Updated to 2020-22 Syllabus

CIE IGCSE
MATHS 0580

SUMMARIZED NOTES ON THE EXTENDED SYLLABUS

TABLE OF CONTENTS

1. NUMBER

- **Natural numbers:**
  - used for counting purposes
  - all possible rational &irrational numbers
- **Integer:** a whole number
- **Prime numbers:**
  - divisible only by itself and one
  - 1 is not a prime number
- **Rational numbers:** can be written as a fraction
- **Irrational numbers:** cannot be written as a fraction e.g.π
- **Cube numbers:** made from multiplying a rational number to itself twice.
- **Reciprocals:** A number made by raising a rational number to -1, or 1 over that number
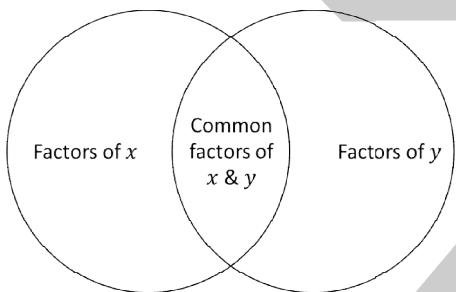
1.1 HCF and LCM
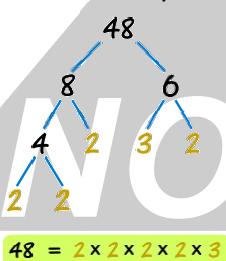
- **Highest Common Factor and Lowest Common Multiple:**

  - HCF = product of common factors of x and y
 - LCM = product of all items in Venn diagram
- **Prime Factorization:** finding which prime numbers
  - multiply together to make the original number

$$48 = 2 \times 2 \times 2 \times 2 \times 3$$
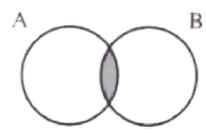
1.2 Sets
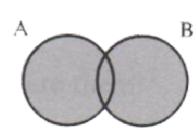
- Definition of sets e.g.
  - $A = \{x : x \text{ is a natural number}\}$
  - $B = \{(x, y) : y = mx + c\}$
  - $C = \{x : a \leq x \leq b\}$
  - $D = \{a, b, c, \dots\}$
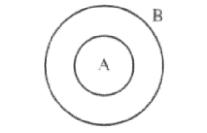
Set representations:
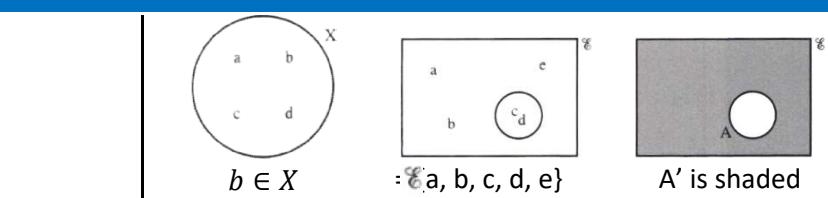
$A \cap B$ is shaded $A \cup B$ is shaded $\subset$ 'is a subset of'

$b \in X$ $= \mathscr{E}\{a, b, c, d, e\}$ A' is shaded

Notation:

- $n(A)$ = no. of elements in A
- $\in$ = …is an element of…
- $\notin$ = …is not an element of…
- A' = compliment of set A
- $\emptyset$ or { } = empty set
- $\mathscr{E}$ = Universal set
- $A \cup B$ = union of A and B
- $A \cap B$ = intersection of A and B
- $A \subseteq B$ = A is a subset of B
- $A \subset B$ = A is a proper subset of B
- $A \nsubseteq B$ = A is not a subset of B
- $A \not\subset B$ = A is not a proper subset of B

1.3 Indices

Standard form:

  - $10^4 = 10000$ $10^{-1} = 0.1$
  - $10^3 = 1000$ $10^{-2} = 0.01$
  - $10^2 = 100$ $10^{-3} = 0.001$
  - $10^1 = 10$ $10^{-4} = 0.0001$
  - $10^0 = 1$ $10^{-5} = 0.00001$

Limits of accuracy:

- The degree of rounding of a number
  - E.g. 2.1 to 1 d.p $2.05 \leq x < 2.15$
  - Finding limits when adding/multiplying: add/multiply respective limits of values
  - Finding maximum value possible when dividing/subtracting: max value divided by/minus min value
  - Finding minimum value possible when dividing/subtracting: min value divided by/minus max value

1.4 Ratio & Proportion

- **Ratio:** used to describe a fraction
  - e.g. 3 : 1
- **Foreign exchange:** money changed from one currency to another using proportion
  - E.g. Convert $22.50 to Dinars
    $$\$1 : 0.30KD$$
    $$\$22.50 : 6.75KD$$
- **Map scales:** using proportion to work out map scales
  - 1km = 1000m
  - 1m = 100cm
  - 1cm = 10mm
- **Direct variation:** y is proportional to x
  $$y \propto x \qquad y = kx$$
- **Inverse variation:** y is inversely proportional to x
  $$y \propto \frac{1}{x} \qquad y = \frac{k}{x}$$

1.5 Percentages

- **Percentage:**
  - Convenient way of expressing fractions
  - Percent means per 100
- **Percentage increase or decrease:**
  $$Percentage\ increase = \frac{Actual\ Change}{Original\ Amount} \times 100$$
- **Simple interest:**
  $$I = \frac{PRT}{100}$$
  $$P = Principal \qquad R = Rate\ of\ Interest$$
  $$T = Period\ of\ Time$$
- **Compound interest:**
  $$A = P\left(1 + \frac{R}{100}\right)^n$$
  $$P = Principal \qquad R = Rate\ of\ Interest$$
  $$n = Period\ of\ Time$$

1.6 Speed, Distance & Time

$$Speed = \frac{Distance}{Time}$$
$$Average\ Speed = \frac{Total\ Distance}{Total\ Time}$$

- **Units of speed:**   km/hr or m/s
- **Units of distance:**   km   or m
- **Units of time:**   hr   or sec

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

2. ALGEBRA & GRAPHS

2.1 Factorisation

- **Common factors:**
  $$3x^2 + 6x$$
  $$3x(x + 2)$$
- **Difference of two squares:**
  $$25 - x^2$$
  $$(5 + x)(5 - x)$$
- **Group factorization:**
  $$4d + ac + ad + 4c$$
  $$4(d + c) + a(c + d)$$
  $$(4 + a)(c + d)$$
- **Trinomial:**
  $$x^2 + 14x + 24$$
  $$x^2 + 12x + 2x + 24$$
  $$x(x + 12) + 2(x + 12)$$
  $$(x + 2)(x + 12)$$

2.2 Quadratic Factorization

- **General equation:**
  $$ax^2 + bx + c = 0$$
- **Solve quadratics by:**
  - Trinomial factorization
  - Quadratic formula
  $$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

- When question says, "give your answer to two decimal places", **use formula!**
- Derivation of the Quadratic Formula is the same as saying "Make x the subject in $ax^2 + bx + c = 0$" →
  $$ax^2 + bx + c = 0$$

Factorize a out
$$a\left(x^2 + \frac{b}{a}x\right) + c = 0$$

Complete the Square
$$a\left(\left(x + \frac{b}{2a}\right)^2 - \frac{b^2}{4a^2}\right) + c = 0$$
$$a\left(x + \frac{b}{2a}\right)^2 - \frac{b^2}{4a} + c = 0$$
$$a\left(x + \frac{b}{2a}\right)^2 = \frac{b^2 - 4ac}{4a}$$
$$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2 - 4ac}{4a^2}$$
$$x + \frac{b}{2a} = \pm\sqrt{\frac{b^2 - 4ac}{4a^2}}$$
$$x + \frac{b}{2a} = \frac{\pm\sqrt{b^2 - 4ac}}{\sqrt{4a^2}}$$

Note: $4a^2$ is a square number

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

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

- **Standardized form:**
  - ○ $y = ax^2 + bx + c$
- **Complete Square form:**
  - ○ $y = (x + a)^2 + b$ (Where axis of symmetry is $x = -a$)
  - ○ To find turning point of quadratic equation, complete the square, then the turning point is: $(-a, \ b)$
- **Ways to solve Quadratic equation:**
  - ○ Graphing Method
  - ○ Factorizing
  - ○ Quadratic Formula
  - ○ Complete the Square

- **Graphing Method –** Graph the equation, see where the it touches the x-axis

- **Factorizing**

e.g. $x^2 - x - 6 = 0$

$$x^2 - x - 6 = 0$$
$$(x - 3)(x + 2) = 0$$
$$x_1 = 3$$
$$x_2 = -2$$

- **Quadratic Formula**

e.g. $x^2 - x - 6 = 0$

Where $a = 1, b = -1, c = -6$

Plug the numbers in the Quadratic Formula:

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

Therefore:

$$x = \frac{-(-1) \pm \sqrt{(-1)^2 - 4(1)(-6)}}{2(1)}$$

$$x_1 = 3$$
$$x_2 = -2$$

-

- **Complete the Square**

e.g. $x^2 + 10x + 5 = 0$

(**WARNING!** Coefficient of x^2 Must be 1 for this to work)

$$x^2 + 10x + 5 = 0$$
$$(x + 5)^2 - 5^2 + 5 = 0$$
$$(x + 5)^2 - 20 = 0$$
$$(x + 5)^2 = 20$$

$$x + 5 = \pm\sqrt{20}$$
$$x = -5 \pm \sqrt{20}$$

Answer is: $x_1 = -5 + \sqrt{20}$ and $x_2 = -5 - \sqrt{20}$
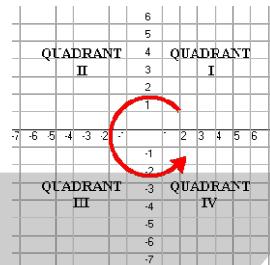
2.3 Reciprocal Graphs (Hyperbola)

- **Standardized Form:**
  - ○ $y = \frac{a}{x}$
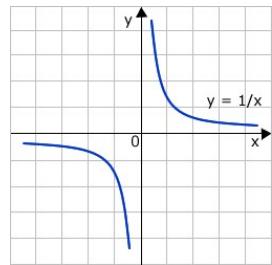
| If a is **Positive**:	If a is **Negative**:
The Line will be in the **1st**&**3rd** Quadrant	The Line will be in the **2nd**&**4th** Quadrant

2.4 Cubic Equation
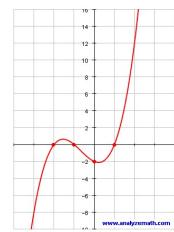
- **Standardized Form:**
  - ○ $y = ax^3 + bx^2 + cx + d$
- **Properties:**
  - ○ Highest Exponent of x is 3
  - ○ Has a maximum of 2 turning points
    Turning points are points after which a graph changes its gradient's sign, therefore changing direction between up or down
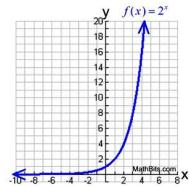

2.5 Exponential Graphs

- **Standardized form:**
  - ○ $y = a(b)^x$
- **Properties:**
  - ○ a is the y-intercept
  - ○ Asymptotes are lines that a curve approaches, but never touches because the curve continues to infinity, in this case the y-axis
  - ○ b is the rate of growth
 - ○ When $0 < b < 1$, the graph will go downwards from left to right
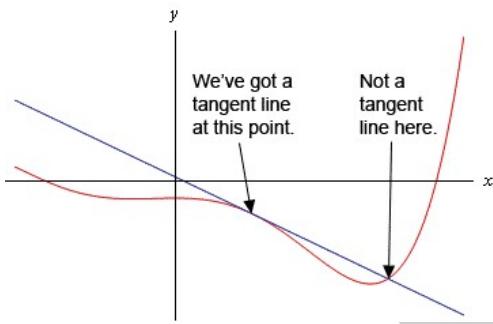
2.6 Gradient of a Curve

- **By drawing tangents**
  - In a straight line, gradient is constant
  - Curves have varying gradients throughout the graph
    To find the gradient at a point:
    1. Draw the graph
    2. Draw a tangent at the point in the graph, ensuring it only touches the graph at that point (Use a ruler)
    3. Find the gradient of the tangent

We've got a tangent line at this point.

Not a tangent line here.

- **Using differentiation**
  - $\frac{dy}{dx}$ gives you the gradient of the curve at any point in terms of x
  - When $y = x^n$, $\frac{dy}{dx} = nx^{n-1}$
  - Stationary/ turning point: $\frac{dy}{dx} = 0$
  - 1st Derivative = $\frac{dy}{dx} = f'(x)$
  - 2nd Derivative = $\frac{d^2y}{dx^2} = f''(x)$
  - To determine if stationary point is maximum or minimum:
    - Use 2nd derivative
      - Maximum point: $\frac{d^2y}{dx^2} < 0$
      - Minimum point: $\frac{d^2y}{dx^2} > 0$
    - Use gradients around the point
      - Input x values slightly above and below stationary point and calculate gradient

2.7 Simultaneous Equations

- Can be solved either by substitution or elimination
- Generally solved by substitution as follows:
  - Step 1: obtain an equation in one unknown and solve this equation
  - Step 2: substitute the results from step 1 into linear equation to find the other unknown
- The points of intersection of two graphs are given by the solution of their simultaneous equations

2.8 Inequalities

- Solve like equations
- Multiplying or dividing by negative ⇒ switch sign

$$\frac{y}{-3} \geq -7$$
$$y \leq -7 \times -3$$
$$y \leq 21$$

- When two inequalities present, split into two
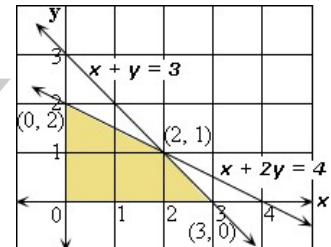
$$x < 3x - 1 < 2x + 7$$
$$x < 3x - 1 \qquad 3x - 1 < 2x + 7$$
$$x > -\frac{1}{2} \qquad x < 8$$

2.9 Linear Programming

- For strict inequalities ($<, >$) use broken line
- For non-strict inequalities ($\leq, \geq$) use solid line
- Steps to solve:
  - Interpret $y = mx + c$
  - Draw straight line graphs
  - Shade
  - Solve
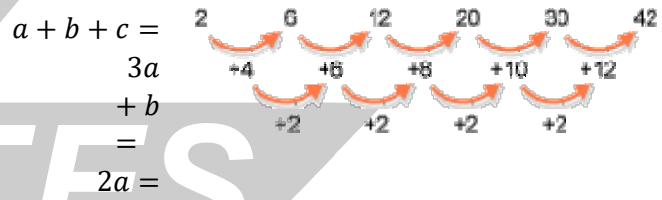
2.10 Sequences

- **Linear sequences:** Find common difference e.g. 3, then multiply by n and work out what needs to be added
- **Quadratic sequences:**
  - Format: $an^2 + bn + c$

$a + b + c =$
$3a$
$+ b$
$=$
$2a =$
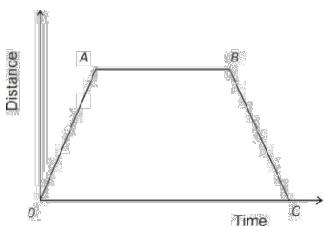
 - Work out the values and then place into formula to work out nth term formula

- **Geometric progression:** sequence where term has been multiplied by a constant to form next term
$$nth\ term\ of\ G.P. = ar^{(n-1)}$$
  - a = 1st term   r = common difference
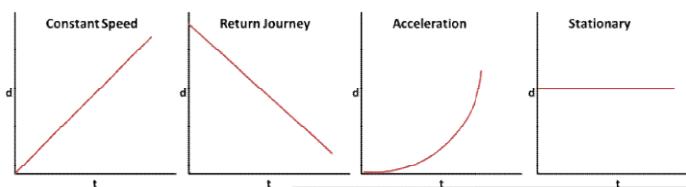
2.11 Distance-Time Graphs
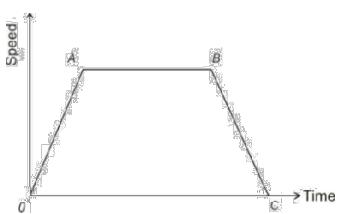
- From O to A: Uniform speed
- From B to C: Uniform speed (return journey)
- From A to B: Stationery (speed = 0)
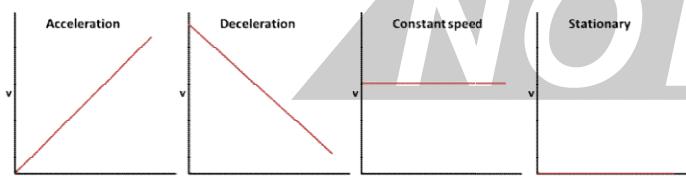
- Gradient = speed

2.12 Speed-Time Graphs

- From O to A: Uniform speed
- From A to B: Constant speed (acceleration = 0)
- From B to C: Uniform deceleration / retardation

- Area under a graph = distance travelled.
- Gradient = acceleration.
- If the acceleration is negative, it is called deceleration or retardation. (moving body is slowing down.)

2.13 Functions
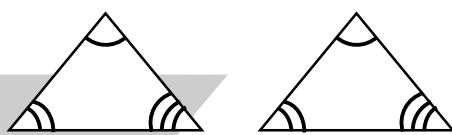
- **Function notation:**
  - $f: x \rightarrow 2x - 1$
  - Function f such that x maps onto $2x - 1$
- **Composite function:** Given two functions $f(x)$ and $g(x)$, the composite function of f and g is the function which maps x onto $f(g(x))$

- $f(2)$
  - Substitute $x = 2$ and solve for $f(x)$
- $fg(x)$
  - Substitute $x = g(x)$
- $f^{-1}(x)$
  - Let $y = f(x)$ and make x the subject

3. GEOMETRY
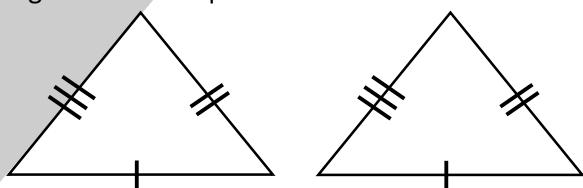
3.1 Similarity

- Similarity can be worked out by the AAA (Angle – Angle – Angle) rule.
- **AAA (Angle – Angle – Angle) rule:** All the corresponding angles of the triangles must be equal.

3.2 Congruence

- **SSS (Side – Side – Side) rule:** All the three sides of the triangles must be equal
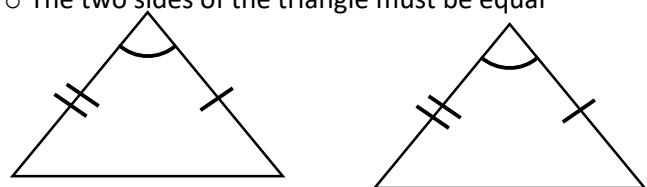
- **RHS (Right angle – Hypotenuse – Side) rule :**
  - There must two right-angled triangles
  - The length of the hypotenuses must be the same
  - One of the corresponding sides of each triangle must be the same
- **SAS (Side – Angle – Side) rule:**
  - There must be an angle and a side present
  - The angle of the adjacent sides must be equal
  - The two sides of the triangle must be equal
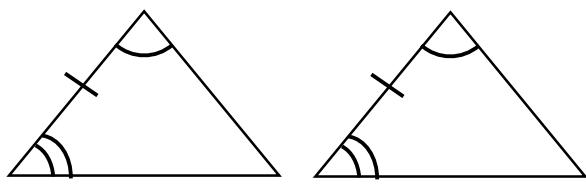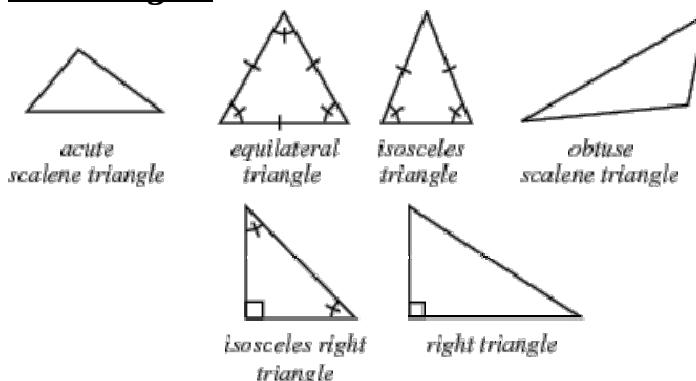
- **ASA (Angle – Side – Angle) rule:** The sides adjacent to the equal angles must be of the same length.

3.3 Triangles

acute
scalene triangle   equilateral triangle   isosceles triangle   obtuse scalene triangle

isosceles right triangle   right triangle

3.4 Quadrilaterals
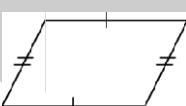
- **Rectangle:**
  - o Opposite sides parallel/equal
  - o all angles 90°
 - o diagonals bisect each other
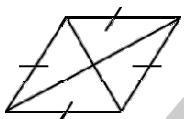
- **Parallelogram:**
  - o Opposite sides parallel/equal
  - o opposite angles equal
 - o diagonals bisect each other
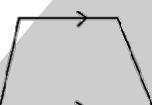
- **Rhombus:**
  - o A parallelogram with all sides equal
  - o opposite angles equal
  - o diagonals bisect each other
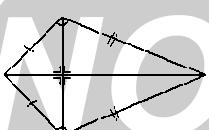
- **Trapezium:**
  - o One pair of sides parallel
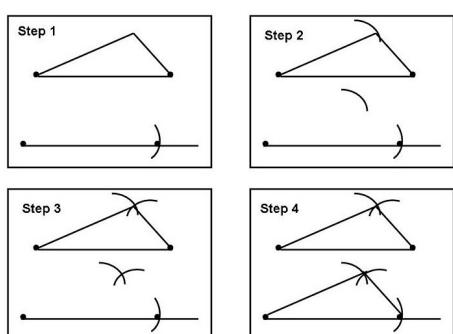
- **Kite:**
  - o Two pairs of adjacent sides equal
  - o diagonals are perpendicular to each other
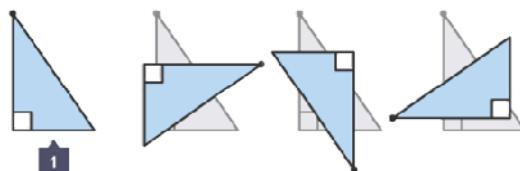
3.5 Construction

- **Constructing triangles:**

Step 1   Step 2

Step 3   Step 4

3.6 Symmetry

- **Line of symmetry**: Divides a two-dimensional shape into two congruent (identical) shapes
- **Plane of symmetry**: Divides a three-dimensional shape into two congruent solid shapes
- The number of times shape fits its outline during a complete revolution is called the order of **rotational symmetry**

Shape	Number of Lines of Symmetry	Rotational Symmetry Order
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

- **Properties of circles:**
  - o Equal chords are equidistant from the centre
  - o The perpendicular bisector of a chord passes through the centre
  - o Tangents from an external point are equal in length
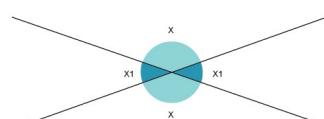
3.7 Polygons

- Sum of angles at a point =360°
- Angles on a straight line = 180°
- Sum of angles in a triangle =180°
- For regular polygon
  - o External angles $= \frac{360°}{n}$
  - o Internal angles $= 180° - \frac{360°}{n}$
- For irregular polygon:
  - o Sum of exterior angles =360°
 - o Sum of interior angles=180(n-2)
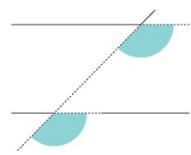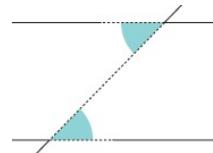
- Vertically opposite angles are equal
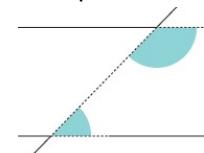
- Corresponding angles are equal
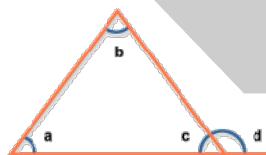
- Alternate angles
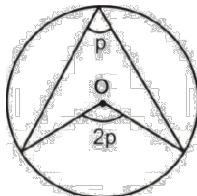
- Co-interior angles add up t0 180°
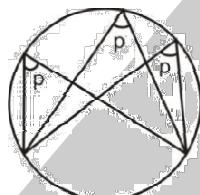
- Exterior angle=sum of interior opposite ∠
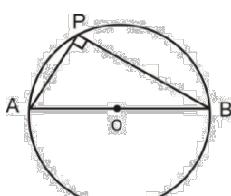
3.8 Circle Theorem
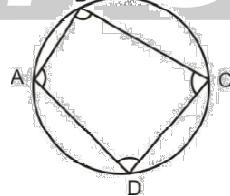
Angle at center = twice angle on circumference
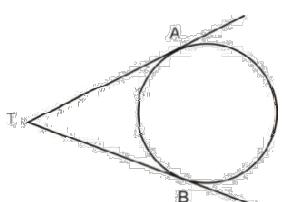
Angle subtended by same arc at circumference are equal
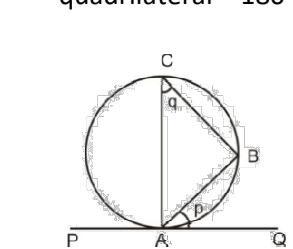
Angles in semicircleare 90°

Opposite angles in a cyclic quadrilateral = 180°

Tangents from one point are equal. ∠ between tangent and radius is 90°

Alternate segment theorem

4. MENSURATION

4.1 Area
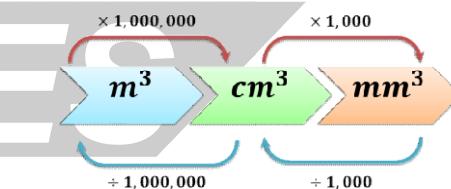
- Parallelogram $= b \times h$ OR $ab \sin \theta$
- Triangle$= \frac{1}{2} b \times h$
- Trapezium$= \frac{1}{2}(a + b)h$
- Circle$= \pi r^2$
- Sector$= \pi r^2 \times \frac{\theta}{360}$

## 4.2 Volume and Surface Area
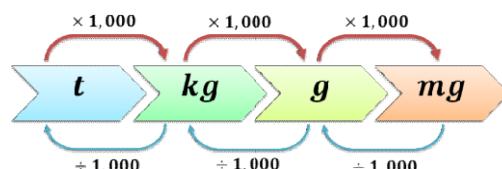
- Cuboid
  - $Surface\ area = 2lw + 2hl + 2hw$
  - $Volume = hlw$
- Cylinder
  - $Curved\ surface\ area = 2\pi rh$
  - $Volume = \pi r^2 h$
- Cone
  - $Curved\ surface\ area = \pi rl$
  - $Volume = \frac{1}{3}(\pi r^2 h)$
- Sphere
  - $Surface\ area = 4\pi r^2$
  - $Volume = \frac{4}{3}\pi r^3$
- Hemisphere
  - $Surface\ area = 2\pi r^2$
 - $Volume = \frac{2}{3}\pi r^3$

4.3 Units

- **Volume:**

$\times 1,000,000$ $\times 1,000$

m^3 cm^3 mm^3

$\div 1,000,000$ $\div 1,000$

- **Mass:**

$\times 1,000$ $\times 1,000$ $\times 1,000$

t kg g mg

$\div 1,000$ $\div 1,000$ $\div 1,000$

- **Capacity:**

$\times 1,000$ $\times 1,000$ $\times 1,000$

kl l cl ml

$\div 1,000$ $\div 1,000$ $\div 1,000$
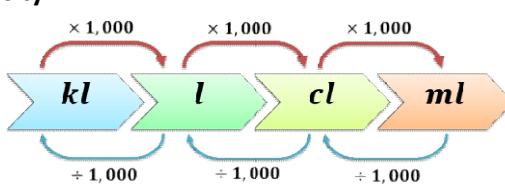
- **Connecting volume and capacity:**

  o $1 ml = 1 cm^3$

  o $1 kl = 1 m^3$

- **Density** $= \dfrac{Mass}{Volume}$

# 5. COORDINATE GEOMETRY
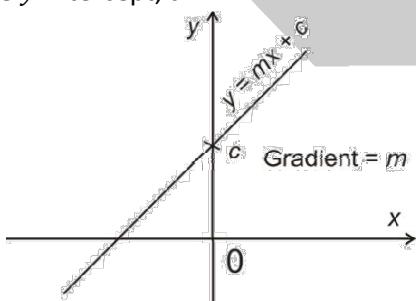
5.1 Graphs
- **Gradient of a Straight Line:**
$$Gradient = \frac{y_2 - y_1}{x_2 - x_1}$$

- **Equation of Line:**
$$y = mx + c$$
 o Find the gradient, m
  o Find the y-intercept, c
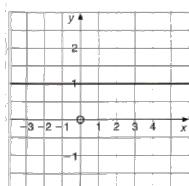
- **Midpoint of Graph:**
$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$
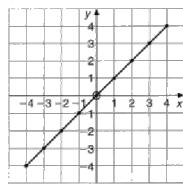
- **Length between two points:**
$$\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$
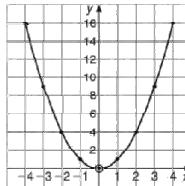
5.2 Sketching Graphs
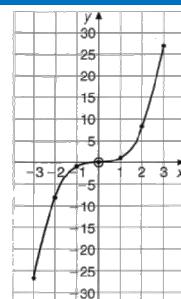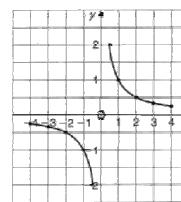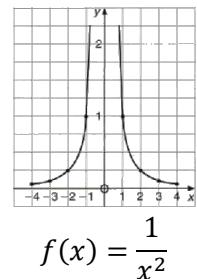
$f(x) = 1$ $f(x) = x$ $f(x) = x^2$


$f(x) = x^3$ $f(x) = \dfrac{1}{x}$ $f(x) = \dfrac{1}{x^2}$
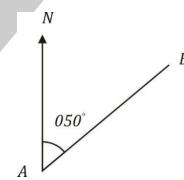
6. TRIGONOMETRY

6.1 Bearings
- **The bearing of a point B from another point A is:**
  o An angle measured from the north at A.
  o In a clockwise direction.
  o Written as three-figure number (i.e. from 000 ° to 360°)
- e.g. The bearing of B from A is 050°
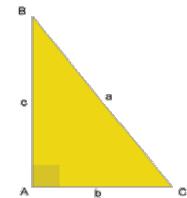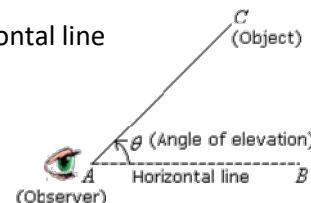
6.2 Pythagoras Theorem
- To find hypotenuse
  o $a^2 + b^2 = c^2$
- To find one of the shorter sides
 o $a^2 = c^2 - b^2$
  o $b^2 = c^2 - a^2$
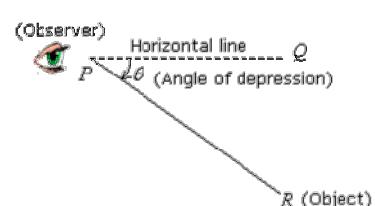
- **Angle of elevation:**
  o Angle above the horizontal line

- **Angle of depression:**
  o Angle below the horizontal line.
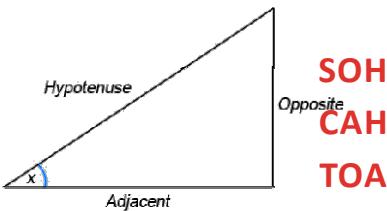
- **Area of a triangle:** $\dfrac{1}{2} ab \sin c$

6.3 Ratios
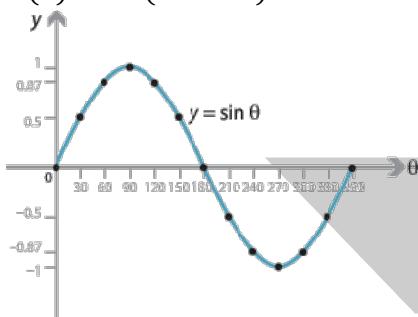
- **Right angled triangles:**
  - $\sin x = \frac{opposite}{hypotenuse}$
  - $\cos x = \frac{adjacent}{hypotenuse}$
  - $\tan x = \frac{opposite}{adjacent}$

SOH
CAH
TOA
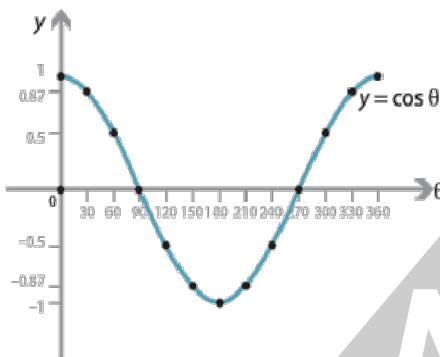
## 6.4 Graphs of simple trigonometric functions
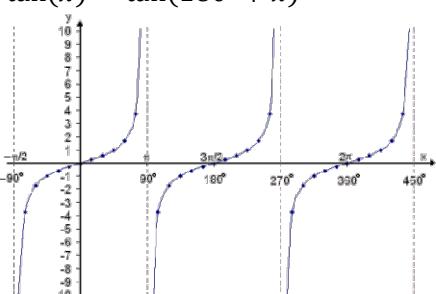
- $\sin(x) = \sin(180 - x)$

- $\cos(x) = \cos(360 - x)$

- Sine and cosine shifted by 90°
- Sine has x-intercepts at multiples 180°, and cosine at (90° + multiples of 180°)

- $\tan(x) = \tan(180° + x)$

- Goes to infinity at 90°, 270°, 450°, …
- Has x-intercepts at multiples of 180°

6.5 Sine & Cosine Rules

- **Sine rule:**

$$\frac{a}{\sin a} = \frac{b}{\sin b} = \frac{c}{\sin c}$$

- **Cosine rule**
  - To find the angle given 3 sides

$$\cos a = \frac{b^2 + c^2 - a^2}{2bc}$$

  - To find side given angle and two sides
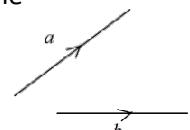
$$a^2 = b^2 + c^2 - 2bc \cos a$$

7. VECTORS & TRANSFORMATIONS

7.1 Vectors

- **Vector quantity** has both magnitude and direction
  - E.g. Vectors a and b represented by the line segments, can be added using 'parallelogram rule' or 'nose-to-tail method'
- **Multiplication by a scalar:**
  - **Scalar quantity:** has a magnitude but <u>no</u> direction
  - The negative sign reverses the direction of the vector
- **Column vector:**
  - Top number = horizontal component
  - Bottom number = vertical component $\begin{pmatrix} x \\ y \end{pmatrix}$
- **Parallel vectors:**
  - Vectors are parallel if they have the same direction
  - In general, the vector $k\begin{pmatrix} a \\ b \end{pmatrix}$ is parallel to $\begin{pmatrix} a \\ b \end{pmatrix}$
- **Modulus of a vector:**
  - In general, if $x = \begin{pmatrix} m \\ n \end{pmatrix}$, $|x| = \sqrt{(m^2 + n^2}$

7.2 Transformation

- **Reflection (M):**
  - When describing a reflection, the position of the mirror line is essential
- **Rotation (R):**
  - To describe a rotation, the centre of rotation, the angle of rotation and direction of rotation are required
  - A clockwise rotation is negative, and an anticlockwise rotation is positive
- **Translation (T):**
  - When describing a translation, it is necessary to give the translation vector $\begin{pmatrix} x \\ y \end{pmatrix}$

• **Enlargement (E):**
  o To describe an enlargement, state the scale factor, K and the centre of enlargement

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

$$Area\ of\ image = K^2 \times area\ of\ object$$

  o If K > 0, both object and image lie on same side of the centre of enlargement
  o If K < 0, object and image lie on opposite side of the centre of enlargement

8. PROBABILITY

• Probability is the study of chance, or the likelihood of an event happening

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

• If probability = 0, event is impossible
• If probability =1, event is certain to happen
• All probabilities lie between 0 and 1
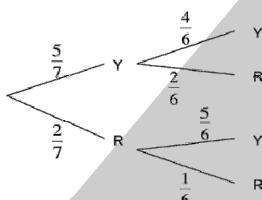
8.1 Events

Exclusive events:
• Two events are exclusive if they cannot occur at the same time
• **The OR Rule:**
  o For exclusive events A and B
 o P(A or B) = P(A) + P(B)

Independent events:
• Two events are independent if occurrence of one is unaffected by occurrence of other
• **The AND Rule:**
  o P(A and B) = P(A) × P(B)
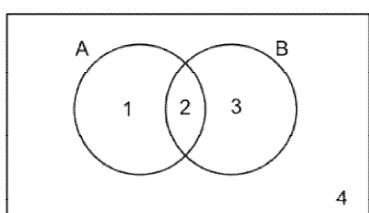
8.2 Conditional Probability

• Probability of an event (A), given that another (B) has already occurred [Symbol: P(A|B)]

P (A | B) is A *given* B
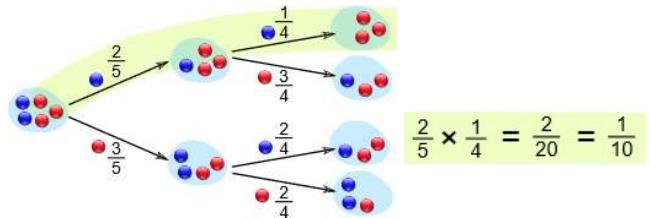
$$P(A|B) = \frac{P(A \cap B)}{P(B)} = \frac{2}{2+3} = \frac{2}{5}$$

• Calculate using Venn diagram:

  o Construct the Venn diagram, using sample space of both events
  o P(A|B) = P(A ∩ B) / P(B)
• Calculate using tree diagrams:

$$\frac{2}{5} \times \frac{1}{4} = \frac{2}{20} = \frac{1}{10}$$

  o Construct tree diagram.
  o Write the outcomes of the first event, connecting them to each outcome of the second event. Write probability on top of each event's line
  o Multiply probabilities on the lines to the required outcome
  o Note: The probabilities reduce with each step if objects are replaced
• Calculate using two-way tables:
  o Column and row headers are the sample space of the two events
  o Fill in each cell with the correct number of outcomes
  o Take the required number from the table and divide by the sum of all values in the row/column of the condition provided.
• Remember: P(A|B) and P(B|A) are not the same
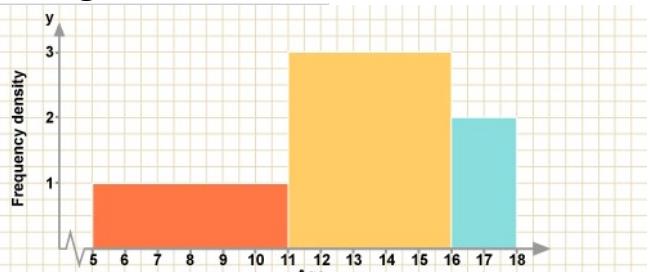
9. STATISTICS

9.1 Histograms

• **Histogram**: Displays frequency of either continuous or grouped discrete data in the form of bars
• Bars are joined together and may be of varying width
• Frequency of the data is represented by the area of the bar and not the height
• When class intervals are different, area of the bar represents the frequency, not the height
• Frequency density plotted on y-axis, not frequency
• **Class width** = Interval
• **Frequency density** = Height

$$Frequency = Class\ width \times Frequency\ density$$

9.2 Averages

- **Mean:**

$$\frac{Sum \ of \ values}{number \ of \ values}$$

- **Median:**
  - The middle value - when the data has been written in ascending or descending order
  - Odd no. of values $\frac{5+1}{2} = 3rd \ value$
  - Even no. of values $\frac{6+1}{2} = 3.5th \ value$
    (add two values divide by 2)
- **Mode:**
  - Most frequently occurring value
- **Range:**
  - Difference between highest and lowest values

- **Estimated mean of grouped data:**
  - Work out midpoints of each group and multiply by frequency
  - Divide by number of values
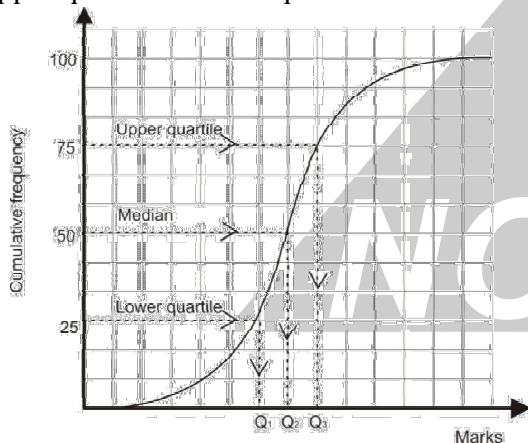
9.3 Cumulative Frequency

- Cumulative frequency is the total frequency up to a given point
- Inter-quartile range
 = upper quartile − lower quartile
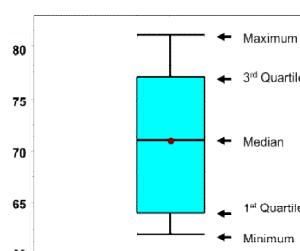
9.4 Box-and-whisker plots
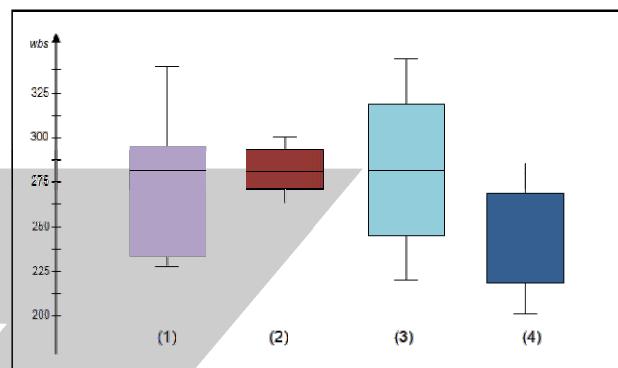
- Construction
  - Find median and two quartiles
  - Draw three lines of equal width along these values
  - Complete the boxes
  - Draw 'whiskers' extending from the box to the maximum and minimum values, draw two more lines at the ends


- Interpretation:
  - Median, quartiles and extreme values can be found by reading on the scale on the y-axis
  - Short boxes mean low IQR and vice versa (2), (3)
  - Long whiskers mean a lot of extreme values and vice versa (1)
  - Difference in position of boxes represents if data in one set is overall higher or lower than another data set. (3) and (4)
  - Variation in lengths of different sections and position of median show how evenly the data is spread, compared to other data sets (1)

9.5 Pie Charts

- Sectors represent data, and these sectors form a circle.
- Angle of a sector:

$$\theta = \frac{Number \ of \ an \ item}{Total \ number \ of \ items} \times 360°$$

- Sum of angles in a pie chart is $360°$

9.6 Stem and Leaf diagrams
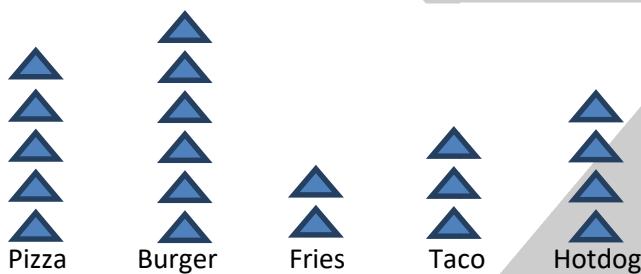
- Stem-and-Leaf diagram is a quick way of summarizing a range of data.
- There is a column known as the stem, contains which contains unique elements of data formed by removing last digits of the data.
- Keys are used in this diagram

stem	leaf
0	1, 1, 2, 2, 3, 4, 4, 4, 4, 5, 8
1	0, 0, 0, 1, 1, 3, 7, 9
2	5, 5, 7, 7, 8, 8, 9, 9
3	0, 1, 1, 1, 2, 2, 2, 4, 5
4	0, 4, 8, 9
5	2, 6, 7, 7, 8
6	3, 6

Key: 6|3 = 63 years old

9.7 Pictograms
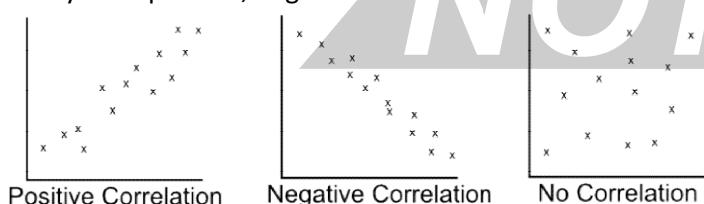
- Data is represented in pictures
- A key is given to represent the value of a picture.

E.g. ▲ = 5 people

Pizza   Burger   Fries   Taco   Hotdog
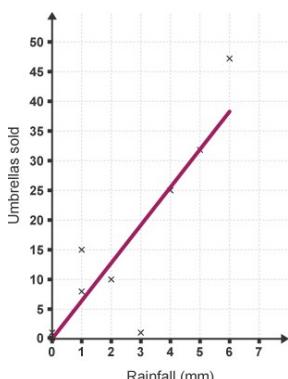
Favorite Fast Food of 100 Children

9.8 Scatter Diagrams

- Displays the correlation between two sets of data
- May have positive, negative or no correlation

Positive Correlation   Negative Correlation   No Correlation

- Line of best fit drawn through points that has an equal number of points on each side to show the trend

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