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## NUMBER

**Natural Numbers:** Numbers which are used for counting purpose are called natural numbers.

Ex: 1, 2, 3, 4, .....100, .....

**Whole Numbers:** Natural numbers including 0 are called Whole Numbers.

Ex: 0, 1, 2, 3, 4, .....

**Integers:** Positive natural numbers, negative natural numbers along with 0 are called integers.

Ex.: ....., -4, -3, -2, -1, 0, 1, 2, 3, 4, .....

**Rational Numbers:** Numbers which are in the form of  $\frac{p}{q}$  ( $q \neq 0$ ) where p and q are positive or negative whole numbers are called rational numbers.

Ex:  $\frac{1}{2}$ ,  $\frac{3}{4}$ ,  $\frac{-5}{7}$ ,  $\frac{49}{-56}$  .....

**Irrational Numbers:** Numbers like  $\sqrt{2}$ ,  $\pi$  cannot be expressed as rational numbers. Such types of numbers are called as irrational numbers.

Ex:  $\sqrt{5}$ ,  $\sqrt{17}$ , .....

### Terminating Decimals

These are decimal numbers which stop after a certain number of decimal places.

For example,  $7/8 = 0.875$ , is a terminating decimal because it stops (terminates) after 3 decimal places.

### Recurring Decimals

These are decimal numbers which keep repeating a digit or group of digits; for example  $137/259 = 0.528\ 957\ 528\ 957\ 528\ 957\ \dots$ , is a recurring decimal. The six digits 528957 repeat in this order. Recurring decimals are written with dots over the first and last digit of the repeating digits, e.g.  $0.\dot{5}28\ 95\dot{7}$

- The order of operations follows the **BODMAS** rule:

Brackets  
Powers Of  
Divide  
Multiply  
Add  
Subtract

- Even numbers:** numbers which are divisible by 2, eg, 2, 4, 6, 8, ...
- Odd numbers:** numbers which are not divisible by 2, eg; 1, 3, 5, 7 ...

- Real numbers** are made up of all possible *rational* and *irrational* numbers.
- An **integer** is a whole number.
- A **prime number** is divisible only by itself and by one (1). 1 is not a prime number. It has only two factors. 1 and the number itself.
- The exact value of **rational** number can be written down as the ratio of two whole numbers.
- The exact value of an **irrational** number cannot be written down.
- A **square number** is the result of multiplying a number by itself.  
Ex:  $1^2, 2^2, 3^2, \dots$  i.e. 1, 4, 9, .....
- A **cube number** is the result of multiplying a number by itself three times.  
Ex:  $1^3, 2^3, 3^3, \dots$  i.e. 1, 8, 27, .....
- The **factors** of a number are the numbers which divide exactly into two.  
eg. Factors of 36  
1, 2, 3, 4, 6, 9, 12, 18
- Multiples** of a number are the numbers in its times table.  
eg. Multiples of 6 are 6, 12, 18, 24, 30, ...

### Significant figures;

Example;

8064 = 8000 (correct to 1 significant figures)  
8064 = 8100 (correct to 2 significant figures)  
8064 = 8060 (correct to 3 significant figures)  
0.00508 = 0.005 (correct to 1 significant figures)  
0.00508 = 0.0051 (correct to 2 significant figures)  
2.00508 = 2.01 (correct to 3 significant figures)

### Decimal Places

Example

0.0647 = 0.1 (correct to 1 decimal places)  
0.0647 = 0.06 (correct to 2 decimal places)  
0.0647 = 0.065 (correct to 3 decimal places)  
2.0647 = 2.065 (correct to 3 decimal places)

### Standard Form:

The number  $a \times 10^n$  is in standard form when  $1 \leq a < 10$  and n is a positive or negative integer.

Eg:  $2400 = 2.4 \times 10^3$   
 $0.0035 = 3.5 \times 10^{-3}$

## Conversion Factors:

### Length:

1 km = 1000 m  
1 m = 100 cm  
1 cm = 10 mm

*km* means kilometer  
*m* means meter  
*cm* means centimeter  
*mm* means millimeter

### Mass:

1 kg = 1000 gm where kg means kilogram  
1 gm = 1000 mgm gm means gram  
1 tonne = 1000 kg mgm means milligram

### Volume:

1 litre = 1000 cm<sup>3</sup>  
1 m<sup>3</sup> = 1000 litres  
1 kilo litre = 1000 litre  
1 dozen = 12

### Time:

1 hour = 60 minutes = 3600 seconds  
1 minute = 60 seconds.  
1 day = 24 hours  
1 year = 12 months  
= 52 weeks  
= 365.25 days.

1 week = 7 days  
1 leap year = 366 days  
1 light year =  $9.46 \times 10^{12}$  km.

### Percentages:

- Percent means per hundred.
- To express one quantity as a percentage of another, first write the first quantity as a fraction of the second and then multiply by 100.
- Profit = S.P. – C.P.
- Loss = C.P. – S.P.
- Profit percentage =  $\frac{SP-CP}{CP} \times 100$
- Loss percentage =  $\frac{CP-SP}{CP} \times 100$

where CP = Cost price and SP = Selling price

### Simple Interest:

#### To find the interest:

- $i = \frac{PRT}{100}$  where  
*P* = money invested or borrowed  
*R* = rate of interest per annum  
*T* = Period of time (in years)

#### To find the amount:

- $A = P + I$  where A = amount

### Compound Interest:

$$A = p \left( 1 + \frac{r}{100} \right)^n$$

Where,

**A** stands for the amount of money accruing after *n* year.

**P** stands for the principal

**R** stands for the rate per cent per annum

**n** stands for the number of years for which the money is invested.

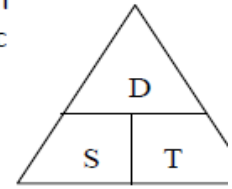
### Speed, Distance and Time:

- Distance = speed  $\times$  time
- Speed =  $\frac{\text{distance}}{\text{time}}$
- Time =  $\frac{\text{distance}}{\text{Speed}}$
- Average speed =  $\frac{\text{total distance}}{\text{total time}}$

- Units of speed: km/hr, m/sec
- Units of distance: km, m
- Units of time: hr, sec

$$\text{km / hr} \times \frac{5}{18} = \text{m / sec}$$

$$\text{m / sec} \times \frac{18}{5} = \text{km / hr}$$



### ALGEBRA

#### Quadratic Equations:

An equation in which the highest power of the variable is 2 is called quadratic equation. Thus  $ax^2 + bx + c = 0$  where  $a, b, c$  are constants and  $a \neq 0$  is a general equation.

Solving quadratic equations:

We can solve quadratic equation by method of,

- Factorization
- Using the quadratic formula
- Completing the square

#### (a) Solution by factors:

Consider the equation  $c \times d = 0$ , where  $c$  and  $d$  are numbers. The product  $c \times d$  can only be zero if either  $c$  or  $d$  (or both) is equal to zero.

i.e.  $c = 0$  or  $d = 0$  or  $c = d = 0$ .

#### (b) Solution by formula:

The solutions of the quadratic equation

$ax^2 + bx + c = 0$  are given by the formula:

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

#### (c) Completing the square

- Make the coefficient of  $x^2$ , i.e.  $a = 1$
- Bring the constant term, i.e.  $c$  to the right side of equation.
- Divide coefficient of  $x$ , i.e. by 2 and add the square i.e.  $(\frac{b}{2})^2$  to both sides of the equation.
- Factorize and simplify answer

#### Expansion of algebraic expressions

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

#### Factorization of algebraic expressions

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

#### Ordering:

= is equal to

$\neq$  is not equal to

> is greater than

$\geq$  is greater than or equal to

< is less than

$\leq$  is less than or equal to

**Variation:**

Direct Variation:

y is proportional to x

$$y \propto x$$

$$y = kx$$

Inverse Variation:

y is inversely proportional to x

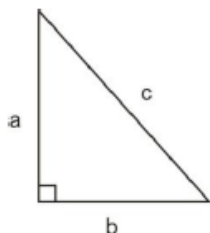
$$y \propto \frac{1}{x}$$

$$y = \frac{k}{x}$$

**MENSURATION****PYTHAGORAS' THEOREM**

For all the **right angled** triangles " the square on the hypotenuse is equal to the sum of the squares on the other two sides"

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

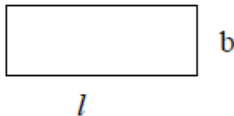
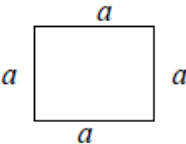
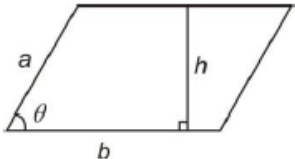
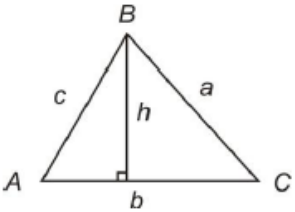


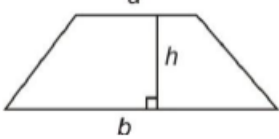
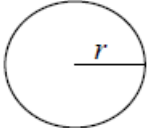
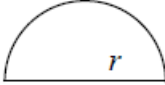
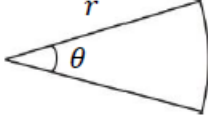
$$c = \sqrt{a^2 + b^2}$$

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

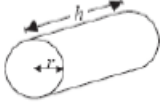
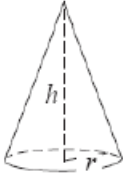
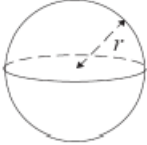
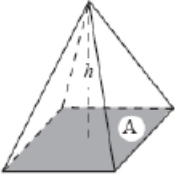
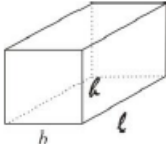
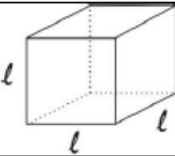

$$a = \sqrt{c^2 - b^2}$$

**Area and Perimeter:**

Figure	Diagram	Area	Perimeter
Rectangle		Area = $l \times b$	perimeter = $2(l + b)$
Square		Area = side $\times$ side = $a \times a$	perimeter = $4 \times$ side = $4 \times a$
Parallelogram		Area = $b \times h$	perimeter = $2(a + b)$
		Area = $ab \sin \theta$ where a, b are sides and $\theta$ is the included angle	
Triangle		Area = $\frac{1}{2} \times \text{base} \times \text{height}$	perimeter = $a + b + c$
		Area = $\frac{1}{2} ab \sin C$	
		= $\sqrt{s(s-a)(s-b)(s-c)}$ where $s = \frac{a+b+c}{2}$	

Trapezium		Area = $\frac{1}{2}(a + b)h$	perimeter = Sum of all sides
Circle		Area = $\pi r^2$	circumference = $2\pi r$
Semicircle		Area = $\frac{1}{2}\pi r^2$	perimeter = $\frac{1}{2}\pi d + d$
Sector		Area = $\pi r^2 \times \frac{\theta}{360}$	length of an arc = $2\pi r \times \frac{\theta}{360}$

### Surface Area and Volume:

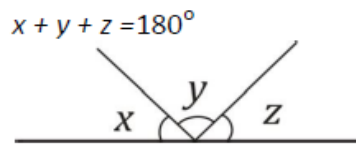
Figure	Diagram	Surface Area	Volume
Cylinder		curved surface area = $2\pi rh$ total surface area = $2\pi r(h + r)$	Volume = $\pi r^2 h$
Cone		curved surface area = $\pi rl$ where $l = \sqrt{(r^2 + h^2)}$ total surface area = $\pi r(l + r)$	Volume = $\frac{1}{3}\pi r^2 h$
Sphere		Surface area = $4\pi r^2$	Volume = $\frac{4}{3}\pi r^3$
Pyramid		Base area + area of the shapes in the sides	Volume = $\frac{1}{3} \times \text{base area} \times \text{perpendicular height}$
Cuboid		Surface area = $2(lb + bh + lh)$	Volume = $l \times b \times h$
Cube		Surface area = $6l^2$	Volume = $l^3$
Hemisphere		Curved surface area = $2\pi r^2$	Volume = $\frac{2}{3}\pi r^3$



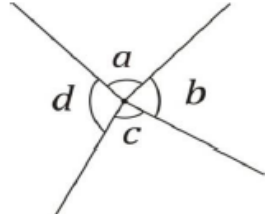
## GEOMETRY

### (a) Angles on a straight line

The angles on a straight line add up to  $180^\circ$ .



### (b) Angle at a point



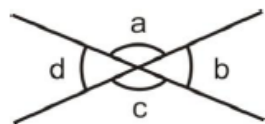
The angles at a point add up to  $360^\circ$ .  
 $a + b + c + d = 360^\circ$

### (c) Vertically opposite angles

If two straight lines intersect, then

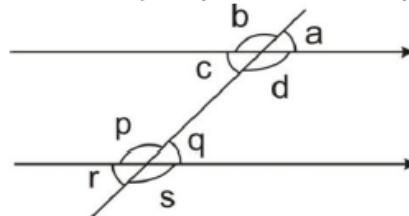
$$a = c$$

$$b = d \text{ (Vert, opp. } \angle\text{s)}$$



### Parallel Lines:

When lines never meet, no matter how far they are extended, they are said to be parallel.

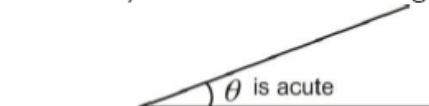


- Vertically opposite angles are equal.  
 $a = c$ ;  $b = d$ ;  $p = s$  and  $q = r$
- Corresponding angles** are equal.  
 $a = q$ ;  $b = p$ ;  $c = r$  and  $d = s$
- Alternate angles** are equal.  
 $c = q$  and  $d = p$ .
- Sum of the angles of a triangle is  $180^\circ$ .
- Sum of the angles of a quadrilateral is  $360^\circ$ .

### Types of angles

Given an angle  $\theta$ , if

$\theta < 90^\circ$ , then  $\theta$  is an **acute** angle



$90^\circ < \theta < 180^\circ$ , then  $\theta$  is an **obtuse** angle



$180^\circ < \theta < 360^\circ$ , then  $\theta$  is an **reflex** angle



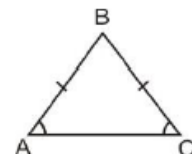
## Triangles

### Different types of triangles:

1. An isosceles triangle has 2 sides and 2 angles the same.

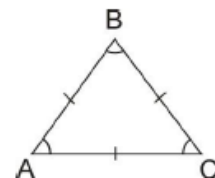
$$AB = AC$$

$$ABC = BCA$$



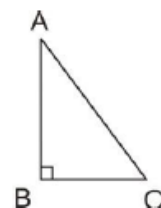
2. An equilateral triangle has 3 sides and 3 angles the same.

$$AB = BC = CA \text{ and } ABC = BCA = CAB$$



3. A triangle in which one angle is a right angle is called the right angled triangle.

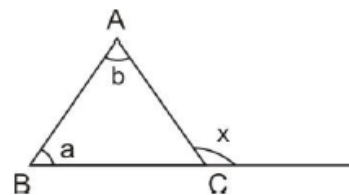
$$ABC = 90^\circ$$



### Angle properties of triangle:

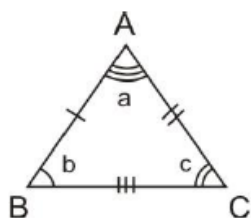
- The sum of the angles of a triangle is equal to  $180^\circ$ .
- In every triangle, the greatest angle is opposite to the longest side. The smallest angle is opposite to the shortest side.
- Exterior angle is equal to the sum of the opposite interior angles.

$$x = a + b$$



### Congruent Triangles:

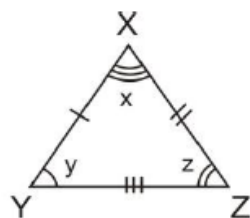
Two triangles are said to be congruent if they are equal in every aspect.



$$AB = XY$$

$$BC = YZ$$

$$AC = XZ$$



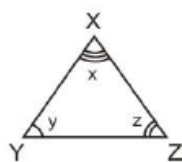
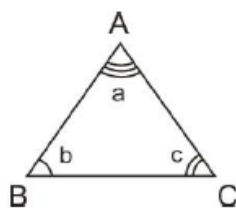
$$\angle a = \angle x$$

$$\angle b = \angle y$$

$$\angle c = \angle z$$

### Similar Triangles:

If two triangles are similar then they have a pair of corresponding equal angles and the three ratios of corresponding sides are equal.

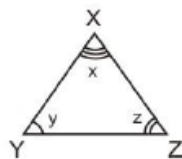
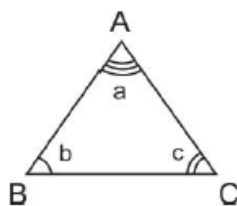


$$\angle a = \angle x; \angle b = \angle y \text{ and } \angle c = \angle z$$

$$\frac{AB}{XY} = \frac{BC}{YZ} = \frac{AC}{XZ}$$

If you can show that one of the following conditions is true for two triangles, then the two triangles are similar.

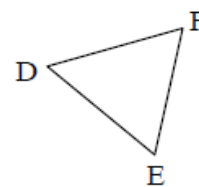
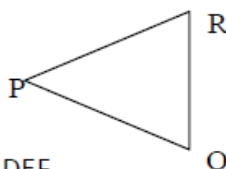
- i) The angles of one triangle are equal to the corresponding angles of the other triangle.



$\Delta ABC$  is similar to  $\Delta XYZ$  because  $\angle a = \angle x; \angle b = \angle y$  and  $\angle c = \angle z$

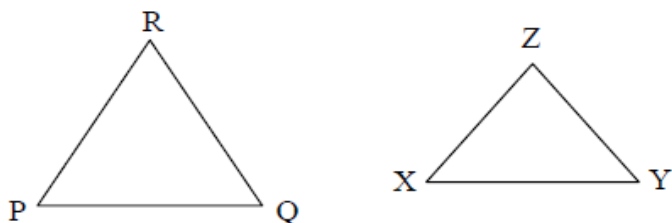
- ii) The ratio of corresponding sides is equal.

$$\text{If } \frac{PQ}{DE} = \frac{PR}{DF} = \frac{QR}{EF} \text{ then } \Delta PQR \text{ is similar to } \Delta DEF$$





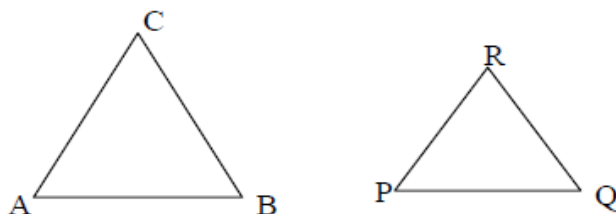
- iii) The ratios of the corresponding sides are equal and the angles between them are equal.



$\Delta PQR$  is similar to  $\Delta XYZ$  (if, for eg:  $\angle P = \angle X$  and  $\frac{PQ}{XY} = \frac{PR}{XZ}$ )

### Areas of Similar Triangles:

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



$$\frac{\text{area of } \Delta ABC}{\text{area of } \Delta PQR} = \frac{AB^2}{PQ^2} = \frac{BC^2}{QR^2} = \frac{AC^2}{PR^2}$$

### Polygons:

- The exterior angles of a polygon add up to  $360^\circ$ .
- The sum of the interior angles of a polygon is  $(n - 2) \times 180^\circ$  where  $n$  is the number of sides of the polygon.
- A regular polygon has equal sides and equal angles.
- If the polygon is regular and has  $n$  sides, then each exterior angle  $= \frac{360}{n}$

3 sides = triangle	4 sides = quadrilateral	5 sides = pentagon
6 sides = hexagon	7 sides = heptagon	8 sides = octagon
9 sides = nonagon	10 sides = decagon	

### Similar Solids:

If two objects are similar and the ratio of corresponding sides is  $k$ , then

- the ratio of their areas is  $k^2$ .
- the ratio of their volumes is  $k^3$ .

#### Length

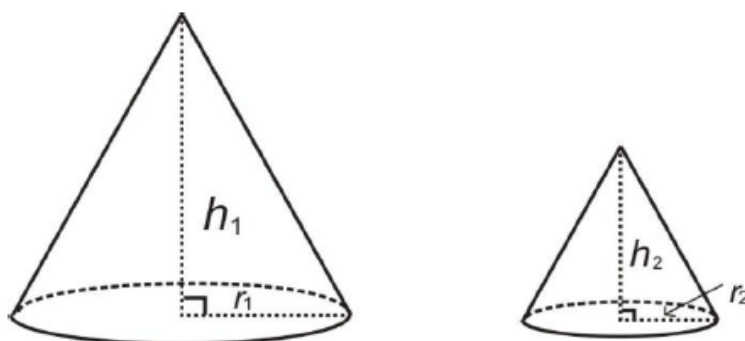
$$\frac{l_1}{l_2} = \frac{r_1}{r_2} = \frac{h_1}{h_2}$$

#### Area

$$\frac{A_1}{A_2} = \frac{r_1^2}{r_2^2} = \frac{h_1^2}{h_2^2}$$

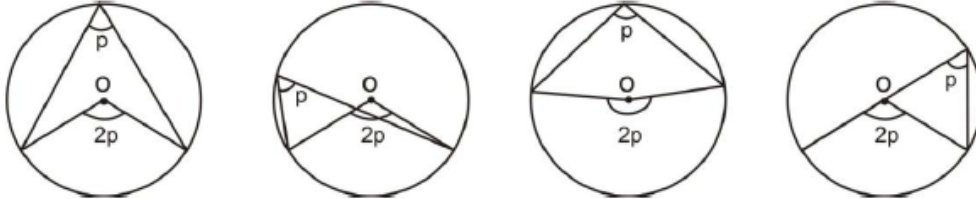
#### Volume

$$\frac{V_1}{V_2} = \frac{r_1^3}{r_2^3} = \frac{h_1^3}{h_2^3}$$

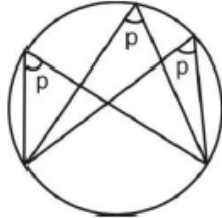


## CIRCLE

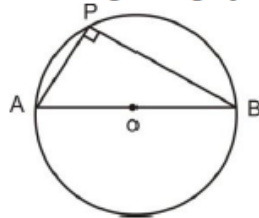
- The angle subtended by an arc at the centre is twice the angle subtended at the circumference



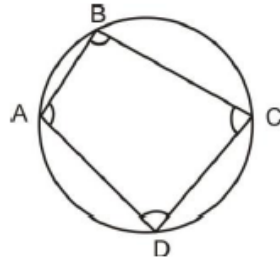
- Angles subtended by an arc in the same segment of a circle are equal.



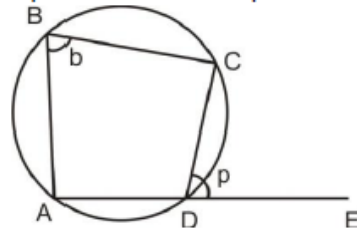
- The angle in a semi-circle is a right angle. [or if a triangle is inscribed in a semi-circle the angle opposite the diameter is a right angle].  $\angle APB = 90^\circ$



- Opposite angles of a cyclic quadrilateral add up to  $180^\circ$  (supplementary). The corners touch the circle.  $A+C = 180^\circ$ ,  $B+D = 180^\circ$



- The exterior angle of a cyclic quadrilateral is equal to the interior opposite angle. ( $b = p$ )



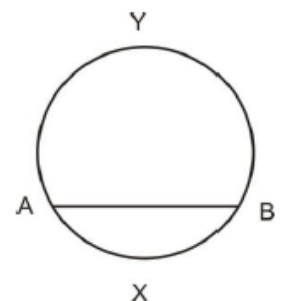
### Chord of a circle:

A line joining two points on a circle is called a **chord**.

The area of a circle cut off by a chord is called a **segment**.

AXB is **the minor arc** and AYB is **the major arc**.

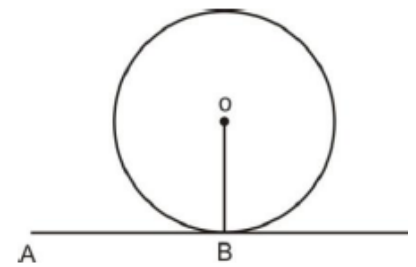
- The line from the centre of a circle to the mid-point of a chord bisects the chord at right angles.
- The line from the centre of a circle to the mid-point of a chord bisects the angle subtended by the chord at the centre of the circle.



### Tangents to a Circle:

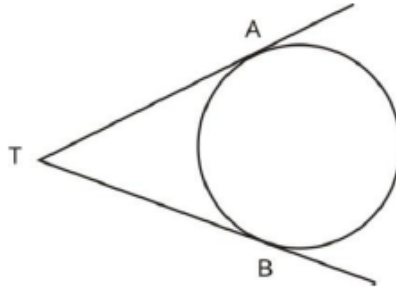
- The angle between a tangent and the radius drawn to the point of contact is  $90^\circ$ .

$$\angle ABO = 90^\circ$$



- From any point outside a circle just two tangents to the circle may be drawn and they are of equal length.

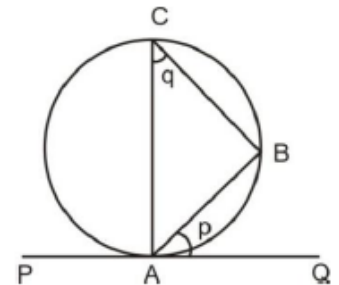
$$TA = TB$$



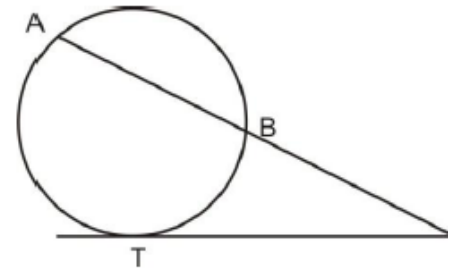
- Alternate Segment Theorem**

The angle between a tangent and a chord through the point of contact is equal to the angle subtended by the chord in the alternate segment.

$$\angle QAB = \angle ACB \quad (p = q)$$



- $TC^2 = AC \times BC$



### INDICES:

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

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

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

- $a^0 = 1$

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

- $(a \times b)^m = a^m \times b^m$

- $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$

- $(\sqrt[n]{a})^m = a^{m/n}$

- $\sqrt{a} \times \sqrt{b} = \sqrt{a \times b}$

- $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$

- $(\sqrt{a})^2 = a$

### Solving Inequalities:

When we multiply or divide by a negative number the inequality is reversed.

Eg:  $4 > -2$

By multiplying by  $-2$   $[4(-2) < (-2)(-2)]$

$-8 < +4$

### TRIGONOMETRY

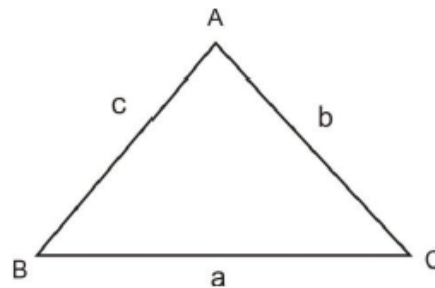
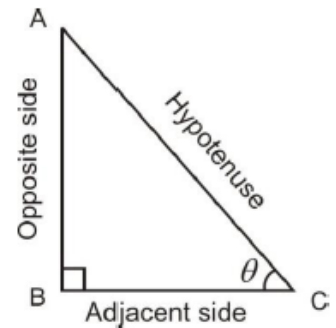
Let ABC be a right angled triangle, where  $\angle B = 90^\circ$

$$\bullet \sin \theta = \frac{\text{Opposite Side}}{\text{Hypotenuse}} = \frac{O}{H}$$

$$\bullet \cos \theta = \frac{\text{Adjacent Side}}{\text{Hypotenuse}} = \frac{A}{H}$$

$$\bullet \tan \theta = \frac{\text{Opposite side}}{\text{Adjacent Side}} = \frac{O}{A}$$

**SOH CAH TOA**



**Sine Rule:**

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

**Cosine Rule:**

**To find the length of a side:**

- $a^2 = b^2 + c^2 - 2bc \cos A$
- $b^2 = a^2 + c^2 - 2ac \cos B$
- $c^2 = a^2 + b^2 - 2ab \cos C$

**To find an angle when all the three sides are given:**

- $\cos A = \frac{b^2 + c^2 - a^2}{2bc}$
- $\cos B = \frac{a^2 + c^2 - b^2}{2ac}$
- $\cos C = \frac{a^2 + b^2 - c^2}{2ab}$

### Bearing

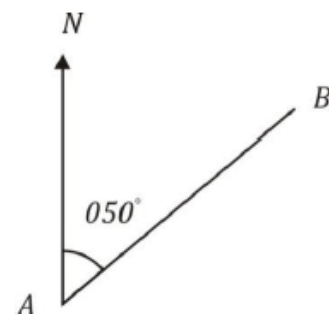
The bearing of a point B from another point A is;

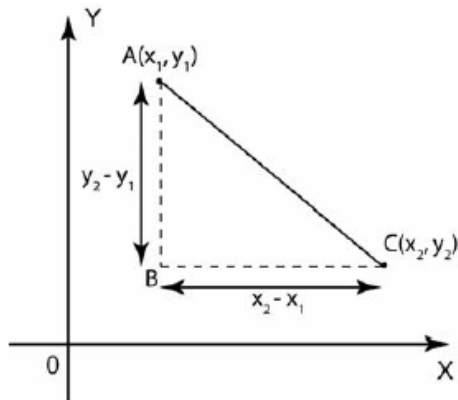
(a) an angle measured from the north at A.

(b) In a clockwise direction.

(c) Written as three-figure number (i.e. from  $000^\circ$  to  $360^\circ$ )

Eg: The bearing of B from A is  $050^\circ$ .



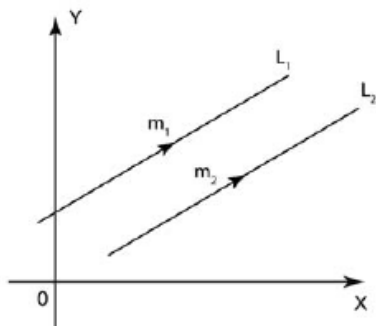
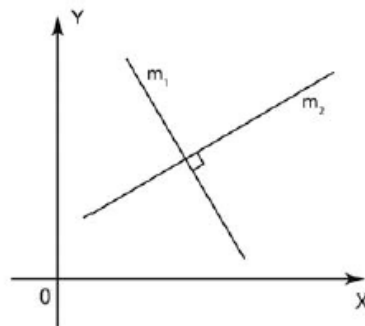
**Distance and Gradient**

Distance Between Point A and C =

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

Gradient of line AC,  $m = \frac{y_2 - y_1}{x_2 - x_1}$ 

Or

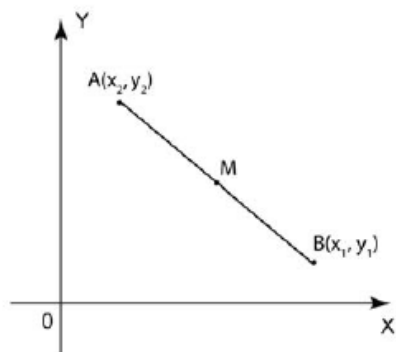
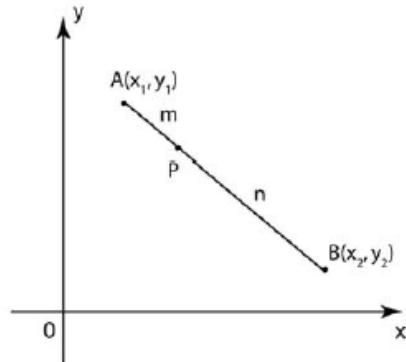
Gradient of a line,  $m = -\left(\frac{y - \text{intercept}}{x - \text{intercept}}\right)$ **Parallel Lines****Perpendicular Lines**

When 2 lines are parallel,

$$m_1 = m_2$$

When 2 lines are perpendicular to each other,

$$m_1 \times m_2 = -1$$

 $m_1$  = gradient of line 1 $m_2$  = gradient of line 2**Midpoint****A point dividing a segment of a line**Midpoint,  $M = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$ 

A point dividing a segment of a line

$$P = \left( \frac{nx_1 + mx_2}{m + n}, \frac{ny_1 + my_2}{m + n} \right)$$

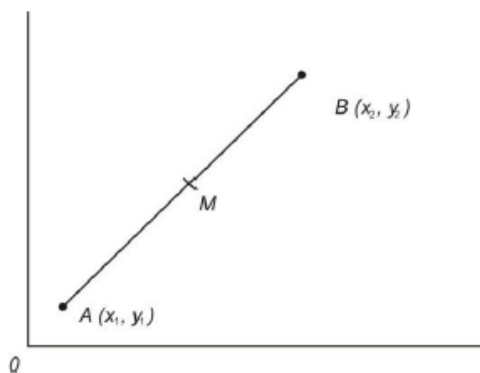
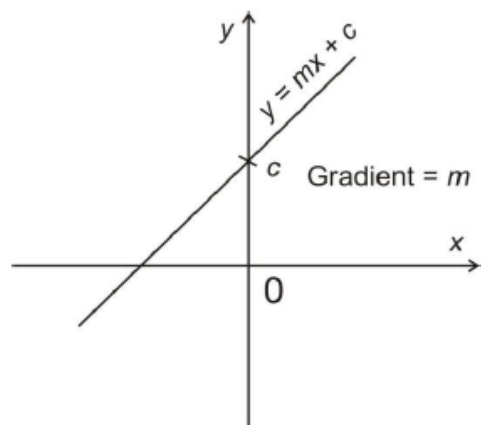
## Cartesian co-ordinates

### Gradient and equation of a straight line

The gradient of the straight line joining any two given points  $A(x_1, y_1)$  and  $B(x_2, y_2)$  is;

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

The gradient/intercept form of the equation of a straight line is  $y = mx + c$ , where  $m$  = gradient and  $c$  = intercept on  $y$  - axis.



- The midpoint of the line joining two points  $A(x_1, y_1)$  and  $B(x_2, y_2)$  is;  $M = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$
- The distance between two points  $A(x_1, y_1)$  and  $B(x_2, y_2)$  is;  $AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
- Parallel lines have the same gradient.
- In a graph, gradient =  $\frac{\text{Vertical height}}{\text{Horizontal height}}$  or  $\frac{y}{x}$

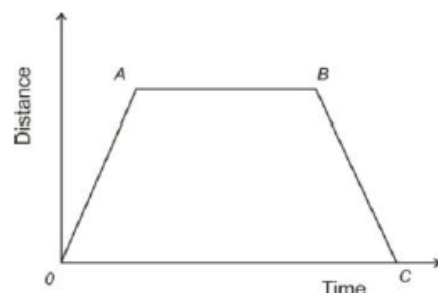
### Distance – Time Graphs:

From O to A : Uniform speed

From B to C : uniform speed

From A to B : Stationary (speed = 0)

The **gradient** of the graph of a distance-time graph gives the **speed** of the moving body.



### Speed – Time Graphs:

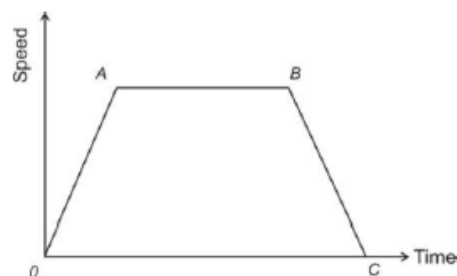
From O to A : Uniform speed

From A to B : Constant speed (acceleration = 0)

From B to C : Uniform deceleration / retardation

The **area** under a speed –time graph represents the **distance travelled**.

The **gradient** of the graph is the **acceleration**. If the acceleration is negative, it is called deceleration or retardation. (The moving body is slowing down.)





**Velocity:**

Velocity is the rate of change of distance with respect to the time.

**Acceleration:**

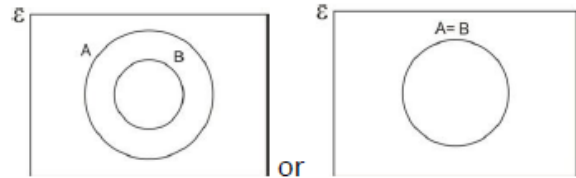
Acceleration is the rate of change of velocity with respect to time.

**SETS:****Notations**

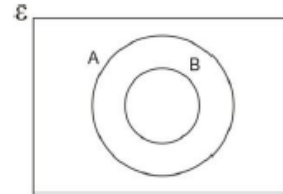
- $\xi$  = universal set
- $\cup$  (union) = all the elements
- $\cap$  (intersection) = common elements
- $\emptyset$  or  $\{ \}$  = empty set
- $\in$  = belongs to
- $\notin$  = does not belongs to
- $\subseteq$  = Subset
- $A'$  = compliment of A (i.e. the elements of  $\xi$  - the elements of A)
- $n(A)$  = the number of elements in A.
- De Morgan's Laws:  $(A \cup B)' = (A' \cap B')$   
 $(A \cap B)' = (A' \cup B')$

**Subset  $\subseteq$** 

$B \subseteq A$  means every elements of set B is also an element of set A.

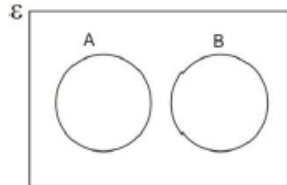
**Proper subset  $\subset$** 

$B \subset A$  means every element of B is an element of set A but  $B \neq A$ .

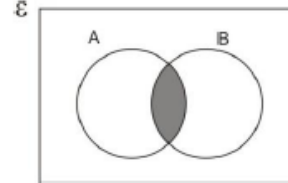
**Disjoint sets**

Disjoint set do not have any element in common. If A and B are disjoint sets, then

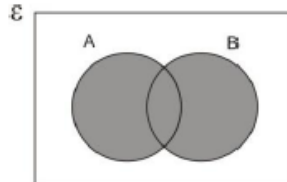
$$A \cap B = \emptyset$$

**Intersection  $\cap$** 

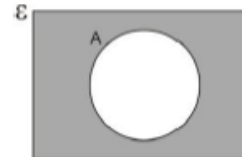
$A \cap B$  is the set of elements which are in A and also in B

**Union  $\cup$** 

$A \cup B$  is the set of elements in either A, B or both A and B.

**Complement**

The complement of A, written as  $A'$  refers to the elements in  $\xi$  but not in A.



### The Inverse of a Matrix:

If  $A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$  then  $A^{-1} = \frac{1}{(ad-bc)} \begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$

- $AA^{-1} = A^{-1}A = I$  where  $I$  is the identity matrix.
- The number  $(ad - bc)$  is called the **determinant** of the matrix and is written as  $|A|$
- If  $|A| = 0$ , then the **matrix has no inverse**.
- Multiplying by the inverse of a matrix gives the same result as dividing by the matrix.

e.g. if  $AB = C$   
 $A^{-1}AB = A^{-1}C$   
 $B = A^{-1}C$

• If  $C = \begin{pmatrix} x \\ y \end{pmatrix}$  and  $D = \begin{pmatrix} r \\ s \end{pmatrix}$  then  $C + D = \begin{pmatrix} x+r \\ y+s \end{pmatrix}$

### Transformations:

#### a) Reflection:

When describing a reflection, the position of the mirror line is essential.

#### b) Rotation:

To describe a rotation, the centre of rotation, the angle of rotation and the direction of rotation are required.

A clockwise rotation is negative and an anticlockwise rotation is positive.

>> (angle) (Direction) rotation about (centre)

#### c) Translation:

When describing a translation it is necessary to give the translation vector

$$\begin{pmatrix} x \\ y \end{pmatrix}$$

- $+x$  represents movement to the right
- $-x$  represents movement to the left
- $+y$  represents movement to the top
- $-y$  represents movement to the bottom.

>> Translation by the column vector -----

#### d) Enlargement:

To describe an enlargement, state;

- The scale factor,  $K$
- The centre of enlargement (the invariant point)

$$\text{Scale factor} = \frac{\text{length of the image}}{\text{length of the object}}$$

>> Enlargement by the scale factor --- centre -----

- If  $K > 0$ , both the object and the image lie on the same side of the centre of enlargement.
- If  $K < 0$ , the object and the image lie on opposite side of the centre of enlargement.
- If the scale factor lies between 0 and 1, then the resulting image is smaller than the object.  
 [although the image is smaller than the object, the transformation is still known as an enlargement]

$\text{Area of image} = K^2 \text{ area of object}$
---

## STATISTICS

### Bar Graph:

A bar chart makes numerical information easy to see by showing it in a pictorial form.

The width of the bar has no significance. The length of each bar represents the quantity.

### Pie Diagram:

The information is displayed using sectors of a circle.

### Histograms:

A histogram displays the frequency of either continuous or grouped discrete data in the form of bars.

The bars are joined together.

The bars can be of varying width.

The frequency of the data is represented by the area of the bar and not the height.

[When class intervals are different it is the area of the bar which represents the frequency not the height]. Instead of frequency being plotted on the vertical axis, frequency density is plotted.

$$\text{Frequency density} = \frac{\text{frequency}}{\text{class width } h}$$

### Mean:

The mean of a series of numbers is obtained by adding the numbers and dividing the result by the number of numbers.

$$\text{Mean} = \frac{\sum fx}{\sum f} \quad \text{where } \sum fx \text{ means 'the sum of the products'}$$

i.e.  $\sum (\text{number} \times \text{frequency})$

and  $\sum f$  means 'the sum of the frequencies'.

### Median:

The median of a series of numbers is obtained by arranging the numbers in ascending order and then choosing the number in the 'middle'. If there are two 'middle' numbers the median is the average (mean) of these two numbers.

### Mode:

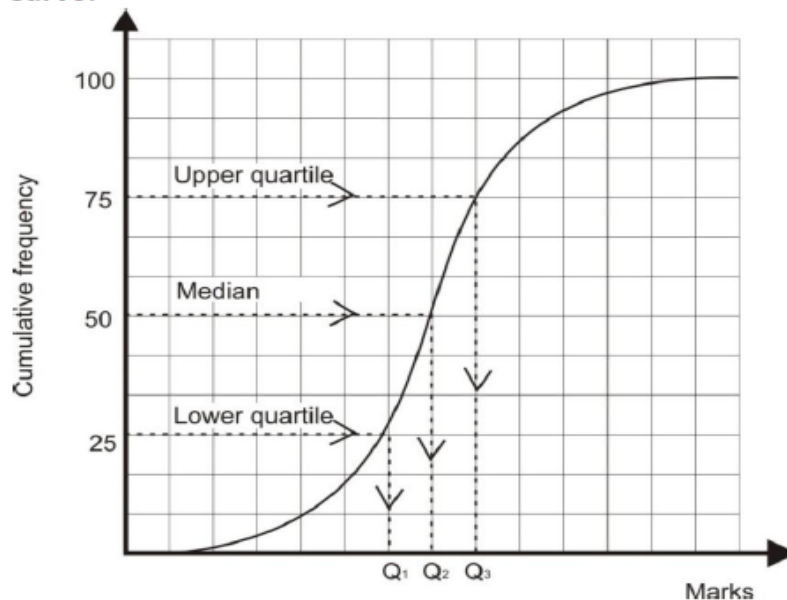
The mode of a series of numbers is simply the number which occurs most often.

### Frequency tables:

A frequency table shows a number  $x$  such as a score or a mark, against the frequency  $f$  or number of times that  $x$  occurs.

**Cumulative frequency:**

Cumulative frequency is the total frequency up to a given point.

**Cumulative frequency Curve:**

A cumulative frequency curve shows the median at the 50<sup>th</sup> percentile of the cumulative frequency. The value at the 25<sup>th</sup> percentile is known as the lower quartile and that at the 75<sup>th</sup> percentile as the upper quartile.

A measure of the spread or dispersion of the data is given by the inter-quartile range where **inter-quartile range = upper quartile – lower quartile.**

**Probability:**

- Probability is the study of chance, or the likelihood of an event happening.
- Probability of an event =  $\frac{\text{number of favourable outcomes}}{\text{Total number of equally likely outcomes}}$
- If the probability = 0 it implies the event is impossible
- If the probability = 1 it implies the event is certain to happen.
- All probabilities lie between 0 and 1.
- Probabilities are written using fractions or decimals.

**Exclusive events:**

Two events are exclusive if they cannot occur at the same time.

The OR Rule:

For exclusive events A and B

$$p(A \text{ or } B) = p(A) + p(B)$$

**Independent events:**

Two events are independent if the occurrence of one even is unaffected by the occurrence of the other.

The AND Rule:

$$p(A \text{ and } B) = p(A) \times p(B)$$

where  $p(A)$  = probability of A occurring

$p(B)$  = probability of B occurring

**Tree diagrams:**

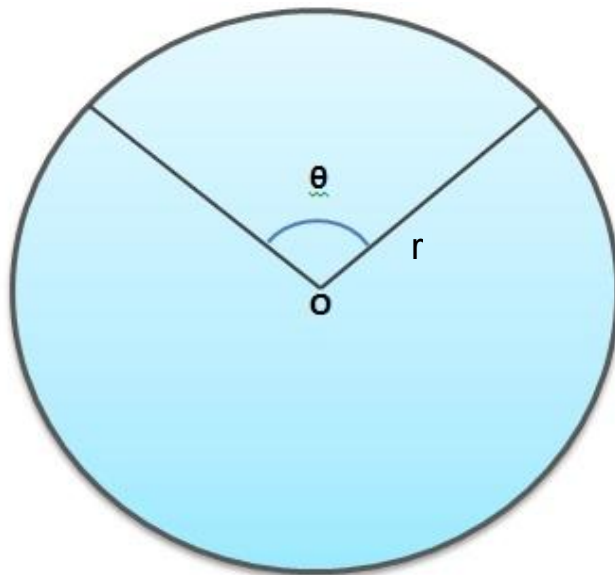
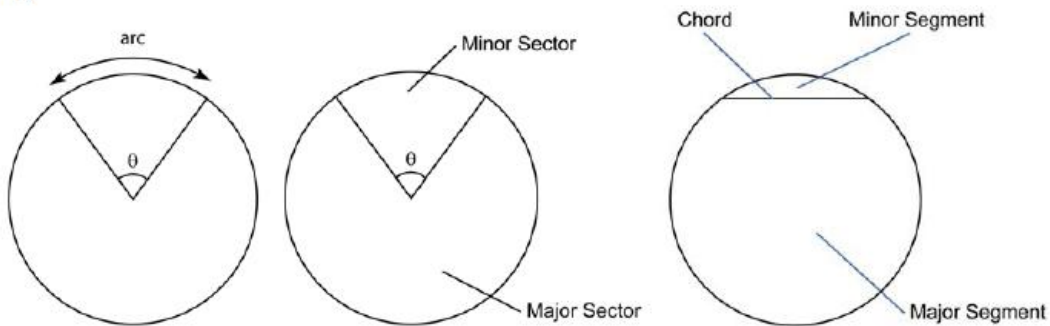
A tree diagram is a diagram used to represent probabilities when two or more events are combined.

### Symmetry:

- A line of symmetry divides a two-dimensional shape into two congruent (identical) shapes.
- A plane of symmetry divides a three-dimensional shape into two congruent solid shapes.
- A two-dimensional shape has rotational symmetry if, when rotated about a central point, it fits its outline. The number of times it fits its outline during a complete revolution is called the order of rotational symmetry.

Shape	Number of Lines of Symmetry	Order of Rotational Symmetry
Square	4	4
Rectangle	2	2
Parallelogram	0	2
Rhombus	2	2
Trapezium	0	1
Kite	1	1
Equilateral Triangle	3	3
Regular Hexagon	6	6

### Terminology



Arc Length	Area of sector	Perimeter of Sector
$\frac{\theta}{360} \times 2\pi r$	$\frac{\theta}{360} \times \pi r^2$	$\frac{\theta}{360} \times 2\pi r + 2r$