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GCSE/iGCSE Maths Formulae Sheet

2D Shapes

Area of Triangle	$\frac{1}{2}$ x base x height
Area of Parallelogram	base x height
Area of Rectangle	$l \times w$
Area of Trapezoid	$\frac{1}{2}$(sum of parallel sides) x height
Circumference & Area: Circle	$c = 2\pi r,\ A = \pi r^2$
Length of an arc	$\frac{\theta}{360} \times 2\pi r$
Area of a Sector	$\frac{\theta}{360} \times \pi r^2$

3D Shapes

Cuboid Surface area	$SA = 2xy + 2xz + 2yz$ where x, y , z are side lengths
Cuboid Volume	$V = xyz$ where x, y , z are side lengths
Cylinder Surface Area	$SA = 2\pi rh + 2\pi r^2$ Note: Curved part: $2\pi rh$
Cylinder Volume	$V = \pi r^2 h$
Cone Surface Area	$SA = \pi rl + \pi r^2$ Note: Curved part: πrl, l is slant length
Cone Volume	$V = \frac{1}{3}\pi r^2 h$
Sphere Surface Area	$SA = 4\pi r^2$ Note: Hemisphere $3\pi r^2$
Sphere Volume	$v = \frac{4}{3}\pi r^3$ Note: Hemisphere= $\frac{2}{3}\pi r^3$
Prism Volume	V =Area of cross section x height
Pyramid Volume	$V = \frac{1}{3} \times base\ area \times h$

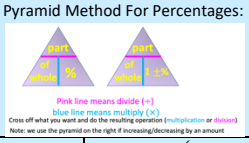
Indices

Multiplication	$x^a \times x^b = x^{a+b}$ $(x^a)^b = x^{ab}$ $(cx^a y^b)^d = c^d x^{ad} y^{bd}$
Division	$x^a \div x^b = \frac{x^a}{x^b} = x^{a-b}$
Negative Powers	$x^{-n} = \frac{1}{x^n}$
Fractions	$\left(\frac{x}{y}\right)^{-n} = \frac{y^n}{x^n}$ and $\left(\frac{x}{y}\right)^n = \frac{x^n}{y^n}$
Fractional Powers	$\frac{n}{a^m} = \left(\sqrt[m]{a}\right)^n$

Percentages

One amount as a % of the other amount (wants answer as a %)	a as a percentage of b $\frac{a}{b} \times 100$ **Look for the words as a percent of**
Percentage gain/loss (wants answer as a %)	$\frac{\text{difference}}{\text{original}} \times 100$ **Look for the words percentage gain/loss/increase/decrease**
Find percentage of an amount	$\frac{\%}{100} \times amount$
Given % of an amount, find the full amount	$\frac{given\ amount}{\frac{\%}{100}}$
Increasing/decreasing by a %	$\text{amount}\left(1 \pm \frac{\%}{100}\right)$ + if increase − if decrease
Reverse percentage	$\frac{Amount}{1 \pm \frac{\%}{100}}$ + if increase − if decrease **Look for the words originally, at the beginning, before…**

Pyramid Method For Percentages:



Simple Interest (interest on initial amount)	$\text{amount} + \left(\text{amount} \times \frac{\%}{100} \times \text{time}\right)$ Interest: = $\text{amount} \times \frac{\%}{100} \times \text{time}$ Note: Make sure t and % are same unit of time
Compound Interest (interest added also earns interest)	$\text{FV} = \text{PV}\left(1 + \frac{r}{100}\right)^t$ FV=future value, PV=present value t=times, r= interest rate

Quadratics

Quadratic Function: Solutions to $ax^2 + bx + c = 0$	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a},\ a \neq 0$
Completing The Square $ax^2 \pm bx + c = 0$	$a\left(x \pm \frac{b}{2a}\right)^2 + c - \frac{b^2}{4a}$
Max/Min Value	$c - \frac{b^2}{4a}$

Congruent Shapes

SSS	Three sides of each triangle equal
SAS	Two sides and included angle equal
AAS	Two angles and corresponding side equal
RHS	Contains right angle and hypotenuse and another side equal

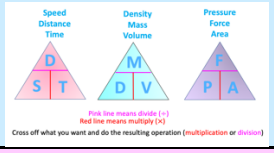
Direct/Indirect Proportion

y is … proportional to x

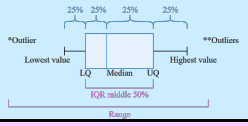
Directly: $y = kx$, Inversely: $y = \frac{k}{x}$

Compound Measures

Speed	speed= $\frac{distance}{time}$
Density	density= $\frac{mass}{volume}$
Pressure	pressure= $\frac{force}{area}$



Statistics

Frequency Density	Frequency density = $\frac{frequency}{class\ width}$ 
Pie chart	Angle= $\frac{category\ frequency}{total} \times 360$
Cumulative frequency	This is a running total of the frequencies
Box Plot	

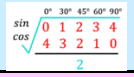
Fractions/Decimals/Percentages

Simplifying Fractions	Step 1: Find a factor of both numbers i.e. a number that fits in both the numerator AND denominator Step 2: Say how many times for each Step 3: Check whether you can do steps 1 and 2 again.
Fraction Of Amount	$\frac{a}{b}$ of amount Step 1: Divide amount by b Step 2: Multiply answer found by a
Improper to Mixed	Step 1: Divide the numerator by the denominator. Step 2: Write down the whole number a Step 3: Put the remainder in the numerator. The new denominator remains the same as that of the original improper fraction.
Mixed to Improper	Step 1: Multiply the whole number by the fraction's denominator Step 2: Add that to the numerator Step 3: Then write the result on the top of the original denominator
$+\ and\ -$ Fractions	Need a common denominator (the smallest number that that both the numerator and denominator fit into)
× Fractions	Don't need common denominator. Can cancel diagonally or vertically, not horizontally.
÷ Fractions	Don't need common denominator. **"Keep change flip"**
Decimal to Fraction	Write over 10,100,1000 etc depending on how many places after the decimal and simplify.
Decimal to Percent	Multiply by 100
Fraction to Decimal	Write as an equivalent fraction over 10,100,1000 etc and then easy to divide by this number OR Use short division if can't write as an equivalent fraction
Fraction to Percent	Turn into a decimal and then just a decimal to percent question i.e. multiply decimal found by 100
Percent to Decimal	Divide by 100
Percent to Fraction	Write over 100 and simplify

Geometry

Straight Line Equation	• Slope intercept $y = mx + c$ • General $ax + by + d = 0$ (get rid of fractions and move all on one side to get into this form)
Methods to find straight line equation	$y = mx + c$ Step 1: Find gradient m • Given a graph – pick any 2 points on the graph and use $\frac{rise}{run}$ • Told parallel to another line⟹ same slope • Told perpendicular to another line ⟹"flip fraction and change the sign (slopes multiply to make -1) • Given 2 points. Use formula $\frac{y_2 - y_1}{x_2 - x_1}$ Step 2: Find y intercept c • Given a graph – where the line crosses the y intercept • Plug point in and solve for c (make sure this is **correct** point-line passes through).
Straight Line Gradient	$m = \frac{y_2 - y_1}{x_2 - x_1}$
Distance between 2 points $(x_1, y_1), (x_2, y_2)$	$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
Coordinates of midpt of $(x_1, y_1), (x_2, y_2)$	$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$
Circles	$(x - a)^2 + (y - b)^2 = r^2$ centre (a, b), radius r

Right Angled Trigonometry

Pythagoras	$a^2 + b^2 = c^2$ if given hyp⟹subtract, if finding hyp⟹add
SOHCAHTOA	$\sin x° = \frac{opp}{hyp},\ \cos x° = \frac{adj}{hyp},\ \tan x° = \frac{opp}{adj}$
	
Exact Trig Values	

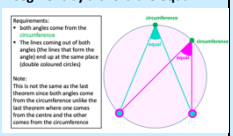
Non Right-Angled Trigonometry

Sine Rule	Finding a side: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$ Finding an angle: $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$
Cosine Rule	Finding a side: $a^2 = b^2 + c^2 - 2bc\cos A$ Finding an angle: $A = \cos^{-1}\left(\frac{b^2 + c^2 - a^2}{2bc}\right)$
Area of Triangle	$\frac{1}{2}absinC$
Sine Rule	Finding a side: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$ Finding an angle: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

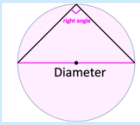
Circle Theorems

Angle at the centre is double the angle at the circumference

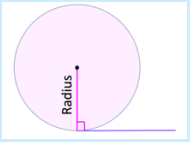
Angles subtended in the same segment by a chord are equal



Angle in a semicircle is a right angle



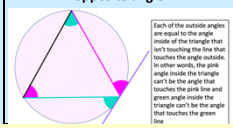
A tangent meets a radius at 90°



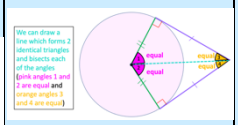
Opposite angles of a cyclic quadrilateral add to 180°

Watch out: All points need to be on the circumference!

Alternate segment theorem: The angle between a tangent and a side of a triangle is equal to the opposite angle

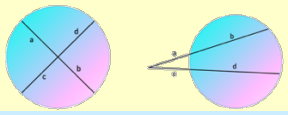


Tangents which meet at a point are equal in length

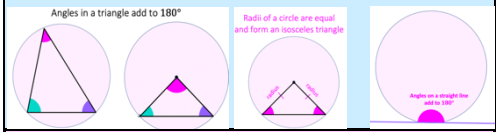


For two intersecting chords, the products of their diagonals are equal

$ab = cd$ $\quad a(a + b) = c(c + d)$



Extra helpful fact to remember



Functions

Inverse	Replace $f(x)$ with y, swap x & y, solve for y
Composite	$fg(x)$ means plug $g(x)$ into $f(x)$
Transformations $af(bx + c) + d$ "anything in a bracket affects x and does the opposite"	a=vertical stretch sf a, b=horizontal stretch sf $\frac{1}{b}$ c=translation c units x direction, d=translation d units in y direction $f(-x)$=reflcn in y axis $\quad -f(x)$=reflcn in x axis

Series (iGCSE only)

Arithmetic sequence:	***nth* term:** $u_n = a + (n-1)d$ **sum of n terms** $S_n = \frac{n}{2}[2a + (n-1)d] = \frac{n}{2}(a + l)$ where a =first term, d= common diff, l=last term
Geometric sequence:	$u_n = ar^{n-1}$ $S_n = \frac{a(1-r^n)}{1-r} = \frac{a(r^n-1)}{r-1},\ r \neq 1$ where a =first term, r= common ratio

Differentiation (iGCSE only)

Rule	$x^n \Rightarrow nx^{n-1}$ Remember: Constants go to 0
Turning/Stationary Points (Max/Min)	Solve $\frac{dy}{dx} = 0$
Proving whether Max/Min	Use knowledge of shape of graph $+x^2$ happy face min $-x^2$ sad face max $+x^3$ max on left, min on right $-x^3$ min on left, max on right