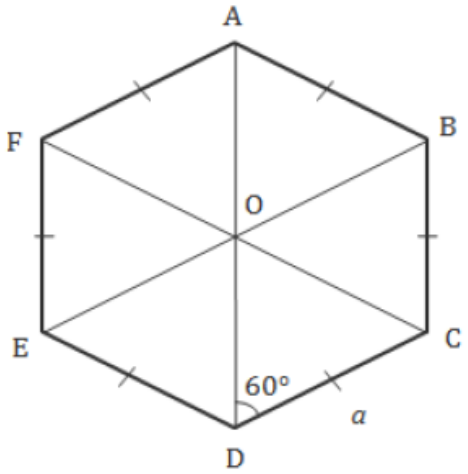
41. Polygon

Number of Diagonals = $\frac{n(n-3)}{2}$

The sum of all the interior angles = $(n-2)180^0$

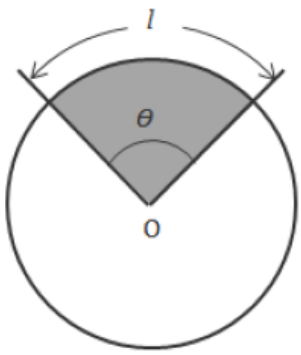
The sum of all exterior angles = 360

42. Area of Regular Hexagon



Area = $\frac{3\sqrt{3}}{2}\ a^2$

43. Circle



Circumference C = $2\pi r$

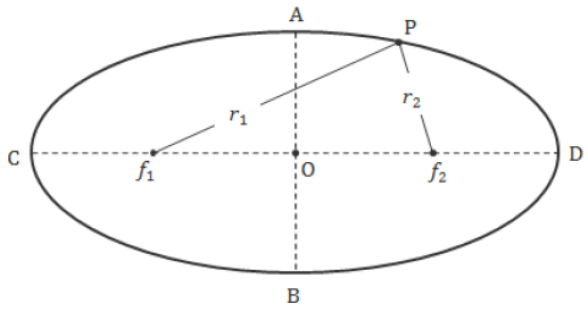
Area (A) = πr^2

Length of Arc (l) = $2\pi r(\frac{\theta}{360^0})$, where θ is in degrees.

Area of Sector =$\pi r^2(\frac{\theta}{360^0})$, where θ is in degrees.

Perimeter of Sector = $l + 2r$

44. Ellipse



If semi-major axis (OD) = *a* and semi-minor axis (OA) = *b*,

Perimeter of the ellipse

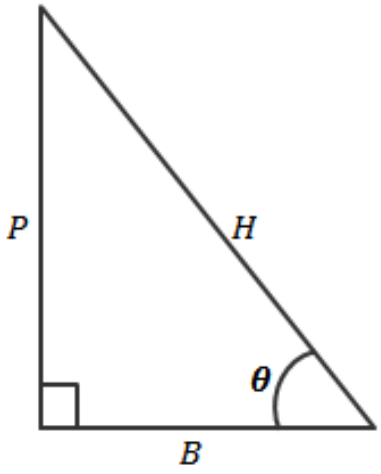
$P_e = \pi(a + b)$

Area of the ellipse

$A_e = \pi ab$

45. Trigonometric Ratios

For a right triangle, if *P* is the length of perpendicular, *B* is the length of base, *H* is the length of hypotenuse and θ is the angle between base and hypotenuse,



$$\sin\theta = \frac{P}{H}$$

$$\cos\theta = \frac{B}{H}$$

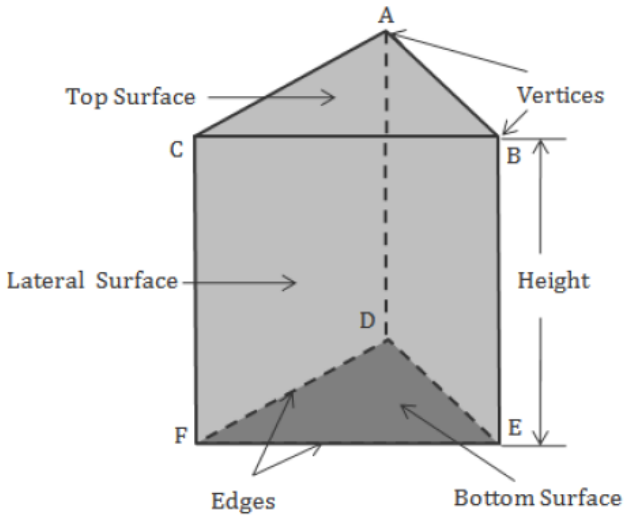
$$\tan\theta = \frac{P}{B}$$

46. Distance between Points

Distance between two points $A\ (x_1, y_1)$ and $B\ (x_2, y_2)$ is given by

$$AB = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

47. Right Prism

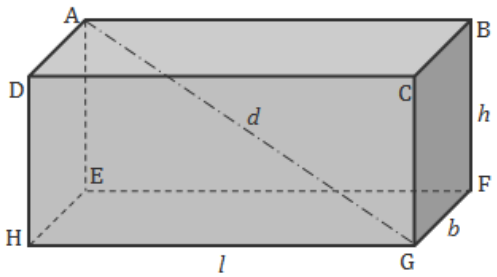


Lateral Surface Area (L.S.A.) = Perimeter of base × height

Total Surface Area (T.S.A.) = L.S.A. + 2 × Area of base

Volume (*V*) = Area of base × height

48. Cuboid



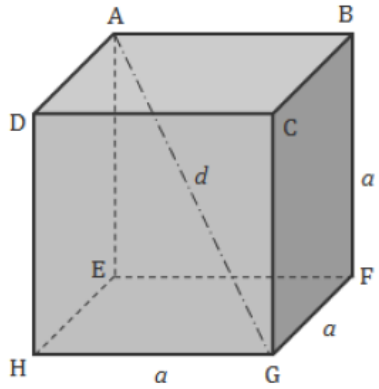
S.A. = 2(lh + bh)

T.S.A. = 2(lh + bh + lb)

Volume (V) = lbh

Body Diagonal (d) = $\sqrt{l^2 + b^2 + h^2}$

49. Cube



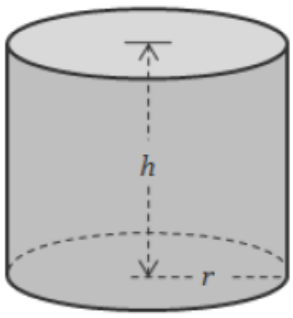
L.S.A = $4a^2$

T.S.A = $6a^2$

Volume (V) = a^3

Body Diagonal (d) = $a\sqrt{3}$

50. Cylinder

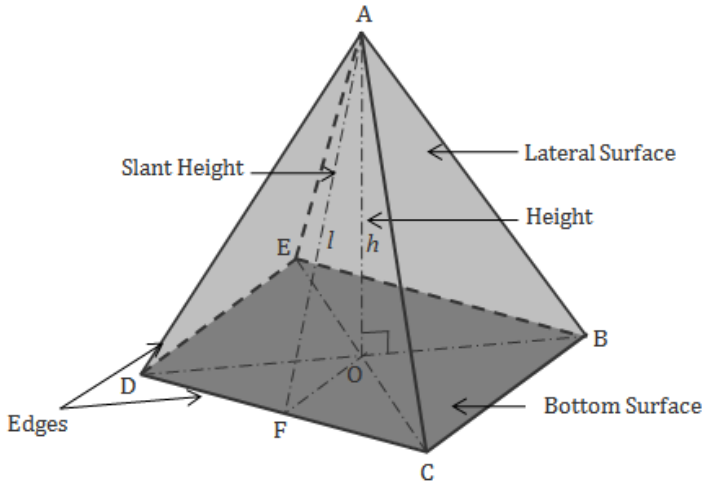


Curved Surface Area (C.S.A.) = 2πrh

T.S.A. = $2\pi rh + 2\pi r^2$

Volume (V) = $\pi r^2 h$

51. Right Pyramid

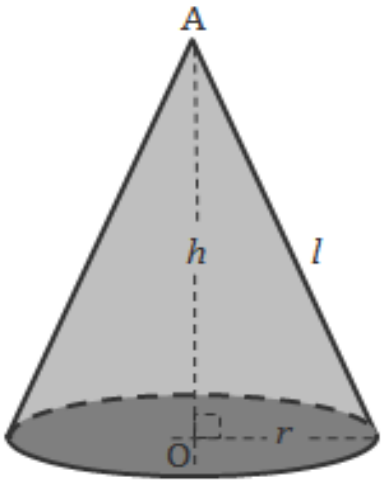


L.S.A = $\frac{1}{2}$ × Perimeter of Base × Slant Height

T.S.A = L.S.A + Area of base

Volume (V) = $\frac{1}{3}$ × Area of Base × Height

52. Cone



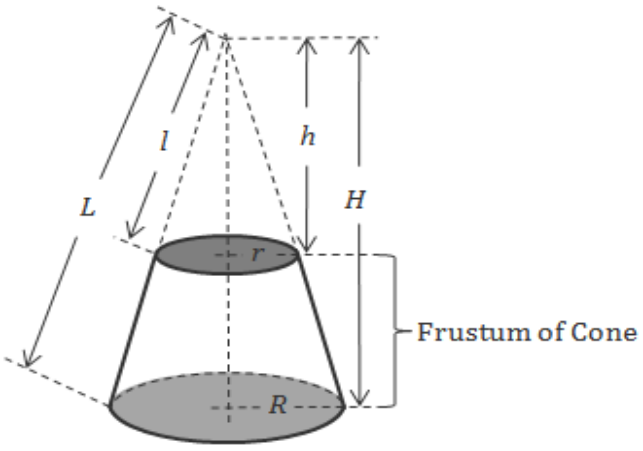
C.S.A. = πrl

T.S.A. = πrl + πr^2

Volume (V) = $\frac{1}{3}\pi r^2 h$

Slant height (l) = $\sqrt{r^2 + h^2}$

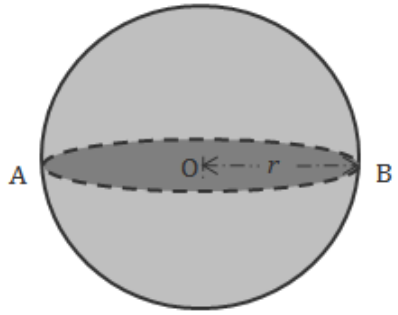
53. Frustum of a cone



$$\frac{Volume\ of\ the\ Original\ Cone}{Volume\ of\ the\ removed\ Cone} = \frac{V}{v} = \left(\frac{R}{r}\right)^3 = \left(\frac{H}{h}\right)^3 = \left(\frac{L}{l}\right)^3$$

Volume (V) = $\frac{1}{3}\pi h(R^2 + r^2 + Rr)$

54. Sphere

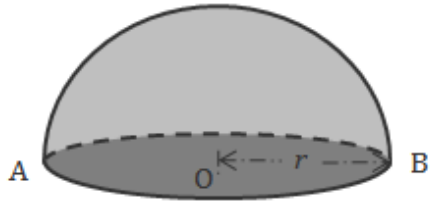


C.S.A. = $4\pi r^2$

T.S.A. = $4\pi r^2$

Volume (V) = $\frac{4}{3}\pi r^3$

55. Hemisphere

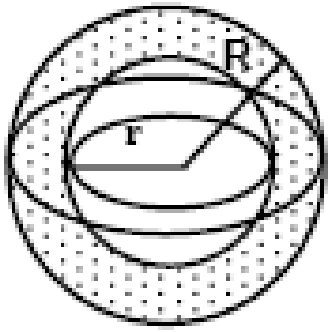


C.S.A. = $2\pi r^2$

T.S.A. = $3\pi r^2$

Volume (V) = $\frac{2}{3}\pi r^3$

56. Spherical shell



T.S.A = $4\pi(R^2 - r^2)$

Volume (V) = $\frac{4}{3}\pi(R^3 - r^3)$