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CHENNAI ACADEMY OF ARCHITECTURE AND DESIGN

PERIYAPALLAYAM, CHENNAI.

NATA 2024

PREPARATORY GUIDE

B.Arch.,

ANNA UNIVERSITY COUNCELLING CODE

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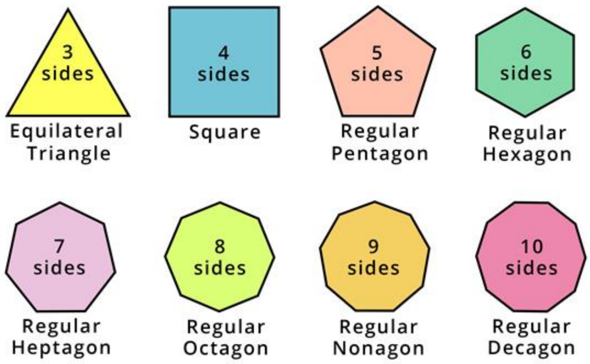
NUMERICAL ABILITY

Basic Mathematics and its association with creative thinking.
To unfold a space with use of geometry.

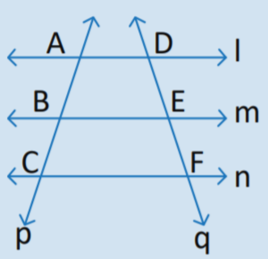
GEOMETRY

REGULAR POLYGON

- Sum of all interior angles of a regular polygon of side n is given by **(2n – 4) 90°.**
- Angle of a regular polygon = **((2n-4)90°)/n**
- Sum of an interior angle and its adjacent exterior angle is 180°
- Sum of all exterior angles of a polygon taken in order is 360°.



PROPERTY OF INTERCEPTS MADE BY THREE PARALLEL LINES

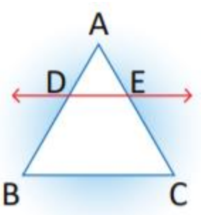


If AD || BE || CF ,

then $\frac{AB}{BC} = \frac{DE}{EF}$

The ratio of intercepts made on transversal by 3 parallel lines is equal to ratio of corresponding intercepts made on any other transversal of the same parallel lines

BASIC PROPORTIONALITY THEOREM



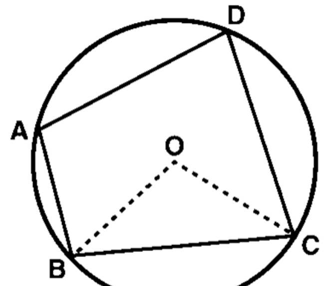
If DE || BC , then by BPT

$\frac{AD}{DB} = \frac{AE}{EC}$

If a line is parallel; to a side of a triangle which intersects other two sides in distinct points, then the line divides other two sides in proportion.

CYCLIC QUADRILATERAL

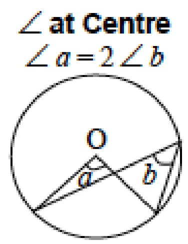
In a cyclic quadrilateral, the sum of a pair of opposite angles is 180^0(supplementary).

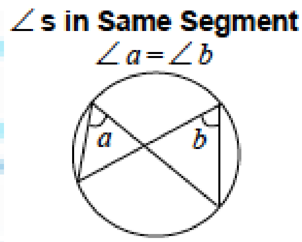


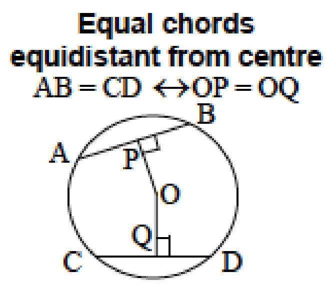
The area of a cyclic quadrilateral is

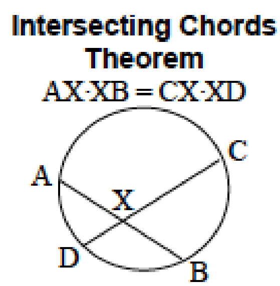
Area=√(s–a)(s–b)(s–c)(s–d)

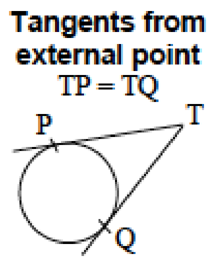
where a, b, c, and d are the four sides of the quadrilateral.

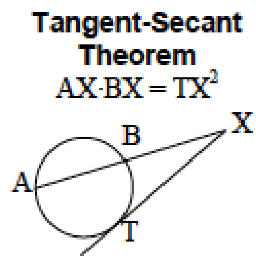












NUMERICAL REASONING

MENSURATION

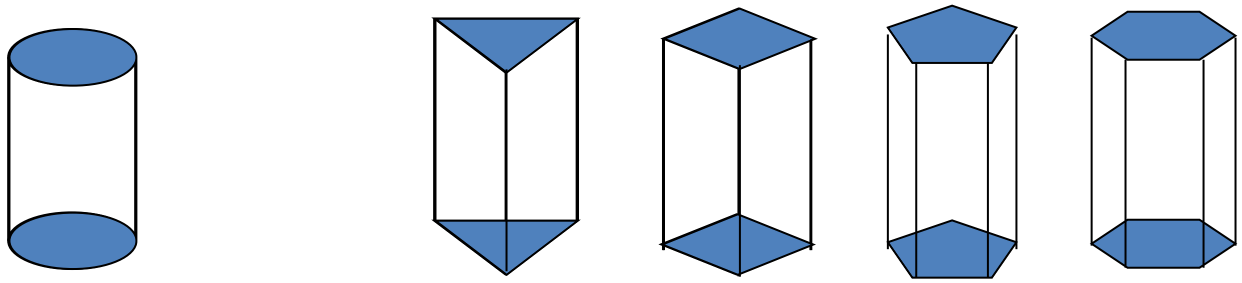
Two-dimensional plane shapes	**Area** *The measure of how many squares will fit into a shape.* ***Units²***	Three-dimensional solid shapes	**Surface Area** *The measure of the area of all outward facing sides.* ***Units²***	**Volume** *The measure of how many cubes will fit into a shape.* ***Units³***
Square (a)	Area = a^2 or $a \times a$ **Example:** *a = 5cm* *Area = 5^2 = 25cm²*	**Cube** (a)	Surface Area = $6 \times a^2$ **Example:** *a = 5cm* *Surface Area = 150cm²*	Volume = a^3 or $a \times a \times a$ **Example:** *a = 5cm.* *Volume = 125cm³*
Rectangle (w, h)	Area = $w \times h$ **Example:** *w = width=10cm* *height=20cm* *Area = 10×20 = 200cm²*	**Prism** (la, ba, h)	Surface Area = $2 \times ba + la$ **Example:** *ba = base area = 20cm²* *la = lateral area (all sides) = 60cm²* *Surface area =* *$2 \times 20 + 60$ = 100cm²*	Volume = $ba \times h$ **Example:** *ba = base area = 20cm²* *h = height = 5cm* *Volume = 20×5 = 100cm³*
Triangle (b, h)	Area = $b \times h \times 0.5$ **Example:** *b = base = 20cm* *h = vertical height = 15cm* *Area = $20 \times 15 \times 0.5$ =150cm²*	**Pyramid** (h, ba)	Surface Area = ba + la **Example:** *ba = base area = 16cm²* *la = lateral area (all sides) = 60cm²* *Surface area = 16 + 60 = 76cm²*	Volume = $ba \times h \times 1/3$ **Example:** *ba = base area = 16cm²* *h = height = 9cm* *Volume = $16 \times 9 \times 1/3$ = 48cm³*
Reg Polygon (a, s)	Area = $n \times s \times a \times 0.5$ **Example:** *n = number of sides = 6* *length of side=5cm* *a = apothem=15cm* *Area = $6 \times 5 \times 15 \times 0.5$ = 225cm²*	**R. Polyhedron** (fa)	Surface Area = $fa \times s$ **Example:** *fa = area of one side = 200cm²* *s = number of sides = 12* *Surface area = 200×12 = 2400cm²*	**Example:** *There is no simple generic formula for working out the volume of a regular polyhedron.*
Circle (r)	Area = $\pi \times r^2$ **Example:** *π = pi = 3.14* *r = radius = 5cm* *Area = $3.14 \times 5^2 = 3.14 \times 5 \times 5$ = 78.5cm²*	**Sphere** (r)	Surface Area = $4 \times \pi \times r^2$ **Example:** *r = radius = 4.5cm* *Surface area = $4 \times 3.14 \times 20.25$ = 254.5 cm² (Approx)*	Volume = $4/3 \times \pi \times r^3$ **Example:** *r = radius = 4.5cm* *Volume = $4/3 \times 3.14 \times 4.5^3$ = 381.5cm³ (Approx)*
Ellipse (a, b)	Area = $\pi \times a \times b$ **Example:** *π = pi = 3.14* *a = radius of long axis = 6* *b = radius short axis = 4* *Area = $3.14 \times 6 \times 4 \times 5$ = 75.36cm²*	**Cylinder** (r, h)	Surface Area = $2\pi rh + 2\pi r^2$ **Example:** *r = radius = 5cm* *h = height = 10cm* *Surface area = $2 \times 3.14 \times 5 \times 10 + 2 \times 3.14 \times 25$ = 471cm²*	Volume = $\pi \times r^2 \times h$ **Example:** *r = radius = 5cm* *h = height = 10cm* *Volume = $3.14 \times 25 \times 10$ = 785cm³ (Approx)*

Source: skillsyouneed.com

SOLIDS

- Solids having top and base of same shape is a prism

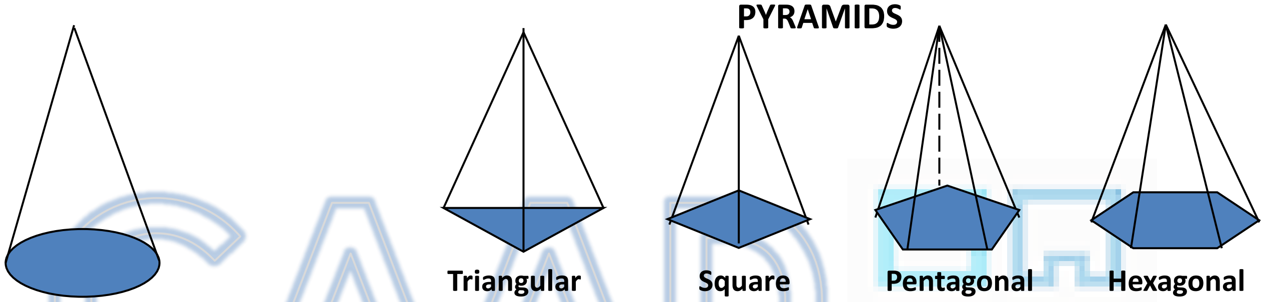
PRISMS



Cylinder **Triangular** **Square** **Pentagonal** **Hexagonal**

- Solids having base of some shape and just a point as a top, called apex is a pyramid

PYRAMIDS

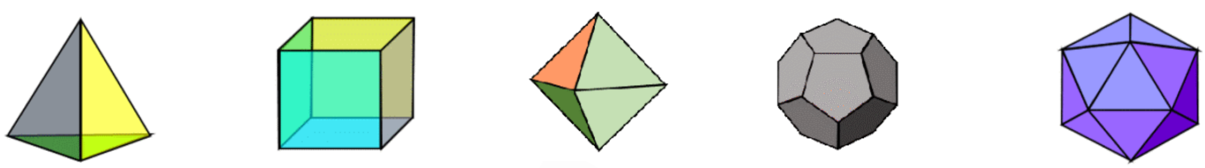


Triangular **Square** **Pentagonal** **Hexagonal**

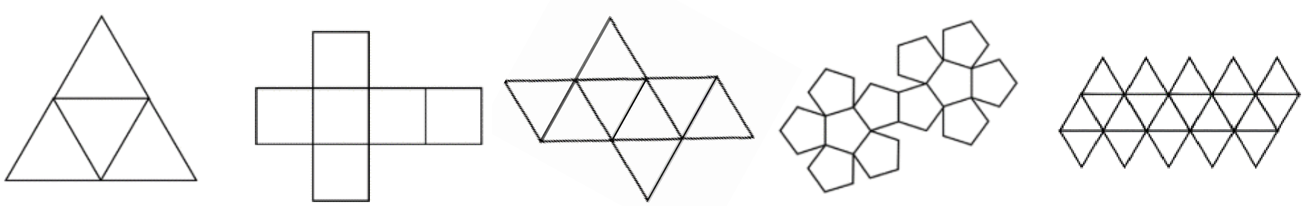
Cone

PLATONIC SOLIDS

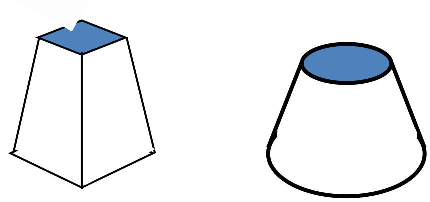
TETRAHEDRON	CUBE	OCTAHEDRON	DODECAHEDRON	ICOSAHEDRON
4 triangle faces	6 square faces	8 triangle faces	12 pentagon faces	20 triangle faces



NETS OF PLATONIC SOLIDS



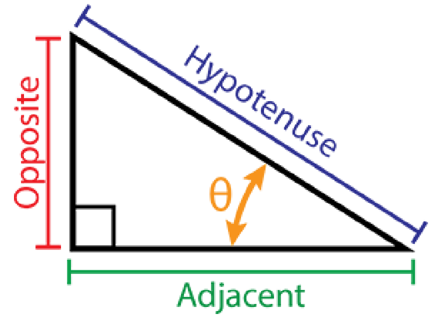
FRUSTUM OF CONE & PYRAMIDS.
(top & base parallel to each other)

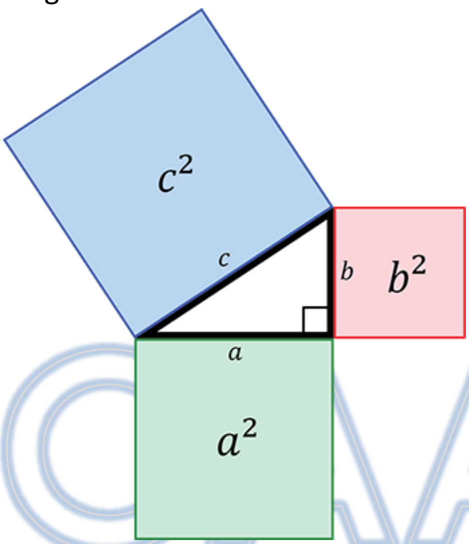


BASICS OF TRIGONOMETRY

TRIGONOMETRIC RATIOS

The most important task of trigonometry is to find the remaining side and angle of a triangle when some of its side and angles are given. This problem is solved by using some ratio of sides of a triangle with respect to its acute angle. These ratio of acute angle are called trigonometric ratio of angle. Let us now define various trigonometric ratio.





Sin θ = Perpendicular/ Hypotenuse
Cos θ = Adjacent / Hypotenuse
Tan θ = Perpendicular / Adjacent
Cosec θ = Hypotenuse / Perpendicular
Sec θ = Hypotenuse / Adjacent
Cot θ = Adjacent / Perpendicular

PYTHAGORAS THEOREM

The square on the hypotenuse is equal to the sum of the squares on the other two sides.

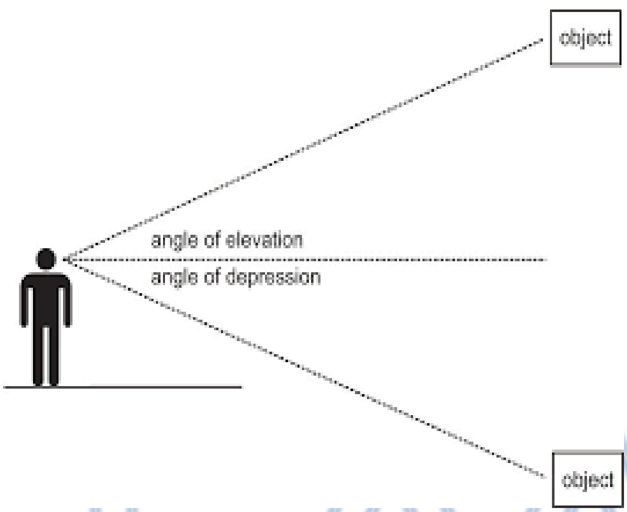
$$c^2 = a^2 + b^2$$

T-ratio \ θ	0°	30°	45°	60°	90°
sin θ	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
cos θ	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
tan θ	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	Not defined
cosec θ	Not defined	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1
sec θ	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	Not defined
cot θ	Not defined	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0

APPLICATIONS OF TRIGONOMETRY

HEIGHT AND DISTANCE

Sometimes, we have to find the height of a tower, building, tree, distance of a ship, width of a river, etc. Though we cannot measure them easily, we can determine these by using trigonometric ratios.



LINE OF SIGHT

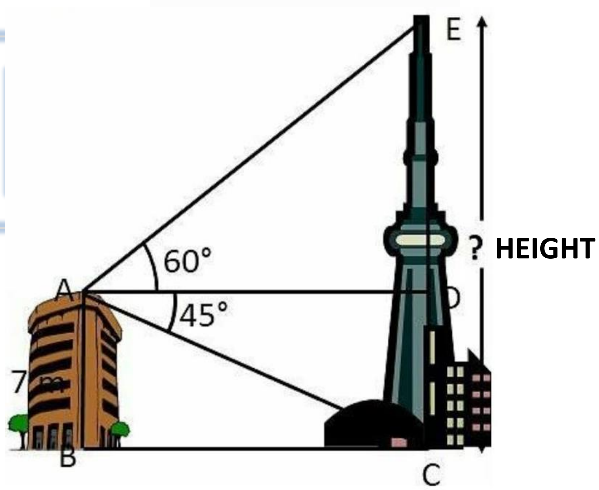
The line of sight or the line of vision is a straight line to the object we are viewing.

ANGLE OF ELEVATION

If the object is above the horizontal from the eye, we have to lift up our head to view the object. In this process, our eye move, through an angle. This angle is called the angle of elevation of the object.

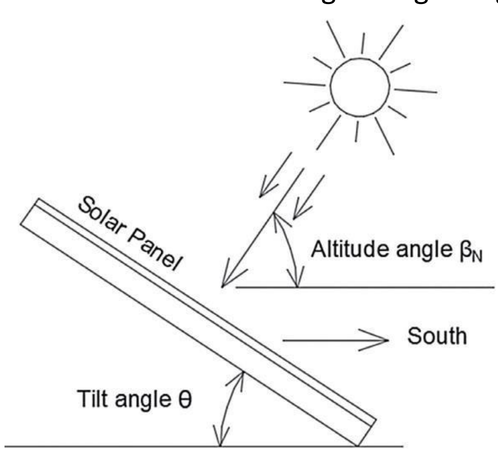
ANGLE OF DEPRESSION

If the object is below the horizontal from the eye, then we have no turn our head downwards no view the object. In this process, our eye move through an angle. This angle is called the angle of depression of the object.

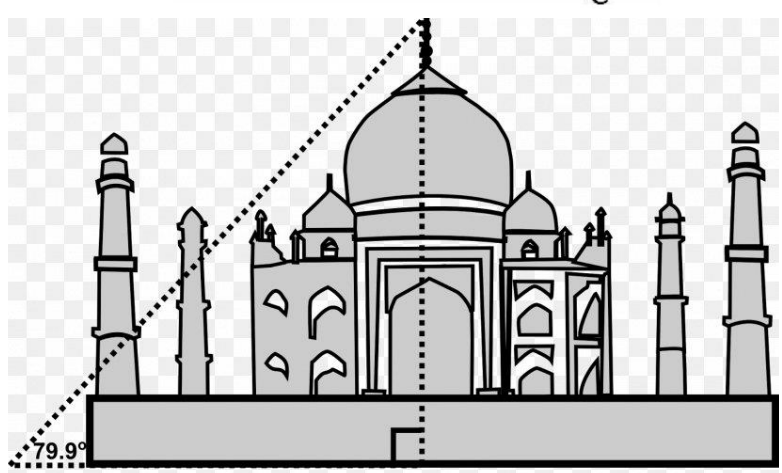


Applications

- Finding heights of towers or buildings or trees
- Finding distance between two non accessible points.
- Measuring fields, lots and areas
- Making walls parallel and perpendicular
- Roof inclination
- To calculate sun shading and light angles.



BEST TILT ANGLE ?



DISTANCE ?

RATIO AND PROPORTION

Ratio and Proportion are explained majorly based on fractions and it is the foundation to understand the various concepts in mathematics as well as in science.

RATIO

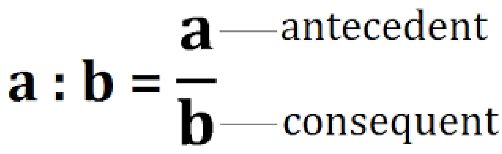
When a fraction is represented in the form of a:b, then it is a ratio.

PROPORTION

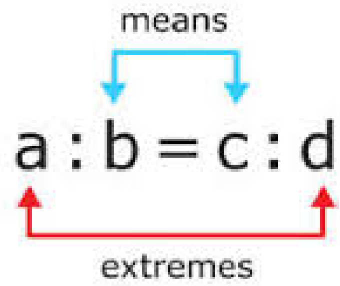
When two ratios are equal, the four quantities composing them are said to be in proportion.

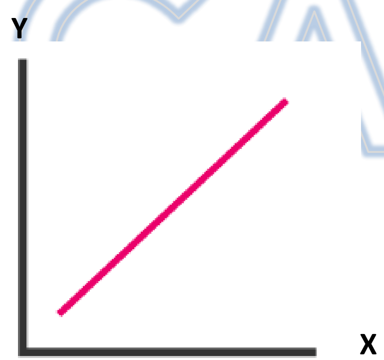
- If , then a, b, c, d are in proportion.
- This is expressed by saying that 'a' is to 'b' as 'c' is to 'd' and the proportion is written as
  a:b::c:d or a:b=c:d
- The terms a and d are called the extremes while the terms b and c are called means.

RATIO



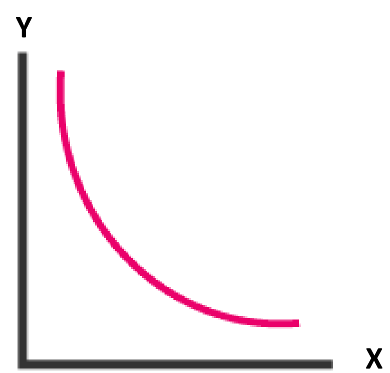
PROPORTION





DIRECT PROPORTION

y = kx, where k is a constant



INVERSE PROPORTION

y = k/x, where k is a constant

DIRECT PROPORTION

If on the increase of one quantity, the other quantity increases to the same extent or on the decrease of one, the other decrease to the same extent, then we say that the given two quantities are directly proportional.

Some Examples:

- Work done /Number of men
- Cost / Number of men
- Work / Wages
- Working hour of a machine / Fuel consumed
- Speed / Distance to be covered

INVERSE PROPORTION

If on the increase of one quantity, the other quantity decreases to the same extent or vice versa, then we say that the given two quantities are indirectly proportional.

Some Examples:

- More men / Less time
- Less men / More hours
- More speed / Less time

PERCENTAGE

A percentage is a fraction with denominator hundred, It is denoted by the symbol %.
Numerator of the fraction is called the rate per cent.

POPULATION FORMULA

If the original population of a town is P, and the annual increase is r %, then the population after n years is **$P(1 + r/100)^n$** and population before n years = **$P/[1 + (r/100)]^n$**

If the annual decrease be r%, then the population after n years is **$P(1 - r/100)^n$** and population before n years = **$P/[1 + (r/100)]^n$**

SUCCESSIVE INCREASE OR DECREASE

In the value is increased successively by x% and y% then the final increase is given by

$$[x + y + (xy/100)]\ \%$$

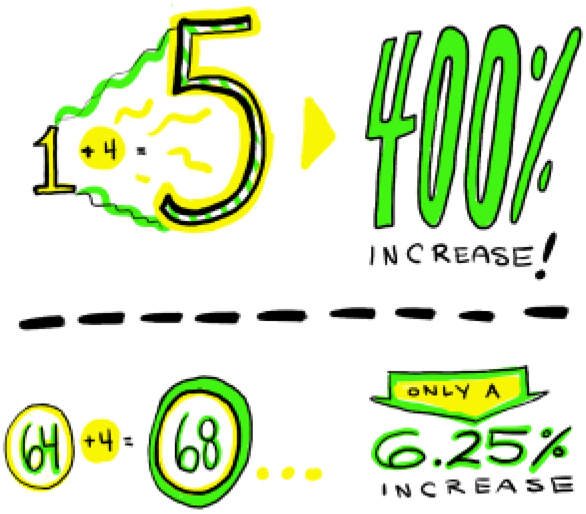
In the value is decreased successively by x% and y% then the final decrease is given by

$$[-x - y - (xy/100)]\ \%$$

2-DIMENSIONAL FIGURE AND AREA

If the sides of a triangle, square, rectangle, rhombus or radius of a circle are increased by a%, its area is increased by **$[a(a+200)]/100$ %**

If the sides of a triangle, square, rectangle, rhombus or radius of a circle are decreased by a %, its area is decreased by **$[a(200-a)]/100$ %**

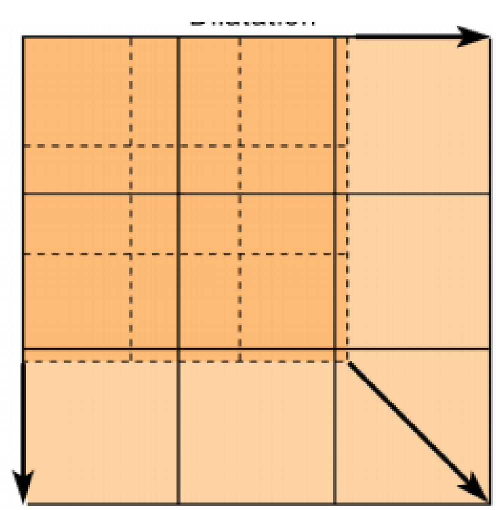


STUDENT AND MARKS

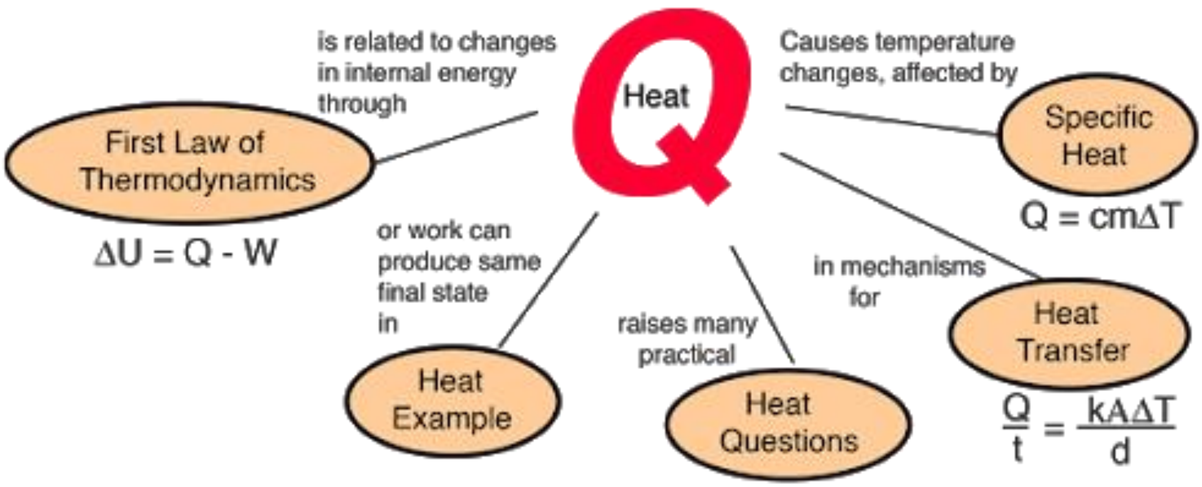
The percentage of passing marks in an examination is x%. If a candidate who scores y marks fails by z marks, then the maximum marks - **M = [100 (y + z)] / x**

A candidate scoring x% in an examination fails by 'a' marks, while another candidate who scores y% marks gets 'b' marks more than the minimum required passing marks, then the maximum marks - **M = [100 (a+b)] / $(y-x)$**

In an examination x% and y% students respectively fail in two different subjects while z% students fail in both subjects, then the % age of student who pass in both the subjects will be **{100-(x + y - z)}%**



PHYSICS



CONVERSION OF FARENHEIT TO CELCIUS SCALE

On any temperature scale, $\frac{T - \text{ice point}}{\text{steam point} - \text{ice point}}$ remains constant. So,

$$\left(\frac{T - \text{ice point}}{\text{steam point} - \text{ice point}}\right)_{\text{Faurenheit scale}} = \left(\frac{T - \text{ice point}}{\text{steam point} - \text{ice point}}\right)_{\text{Celsius scale}} \Rightarrow T_C = \frac{5}{9}(T_F - 32)$$

SPEED, DISTANCE AND TIME TAKEN

Speed is the rate at which any moving body covers a particular distance.

SPEED = DISTANCE / TIME

RELATIVE SPEED

When two bodies are moving in same direction with speeds s1 and s2respectively, their relative speed is the difference of their speeds.

RELATIVE SPEED=S1-S2

When two bodies are moving in opposite direction with speeds s1and s2 respectively, their relative speed is the sum of their speed.

RELATIVE SPEED=S1+S2

TRAINS

When two trains with lengths L1 and L2 and with speeds S1 and S2 respectively, then

(a) When they are moving in the same direction, time taken by the faster train to cross the slower train = **(L1+ L2) /difference of their speeds.**

(b) When they are moving in the opposite direction, time taken by the trains to cross each other = **(L1+ L2) /sum of their speeds.**

BOAT AND STREAM

Let the speed of a boat (or man) in still water be X m/sec and the speed of the stream (or current) be Y m/sec. Then,

Speed of boat with the stream (or downstream) =(X+Y) m/sec

Speed of boat against the stream (or upstream) =(X - Y) m/sec

Speed of boat in still water is

X = (Downstream+Upstream)/2

DIRECTIONS

In our day to day life, we get our direction after seeing the position of sun.

Left turn is a clockwise turn

Right turn is an Anti-clockwise turn