



eduresourceza.com

NBT-MAT

Notes

A+



NOTES

Function or Non-Function	2
Nature of Roots	2
Real Number System	3
Domain & Range	4
Reading Off The Graphs	4
Parabola	5
Hyperbola	6
Exponential Function	6
Logarithm Functions	7
Inverse Function	8
Transformations with Respect to Functions	8
Sequences	9
Quadratic Pattern (2^{nd} level difference)	9
Exponents	10
Surds	10
Logarithms	11
Pythagoras Theorem	12
Lengths of Sides of Triangles	12
Area	13
Polygons	14
Surface Area & Volume	15
Trigonometry	16
Trigonometric Equations	18
Trigonometric Rules	21
Circle Geometry	22
Quadrilaterals	25
Coordinate Geometry / Analytical Geometry	26
Data Handling	27
Ratio	28
Problem Solving	29



FUNCTION OR NON-FUNCTION

GIVEN	FUNCTION	NON-FUNCTION
GRAPH	Vertical line test – cut once and only once.	
RULE		$<; >; \leq; \geq; \neq$ y is to the power of an even number If the rule is $x = c$
Set of ordered numbered pairs	x – <i>coordinates</i> are never repeated.	
MAPPING Horizontal line test TO Vertical line test	One to One Many to One	Many to Many One to Many

NATURE OF ROOTS

$$ax^2 + bx + c = 0$$

Nature of Roots	$b^2 - 4ac$
Equal roots	$b^2 - 4ac = 0$ $ax^2 + bx + c$ is a square trinomial i.e $ax^2 + bx + c = a(x - k)^2$
Real and equal roots	$b^2 - 4ac = 0$
Real Roots	$b^2 - 4ac \geq 0$
Real and unequal roots	$b^2 - 4ac > 0$
Roots are rational	$b^2 - 4ac = p^2$ (perfect square)
Roots are irrational	$b^2 - 4ac = a \text{ non} - p^2$
Roots are non-real	$b^2 - 4ac < 0$



REAL NUMBER SYSTEM

Real Numbers - R		Non-Real Numbers
Rational - Q is a number that can be expressed in the form $\frac{\text{integer}}{\text{integer}}$ where the denominator $\neq 0$ $\therefore$ includes all terminating decimals and recurring decimals	Irrational - Q' π $\sqrt{\text{non square numbers}}$ A decimal that never ends and does not recur	$\sqrt{\text{negative number}}$
Integers - Z Integers are directed whole numbers. Integers are rational.; -3 ; -2 ; -1 ; 0 ; 1 ; 2 ; 3 ;		
Whole Numbers - N_0 Whole numbers are integers as well as rational numbers. 0 ; 1 ; 2 ; 3 ;		
Natural Numbers - N Natural numbers are whole numbers, integers and rational numbers. 1 ; 2 ; 3 ; 4 ;		

Even Numbers: 2 ; 4 ; 6 ; 8 ; $T_n = 2n$

Odd Numbers: 1 ; 3 ; 5 ; 7 ; $T_n = 2n - 1$

Square numbers: 1 ; 4 ; 9 ; 16 ; 25 ; 36 ; 49 ; $T_n = n^2$

Cubic numbers: 1 ; 8 ; 27 ; 64 ; 125 ; 216 ; $T_n = n^3$

Consecutive Numbers: $x ; x + 1 ; x + 2$

Where x is the smallest number?

Consecutive Even Numbers: $x ; x + 2 ; x + 4$

Where x is the smallest even number?

Consecutive Odd Numbers: $x ; x + 2 ; x + 4$

Where x is the smallest odd number?



DOMAIN & RANGE

DOMAIN (x):

Look for problem – Fraction - $\frac{\text{numerator}}{\text{denominator}}$ - denominator $\neq 0$

- $\sqrt{\text{expression}}$ - expression ≥ 0
- $\log_{\text{base}}(\text{expression})$ - expression > 0
- The graph is a circle [$x^2 + y^2 = r^2$]
- The graph is $x = c$

If no problem then Domain is $x \in R$

RANGE (y): (Very difficult)

- Sketch the graph
- Rearrange into the x – form (make x the subject of the formula)
- Look for problems as given in Domain.

READING OFF THE GRAPHS

TYPE 1

$$f(x) > g(x) , f(x) \geq g(x) \quad \text{or} \quad f(x) < g(x) , f(x) \leq g(x) \quad \text{or} \quad f(x) - g(x) < 0$$

The x – **values of the points of intersection of the 2 graphs** will divide the x – axis into sections. The x – values of the points of intersection of the 2 graphs will be used in the answers, these are the C.V (Critical Values).

TYPE 2

$$f(x).g(x) < 0 \quad \text{or} \quad f(x).g(x) \leq 0 \quad \text{etc}$$

The x – **intercepts of each graph** will divide the x – axis into sections.

The x – **intercepts** of each graph will be used in the answers, these are the C.V (Critical Values).

INTERVAL NOTATION

($\rightarrow$ o (Open dot) - $< ; >$

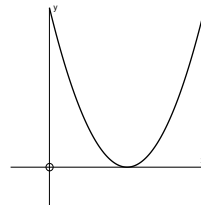
[$\rightarrow$ ● (Closed dot) - $\geq ; \leq$

PARABOLA

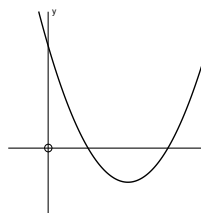
$$y = ax^2 + bx + c$$

$y = a(x - p)^2 + q$	TP Form TP = (p ; q)
$y = a(x - x_1)(x - x_2)$	x-int Form (x_1 and x_2 are the x-ints)
$x = \frac{-b}{2a}$	x- value of TP (eqn of axis of symmetry)
$y = \frac{-(b^2 - 4ac)}{4a}$	y-value of TP
$x = \frac{x_1 + x_2}{2}$	x- value of TP (midpt of x-ints)

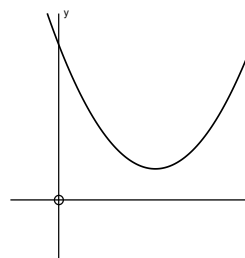
$b^2 - 4ac = 0$ TP on x - axis = Roots are equal.



$b^2 - 4ac > 0$ Two x - intercepts



$b^2 - 4ac < 0$ No roots = roots are non-real



HYPERBOLA

$$y = \frac{a}{x - p} + q$$

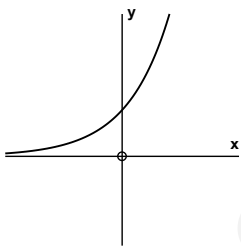
$y = q$	Horizontal asymptote
$x = p$	Vertical asymptote
$y = (x - p) + q$ $y = -(x - p) + q$	Axes of symmetry
	Pt. of intersection of axes of symmetry is the Pt. of intersection of the asymptote = $(p; q)$
Domain	$x \in R ; x \neq p$
Range	$y \in R ; y \neq q$

EXPONENTIAL FUNCTION

$$y = a \cdot b^{x-p} + q$$

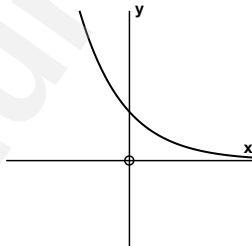
$y = q$ - Horizontal asymptote

$$f(x) = b^x$$



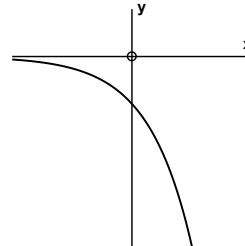
$$b > 1$$

$$y = f(-x) = b^{-x}$$



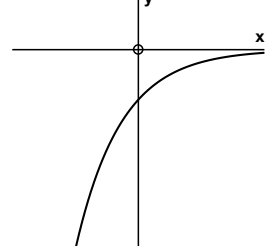
$$0 < b < 1$$

$$y = -f(x) = -b^x$$



$$b > 1$$

$$y = -f(-x) = -b^{-x}$$



$$0 < b < 1$$

LOG FUNCTIONS

$$f(x) = \log_a(x - p)$$

Vertical Asymptote - $x = p$

$$f(x) = \log_a x \quad a > 1$$

Coordinates $(1; 0)$ $(a; 1)$ $(\frac{1}{a}; -1)$

$$y = -f(x) = \log_{\frac{1}{a}} x = -\log_a x \quad 0 < \frac{1}{a} < 1$$

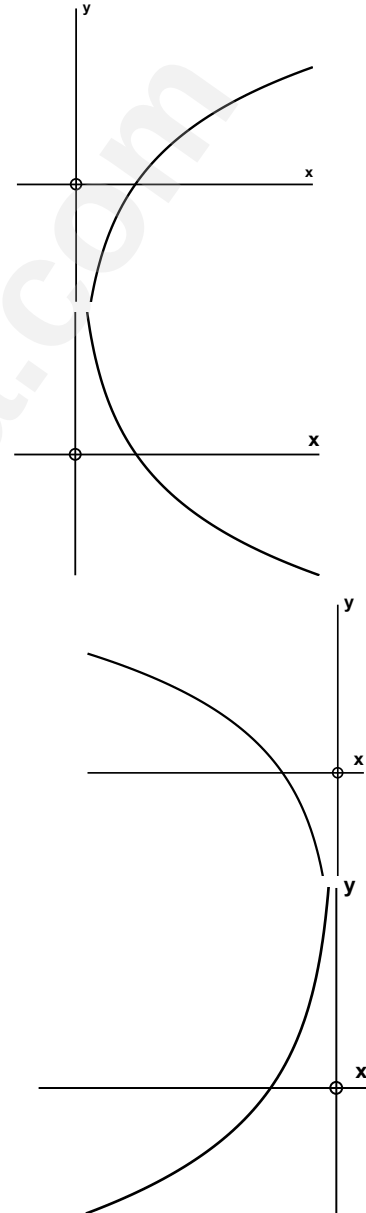
Coordinates $(1; 0)$ $(a; -1)$ $(\frac{1}{a}; 1)$

$$y = f(-x) = \log_a(-x)$$

Coordinates $(-1; 0)$ $(-a; 1)$ $(-\frac{1}{a}; -1)$

$$y = -f(-x) = \log_{\frac{1}{a}}(-x) = -\log_a(-x)$$

Coordinates $(-1; 0)$ $(-\frac{1}{a}; 1)$ $(-a; -1)$



Domain: $y = \log_{base}(expression)$

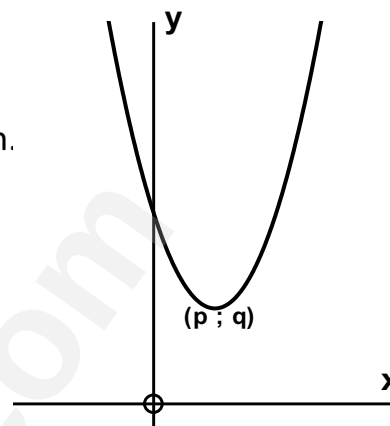
$expression > 0$

INVERSE FUNCTION

Reflection about the $y = x$ line (interchange x and y)

Restrict the domain of parabola for the inverse to be a function.

Restriction: $x \leq p$ or $x \geq p$



TRANSFORMATIONS WITH RESPECT TO FUNCTIONS

STRETCHES

Vertical

$$y = af(x) \quad (x; y) \rightarrow (x; ay)$$

Horizontal

$$y = f(bx) \quad (x; y) \rightarrow \left(\frac{x}{b}; y\right)$$

REFLECTIONS

About x-axis

$$y = -f(x) \quad (x; y) \rightarrow (x; -y)$$

About y-axis

$$y = f(-x) \quad (x; y) \rightarrow (-x; y)$$

About $y = x$ Inverse Function f^{-1}

$$(x; y) \rightarrow (y; x)$$

SHIFTS

Horizontal

$$y = f(x - p) \quad (x; y) \rightarrow (x + p; y)$$

$$y = f(x + p) \quad (x; y) \rightarrow (x - p; y)$$

Vertical

$$y = f(x) - q \quad (x; y) \rightarrow (x; y - q)$$

$$y = f(x) + q \quad (x; y) \rightarrow (x; y + q)$$

SEQUENCES

$$r = \frac{T_2}{T_1} = \frac{T_3}{T_2} \quad \text{use when unknowns in sequence} \quad T_n = a(r)^{n-1}$$

$$d = T_2 - T_1 = T_3 - T_2 \quad \text{use when unknowns in sequence} \quad T_n = a + (n - 1)d$$

Converges: $-1 < r < 1$

$$T_n = S_n - S_{n-1} \quad \text{Given the Sum formula e.g. } T_{10} = S_{10} - S_9$$

$$\sum_{k=m}^n (\text{general term}) = S_{n-m+1} \quad (n - m + 1 = \text{number of terms})$$

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

$$S_n = \frac{a[1 - (r)^n]}{1 - r} \quad S_\infty = \frac{a}{1 - r}$$

QUADRATIC PATTERN (2ND LEVEL DIFFERENCE)

$$T_n = an^2 + bn + c$$

$$\begin{array}{ccccccc} T_1 & ; & T_2 & ; & T_3 & ; & T_4 \\ \underbrace{\quad} & & \underbrace{\quad} & & \underbrace{\quad} & & \\ D_1 & & D_2 & & D_3 & & \\ \underbrace{\quad} & & \underbrace{\quad} & & & & \\ & d & & d & & & \end{array}$$

$$2a = d \quad 3a + b = D_1 \quad a + b + c = T_1$$

EXPONENTS

EXPONENTIAL LAWS ($a \neq 1; b \neq 1; a > 0; b > 0$)

- $(a^x \cdot b^y)^m = a^{xm} \cdot b^{ym} \quad \left(\frac{a^x}{b^y}\right)^m = \frac{a^{xm}}{b^{ym}}$
- $a^x \cdot a^y = a^{x+y}$
- $\frac{a^x}{a^y} = a^x \div a^y = a^{x-y}$

EXPONENTIAL DEFINITIONS ($a \neq 1; b \neq 1; a > 0; b > 0$)

- $\sqrt[n]{a^m} = (\sqrt[n]{a})^m = a^{\frac{m}{n}}$
- $a^{-n} = \frac{1}{a^n}$
- $a^0 = 1$

NOTE

$$(a + b)^n \neq a^n + b^n$$

$$(a - b)^n \neq a^n - b^n$$

$$\sqrt{a^2 + b^2} \neq a + b$$

$$\frac{1}{x^{-1} + y^{-1}} \neq x + y$$

$$\frac{1}{x^{-1} + y^{-1}} = \frac{1}{\frac{1}{x} + \frac{1}{y}}$$

SURDS

- $\sqrt[n]{xy} \Leftrightarrow \sqrt[n]{x} \times \sqrt[n]{y}$
- $\sqrt[n]{\frac{x}{y}} \Leftrightarrow \frac{\sqrt[n]{x}}{\sqrt[n]{y}}$
- Add/Subtract like terms e.g. $3\sqrt[n]{x} + \sqrt[n]{x} = 4\sqrt[n]{x}$
- Rationalise the denominator:

$$\text{e.g. } \frac{3}{\sqrt{3}} = \frac{3}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{3\sqrt{3}}{3} = \sqrt{3}$$

$$\text{e.g. } \frac{\sqrt{2}}{1+\sqrt{2}} = \frac{\sqrt{2}}{1+\sqrt{2}} \times \frac{1-\sqrt{2}}{1-\sqrt{2}} = \frac{\sqrt{2}(1-\sqrt{2})}{1-2} = \frac{\sqrt{2}-2}{-1} = 2 - \sqrt{2}$$



LOGARITHMS

$$\text{base}^{\text{exp}} = \text{value} \Leftrightarrow \log_{\text{base}} \text{value} = \text{exp}$$

$$\text{base} > 0 \text{ and } \text{base} \neq 1 \qquad \text{value} > 0$$

LOG LAWS

$$1. \log_m x^a = a \log_m x$$

$$2. \log_m (xy) = \log_m x + \log_m y$$

$$3. \log_m \left(\frac{x}{y} \right) = \log_m x - \log_m y$$

$$4. \log_m x = \frac{\log_n x}{\log_n m} \text{ (Change of base law)} \quad \log_x m = \frac{1}{\log_m x}$$

LEARN THE FOLLOWING

$$\log_a 1 = 0 \quad (a > 0 \text{ and } a \neq 1)$$

$$\log_a a = 1 \quad (a > 0 \text{ and } a \neq 1)$$

$$\log_a \left(\frac{1}{a} \right) = -1 \quad (a > 0 \text{ and } a \neq 1)$$

$$\log 5 = \log \left(\frac{10}{2} \right) = \log 10 - \log 2$$

$$\log 2 = \log \left(\frac{10}{5} \right) = \log 10 - \log 5$$

$$\log 1 = 0$$

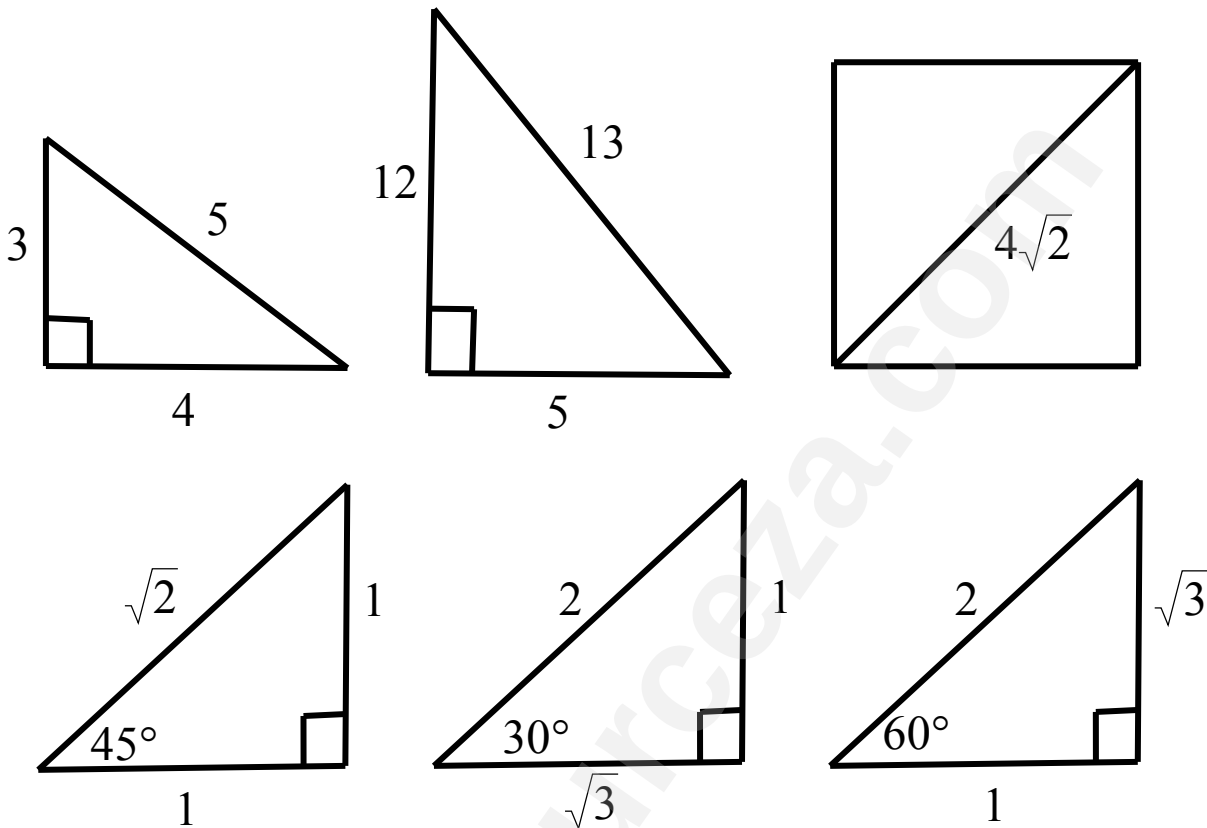
$$\log 10 = 1$$

$$\log 100 = 2$$

$$\log 0,1 = -1$$

$$\log 0,01 = -2$$

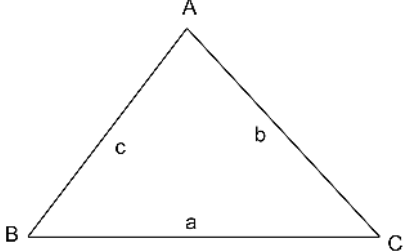
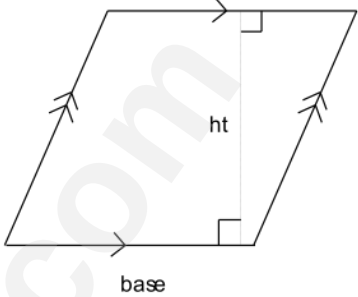
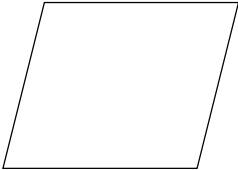
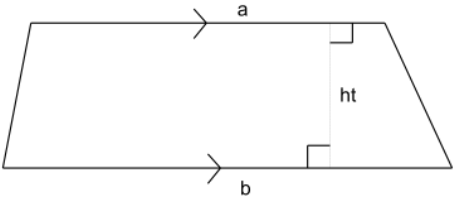
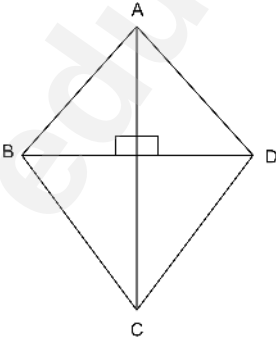
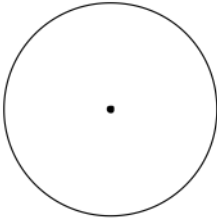
PYTHAGORAS THEORM



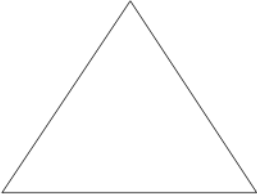
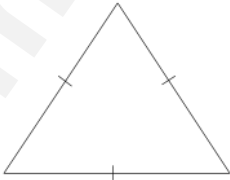
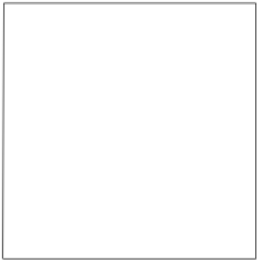
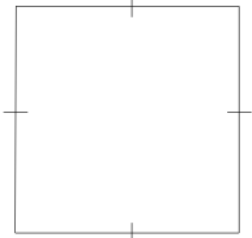
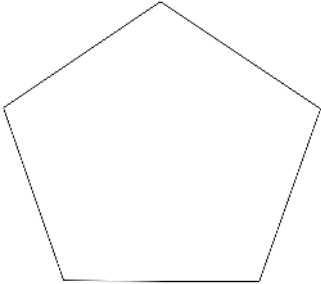
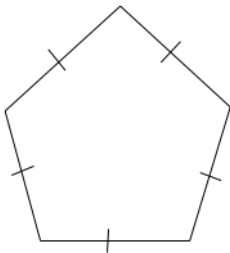
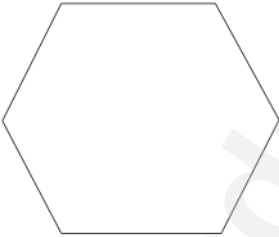
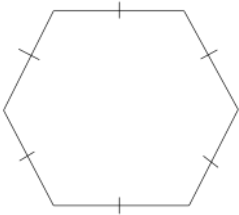
LENGTHS OF SIDES OF TRIANGLES

Any side of a triangle must be longer than the difference between the other 2 sides, AND less than the sum of the other 2 sides.

AREA

△ TRIANGLE	PARALLELOGRAM
 $\text{Area} = \frac{1}{2}(\text{base})(\text{ht})$ $\text{Area} = \frac{1}{2}a \cdot b \cdot \sin \hat{C}$ $\text{Area} = \frac{1}{2}(\text{product of 2 sides})\sin(\text{included } \angle)$	 $\text{Area} = (\text{base})(\text{ht})$
RHOMBUS	TRAPEZIUM
 $\text{Area} = (\text{base})(\text{height})$ OR $\text{Area} = \frac{1}{2}(\text{product of diags})$	 $\text{Area} = \frac{1}{2}(\text{sum of } \parallel \text{ sides})(\text{ht})$ $\text{Area} = \frac{1}{2}(a + b)(\text{ht})$
KITE	CIRCLE
 $\text{Area} = \frac{1}{2}(\text{product of diags})$ $\text{Area} = \frac{1}{2}(BD)(AC)$	 $\text{Area} = \pi r^2$ $\text{Circumference} = \text{Perimeter} = 2\pi r$

POLYGONS

	Type	Sum of Interior angles	Size of Interior Angle of Regular Shape
 3 sides	Triangle	180°	60° 
 4 sides	Quadrilateral	360°	90° 
 5 sides	Pentagon	540°	108° 
 6 sides	Hexagon	720°	120° 
n sides		$(n - 2)180^\circ$	$\frac{(n - 2)(180^\circ)}{n}$

Sum of Exterior Angles of every polygon = 360°

When a shape is **regular** it means all sides & angles are **equal**.

SURFACE AREA & VOLUME

PYRAMIDS

A **right pyramid** has the apex $\perp$ above the centre of the base.

$$\text{Volume} = \frac{1}{3}AH$$

A = Area of Base

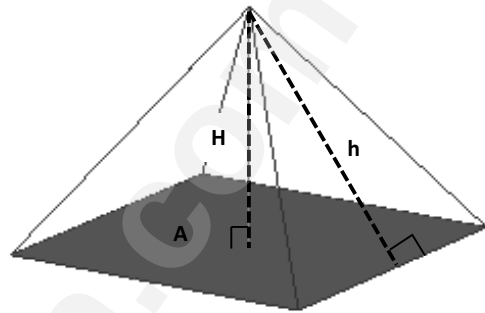
H = $\perp$ Distance from its Apex to its Base

$$\text{Surface Area} = A + \frac{1}{2}ph$$

A = Area of Base

p = Perimeter of Base

h = Slant Height (ht of Δ)



CONE

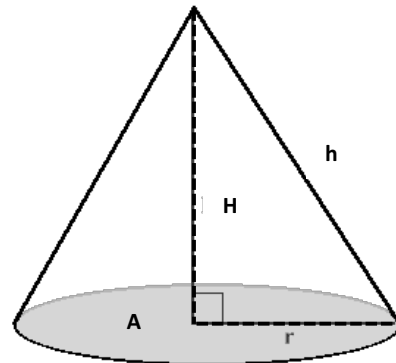
$$\text{Volume} = \frac{1}{3}AH$$

A = Area of base

H = $\perp$ distance from its apex to its base

$$\text{Surface Area} = \pi rh + \pi r^2$$

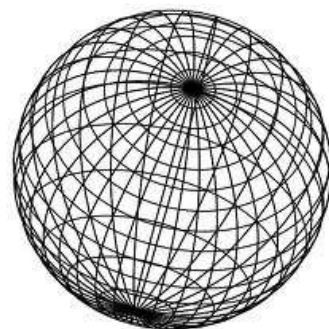
(only for right cones)



SPHERE

$$\text{Volume} = \frac{4}{3}\pi r^3$$

$$\text{Surface Area} = 4\pi r^2$$



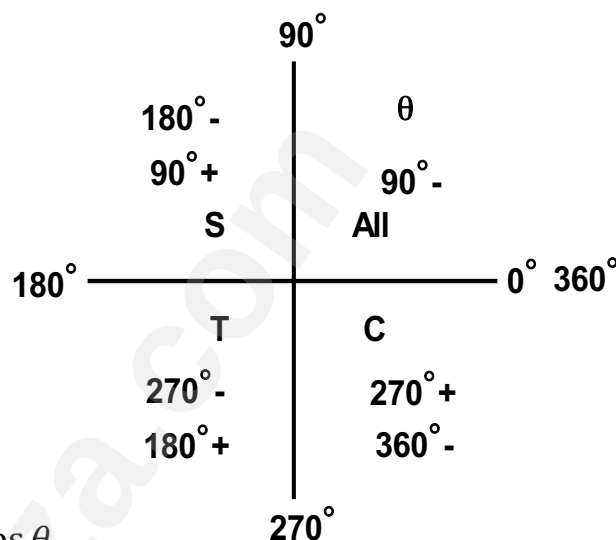


TRIGONOMETRY

$$\sin \theta = \frac{y}{r} = \frac{o}{h}$$

$$\cos \theta = \frac{x}{r} = \frac{a}{h}$$

$$\tan \theta = \frac{y}{x} = \frac{o}{a}$$



CO – FUNCTIONS (90°/270°)

$$\sin(90^\circ - \theta) = \cos \theta$$

$$\sin(90^\circ + \theta) = \cos \theta$$

$$\cos(90^\circ - \theta) = \sin \theta$$

$$\cos(90^\circ + \theta) = -\sin \theta$$

IDENTITIES

$$\tan \theta = \frac{\sin \theta}{\cos \theta}$$

$$\sin^2 \theta + \cos^2 \theta = 1$$

$$\sin 2\theta = 2 \sin \theta \cdot \cos \theta$$

$$1 - \sin^2 \theta = \cos^2 \theta$$

$$\cos 2\theta = \cos^2 \theta - \sin^2 \theta$$

$$1 - \cos^2 \theta = \sin^2 \theta$$

$$= 2\cos^2 \theta - 1$$

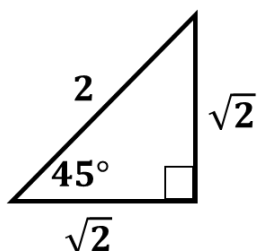
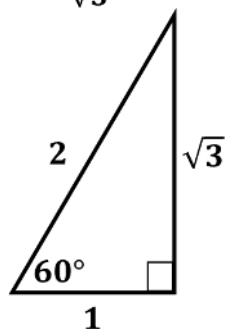
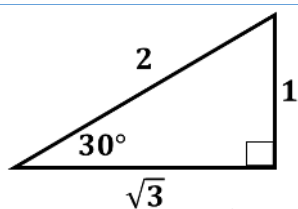
$$= 1 - 2\sin^2 \theta$$

$$\cos(A - B) = \cos A \cos B + \sin A \sin B$$

$$\cos(A + B) = \cos A \cos B - \sin A \sin B$$

$$\sin(A - B) = \sin A \cos B - \cos A \sin B$$

$$\sin(A + B) = \sin A \cos B + \cos A \sin B$$



SPECIAL ANGLES

	30°	45°	60°
sin			
cos			
tan			

$$y = a \sin bx + q$$

$$y = a \cos bx + q$$

$$\text{Period} = \frac{360^\circ}{b}$$

Amplitude = positive a

$$a = \frac{\text{Max value} - \text{Min value}}{2}$$

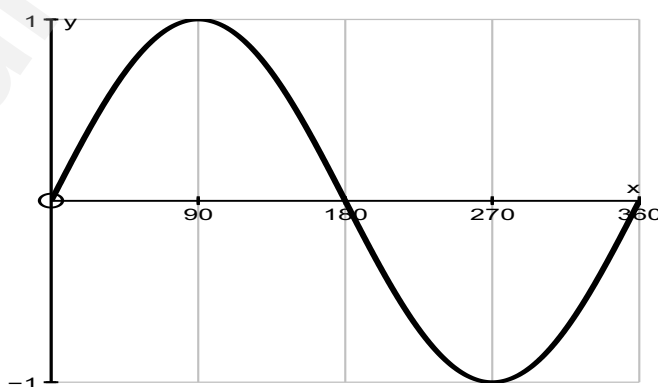
$$q = \frac{\text{Max value} + \text{Min value}}{2}$$

$$b = \frac{360^\circ}{\text{period of graph}}$$

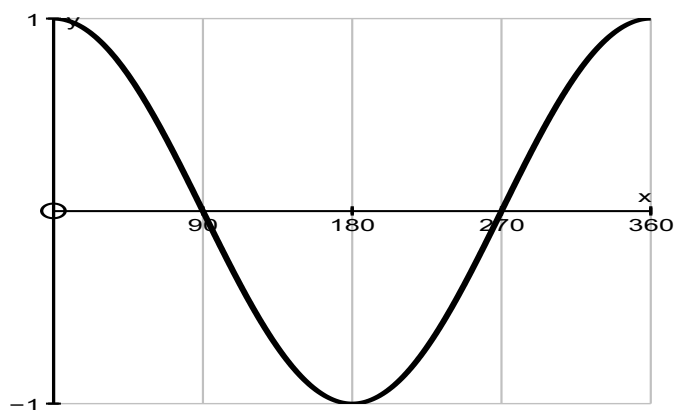
Or

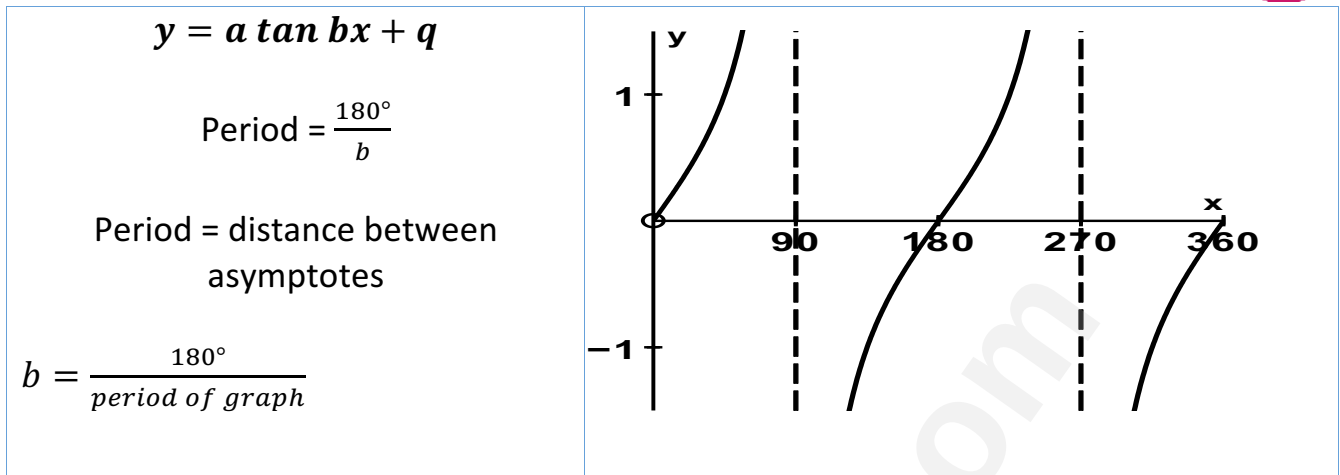
b = what must you multiply by to get back to original

$$y = \sin x$$



$$y = \cos x$$



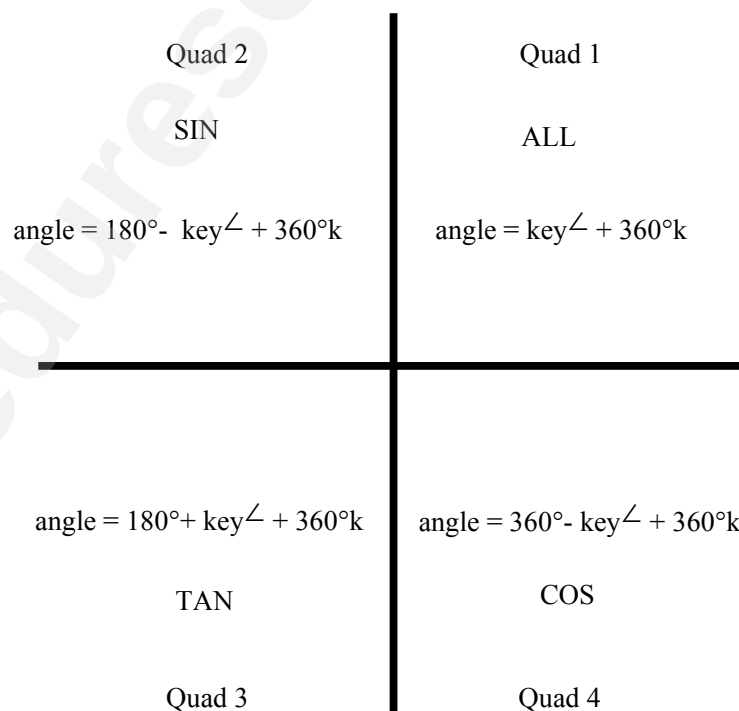


TRIGONOMETRIC EQUATIONS

PATTERN A

$\sin(\text{angle}) = \pm \text{number}$ and $\cos(\text{angle}) = \pm \text{number}$

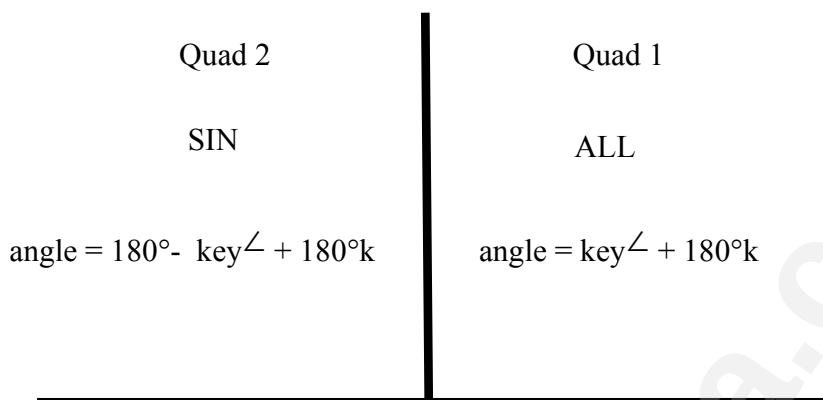
1. $\text{key}\angle = \sin^{-1}(\text{positive number}) = \text{positive acute } \angle$
the same for cos
2. Decide on which quadrants by looking at the sign in front of the number and hence determine the 2 general solutions





$$\tan(\text{angle}) = \pm \text{number}$$

1. $\text{key}\angle = \tan^{-1}(\text{positive number}) = \text{positive acute } \angle$
2. Decide on whether it is quadrant 1 or 2 by looking at the sign in front of the number and hence determine the general solution. (one general solution)



PATTERN B (note no significant coefficient in front)

$$\sin(\text{angle}) = \sin(\text{diff angle})$$

$$\text{key}\angle = (\text{diff angle})$$

1st and 2nd Quads

$$\cos(\text{angle}) = \cos(\text{diff angle})$$

$$\text{key}\angle = (\text{diff angle})$$

1st and 4th Quads

$$\tan(\text{angle}) = \tan(\text{diff angle})$$

$$\text{key}\angle = (\text{diff angle})$$

1st Quad

$$\sin(\text{angle}) = -\sin(\text{diff angle})$$

$$\text{key}\angle = \text{diff angle}$$

3rd and 4th Quads

$$\cos(\text{angle}) = -\cos(\text{diff angle})$$

$$\text{key}\angle = \text{diff angle}$$

2nd and 3rd Quads

$$\tan(\text{angle}) = -\tan(\text{diff angle})$$

$$\text{key}\angle = \text{diff angle}$$

2nd Quad

**NOTE!**

$$\sin(\text{angle}) = \cos(\text{diff angle})$$

$$\cos(90^\circ - \text{angle}) = \cos(\text{diff angle})$$

$$(90^\circ - \text{angle}) = \text{diff angle}$$

$$\text{key} \angle = \text{diff angle}$$

$$1^{\text{st}} \text{ and } 4^{\text{th}} \text{ Quads}$$

PATTERN C (Same angle, sin & cos and can have a significant coefficient in front)

$$a \sin(\text{angle}) = b \cos(\text{same angle})$$

÷ by a cos (angle)

$$\frac{a \sin(\text{angle})}{a \cos(\text{angle})} = \frac{b \cos(\text{same angle})}{a \cos(\text{angle})}$$

$$\tan(\text{angle}) = \frac{b}{a}$$

If none of the above try the following:

- Equate to zero
- Count the number of terms
- Factorise
- **Use an Identity**

TRIGONOMETRIC RULES

First of all **CHECK** if the **COS RULE** is being applied

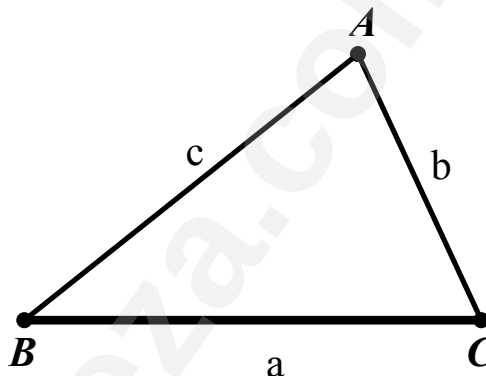
When to use the Cos Rule?

If given:

- i. **2 sides and the included angle** OR
- ii. **3 sides**

COS RULE:

$$a^2 = b^2 + c^2 - 2bccos\hat{A}$$



If **NOT** the **COS RULE** then apply the **SINE RULE**

SINE RULE

$$\frac{a}{\sin \hat{A}} = \frac{b}{\sin \hat{B}} = \frac{c}{\sin \hat{C}} \quad (\text{Use to find a side})$$

$$\text{OR} \quad \frac{\sin \hat{A}}{a} = \frac{\sin \hat{B}}{b} = \frac{\sin \hat{C}}{c} \quad (\text{Use to find angle})$$

THE AMBIGUOUS CASE

The ambiguous case occurs in Δ s where 2 sides and 1 $\angle$ are given such that the given angle is opposite the shorter of the 2 given sides.

AREA RULE

$$\text{Area of } \Delta ABC = \frac{1}{2}bc \sin \hat{A}$$

Only apply the Area Rule when you see the word Area

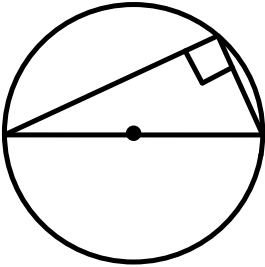
Must have **2 sides and included angle** to use the Area Rule.

CIRCLE GEOMETRY

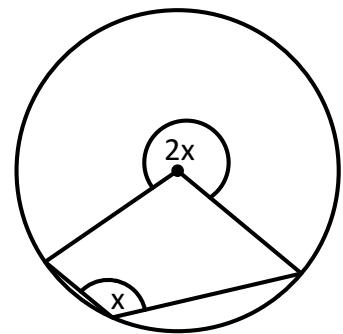
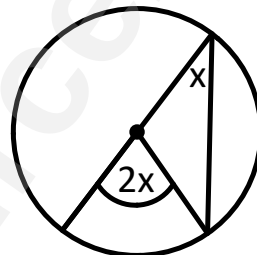
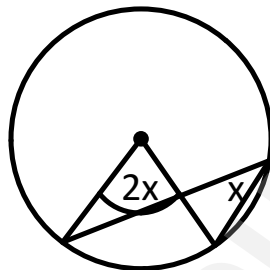
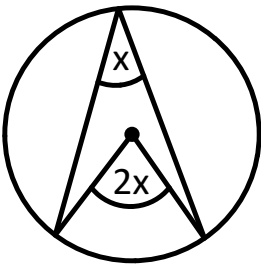
GIVEN

Centre [5]

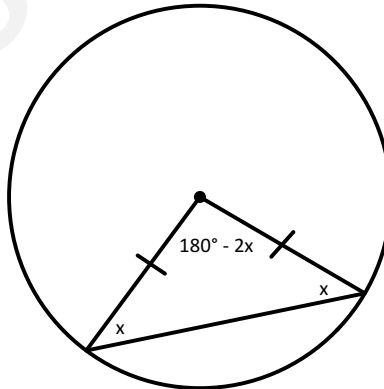
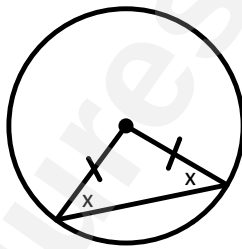
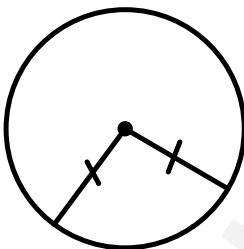
1. Diameter ($\angle$ in semi – circle)



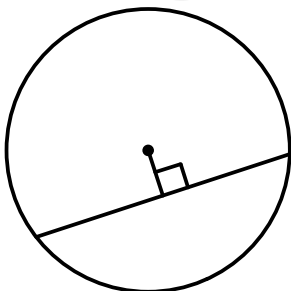
2. ($\angle$ at centre)



3. radii – Isos Δ

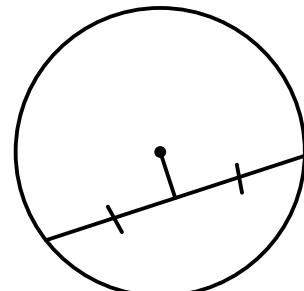


4. (line from centre $\perp$ chord)



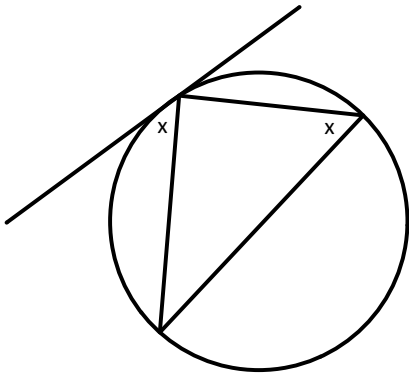
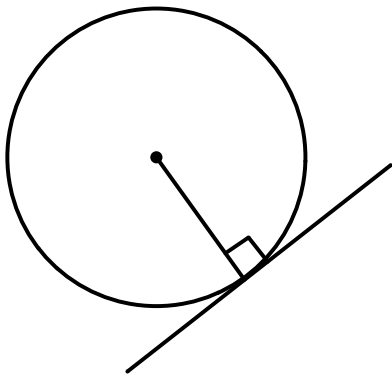
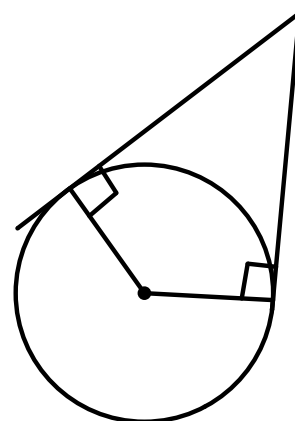
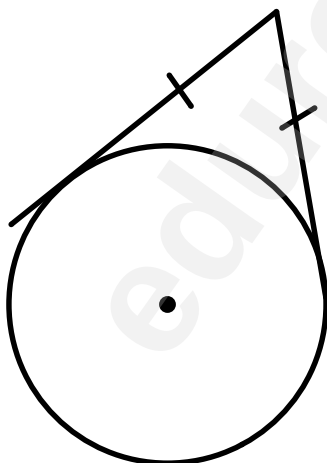
$\therefore$ midpt chord

5. (midpt – chord th)



$\therefore 90^\circ$

Tangent [3]

1. (*tan – chord th.*)2. (*rad $\perp$ Tan*)3. (*tangents from the same pt.*)

Cyclic Quad

Parallel [3]

1. corresp. $\angle$'s

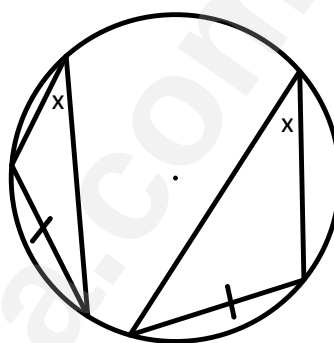
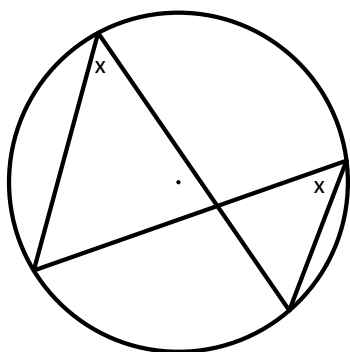
2. alt. $\angle$'s

3. co - int. $\angle$'s

NOT GIVEN [3]

1. ($\angle$'s in the same seg.)

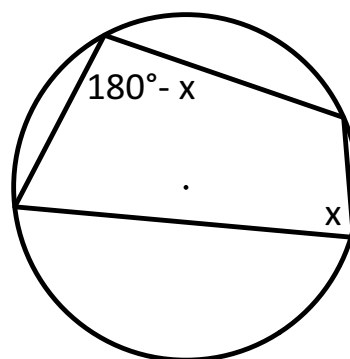
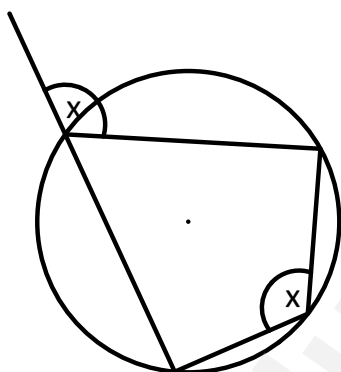
(= chords subtend = $\angle$'s)



2. Cyclic Quads (2)

(ext $\angle$ of cyclic quad)

(opp. $\angle$ s of cyclic quad)



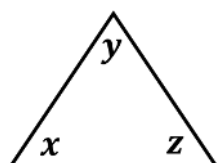
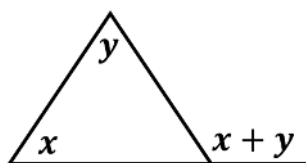
3. Triangles (4)

(Ext. $\angle$ of Δ)

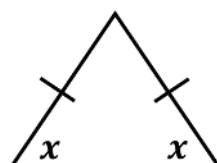
($\angle$ sum of Δ)

(Isos Δ)

Congruent Δ s



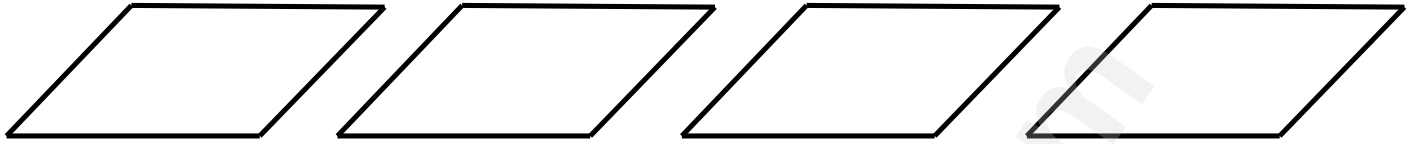
$$x + y + z = 180^\circ$$



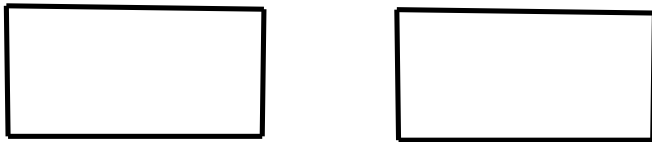
RHS
SSS
SAS
AAS ; SAA ; ASA

QUADRILATERALS

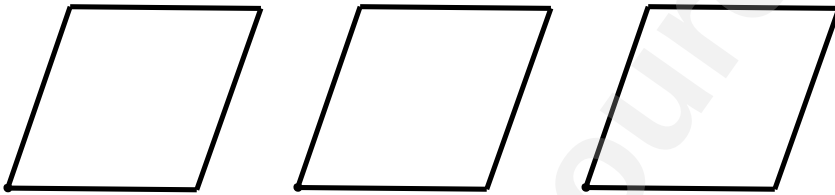
PARALLELOGRAM



RECTANGLE



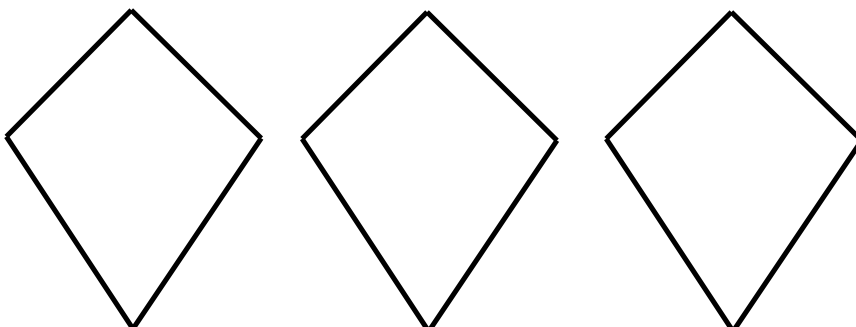
RHOMBUS



SQUARE



KITE



COORDINATE GEOMETRY / ANALYTICAL GEOMETRY

FORMULAE

$$\text{Gradient} = \frac{y_2 - y_1}{x_2 - x_1}$$

Parallel $\therefore = \text{gradient}$

Collinear All points lie on the same straight line $\therefore = \text{gradient}$

Perpendicular $\perp$ Lines meet at right $\angle$'s $= 90^\circ$ $\left[m_1 = \frac{a}{b} \therefore m_2 = -\frac{b}{a} \right]$

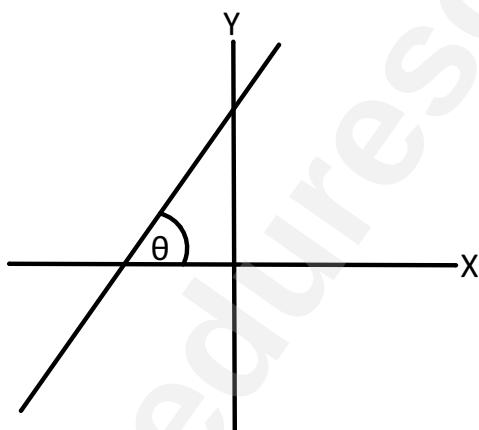
Inclination size of $\angle$ between line and positive direction of x - axis.

$$\tan \theta = \text{gradient}$$

Inclination $= \theta$

If grad > 0 then

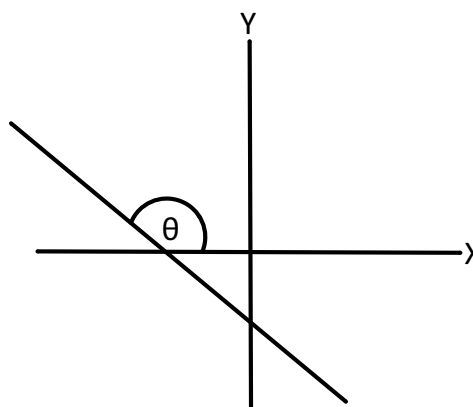
$$0^\circ < \theta < 90^\circ$$



Inclination $= \theta$

If grad < 0 then

$$90^\circ < \theta < 180^\circ$$



$$\text{midpoint} = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$$

Distance $AB^2 = (x_1 - x_2)^2 + (y_1 - y_2)^2$

CIRCLE

Standard Form

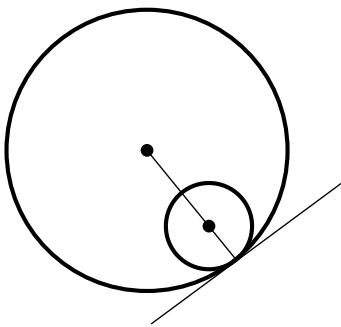
$$x^2 + y^2 - 2ax - 2by + c = 0$$

Rewrite in centre form:

$$\left(x + \frac{-2a}{2}\right)^2 + \left(y + \frac{-2b}{2}\right)^2 = -c + \left(\frac{2a}{2}\right)^2 + \left(\frac{2b}{2}\right)^2$$

$$\therefore \text{Centre} = (a; b)$$

$$\text{radius} = \sqrt{a^2 + b^2 - c}$$

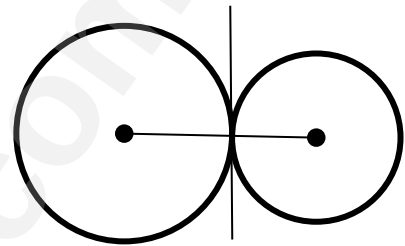


Distance between the 2 centres = the difference of radii

Centre Form

$$(x - a)^2 + (y - b)^2 = r^2$$

$$\text{Centre } (a; b) \quad \text{radius} = \sqrt{r^2}$$



Sum of radii = distance between the 2 centres

DATA HANDLING

If the **same** amount (y) is **added** to each of the data set then:

- New mean ($\bar{x}$) = original mean + y
- New range = no change (= original range)
- New Median = original median + y
- New standard deviation = no change (= original s.d)

If the **same** amount (y) is **multiplied** to each of the data set then:

- New mean ($\bar{x}$) = original mean $\times y$
- New range = original range $\times y$
- New Median = original median $\times y$
- New standard deviation = original s.d $\times y$



RATIO

DIRECT PROPORTION

The quantities x and y are directly proportional if there is a constant ratio i.e. $\frac{x}{y} = k$

$\therefore y = kx$ for some constant k .

INVERSE VARIATION

The quantities x and y are inversely proportional if there is a constant product i.e. $xy = k$ for some constant k .

THE RATIO RULE

You can multiply or divide a ratio or part of a ratio:

- If the number of hockey players to rugby players is 2 : 4 and you double the number of rugby players, then the new ratio is 2 : 8.
- If instead you halve the number of rugby players, then the new ratio is 2 : 2, or an equal number of each.
- However, you cannot add a fixed quantity to or remove one from a ratio without knowing the original quantities.

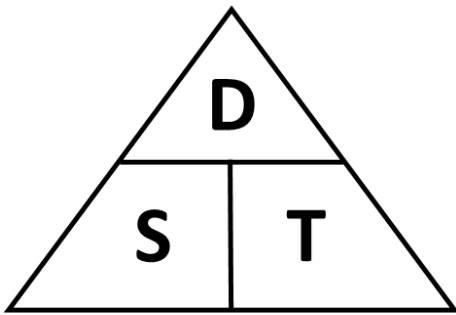
PROBLEM SOLVING

PROFIT FORMULA

$$\text{Total Profit} = \frac{\text{Total selling price}}{\text{no.of items sold}} - \frac{\text{Total cost price}}{\text{no.of items bought}}$$

$$\text{AVERAGE SPEED} = \frac{\text{Total Distance}}{\text{Total Time taken}}$$

DISTANCE, SPEED & TIME



Rate of Flow (or rate of work) Problem

- 2 items doing the same job in their own time
- Let x be the number of units (days, weeks, hours, seconds) taken to do a job working together
- Let m be the number of same units taken to do the same job on her own
- Let n be the number of same units taken to do the same job on his own.

How long would it take to do the job working together?

$$\frac{1}{x} = \frac{1}{m} + \frac{1}{n} \quad \Rightarrow \quad x = \frac{mn}{m+n}$$