

Unit 11

3D Geometry

PROPERTIES OF 3D SOLIDS

surface	the outside layer of an object, it has an area and can be flat or curved
face	any of the individual flat surfaces of a solid object
edge	for a 3D shape, the line segment where two faces meet
vertex (vertices)	for a 3D shape, the point where two or more edges meet, a corner

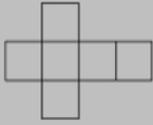
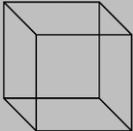
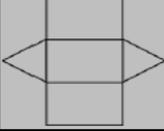
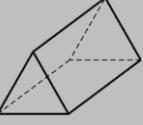
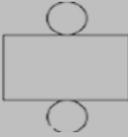
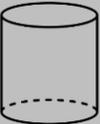
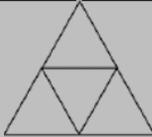
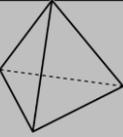
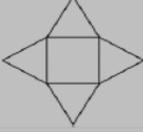
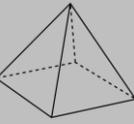
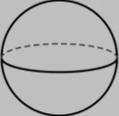
2D REPRESENTATIONS OF 3D SHAPES

plan	a 2D view of a 3D solid as viewed from above , birds-eye view
elevation	the 2D view of a 3D solid from the front or the side
net	a pattern that you can cut and fold to make a model of a 3D shape

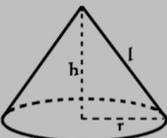
VOLUME

volume	the amount of space a 3D shape takes up	
volume units	mm ³ , cm ³ , m ³ ...	
prism	volume = area of cross section x length	
cube	volume = one side cubed (or, area of square x length of prism)	$V = l^3$
cuboid	volume = area of rectangle x length of prism	$V = lbh$
triangular prism	volume = area of triangle x length of prism	$V = \frac{lbh}{2}$
cylinder	volume = area of circle x length of prism	$V = \pi r^2 h$
pyramid	volume = $\frac{1}{3}$ x area of cross section x length	
square based pyramid	volume = $\frac{1}{3}$ x area of square base x height of pyramid	$V = \frac{lwh}{3}$
cone	volume = $\frac{1}{3}$ x area of circle base x height of cone	$V = \frac{\pi r^2 h}{3}$
sphere	$V = \frac{4}{3} \pi r^3$	

3D SOLIDS

prism	a 3D solid with a consistent cross section		
cube	6 faces 12 edges 8 vertices		
cuboid	6 faces 12 edges 8 vertices		
triangular prism	5 faces 9 edges 6 vertices		
cylinder	2 faces with 1 curved surface 2 edges no vertices		
pyramid	a solid three-dimensional shape with a polygon base , and triangular faces that meet at the apex (a vertex)		
triangular based pyramid (tetrahedron)	4 faces 6 edges 4 vertices		
square based pyramid	5 faces 8 edges 5 vertices		
cone	1 face with 1 curved surface 1 edge 1 vertex		
sphere	All dimensions are the same. The centre point is equal from every point on its surface.		

SURFACE AREA

surface area	the total area of all the surfaces on a 3D shape	
surface area method	find the area of each face separately, then add them together	
surface area of a sphere	$A = 4\pi r^2$	
surface area of a cone	curved surface area = $\pi r l$ circle base area = πr^2 add these together	

Unit 12

Statistics

TYPES OF DATA	
data	a collection of information
qualitative	data that can only be written in words , not numbers, e.g. eye colour, favourite animal
quantitative	numerical data , e.g. shoe size, height of a plant
continuous	numerical data that can be measured , e.g. height of a plant, it has an infinite number of possible values within a selected range, it is on a scale
discrete	data which can only take certain values , e.g. eye colour, shoe size (categorical in science)
grouped	numerical data that has been ordered and sorted into groups called classes
data representation	a table or chart or graph which gives more meaning to a set of data these include bar charts, line graphs, pictograms, pie charts, stem and leaf diagrams, two-way tables, scatter graphs, frequency polygons and histograms

COMPARING DATA	
comparing data	compare averages to say who is better/faster/taller compare ranges to say who is more consistent / less varied

AVERAGES AND RANGE FROM A FREQUENCY TABLE	
mean	method: multiply the variables by their frequencies (fx column), total the fx column, divide by total frequency
mode / modal class	the most frequent value or class; the one with the highest frequency
median	use half the total frequency to find the middle position , then locate the row this occurs in using the 'subtotal' column
range	difference between the largest and smallest values of the variable (first column)

DISPLAYING GROUPED DATA	
class width	the range of a group (class) i.e. aged 15-20 has a class width of 5
histogram	the area of the bars represents the frequency, there are no gaps between bars
frequency density	the heights of the bars on a histogram $\text{frequency density} = \frac{\text{frequency}}{\text{class width}}$
frequency polygon	a line graph made by plotting the frequency against the midpoints of each group

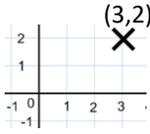
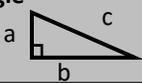
DISPLAYING UNGROUPED DISCRETE NUMERICAL DATA										
stem and leaf diagram	a way of displaying a list of numbers the stem goes down and the leaves go out to the right, It has a key	<table border="1"> <thead> <tr> <th>stem</th> <th>leaf</th> </tr> </thead> <tbody> <tr> <td>5</td> <td>6</td> </tr> <tr> <td>6</td> <td>7, 7, 9</td> </tr> <tr> <td>7</td> <td>2, 4, 7, 7, 8</td> </tr> </tbody> </table>	stem	leaf	5	6	6	7, 7, 9	7	2, 4, 7, 7, 8
stem	leaf									
5	6									
6	7, 7, 9									
7	2, 4, 7, 7, 8									
vertical line graph	like a bar chart , but the bars have no width , they are just straight lines up the page									

DISPLAYING BIVARIATE DATA																						
bivariate data	data containing two variables																					
variable	something that can change or vary																					
two-way table	shows information about two variables which do not overlap , the numbers represent frequencies	<table border="1"> <thead> <tr> <th></th> <th>Female</th> <th>Male</th> <th>Total</th> </tr> </thead> <tbody> <tr> <th>English</th> <td>12</td> <td>18</td> <td>30</td> </tr> <tr> <th>Maths</th> <td>28</td> <td>27</td> <td>55</td> </tr> <tr> <th>Science</th> <td>19</td> <td>16</td> <td>35</td> </tr> <tr> <th>Total</th> <td>59</td> <td>61</td> <td>120</td> </tr> </tbody> </table>		Female	Male	Total	English	12	18	30	Maths	28	27	55	Science	19	16	35	Total	59	61	120
	Female	Male	Total																			
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scatter graph	a graph to show bivariate data																					
correlation	when there is a relationship between two sets of data, but we don't know if one caused the other																					
causation	when the independent variable causes the dependent variable																					
positive correlation	as one variable increases, the other increases																					
negative correlation	as one variable increases, the other decreases																					
no correlation	there is no relationship between the two variables																					
line of best fit	a line that best represents the data on a scatter graph In maths GCSE it is always straight , but in science it can be curved																					
outlier	a value that ' lies outside ' most of the other values in a set of data, it is much smaller or much larger than the other values in a set of data																					

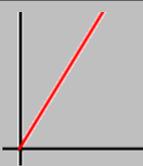
MISLEADING REPRESENTATIONS	
misleading representations	Look for: <ul style="list-style-type: none"> frequency scales: too large, or too small; has missing numbers; doesn't start at zero; the axes are incorrectly labelled; data is missing; bar charts with varying width bars or varying space between them; proportions for pie charts not adding up to 100%

Unit 13: Graphs and Proportion

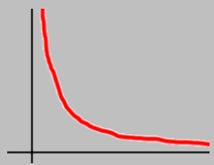
COORDINATES

axis (plural: axes)	the x axis is horizontal the y axis is vertical
quadrant	the four regions separated by the axes
coordinate e.g.	give a position of a point on a grid the first number (x) moves left (-) or right (+) the second number (y) moves up (+) or down (-) (x, y) e.g. (3,2) means the point that is 3 to the right and 2 up from the origin
	
origin	the coordinate (0, 0)
line segment	a line joining two points
length of line segment	distance between two points calculated using Pythagoras' theorem .
Pythagoras' theorem	a relationship between the 3 sides on a right angled triangle  $a^2 + b^2 = c^2$
midpoint	the middle of a line segment

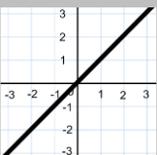
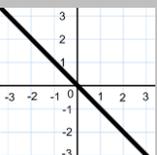
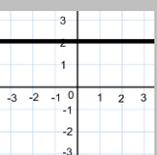
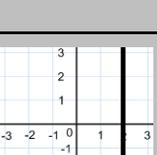
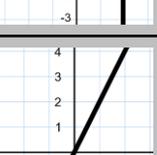
DIRECT PROPORTION

direct proportion	as one increases , the other increases at the same rate if y is directly proportional to x , this can be written as $y \propto x$
$y = kx$	an equation of the form $y=kx$ represents direct proportion, where k is the constant of proportionality
direct proportion graphically	

INVERSE PROPORTION

inverse proportion	if two quantities are in inverse proportion, as one increases , the other decreases in proportion their product is always the same if y is inversely proportional to x , this can be written as $y \propto \frac{1}{x}$
$y = \frac{k}{x}$	an equation of the form $y = \frac{k}{x}$ represents inverse proportion, where k is the constant
inverse proportion graphically	

LINEAR GRAPHS

$y = x$	every point on this line, the y coordinate is equal to the x coordinate e.g. (3,3), (-2,-2), (0,0)	
$y = -x$	every point on this line, the y coordinate is equal to the negative of the x coordinate e.g. (3, -3), (-2,2)	
$y = a$	these lines are always horizontal for example $y = 2$, every point on this graph, the y coordinate equals 2 , e.g. (0,2), (5,2)	
$x = a$	these lines are always vertical for example $x = 2$, every point on this graph, the x coordinate equals 2 , e.g. (2,0), (2,5)	
$y = kx$	these lines always go through the origin for example $y = 2x$, every point on this graph, the y coordinate is double the x coordinate , e.g. (2, 4), (1, 2)	
$y = mx + c$	the general equation of a linear graph m is the gradient c is the y-intercept when plotting: use a table of values , substitute in values of ' x ' to generate ' y ', plot the coordinates , join with line	
gradient	How steep a line is. Can be positive or negative. (Change in y) (Change in x) It gives the rate of change .	
y- intercept	where the line crosses the y-axis (0, a)	

SCALE

scale	the ratio of the lengths in a model/map/diagram to the lengths in real life
scale factor	the ratio of corresponding sides of two similar shapes
units in scales	scales with units: use the box method to find the new value giving it in the correct units scales without units: both sides of the scale have the same unit stated in the question , use the box method to find the new value and then convert the answer to sensible units

Year 9 Unit 2: Algebraic Expressions

SEQUENCES

sequence	a pattern of terms/numbers which follow a rule
position-to-term rule (n^{th} Term)	a rule which allows you to calculate any term that is in the n^{th} position of the sequence
generate	to produce or create
linear sequences	a sequence where the difference between terms increases or decreases by the same amount each time also known as an arithmetic sequence use DiNO to find the n^{th} term to generate a sequence substitute values of 'n' in, e.g. 2nd term, $n=2$ <i>algebraically: $x_n = an + b$</i>
common difference	the amount we add or subtract each time in a linear sequence
quadratic sequences	a sequence of numbers with an n^2 in the position to term rule (n^{th} term) the second difference between consecutive terms is constant <i>algebraically: $x_n = an^2 + bn + c$</i>
geometric sequences	a sequence of numbers where each term is found by multiplying the previous one by a number called the common ratio 'r' <i>algebraically: $x_n = ar^{n-1}$</i> increasing: the ratio is an integer , decreasing: the ratio is a fraction
common ratio (r)	the amount we multiply by each time in a geometric sequence, can be a fraction

INSTRUCTIONS: GENERAL

expand	multiply terms inside a bracket by those outside the bracket, remove the brackets using the grid method
simplify	to reduce to its simplest form

FACTORISING

factorise	finding the factors of an expression the reverse of expand , it is when we write an expression using brackets , use reverse grid
factor	a quantity which divides equally into a number, e.g. <i>factors of 8 are 1, 2, 4 and 8</i>
factorising a general quadratic	quadratic: $x^2 + bx + c$, factorised form: $(x + ?)(x + ?)$ '?' are two numbers whose product is ' c ' and sum is ' b ', split the middle term and put into a reverse grid to find the brackets
difference of two squares	quadratic: $a^2 - b^2$ factorised form: $(a - b)(a + b)$ square root each number from the original expression

INSTRUCTIONS: EQUATIONS AND INEQUALITIES

rearrange	changing the subject of a formula sometimes called transposing use inverse operations and the balancing method , like when we solve an equation
inverse	the opposite
balance an equation	do the same to both sides of the "=" use to solve an equation, or rearrange a formula
subject of an equation	a single unknown or variable that everything else is equal to
solution of an equation	a value we can put in place of a variable that makes the equation true
order of operations	the laws regarding the order in which to calculate , used in algebra too brackets, other, multiply and divide, add and subtract
solving inequalities	using the balancing method to write an inequality in its simplest form
solving quadratic equations	To solve you must factorise the quadratic equation then set each bracket equal to zero to find solutions for x .

LINEAR SEQUENCES inks to: LINEAR GRAPHS

$y = mx + c$	the general equation of a linear graph m is the gradient c is the y-intercept
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ALGEBRAIC NOTATION

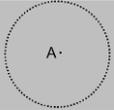
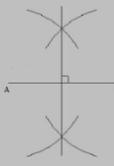
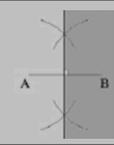
coefficient	a number used to multiply a variable the number that comes in front of a letter , e.g. $3b$ means $3 \times b$ the coefficient is 3 , the variable is b
simplifying algebraic fractions	factorise the numerator and denominator and cancel common factors , sometimes requires factorisation
identity	an equation that is true for all of its variables , indicated by the \equiv symbol e.g. $b + b \equiv 2b$
prove	even number: $2n$, odd number: $2n+1$ or $2n-1$, consecutive numbers: $n, n+1, n+2$, consecutive even numbers: $2n, 2n+2, 2n+4$, consecutive odd numbers: $2n+1, 2n+3, 2n+5$ or $2n-1, 2n-3, 2n-5$, multiples of a number: it will factorise by that number

Unit 15: Geometry Angles

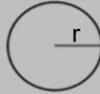
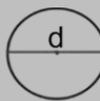
LOCI VOCABULARY

loci	a locus is a path of points that follow a rule
equidistant	equal distance
regions	' more/further than ' indicates shading outside the loci ' within/less than ' indicates shading inside the loci

LOCI

locus of points equidistant from A	a circle with A at the centre radius is the distance given	
locus of points equidistant from two points	perpendicular bisector : open compass to over halfway, draw an arc from each end, join where they cross	
locus of points closer to B than A	perpendicular bisector of AB, shade the side closest to B	
locus of points equidistant from two lines	an angle bisector : place compass on corner, draw two arcs cross both lines, one further away, draw lines joining top left cross to bottom right and vice versa, join where these lines meet to corner	
locus of points a set distance from a line	create two semi-circles at either end joined by two parallel lines	

CIRCLE CALCULATIONS

circle area	$A = \pi r^2$ area = pi x radius ²	
sector	the region of a circle enclosed by two radii and an arc	
sector area	$A = \frac{\theta}{360} \pi r^2$ area = the fraction of the full circle x pi x radius ²	
circumference of a circle	$C = \pi d$ circumference = pi x diameter	
arc	a part of the circumference of a circle	
arc length	$L = \frac{\theta}{360} \pi d$ arc length = the fraction of the full circle x pi x diameter	

CONGRUENCE

congruent	objects with exactly the same shape and size all angles and all sides are the same
similarity	two shapes are similar when one is an enlargement of the other all angles are the same, but the lengths of sides are different
scale factor	the ratio of corresponding sides of two similar shapes

CONGRUENT TRIANGLES

there are four ways to prove triangle congruency	
side, angle, side (SAS)	show two sides and the angle between them are congruent
angle, side, angle (ASA)	show two angles and the side between them are congruent
side, side, side (SSS)	show all corresponding sides are congruent
right-angle, hypotenuse, side (RHS)	show both triangles have a right angle , congruent hypotenuses and one other congruent side

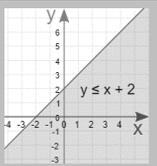
SIMILARITY

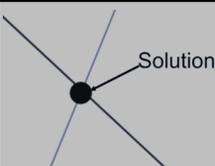
two or more shapes with **congruent angles** but **corresponding sides** all linked by the **same scale factor**
if the **scale factor** of enlargement is x
length scale factor: x
area scale factor: x^2
volume scale factor: x^3

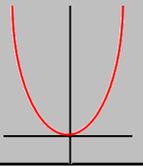
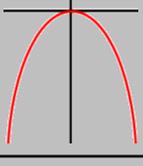
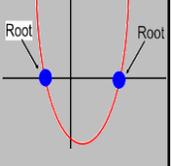
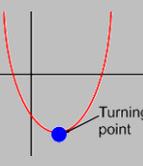
ANGLES IN POLYGONS: FACTS

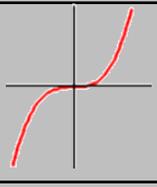
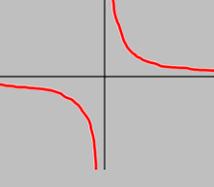
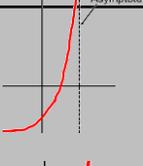
polygon	a 2D shape with 3 or more straight sides								
regular polygon	a polygon with sides that are all equal and angles that are all equal								
interior angle	an angle inside a polygon								
sum of interior angles	$(n - 2) \times 180^\circ$ where n is the number of sides								
interior angle of regular polygon	$\frac{(n - 2) \times 180}{n}$ where 'n' is number of sides								
exterior angle	the angle formed outside a polygon when one side is extended interior angle + exterior angle = 180° because they made a straight line all exterior sum to 360°								
some polygon interior angle sums	<table border="0"> <tr> <td>triangle = 180°</td> <td>heptagon = 900°</td> </tr> <tr> <td>quadrilateral = 360°</td> <td>octagon = 1080°</td> </tr> <tr> <td>pentagon = 540°</td> <td>nonagon = 1260°</td> </tr> <tr> <td>hexagon = 720°</td> <td>decagon = 1440°</td> </tr> </table>	triangle = 180°	heptagon = 900°	quadrilateral = 360°	octagon = 1080°	pentagon = 540°	nonagon = 1260°	hexagon = 720°	decagon = 1440°
triangle = 180°	heptagon = 900°								
quadrilateral = 360°	octagon = 1080°								
pentagon = 540°	nonagon = 1260°								
hexagon = 720°	decagon = 1440°								

Unit 16: Algebraic Graphs

INEQUALITIES		
inequality	where two expressions are not equal in value	
inequality symbols	< less than	> greater than
	≤ less than or equal to	≥ greater then or equal to
plotting inequalities	create a table of values and substitute in values of 'x' (like with linear graphs) < or > means a dashed line ≤ or ≥ means a solid line	
inequality regions	for greater than symbols, shade above the line	
	for less than symbols, shade below the line	
simultaneous inequalities (graphically)	regions can be shaded that satisfy inequalities : strict (< or >) are a dashed line ----- non-strict (≤ or ≥) are a solid line _____	

SIMULTANEOUS EQUATIONS		
simultaneous	occurring at the same time	
simultaneous equations	equations with the same variables whose solutions hold the same value must be solved at the same time to find the values of 'x' and 'y'	
solving	add or subtract the equations to eliminate one variable , then solve as a linear equation variables must have the same coefficient to be eliminated when one variable is known, substitute into one of the equations and solve to find the value of the other variable	
	for the variable being eliminated with... the same sign , subtract the equations different signs , add the equations	
same coefficients of variables	when simultaneous equations have variables with the same coefficients , decide whether to add or subtract straight away	
different coefficients of variables	when simultaneous equations have variables with different coefficients , find the LCM and scale up (multiply) the equations until they have the same coefficient, then add or subtract	
solve by substitution	make one variable the subject of one of the equations and substitute into the other to eliminate it, then solve as with linear	
simultaneous equations (graphically)	can be solved graphically by plotting the two lines and finding the coordinate where they cross	

QUADRATIC GRAPHS		
quadratic graph	a graph where the highest power of x is x² general format ax² + bx + c it is always a parabola (a U-shape) in the general format, 'c' is where the graph crosses the y-axis	
	$y = x^2$	
	$y = -(x^2)$	
roots (of graphs)	the ' solutions ' of a graph, where a function equals zero can be found in a graph where the curve meets the x axis	
turning point	the point where a graph turns , from negative to positive gradient or positive to negative gradient	

OTHER NON-LINEAR GRAPHS		
cubic graph	a graph where the highest power of x is x³ general format ax³ + bx² + cx + d 'd' is where the graph crosses the y-axis	
	$y = x^3$	
reciprocal graph	$y = \frac{k}{x}$ the graph has asymptotes on the x-axis and y-axis (as it is impossible to divide by zero)	
asymptote	a straight line a graph approaches but never touches	
exponential graph	$y = k^x$ the graph has an asymptote on the x-axis	