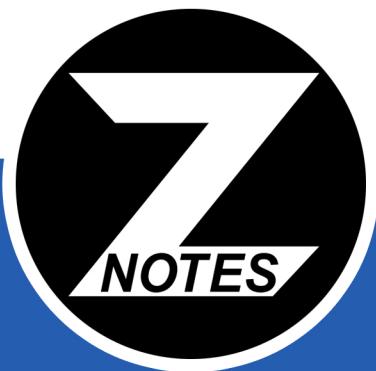


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Updated to 2019 Syllabus

CIE IGCSE MATHS 0580

SUMMARIZED NOTES ON THE EXTENDED SYLLABUS

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NOTES

1. NUMBER

- Natural numbers:**

- o used for counting purposes
- o made up off all possible rational & irrational numbers

- Integer:** a whole number

- Prime numbers:**

- o divisible only by itself and one
- o 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

- Square numbers:** A number which is equivalent to a rational number multiplied by itself

- Common factors:** Common divisors of a number

- Common multiples:** Multiples of two or more numbers that are the same.

- Real numbers:** A number that lies on the number line.

- Converting recurring numbers to fractions.

$$45.342342\dots$$

$$x = 45.342342\dots$$

$$1000x = 45342.342\dots$$

$$\begin{aligned} \therefore 1000x - x &= 45342.342\dots - 45.342\dots \\ &\quad 45342.342\dots \\ &\quad \underline{-45.342\dots} \\ &45297.000 \end{aligned}$$

$$999x = 45297$$

$$x = \frac{45297}{999}$$

$$\therefore 45.342\dots = \frac{45297}{999}$$

1.1 Order of Operations:

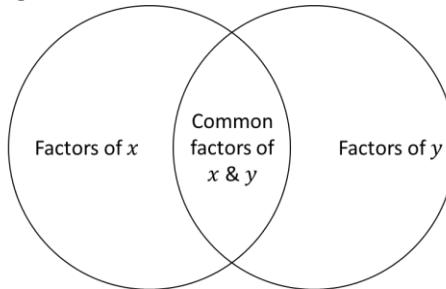
- Expressions have to be evaluated in the following order:

- o The contents of brackets
- o Any exponents
- o Division
- o Multiplication
- o Addition
- o Subtraction

- Note: If items of the same precedence are present, evaluate from left to right.

1.2 HCF and LCM

- Highest Common Factor and Lowest Common Multiple:**



- o HCF = product of common factors of x and y

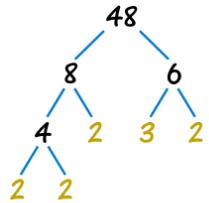
- o LCM = Lowest common multiple

$$LCM(x, y) = \frac{x \times y}{HCF(x, y)}$$

- Prime Factorization:** finding which

- prime numbers

- o multiply together to make the original number



$$48 = 2 \times 2 \times 2 \times 2 \times 3$$

1.3 Sets

- Definition of sets e.g.**

- o $A = \{x: x \text{ is a natural number}\}$
- o $B = \{(x, y): y = mx + c\}$
- o $C = \{x: a \leq x \leq b\}$
- o $D = \{a, b, c, \dots\}$

Notation:

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

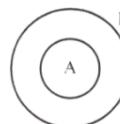
Set representations:



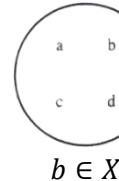
$A \cap B$ is shaded



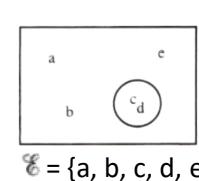
$A \cup B$ is shaded



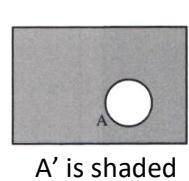
A is a subset of B



$b \in X$



$E = \{a, b, c, d, e\}$



A' is shaded

1.4 Ordering Quantities by Magnitude

$A = B$	A is equal to B
$A \neq B$	A is not equal to B
$A > B$	A is greater than B
$A < B$	A is lesser than B/ B is greater than A
$A \geq B$	A is greater than or equal to B/ B is lesser than or equal to A
$A \leq B$	A is lesser than or equal to B/ B is greater than or equal to A

o Note:

$$\text{Upper Bound of } a + b = UB(a) + UB(b)$$

$$\text{Lower Bound of } a + b = LB(a) + LB(b)$$

$$\text{Upper Bound of } a - b = UB(a) - LB(b)$$

$$\text{Lower Bound of } a - b = LB(a) - UB(b)$$

$$\text{Upper Bound of } a \times b = UB(a) \times UB(b)$$

$$\text{Lower Bound of } a \times b = LB(a) \times LB(b)$$

$$\text{Upper Bound of } \frac{a}{b} = \frac{UB(a)}{LB(b)}$$

$$\text{Lower Bound of } \frac{a}{b} = \frac{LB(a)}{UB(b)}$$

1.5 Indices

$$\begin{aligned}x^{\frac{1}{2}} &= \sqrt{x} \\x^{\frac{1}{n}} &= \sqrt[n]{x} \\x^a \times x^b &= x^{a+b} \\ \frac{x^a}{x^b} &= x^{a-b} \\x^{ab} &= x^{a \times b}\end{aligned}$$

Standard form:

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

Any number can be expressed in standard form if written in this format:

$$A \times 10^n \quad \text{such that } 1 \leq n < 10$$

Limits of accuracy:

- The degree of rounding of a number
 - o E.g. 2.1 to 1 d.p. $2.05 \leq x < 2.15$
- **Upper and lower bounds**
 - o Given the accuracy to which a figure is given to, the original value which the arrived value is reached can be found.
 - o If 5.4 to correct to 2 d.p, the original number could be anywhere between 5.35 to 5.45
- **Therefore:**
 - Upper Bound of 5.4 = 5.45
 - Lower Bound of 5.4 = 5.35

1.6 Ratio & Proportion

- **Ratio:** used to describe a fraction
 - o e.g. 3 : 1
- **Foreign exchange:** money changed from one currency to another using proportion
 - o E.g. Convert \$22.50 to Dinars

$$\begin{aligned} \$1 &: 0.30\text{KD} \\ \$22.50 &: 6.75\text{KD} \end{aligned}$$
- **Map scales:** using proportion to work out map scales
 - o 1km = 1000m
 - o 1m = 100cm
 - o 1cm = 10mm
- **Direct variation:** y is directly proportional to x

$$y \propto x \quad y = kx$$
- **Inverse variation:** y is inversely proportional to x

$$y \propto \frac{1}{x} \quad y = \frac{k}{x}$$

1.7 Percentages

- **Percentage:**
 - o Convenient way of expressing fractions as a part of a whole- considered 100
 - o Percent means per 100
- **Percentage increase or decrease:**

$$\text{Percentage increase} = \frac{\text{Actual Increase}}{\text{Original Amount}}$$
- **Simple interest:**

$$I = \frac{PRT}{100}$$

$P = \text{Principal}, R = \text{Rate of Interest (as a number)}, T = \text{Period of Time}$
- **Compound interest:**

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

$P = \text{Principal}, R = \text{Rate of Interest as a number}, n = \text{Period of Time}$

1.8 Speed, Distance & Time

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

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

- Units of speed: km/hr m/s

- Units of distance: km m

- Units of time: hr sec

$$\frac{1\text{km}}{\text{hr}} \times \frac{1\text{hr}}{60\text{ min}} \times \frac{1\text{min}}{60\text{ s}} \times \frac{1000\text{m}}{\text{km}} = \frac{1000}{3600} \frac{\text{m}}{\text{s}} = \frac{5}{18} \frac{\text{m}}{\text{s}}$$

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:

$$x^2 + 14x + 24 \\ x^2 + 12x + 2x + 24 \\ x(x + 12) + 2(x + 12) \\ (x + 2)(x + 12)$$

- Full square:

$$x^2 + 2xy + y^2 \\ x^2 + xy + xy + y^2 \\ x(x + y) + y(x + y) \\ (x + y)(x + y) \\ (x + y)^2$$

2.2 Quadratic Factorization

- General equation:

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

- Solve quadratics by:

 - Trinomial factorization: Get equation from:

$$ax^2 + bx + c$$

To

$$\left(x + \frac{b}{2a}\right)^2 + \frac{c}{a} - \frac{b^2}{4a^2}$$

Then, solve for x.

 - Quadratic formula

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

- When question says "give your answer to two decimal places", use formula!

2.3 Simultaneous Equations

- Simultaneous linear equations can be solved either by substitution or elimination

- Simultaneous linear and non-linear equations are 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 the linear equation to find the other unknown

- Elimination:

$$2a + b = 10 \\ 2b + a = 11$$

$$2a + b = 10 \\ 2(a + 2b) = 11(2)$$

$$2a + b = 10 \\ 2a + 4b = 22$$

$$2a + b - (2a + 4b) = 10 - 22 \\ b = 4$$

$$2a + 4 = 10 \\ \therefore a = 3$$

- The points of intersection of two graphs are given by the solution of their simultaneous equations

2.4 Inequalities

- Solve like equations
- Multiplying or dividing by negative \Rightarrow switch sign

$$\frac{y}{-3} \geq -7$$

$$y \leq -7 \times -3$$

$$y \leq 21$$

- When two inequalities present, split into two

$$x < 3x - 1 < 2x + 7$$

$$x < 3x - 1 \quad 3x - 1 < 2x + 7$$

$$x > -\frac{1}{2} \quad x < 8$$

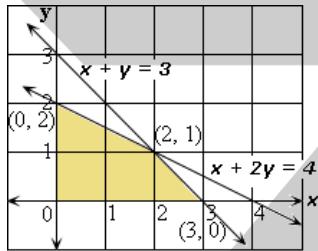
$$-\frac{1}{2} < x < 8$$

2.4 Linear Programming

- For strict inequalities ($<$, $>$) use broken line
- For non-strict inequalities (\leq , \geq) use solid line

Steps to solve:

- Interpret in the form $y = mx + c$
- Draw straight line graphs
- Shade the unwanted region- after all the inequalities are plotted the end the non-shaded region will be the solution.

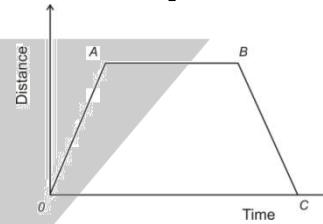


2.5 Sequences

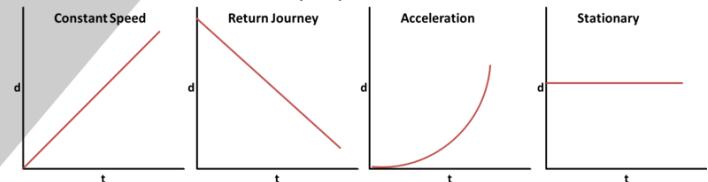
- Linear sequences:** Where a pattern in the members of a sequence is in the first level difference between the terms.
 - General equation:** $an + b$
- Quadratic sequences:** Where a pattern in the members of a sequence is in the second level difference between the terms.
 - General equation:** $an^2 + bn + c$
- Cubic sequences:** Where a pattern in the members of a sequence is in the third level difference between the terms.
 - General equation:** $an^3 + bn^2 + cn + d$

- Finding the n^{th} term of a sequence.
 - Equate the general equation to the actual terms in a sequence by substituting n with the term number.
 - Equate the difference in the sequence's general equation to the difference in the terms of the actual sequence
 - Substitute the variables into the following formula
- $U_n = \text{GENERAL EQUATION}$
- Geometric progression:** sequence where term has been multiplied by a constant to form next term
 - $n^{\text{th}} \text{ term of G.P.} = ar^{(n-1)}$
 - $a = 1^{\text{st}}$ term $r = \text{common difference}$

2.6 Distance-Time Graphs

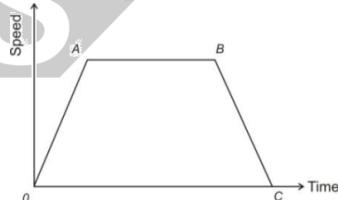


- From O to A : Uniform speed
- From B to C : Uniform speed (return journey)
- From A to B : Stationery (speed = 0)

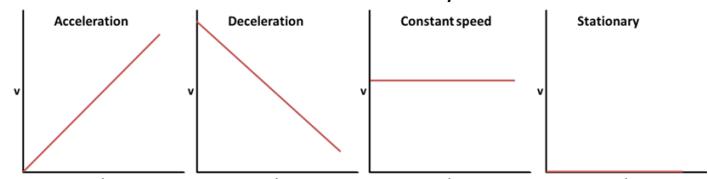


$$\text{Gradient} = \text{speed} = \frac{\Delta d}{\Delta t}$$

2.7 Speed-Time Graphs



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



- Area under a graph = distance travelled.
- Gradient = acceleration = $\frac{\Delta v}{\Delta t}$

2.8 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 $f(g(x))$

- $f(2)$

- Solve for $f(x)$ when $x = 2$

- $f(g(x))$

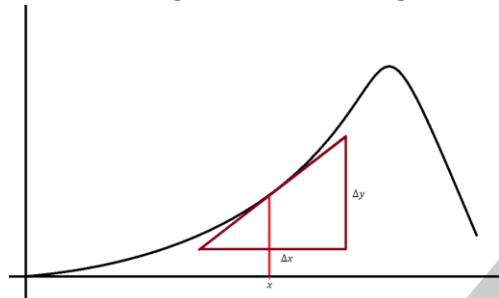
- Solve for $f(g(2))$
- Solve for $g(x)$ when $x = 2$ and solve for $f(x)$ when $x = g(x)$

- $f^{-1}(x)$

- Let $y = f(x)$ and make x the subject, and then change y to x and change x to $f^{-1}(x)$

2.9 Gradient at a point on a curve

- Draw tangent to the specified x point on the curve.
- Calculate the gradient of the tangent.



$$\text{Gradient at } x = \frac{\Delta y}{\Delta x}$$

3. GEOMETRY

- **Point:** A single spot

- **Parallel:** (in reference to lines and curves) When the corresponding points on two or more lines/curves are a constant distant apart, the two or more lines/curves are parallel.

- **Bearing:** The direction given in as an angle one point/object is as compared to another.

- Measured from the top- clockwise



B is at a bearing of 030° from A

- **Right Angle:** The angle formed at the intersection of two lines at 90°

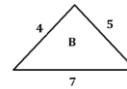
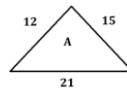
- **Acute:** An angle lesser than 90°

- **Obtuse:** An angle greater than 90° and less than 180°

- **Reflex Angles:** $360^\circ - \theta$ and θ are reflex angles. The angle formed on the opposite side of θ

- **Perpendicular:** Lines that meet at 90°

- **Similarity:** When two figures' corresponding sides are proportional and corresponding angles equal



$$\Delta A \sim \Delta B, S_f = \frac{1}{3}$$

ΔA is similar to ΔB , Scale factor = $\frac{1}{3}$

- **Scale Factor:** The constant sides in similar shapes are proportional by.

- **Scale Factor² = Area Factor** = The constant the area in similar shapes are proportional by.

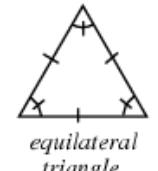
- **Scale Factor³ = Volume Factor** = The constant the volume in similar shapes are proportional by.

- **Congruent:** When 2 figures have exactly the same dimensions and angles

3.1 Triangles



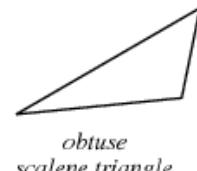
acute
scalene triangle



equilateral
triangle



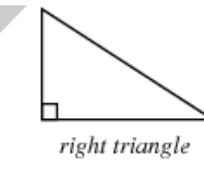
isosceles
triangle



obtuse
scalene triangle



isosceles right
triangle



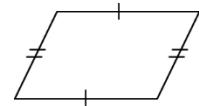
right triangle

3.2 Quadrilaterals

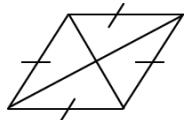
- **Rectangle:** Opposite sides parallel and equal, all angles 90° , diagonals bisect each other.



- **Parallelogram :** Opposite sides parallel and equal, opposite angles equal, diagonals bisect each other



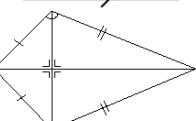
- Rhombus:** A parallelogram with all sides equal, opposite angles equal, diagonals bisect each other



- Trapezium:** One pair of sides parallel

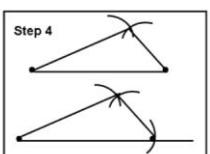
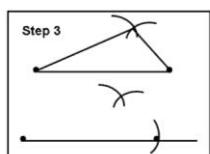
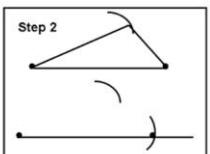
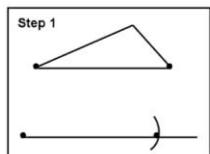


- Kite:** Two pairs of adjacent sides equal, diagonals meet at right angles bisecting one of them

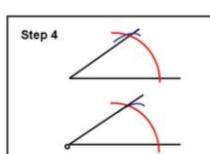
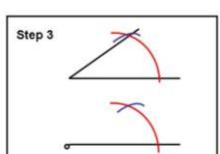
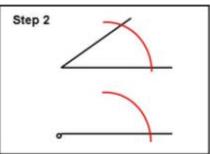
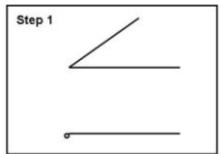


3.3 Construction

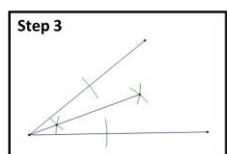
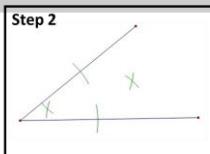
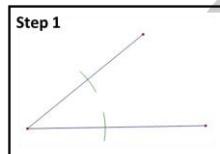
- Constructing triangles:



- Perpendicular bisector:

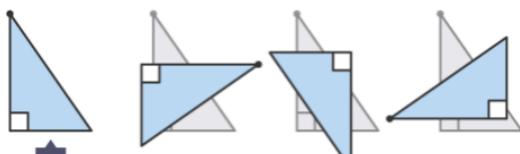


- Angle bisector:



3.4 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.
- 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

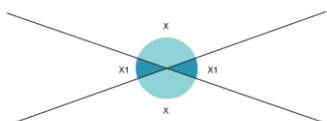
Square	4	4
Rectangle	2	2
Parallelogram	0	2
Rhombus	2	2
Trapezium	0	1
Kite	1	1
Equilateral	3	3
Triangle		
Regular Hexagon	6	6

• Properties of circles:

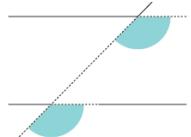
- Equal chords are equidistant from the centre
- The perpendicular bisector of a chord passes through the centre
- Tangents from an external point are equal in length

3.5 Polygons

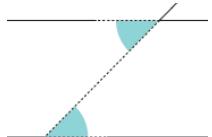
- Sum of angles at a point = 360
- Angles on a straight line = 180
- Sum of angles in a triangle = 180
- For regular polygon
 - External angles = $\frac{360}{n}$
 - Internal angles = $180 - \frac{360}{n}$
- For irregular polygon:
 - Sum of exterior angles = 360
 - Sum of interior angles = $180(n-2)$
- Vertically opposite angles are equal



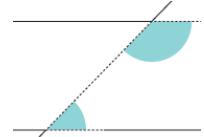
- Corresponding angles are equal



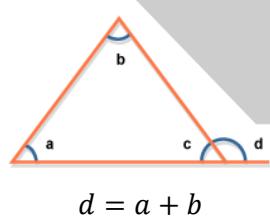
- Alternate angles are equal



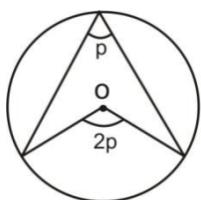
- Co-interior angles are supplementary



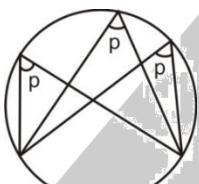
- Exterior angle = sum of interior opposite \angle



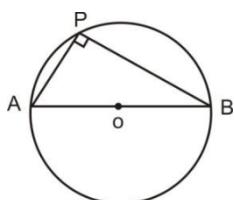
3.6 Circle Theorem



Angle at centre = twice angle on circumference



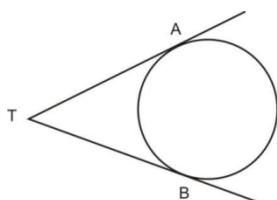
Angle subtended by same arc at circumference are equal



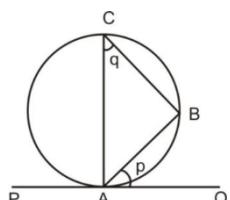
Angles in semicircle are 90°



Opposite angles in a cyclic quadrilateral add to 180°



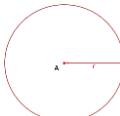
Tangents from one point are equal \angle between tangent and radius is 90°



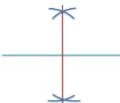
Alternate segment theorem
 $q=p$

3.7 Loci

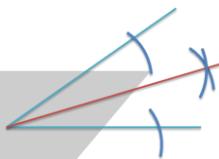
- The locus of points equidistant from a given point is a circle



- The locus of points equidistant from 2 points is the perpendicular bisector of a line connecting them.



- The locus of points equidistant from two given intersecting straight lines.



- The locus of points at a given distance from a straight line



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 = πr^2
- Sector = $\pi r^2 \times \frac{\theta}{360}$

4.2 Volume and Surface Area

- Regular Prism:

o Volume = Area of crosssection \times Height

- Cylinder

o Curved surface area = $2\pi rh$

o Volume = $\pi r^2 h$

- Cone

o Curved surface area = πrl

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

- Sphere

o Surface area = $4\pi r^2$

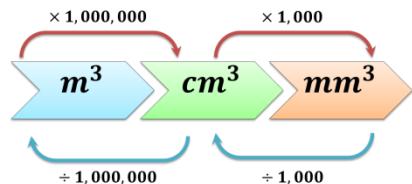
o Volume = $\frac{4}{3}\pi r^3$

• Hemisphere

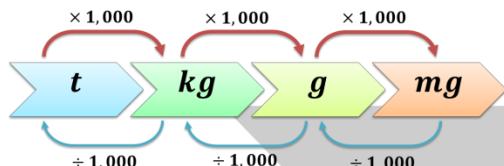
- Curved Surface area = $2\pi r^2$
- Volume = $\frac{2}{3}\pi r^3$

4.3 Units

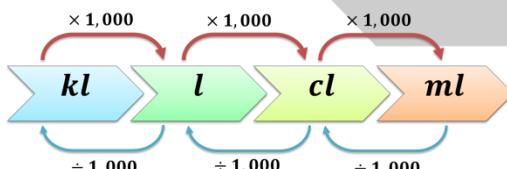
• Volume:



• Mass:



• Capacity:



• Connecting volume and capacity:

- $1ml = 1cm^3$
- $1kl = 1m^3$

$$\bullet \text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

5. COORDINATE GEOMETRY

5.1 Graphs

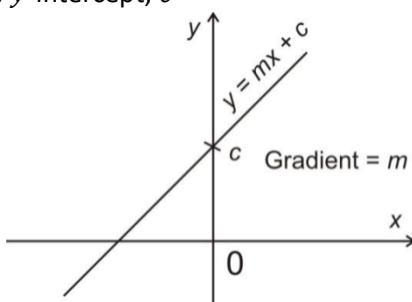
• Gradient of a Straight Line:

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

• Equation of Line:

$$y = mx + c$$

- Find the gradient, m
- Find the y -intercept, c



• Midpoint of Graph:

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

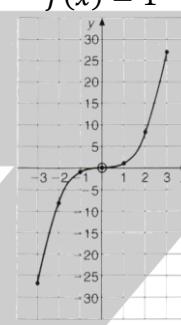
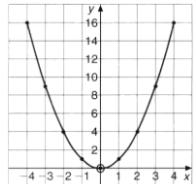
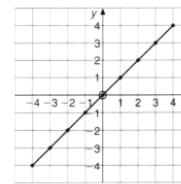
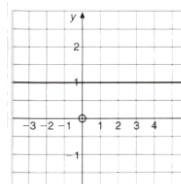
Where (x_1, y_1) is one end and (x_2, y_2) is the other end

• Length between two points:

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

Where (x_1, y_1) is one point and (x_2, y_2) is the other point

5.2 Sketching Graphs



$$f(x) = \frac{1}{x}$$

$$f(x) = \frac{1}{x^2}$$

• The gradient of 2 parallel lines are the same.

• The gradient of 2 perpendicular lines are negative inverses of each other

$$m_1 = -(m_2)^{-1}$$

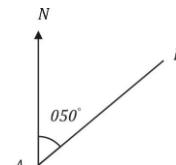
6. TRIGONOMETRY

6.1 Bearings

• The bearing of a point B from another point A is:

- An angle measured from the north at A.
- In a clockwise direction.
- Written as three-figure number (i.e. from 000° to 360°)

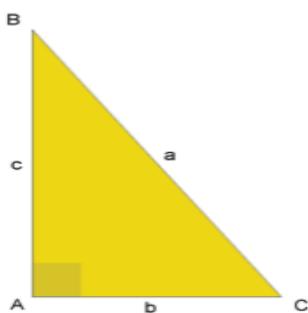
• e.g. The bearing of B from A is 050°



6.2 Pythagoras Theorem

- To find hypotenuse

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

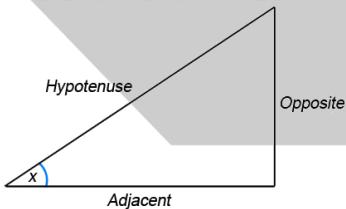


6.3 Ratios

- Right angled triangles:

- $\sin x = \frac{\text{opposite}}{\text{hypotenuse}}$
- $\cos x = \frac{\text{adjacent}}{\text{hypotenuse}}$
- $\tan x = \frac{\text{opposite}}{\text{adjacent}}$

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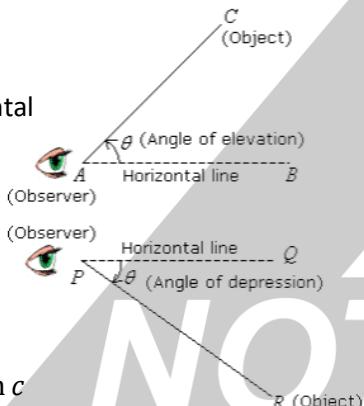
- Angle of elevation:

- Angle above the horizontal line.

- Angle of depression:

- Angle below the horizontal line.

- Area of a triangle: $\frac{1}{2}ab \sin c$



6.4 Sine & Cosine Rules

- Sine rule:

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

- One pair of information needed

- Cosine rule

- To find the angle given 3 sides

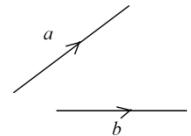
$$\cos a = \frac{b^2 + c^2 - a^2}{2bc}$$

- To find side given angle and two sides

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

7. MATRICES & TRANSFORMATION

7.1 Vector



- A vector quantity has both magnitude and direction.

- E.g. Vectors a and b represented by the line segments can be added using the parallelogram rule or the nose-to-tail method.

- Multiplication by a scalar:

- A scalar quantity has a magnitude but no direction
- The negative sign reverses the direction of the vector

- Column vector:

- Top number is the horizontal component and bottom number is the 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 $\begin{pmatrix} a \\ b \end{pmatrix}$

- Magnitude of a vector:

- In general, if $x = \begin{pmatrix} m \\ n \end{pmatrix}$, $|x| = \sqrt{(m^2 + n^2)}$

7.2 Matrices

- Addition:

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix} + \begin{pmatrix} p & q \\ r & s \end{pmatrix} = \begin{pmatrix} a+p & b+q \\ c+r & d+s \end{pmatrix}$$

- Multiplication by scalar

$$k \begin{pmatrix} a & b \\ c & d \end{pmatrix} = \begin{pmatrix} ka & kb \\ kc & kd \end{pmatrix}$$

- Multiplication by vector:

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix} \times \begin{pmatrix} p & q \\ r & s \end{pmatrix} = \begin{pmatrix} ap + br & aq + bs \\ cp + dr & cq + ds \end{pmatrix}$$

- You can only multiply if no. of columns in left equals to no. of rows in right

• Determinant:

- Determinant = leading diagonal – secondary diagonal

$$A = \begin{pmatrix} a & b \\ c & d \end{pmatrix} \quad |A| = (ad) - (bc)$$

• Inverse:

- To work out inverse, switch leading diagonal, negate secondary diagonal, multiply by $\frac{1}{|a|}$

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

• The zero matrix $\begin{pmatrix} 0 & 0 \\ 0 & 0 \end{pmatrix}$

- A matrix multiplied by its inverse is the zero matrix

7.3 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):

- To describe an enlargement, state the scale factor, K and the centre of enlargement

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

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

- If $K > 0$, both object and image lie on same side of the centre of enlargement.
- If $K < 0$, object and image lie on opposite side of the centre of enlargement.
- If the absolute value of K is greater than 0 and lesser than 1, the image is smaller than the object.

7.4 Transformation by Matrices**• Reflection:**

- $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$ Reflection in the $x - axis$
- $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$ Reflection in the $y - axis$
- $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ Reflection in the line $y = x$
- $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$ Reflection in the line $y = -x$

• Enlargement:

$$\circ \begin{pmatrix} k & 0 \\ 0 & k \end{pmatrix}$$

where k=scale factor and centre of enlargement = (0,0)

• Rotation:

$$\circ \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$$

Rotation 90° anticlockwise, centre (0,0)

$$\circ \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$$

Rotation 90° clockwise, centre (0,0)

$$\circ \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$$

Rotation 180° clockwise/anticlockwise, centre (0,0)

8. PROBABILITY

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

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

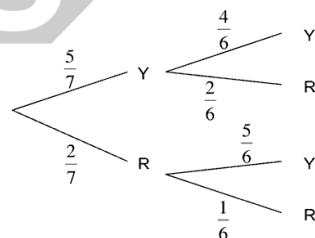
- If probability = 0, the event is impossible and if probability =1, the event is certain to happen
- All probabilities lie between 0 and 1.
- The probability of an event occurring = 1 - the probability of the event not occurring
- Relative frequency (the frequency event X occurs divided by the total number of trials) is an estimate for the probability of event X occurring

8.1 Events**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 occurrence of one is unaffected by occurrence of other.

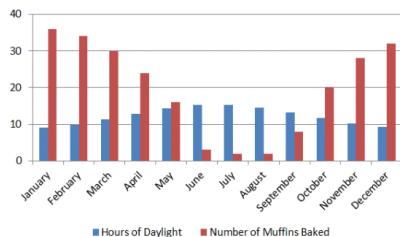
• The AND Rule:

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

9. STATISTICS

9.1 Bar Charts:

- Where a variable for different scenarios is plotted on the y axis, and the scenarios are plotted on the x axis. The length of the bar represents the y value for the given scenario.



- Alternatively, the axes could be inverted

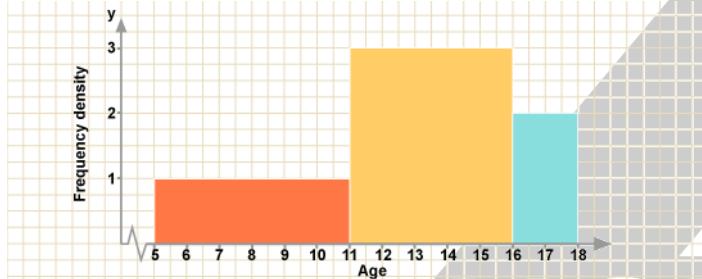
9.2 Pie Chart

- The Area on a circle is representative of a percentage:
- The Formula for the angle for a given percentage is:

$$\theta = p \times 360^\circ$$

Where p is the percentage (Note: $1\% = 1/100$)

9.3 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.
- Class width** = Interval
- Frequency density** = Height

$$\text{Frequency} = \text{Class width} \times \text{Frequency density}$$

9.4 Averages

- Mean:

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

- Median:

- The middle value when the data has been written in ascending or descending order
- If 2 values are the middle ones (even number of data), then take the average of the two.

- Mode:

- Most frequently occurring value

- Range:

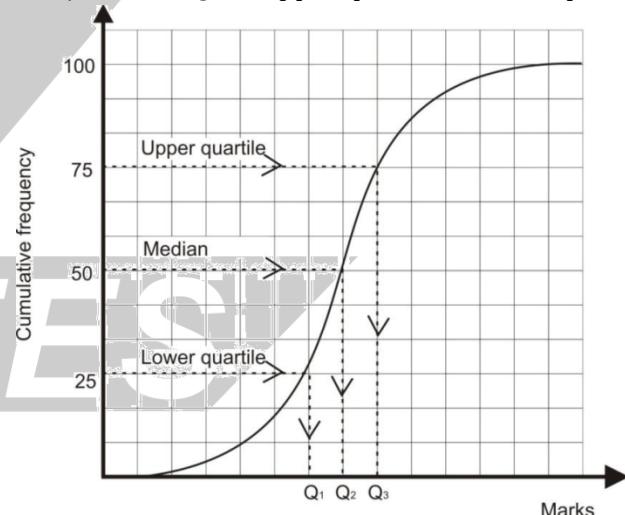
- Difference between highest and lowest values

- Estimated mean of grouped data:

- Work out midpoints of each group and multiply by frequency
- Divide by number of values

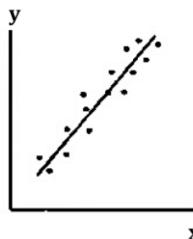
9.5 Cumulative Frequency

- Cumulative frequency is the total frequency up to a given point.
- Inter-quartile range = upper quartile – lower quartile

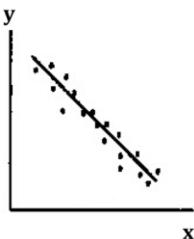


9.6 Scatter Diagrams

- A scatter diagram shows 2 variables plotted against each other, in an attempt to draw a correlation in the data.



Positive Correlation



Negative Correlation



Zero Correlation

- Given points on a graph, if a correlation exists, a line of best fit can be drawn, like shown in the above diagram for Positive and Negative Correlation.

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NOTES

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**NOTES
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The logo features a stylized 'Z' composed of overlapping triangles in shades of pink, purple, and blue. To the right of the 'Z', the word 'NOTES' is in a large, bold, black sans-serif font, and '.ORG' is in a slightly smaller bold black font below it.