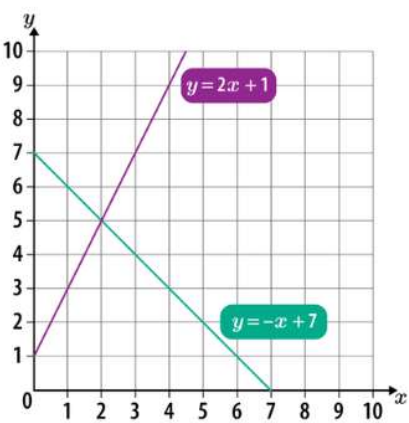
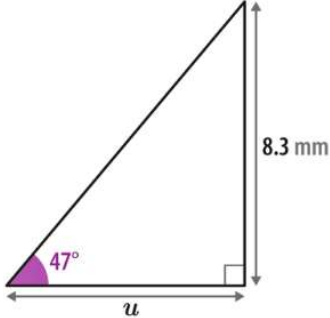
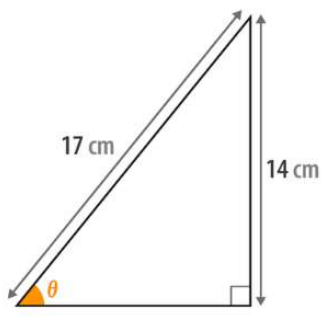
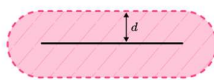
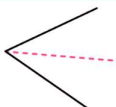
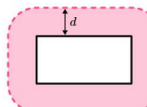
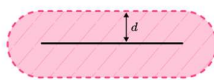
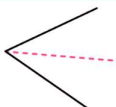
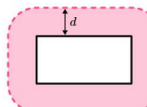
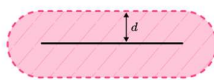
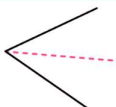
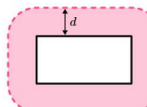
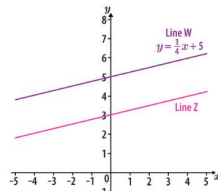


Unit	Topic/Skill	Definition/Tips	Example	Sparx Code
Repeated percentage change	Compound interest	Compound interest is interest calculated on the initial principal of a deposit or loan, as well as the accumulated interest from previous periods.	Compound Interest Where P is the principal amount, r is the interest rate over a given period and n is number of times that the interest is compounded: $\text{Total accrued} = P \left(1 + \frac{r}{100} \right)^n$ £1200 is invested in a bank account at a rate of 2% for 5 years. How much is in the account at the end of the 5 years? $1200 \left(1 + \frac{2}{100} \right)^5 = \text{£}1324.90$	U671
	Repeated growth/decay	Growth and decay, in a mathematical context, refer to the direction in which a quantity is changing over time. Growth signifies an increase in value, while decay signifies a decrease.	Water in a tank is leaking at a rate of 5.5% per second. The tank is filled with 6 litres of water. How much water is in the tank after 8 seconds? $6 \left(1 - \frac{5.5}{100} \right)^8 = 3.82 \text{ litres}$	U286
Surface area and volume	Surface area of pyramids, cones, frustums, spheres and composite shapes	Surface area is the sum of all of the faces of a 3D shape	Curved surface of a cone = $\pi r l$ Surface area of a sphere = $4\pi r^2$	U871 U523 U893 U334 U561
	Volume of pyramids, cones, frustums, spheres and composite shapes	Volume is the amount of space inside a 3D shape	Prism $V = \text{area of cross section} \times \text{length}$ Pyramid and cone $V = \frac{1}{3} \times \text{base} \times \text{height}$ Sphere $V = \frac{4}{3} \pi r^3$	U484 U116 U617 U350 U543

Linear simultaneous equations	Elimination	This means that we make the coefficients of either x or y the same and then add or subtract the equations	$6x + 7y = 27$ $8x + 11y = 41$ $48x + 56y = 216$ $48x + 66y = 246$ So $10y = 30$ and $y=3$ Substituting back into the original equation: $6x + 21 = 27$ $6x = 6 \text{ and } x=1$	U760
	Substitution	This involves rearranging one equation and substituting into the other to find the missing variables.	$y = 5x - 4$ $y = 3x + 12$ Which gives $5x - 4 = 3x + 12$ $2x - 4 = 12$ $2x = 16$ $x = 8$ $y = 5 \times 8 - 4 = 36$	U757
	Graphically	We look for the point of intersection for the solution.	 $x=2$ and $y=5$	U836
	Constructing and solving	These are questions in context for which we have to set up equations for.	The cost of 7 potted plants and 2 bags of fertiliser is £43 The cost of 5 potted plants and 4 bags of fertiliser is £41 Louis wants to buy 2 potted plants and 5 bags of fertiliser. How much will this cost Louis? Let p be plants and b be bags. $7p + 2b = 43$ $5p + 4b = 41$	U137

			$14p+4b=86$ $5p+4b=41$ $9p=45$ $p=5$ So a plant is £5 and a bag is £4	
Rearranging formulae	Two or more steps	We must do the same inverse operation to both sides of the equation.	Rearrange $cq - u = h$ to make q the subject $cq = h + u$ $q = \frac{h + u}{c}$	U181
	Where the subject appears more than once		Make x the subject of $c = 7x - hx$ $c = x(7 - h)$ $\frac{c}{7 - h} = x$	U191
Right-angled trigonometry	Missing sides	Use SOHCAHTOA to determine which trigonometric ratio to use $\sin \theta = \frac{\text{opposite}}{\text{hypotenuse}}$ $\cos \theta = \frac{\text{adjacent}}{\text{hypotenuse}}$ $\tan \theta = \frac{\text{opposite}}{\text{adjacent}}$	 $\tan 47 = \frac{8.3}{u}$ $u = \frac{8.3}{\tan 47} = 7.74 \text{ mm}$	U283
	Missing angles		 $\sin \theta = \frac{14}{17}$ $\theta = \sin^{-1} \frac{14}{17} = 55.4^\circ$	U545

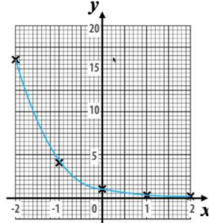
	Exact values	These are most likely to appear on the non-calculator papers and are to be learned.	<table><tr><td></td><td>0°</td><td>30°</td><td>45°</td><td>60°</td><td>90°</td></tr><tr><td>sin</td><td>0</td><td>$\frac{1}{2}$</td><td>$\frac{\sqrt{2}}{2}$</td><td>$\frac{\sqrt{3}}{2}$</td><td>1</td></tr><tr><td>cos</td><td>1</td><td>$\frac{\sqrt{3}}{2}$</td><td>$\frac{\sqrt{2}}{2}$</td><td>$\frac{1}{2}$</td><td>0</td></tr><tr><td>tan</td><td>0</td><td>$\frac{\sqrt{3}}{3}$</td><td>1</td><td>$\sqrt{3}$</td><td>X</td></tr></table>		0°	30°	45°	60°	90°	sin	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1	cos	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0	tan	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	X	U627
	0°	30°	45°	60°	90°																							
sin	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1																							
cos	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0																							
tan	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	X																							
Constructions	Constructing loci	"Loci" is the plural form of the Latin word "locus," which generally refers to a location or position. In mathematics, loci (plural) are sets of points that satisfy specific geometric conditions	<table><tr><td>The locus of points that are a given distance, d, from a point.</td><td></td></tr><tr><td>The locus of points within a given distance, d, of a line.</td><td></td></tr><tr><td>The locus of points equidistant between two points (perpendicular bisector).</td><td></td></tr><tr><td>The locus of points equidistant between two lines (angle bisector).</td><td></td></tr><tr><td>The locus of points a given distance, d, from a polygon.</td><td></td></tr></table>	The locus of points that are a given distance, d , from a point.		The locus of points within a given distance, d , of a line.		The locus of points equidistant between two points (perpendicular bisector).		The locus of points equidistant between two lines (angle bisector).		The locus of points a given distance, d , from a polygon.		U820														
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Linear graphs	Equations of parallel lines	Parallel lines have the same gradients.	Line W and line Z are parallel. Give the equation of line Z in the form $y = mx + c$ where m and c are integers or fractions in their simplest form  $y = \frac{1}{4}x + 3$	U377																								
	Equations from a gradient and point	Use $y=mx+c$ with the gradient and point to find c	A line has gradient 4 and passes through (2,11). Find the equation of the line. $11 = 2 \times 4 + c$ $c = 3$ $y = 4x + 3$ is the equation.	U477																								
	Equation from two points	We need to find the gradient using $\frac{\text{change in } y}{\text{change in } x}$ and then use this with $y=mx+c$ to find the c value.	Work out the equation of the line which passes through (6,8) and (9,23) $m = \frac{23 - 8}{9 - 6} = 5$ $8 = 5 \times 6 + c$ $c = -22$	U848																								

			$y = 5x - 22$											
	Equations of perpendicular lines	Perpendicular lines have negative reciprocal gradients. $m_2 = -\frac{1}{m_1}$	A line passes through (2,3) and is perpendicular to $y=4x+1$. What is the equation of the line? $m = -\frac{1}{4}$ $3 = -\frac{1}{2} + c$ $c = \frac{7}{2}$ $y = \frac{1}{4}x + \frac{7}{2}$	U898										
Real life graphs	Plotting real life graphs	Plot the coordinates first and then join them up.	A bucket contains 640 ml of water. Each hour, 120 ml drains from the bucket. a) Complete the table of values below. b) Plot the line to show this relationship. Complete the table <table border="1"> <tr> <td>Hours</td><td>0</td><td>1</td><td>2</td><td>3</td></tr> <tr> <td>Water in bucket (ml)</td><td>640</td><td>520</td><td>400</td><td>280</td></tr> </table> On the graph, mark the coordinates of each point in the table Draw a straight line through the points	Hours	0	1	2	3	Water in bucket (ml)	640	520	400	280	U652
Hours	0	1	2	3										
Water in bucket (ml)	640	520	400	280										
	Interpreting real life graphs	Use a ruler to help you take the most accurate reading.	If 1.4 g of chemical A is used, how much of chemical B is needed? Give your answer in grams (g). Mass of chemical B against chemical A 1.2g	U862										
	Water flows	These graphs show the rate of change of the depth of the water based on the shape of the container.	Depth Time	U896										

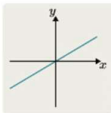
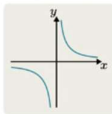
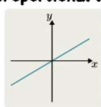
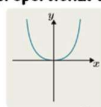
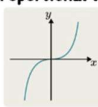
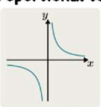
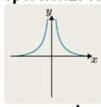
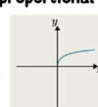
Unit	Topic/Skill	Definition/Tips	Example	Sparx Code
Set Notation	Venn diagrams with set notation	Set Union Intersection Complement	$\cup$ means "union" $\cap$ means "intersection" $\prime$ means "complement" A contains all of the items that are in set A B contains all of the items that are in set B $A \cup B$ contains all of the items that are in set A or set B or both $A \cap B$ contains all of the items that are in both set A and set B G' contains all of the items that are not in set G	U748
	Using set notation	Braces Element Universal Set	elements $A = \{1, 2, 3, 4, 5, 6\}$ braces ξ universal set $\xi = \{12, 13, 14, 15, 16, 17, 18, 19, 20, 21\}$ $D = \{13, 14, 15, 16, 17\}$ $E = \{12, 15, 17, 18, 20\}$ List the members of $D \cup E$ $12, 13, 14, 15, 16, 17, 18, 20$ List the members of $D' \cap E'$ $19, 21$ $D' = \{12, 14, 19, 20, 21\}$ $E' = \{13, 16, 18, 19, 21\}$	U296
Tree Diagrams	Tree diagrams for independent events	A tree diagram lists all possible outcomes for two or more events. Independent events do not affect each other. Event Outcomes Independent	Macie spins a three-sided spinner and picks a marble at random from a bag containing three marbles. The tree diagram below shows all the possible outcomes. How many possible outcomes are there in total? R: Red, B: Blue, G: Green, P: Purple, Y: Yellow Spinner: Red, Blue, Green Marble: Red, Purple, Yellow Outcome: R,R, R,P, R,Y, B,R, B,P, B,Y, G,R, G,P, G,Y List the outcomes Count the total number of outcomes 9 9 ans	U558

	Tree diagrams for dependent events	The events are dependent if the probability of the second event happening depends on the first. Multiply probabilities along the branches and add to combine at the end.	If it is sunny on a given day, the probability that it is sunny the next day is $\frac{8}{11}$. If it is not sunny on a given day, the probability that it is sunny the next day is $\frac{5}{11}$. It is sunny today. Work out the probability that it will be sunny on exactly one of the next two days. Give your answer as a fraction in its simplest form. Draw a tree diagram Add probabilities to the tree diagram $P(\text{S on exactly one day}) = P(\text{S, not S}) + P(\text{not S, S})$ $P(\text{S, not S}) = \frac{8}{11} \times \frac{3}{11} = \frac{24}{121}$ $P(\text{not S, S}) = \frac{3}{11} \times \frac{5}{11} = \frac{15}{121}$ $\frac{24}{121} + \frac{15}{121} = \frac{39}{121}$ Simplify if possible $\frac{39}{121}$ ans	U729
Compound Measures	Calculating with density	Density is a way of comparing how heavy different materials are. $\text{density} = \frac{\text{mass}}{\text{volume}}$ The standard units of density are kg/m^3 and g/cm^3.	8.2 m^3 of basalt has a mass of $24,682 \text{ kg}$. a) Calculate the density of basalt in kg/m^3. b) Work out the mass of 3.2 m^3 of basalt in kg. a) Substitute into the formula to find the density $\text{density} = \frac{24682}{8.2} = 3010$ answer: 3010 kg/m^3 b) Rearrange the formula to make mass the subject Substitute into the formula $\text{mass} = \text{density} \times \text{volume}$ $= 3010 \times 3.2$ $= 9632$ answer: 9632 kg	U910
	Calculating with pressure	The pressure is the force exerted per unit area. $\text{pressure} = \frac{\text{force}}{\text{area}}$ The standard units of pressure are N/m^2	Two boxes are placed on a shelf. Box A has a base area of 234 cm^2. Box B exerts a force of 6080 N and a pressure of 32 N/cm^2. Find the difference between the base areas of the boxes in cm^2. Rearrange the formula to make area the subject $\text{area} = \frac{\text{force}}{\text{pressure}}$ $= \frac{6080}{32}$ $= 190$ Box B area = 190 cm^2 Work out the difference between the areas $234 - 190 = 44$ answer: 44 cm^2	U527
Working with ratio	Combining ratios	Multiplying ratios Equivalent ratio Lowest common multiple Simplify	A sports club has three types of members: seniors, adults and children. The ratio of adults to children is $3:8$. The ratio of children to seniors is $6:5$. What is the ratio of adults to seniors in its simplest form? Look for a section that is common to both ratios Find equivalent ratios which have the same number of parts for children $3 : 8 \times 3 = 9 : 24$ $6 : 5 \times 4 = 24 : 20$ Combine into one ratio adults : children : seniors $9 : 24 : 20$ Remove any sections that you don't need from the ratio Simplify if possible adults : seniors $9 : 20$ answer: $9 : 20$	U921
	Calculating with ratios and algebra	Scale up one or both ratios until one element is equal. Form an equation and solve to find x.	If $(3x - 7) : 2$ is equivalent to $9x : 20$, then what is the value of x? Give your answer as a fraction in its simplest form. Notice that 20 is a multiple of 2 For the first ratio, find an equivalent ratio where the right-hand side is equal to 20 $(3x - 7) : 2 \times 10 = 10(3x - 7) : 20$ The left-hand sides of the two ratios must be equal $10(3x - 7) = 9x$ $30x - 70 = 9x$ $21x = 70$ $x = \frac{70}{21}$ Simplify if possible $x = \frac{10}{3}$ answer: $x = \frac{10}{3}$	U676

	Changing ratios	Identify what stays the same after the change (e.g. number of bees) Then use equivalent ratios.	In an insectarium, the ratio of ants to bees was 31 : 10. 20 ants then hatched and the ratio of ants to bees became 7 : 2. Work out how many ants and how many bees were in the insectarium to begin with. The number of bees stays the same Find equivalent ratios where the number of parts representing bees stays the same The number of parts representing ants increases by 4 but the actual increase in ants is 20 Multiply both ratios by 5 Start ants: bees 31 : 10 End ants: bees 7 : 2 31 : 10 → 35 : 10 (×1.5) 7 : 2 → 35 : 10 (×5) 35 - 31 = 4 175 : 50 175 - 155 = 20 Work out how many ants and bees the insectarium had at the start answer: 155 ants, 50 bees	U865																				
Velocity-time graphs	Calculating acceleration from velocity-time graphs	Acceleration is the rate of change of velocity. It is the gradient of a velocity time graph. The units of acceleration are usually m/s^2	This velocity-time graph shows the journey of a car. a) Find the acceleration of the car between 17 and 25 seconds. b) Find the acceleration of the car between 9 and 17 seconds. c) Find the average acceleration of the car during this journey. Speed-time and velocity-time graphs can be treated the same way acceleration = $\frac{\text{increase in velocity}}{\text{time taken}}$ a) Identify the time period from the question acceleration = $\frac{21 - 0}{25 - 17} = \frac{21}{8} = 2.125$ Remember units answer: a) $2.125 m/s^2$ b) The velocity does not change between 9 and 17 seconds, so the acceleration = $0 m/s^2$ c) average acceleration = $\frac{21 - 0}{25 - 0} = \frac{21}{25} = 0.84$	U562																				
	Plotting velocity-time graphs	A positive gradient indicates acceleration. A negative gradient indicates deceleration. A horizontal line (zero gradient) indicates the object is stationary or traveling at constant velocity.	An object starts from rest and travels with constant acceleration for 10 seconds to reach a velocity of 28 m/s. It travels at this velocity for 4 seconds, before decelerating at a constant rate to decrease its velocity by 12 m/s over 9 seconds. Draw the velocity-time graph of the object's journey. Draw the first part of the journey on the graph When an object is at rest, or stopped, its velocity is 0 After 10 seconds the object was travelling at 28 m/s Constant acceleration is shown by a straight line on the graph Draw the second part of the journey on the graph Constant velocity is shown by a horizontal line on the graph The object travels at constant velocity for 4 seconds So after 14 seconds the object was travelling at 28 m/s Draw the final part of the journey on the graph The object decreased its velocity by 12 m/s in 9 seconds So after 23 seconds the object was travelling at 16 m/s	U937																				
Cubic, reciprocal and exponential graphs	Graphs of cubic functions	Cubic graphs have up to 2 turning points.	By first completing the table of values, draw the graphs of $y_1 = 3x^3 - 6x + 1$ and $y_2 = -3x^3 + 6x - 1$ on the axes below. <table><tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td></tr><tr><td>y₁</td><td>-11</td><td>4</td><td>1</td><td>-2</td><td>13</td></tr><tr><td>y₂</td><td>11</td><td>-4</td><td>-1</td><td>2</td><td>-13</td></tr></table> For each equation: - Substitute each x value into the equation to find the corresponding y values - On the set of axes, mark the coordinates of each point in the table - Draw a smooth curve through the points	x	-2	-1	0	1	2	y ₁	-11	4	1	-2	13	y ₂	11	-4	-1	2	-13	U980		
x	-2	-1	0	1	2																			
y ₁	-11	4	1	-2	13																			
y ₂	11	-4	-1	2	-13																			
	Graphs of reciprocal functions	A reciprocal function is in the form $y = \frac{k}{x}$ Because the result of dividing a number by zero is undefined, the graph is discontinuous.	By first filling in the table of values, draw the graph of $y = -\frac{3}{x}$ on the axes below. <table><tr><td>x</td><td>-3</td><td>-2</td><td>-1.5</td><td>-1</td><td>0</td><td>1</td><td>1.5</td><td>2</td><td>3</td></tr><tr><td>y</td><td>1</td><td>1.5</td><td>2</td><td>3</td><td>undefined</td><td>-3</td><td>-2</td><td>-1.5</td><td>-1</td></tr></table> Draw a smooth curve through the points on either side of where the graph is undefined	x	-3	-2	-1.5	-1	0	1	1.5	2	3	y	1	1.5	2	3	undefined	-3	-2	-1.5	-1	U593
x	-3	-2	-1.5	-1	0	1	1.5	2	3															
y	1	1.5	2	3	undefined	-3	-2	-1.5	-1															

	Graphs of exponential functions*	An exponential function is in the form $y = ab^x$ When $b > 1$ the graph curves up steeply left to right. When $0 < b < 1$ the graph curves down left to right.	By first filling in the table of values, draw the graph of $y = (\frac{1}{4})^x$ on the axes given. Substitute each x value into the equation of the graph to find the corresponding y value <table><tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td></tr><tr><td>y</td><td>16</td><td>4</td><td>1</td><td>0.25</td><td>0.0625</td></tr></table> On the set of axes, mark the coordinates of each point in the table Draw a smooth curve through the points Graphs of the form $y = a^x$ don't intersect the x-axis 	x	-2	-1	0	1	2	y	16	4	1	0.25	0.0625	U229																		
x	-2	-1	0	1	2																													
y	16	4	1	0.25	0.0625																													
Sequences	Position-to-term rules for arithmetic sequences	A sequence is a list of numbers in a certain order. Each number in the sequence is a term. Arithmetic sequences have a common difference. They go up or down by the same amount each time. The n th term helps you to find any term in the sequence	The beginning of an arithmetic sequence is shown below. By first working out the n^{th} term rule, calculate the 11 th term of this sequence. Arithmetic sequences have a common difference between the terms Find the differences between the terms The number that n is multiplied by is the difference between the terms rule: $9n + ?$ <table><tr><td>n</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>Sequence</td><td>14</td><td>23</td><td>32</td><td>41</td></tr><tr><td>$9n$</td><td>9</td><td>18</td><td>27</td><td>36</td></tr><tr><td>Sequence - $9n$</td><td>5</td><td>5</td><td>5</td><td>5</td></tr></table> Subtract $9n$ from the sequence to find the rest of the rule rule: $9n + 5$ Substitute 11 into the rule to find the term $9 \times 11 + 5 = 99 + 5 = 104$ 104 ans	n	1	2	3	4	Sequence	14	23	32	41	$9n$	9	18	27	36	Sequence - $9n$	5	5	5	5	U498										
n	1	2	3	4																														
Sequence	14	23	32	41																														
$9n$	9	18	27	36																														
Sequence - $9n$	5	5	5	5																														
	Position-to-term rules for sequences of patterns	Terms in a sequence can also be patterns or shapes. Convert the pattern into a number sequence to find the n th term.	Evie makes a sequence of patterns using tiles. Use the rule to work out how many tiles there are in the 11 th pattern. Tiles in n^{th} pattern: $6n + 1$ <table><tr><td>Pattern number, n</td><td>1</td><td>2</td><td>3</td><td>...</td></tr><tr><td>Pattern</td><td></td><td></td><td></td><td>...</td></tr></table> The 11 th pattern is when the pattern number is 11 rule: $6n + 1$ Substitute 11 for n in the expression Do the multiplying Then do the adding $6 \times 11 + 1 = 66 + 1 = 67$ 67 ans	Pattern number, n	1	2	3	...	Pattern				...	U978																				
Pattern number, n	1	2	3	...																														
Pattern				...																														
	Position-to-term rules for geometric sequences	In a geometric sequence the next term is found by multiplying the term before it by a fixed number. The number you multiply by is called the common ratio.	The term-to-term rule for the sequence below is to start at 5 and multiply by 4 each time. Work out the next term in the sequence. <table><tr><td>5</td><td>20</td><td>80</td><td>...</td></tr><tr><td>$\times 4$</td><td>$\times 4$</td><td>$\times 4$</td><td></td></tr></table> Use the term-to-term rule to find the next term in the sequence $80 \times 4 = 320$ 320 ans	5	20	80	...	$\times 4$	$\times 4$	$\times 4$		U958																						
5	20	80	...																															
$\times 4$	$\times 4$	$\times 4$																																
Sequences (Higher Only)	Position-to-term rules for quadratic sequences	In a quadratic sequence the second difference is constant. If you halve the second difference you can find the coefficient of n^2 in the n th term.	A quadratic sequence begins 15, 24, 35, 48, 63, ... Quadratic sequences have n^2 terms containing n^2 Work out the n^{th} term rule for this sequence. Find the differences between the terms Find the second difference coefficient of $n^2 = \frac{\text{second difference}}{2}$ rule: $\frac{2}{2}n^2 + ? = n^2 + ?$ <table><tr><td>n</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr><tr><td>Sequence</td><td>15</td><td>24</td><td>35</td><td>48</td><td>63</td></tr><tr><td>n^2</td><td>1</td><td>4</td><td>9</td><td>16</td><td>25</td></tr><tr><td>Sequence - n^2</td><td>14</td><td>20</td><td>26</td><td>32</td><td>38</td></tr><tr><td>Sequence - $n^2 - 6n$</td><td>8</td><td>8</td><td>8</td><td>8</td><td>8</td></tr></table> Subtract n^2 from the sequence Then subtract the n term rule: $n^2 + 6n + 8$ ans Side working: 14, 20, 26, ...	n	1	2	3	4	5	Sequence	15	24	35	48	63	n^2	1	4	9	16	25	Sequence - n^2	14	20	26	32	38	Sequence - $n^2 - 6n$	8	8	8	8	8	U206
n	1	2	3	4	5																													
Sequence	15	24	35	48	63																													
n^2	1	4	9	16	25																													
Sequence - n^2	14	20	26	32	38																													
Sequence - $n^2 - 6n$	8	8	8	8	8																													

	Position-to-term rules for geometric sequences	The nth term for a geometric sequence is in the form $u_n = ar^{n-1}$ Where n is the position number, a is the first term and r is the common ratio.	The term-to-term rule for a sequence is to start at 3 and multiply by 11 each time. Below are some statements that describe terms in the sequence. Work out the missing index in each of the statements. a) Term 2 is given by $3 \times 11^{\square}$ b) Term 6 is given by $3 \times 11^{\square}$ c) Term n is given by $3 \times 11^{\square}$ Use the term-to-term rule to work forwards through the sequence Term 1 Term 2 Term 3 ... 3 33 363 ... Write each term as 3 multiplied by a power of 11 Term 1 Term 2 Term 3 ... Term n 3 3×11 $3 \times 11 \times 11$... $3 \times 11 \times 11 \times \dots \times 11$
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	Graphs of direct and inverse proportion	Direct and indirect proportion are easy to spot from their graphs.	Sketch the graphs to show the following relationships. a) y is directly proportional to x and when $x = 3, y = 15$. b) y is inversely proportional to x and when $x = 1, y = 2$. Recall the shape of the proportion graph y is directly proportional to x  y is inversely proportional to x  Sketch the graph with this shape that passes through the correct point	U238						
Proportion (Higher only)	Constructing direct proportion equations	Use the information in the question to write a direct proportion equation and use it to find any missing values. Direct proportion equations are in the form $y = kx$	When a marble is dropped it falls d metres in t seconds. d is directly proportional to t^2 It takes 4 seconds for the marble to fall 81.6 metres. How far, in metres, would it fall in 7 seconds?  Not to scale Write a proportion $d \propto t^2$ Write the proportion as an equation involving a constant, k Change the $\propto$ to $= k \times$ $d = k \times t^2$$d = kt^2$ Work out the value of k Make the substitutions $d = kt^2$$81.6 = k \times 4^2$$81.6 = k \times 16$$5.1 = k$ Rewrite the equation using this value $d = kt^2$$d = 5.1t^2$ Work out the value of d when $t = 7$ Make the substitution $d = 5.1t^2$$d = 5.1 \times 7^2$$d = 5.1 \times 49$$d = 249.9$ Remember units 249.9 m, <u>ans</u>	U407						
	Constructing inverse proportion equations	Use the information in the question to write a direct proportion equation and use it to find any missing values. Inverse proportion equations are in the form $y = \frac{k}{x}$	p is inversely proportional to v. Work out the missing value in the table below. <table><tr><th>p</th><th>v</th></tr><tr><td>23</td><td>11</td></tr><tr><td>?</td><td>5</td></tr></table> Write a proportion $p \propto \frac{1}{v}$ Write the proportion as an equation involving a constant, k Change the $\propto$ to $= k \times$ $p = k \times \frac{1}{v}$$p = \frac{k}{v}$ Work out the value of k Make the substitutions $p = \frac{k}{v}$$23 = \frac{k}{11}$$253 = k$ Rewrite the equation using this value $p = \frac{k}{v}$$p = \frac{253}{v}$ Work out the value of p when $v = 5$ Make the substitution $p = \frac{253}{v}$$p = \frac{253}{5}$$p = 50.6$ 50.6 <u>ans</u>	p	v	23	11	?	5	U138
p	v									
23	11									
?	5									
	Graphs of direct and inverse proportion	It is important to be able to recognise and use the graphs of direct and inverse proportion that involve squares, cubes, square roots and cube roots.	y is directly proportional to x  $y \propto x$ y is directly proportional to x^2  $y \propto x^2$ y is directly proportional to x^3  $y \propto x^3$ y is inversely proportional to x  $y \propto \frac{1}{x}$ y is inversely proportional to x^2  $y \propto \frac{1}{x^2}$ y is directly proportional to $\sqrt{x}$  $y \propto \sqrt{x}$	U238						

Unit	Topic/Skill	Definition/Tips	Example	Sparx Code
Transformations	Enlarging by a positive and negative scale factor	Enlargement changes the size of a shape. All of the sides are multiplied by a scale factor	a) Select all of the shapes which are enlargements of shape X. b) Which shape shows an enlargement of shape X by a scale factor of 3? Enlarging a shape changes its size. The lengths are all multiplied by a scale factor answer: a) A and D	U134
	Combining Transformations	Multiple transformations can be performed on a shape	What has changed? Identify the type of transformation that does this Sloping side swapped from left to right side of shape Shape moved down Reflection Translation answer: Reflection, Translation	U766
Rounding	Error Intervals	Identifying the smallest and/or biggest number that would round to a given number	I think of a number that has 3 decimal places. My number rounds to 21.73 to 2 decimal places. What is the smallest number that I could be thinking of? Use a number line Mark the values that round to 21.73 to 2 d.p. What is the smallest value? 21.725 ans	U657
	Bounds	Finding the error interval of the result of a calculation using rounded numbers	A number, x, rounded to 2 d.p. is 25.34 Another number, y, rounded to 2 d.p. is 17.68 What are the lower and upper bounds of $x - y$? Work out the lower bound of x $25.34 - 0.005 = 25.335$ Work out the upper bound of x $25.34 + 0.005 = 25.345$ Work out the lower bound of $x - y$ Subtract the upper bound of y from the lower bound of x lower bound = $25.335 - 17.685 = 7.65$ Work out the lower bound of y $17.68 - 0.005 = 17.675$ Work out the upper bound of y $17.68 + 0.005 = 17.685$ Work out the upper bound of $x - y$ Subtract the lower bound of y from the upper bound of x upper bound = $25.345 - 17.675 = 7.67$ answer: lower bound = 7.65, upper bound = 7.67	U587
Index Laws	Simplifying expressions using index laws	Index laws allow you to combine and simplify expressions involving indices	Fully simplify $(3k^{12})^3$ $(3k^{12})^3$ $= (3 \times k^{12})^3$ $= (3)^3 \times (k^{12})^3$ $= 27 \times k^{(12 \times 3)}$ $= 27 \times k^{36}$ $= 27k^{36} \text{ ans}$ $(x \times y)^a = x^a \times y^a$ $(x^a)^b = x^{(a \times b)}$	U662

Brackets	Expanding and factorising brackets	When expanding double brackets every term in the first bracket must be multiplied by every term in the second	Expand and simplify $(x - 4)(12x + 5)$ Multiply each term in the <u>first set of brackets</u> by each term in the <u>second set of brackets</u> Use the <u>eyebrows</u> to help $(x-4)(12x+5)$ $= x \times 12x + x \times 5 + -4 \times 12x + -4 \times 5$ $= 12x^2 + 5x - 48x - 20$ $= 12x^2 - 43x - 20$ Collect like terms $12x^2 - 43x - 20$, <u>ans</u>	U768, U178
Recurring Decimals (H)	Fractions and recurring decimals	All recurring decimals can be written as fractions	Convert 0.021 to a fraction in its lowest terms. Call the value x and write it out with a few copies of the recurring pattern $x = 0.021021021...$ There are <u>three</u> recurring digits so multiply by 10 <u>three</u> times $10 \times 10 \times 10 = 1000$ Subtract these values to get rid of the recurring part of the decimal $1000x - x = 21.021021... - 0.021021...$ $999x = 21$ Solve to find x $x = \frac{21}{999}$ Simplify the fraction $x = \frac{21}{999} = \frac{7}{333}$ <u>7</u> <u>333</u> <u>ans</u>	U550, U689
Handling Data and Statistical Diagrams	Grouped data and averages	A frequency table can be used to help summarize large sets of data.	Marco measured the height, x, of each of the students in his class. He recorded the heights in the table below. Calculate an estimate of the mean height of the students. mean = <u>sum of values</u> ÷ <u>number of values</u> Find the midpoint of each interval Find half of the difference and add this to the smaller value Use the midpoint to estimate the total for each column Add the column totals together to estimate the <u>total height</u> Add the frequencies to find the <u>number of students</u> Estimate the mean Remember units (cm) <u>163 cm</u>, <u>ans</u>	U877
	Drawing and interpreting statistical diagrams	Diagrams can provide a better visual representation of data	The frequency polygon shows information about the masses of all the boxes in a warehouse. How many boxes are in the warehouse in total? Frequency polygons show the midpoint of each interval against its frequency Read the frequency of each point from the frequency polygon $4 + 5 + 11 + 14 + 2 = 36$ Add the frequencies together to find the total answer: <u>36</u>	U200, U590, U840, U642, U879
Factors, Multiples and Primes (F)	HCF and LCM	The highest common factor (HCF) is the biggest number that goes into a set of numbers. The lowest common multiple (LCM) is the smallest number that a set of numbers go into	The prime factor tree for 450 is given below. Draw the prime factor tree for 825 and use it to work out the highest common factor (HCF) of 825 and 450. Draw the prime factor tree for 825 Draw a Venn diagram showing the prime factors of each number Put the numbers that are prime factors of both numbers in the overlapping section Prime factors of 450: 2, 3, 3, 5, 5, 5 Prime factors of 825: 3, 5, 5, 11 The HCF is equal to the product of the <u>common prime factors</u> $\text{HCF}(450, 825) = 3 \times 5 \times 5 = 75$ <u>75</u>, <u>ans</u>	U751, U529, U250

Fractions (F)	Fractions and mixed numbers	Fractions greater than 1 can be represented as mixed numbers	Slices of cake are being sold at a bake sale. In total, Jenny sells $4\frac{7}{10}$ cakes and Herman sells $6\frac{4}{5}$ cakes. How many more cakes does Herman sell? Give your answer as a mixed number. Find the calculation $6\frac{4}{5} - 4\frac{7}{10}$ Convert the fractions so they have the same denominator $= 6\frac{8}{10} - 4\frac{7}{10}$ Check that the first fraction is bigger than the second fraction $\frac{8}{10}$ is more than $\frac{7}{10}$ ✓ Subtract the whole numbers $6 - 4 = 2$ Subtract the fractions $\frac{8}{10} - \frac{7}{10} = \frac{1}{10}$ Write as a mixed number $2\frac{1}{10}$ <u>ans</u>	U439, U793, U224, U538
Expressions (F)	Simplifying expressions	Algebraic expressions can be simplified by collecting like terms, using the index laws and by cancelling common factors	Fully simplify $(9r^{-3}t^{10})^2$. Give your answer without any negative indices. $\begin{aligned} (9r^{-3}t^{10})^2 &= (9 \times r^{-3} \times t^{10})^2 \\ &= (9)^2 \times (r^{-3})^2 \times (t^{10})^2 \\ &= 81 \times r^{-6} \times t^{20} \\ &= 81 \times \frac{1}{r^6} \times t^{20} \\ &= \frac{81t^{20}}{r^6} \end{aligned}$ <u>ans</u> $(x \times y)^a = x^a \times y^a$ $(x^a)^b = x^{(a \times b)}$ $x^{-a} = \frac{1}{x^a}$	U662, U103
Equations (F)	Solving Equations	Solving an equation means finding the value(s) of an unknown variable that make the equation true	Solve $11x + 10 = 7x + 6$ Get x on its own Write out the equation $\begin{array}{rcl} 11x + 10 & = & 7x + 6 \\ -7x & & -7x \\ \hline 4x + 10 & = & 6 \\ -10 & & -10 \\ \hline 4x & = & -4 \\ \div 4 & & \div 4 \\ \hline x & = & -1 \end{array}$ <u>ans</u> Always do the same thing to both sides of an equation	U870 U228
	Simultaneous Equations	If there is more than 1 unknown, then you will need to solve more than 1 equations simultaneously	Solve the simultaneous equations below. ① $8y + 5x = 40$ ② $10y + 9x = 61$ Eliminate one of the variables eliminate y Multiply each equation by a constant so we have two equations with the same number in front of the y $\begin{array}{rcl} \text{①} & 8y + 5x = 40 & \times 5 \\ \text{③} & 40y + 25x = 200 & \\ \text{②} & 10y + 9x = 61 & \times 4 \\ \text{④} & 40y + 36x = 244 & \\ \hline & 40y + 25x = 200 & \\ & 40y + 36x = 244 & \\ \hline & 0 + 11x = 44 & \\ & x = 4 & \end{array}$ Subtract equation ③ from equation ④ Solve to find x Substitute the value of x into one of the original equations and solve for y $\begin{array}{rcl} \text{①} & 8y + 5x = 40 & \\ & 8y + 5(4) = 40 & \\ & 8y + 20 = 40 & \\ & 8y = 20 & \\ & y = 2.5 & \end{array}$ Side working $\begin{array}{r} 21 \\ \times 5 \\ \hline 105 \end{array}$ Side working $\begin{array}{r} 21 \\ \times 5 \\ \hline 105 \end{array}$ answer: $x = 4$ and $y = 2.5$	U760, U757
Surds (H)	Multiplying and dividing surds	Surds can be multiplied and divided by multiplying or dividing the numbers inside the root.	Calculate the value of y in the following equality: $\frac{\sqrt{21} \times \sqrt{5}}{\sqrt{7}} = \sqrt{y}$ Write the left-hand side as a single root $\sqrt{a \times b} = \sqrt{a \times b}$ $\frac{\sqrt{21} \times \sqrt{5}}{\sqrt{7}} = \sqrt{\frac{21 \times 5}{7}} = \sqrt{15}$ Compare the numbers inside the roots $\sqrt{15} = \sqrt{y}$ <u>ans</u>: $y = 15$ Side working $\begin{array}{r} 21 \\ \times 5 \\ \hline 105 \end{array}$	U633

	Simplifying surds	Surds can be simplified if the number in the surd has a square number as a factor	Fully simplify $\sqrt{162}$ Write 162 as a factor pair containing the highest possible square number $\sqrt{a} \times \sqrt{b} = \sqrt{a \times b}$ Write the answer without a multiplication sign $\begin{aligned}\sqrt{162} &= \sqrt{81 \times 2} \\ &= \sqrt{81} \times \sqrt{2} \\ &= 9 \times \sqrt{2} \\ &= 9\sqrt{2}\end{aligned}$ Side working $\begin{aligned}2^2 &= 4 \\ 3^2 &= 9 \\ 4^2 &= 16 \\ 5^2 &= 25 \\ 6^2 &= 36 \\ 7^2 &= 49 \\ 8^2 &= 64 \\ 9^2 &= 81 \\ 10^2 &= 100 \\ &\dots\end{aligned}$ answer: $9\sqrt{2}$	U338
	Adding and subtracting surds	Surds with the same numbers under the roots can be added or subtracted	Fully simplify $2\sqrt{6} + 8\sqrt{13} + 9\sqrt{6}$ We can only collect terms which contain the same number inside their roots Simplify each term if possible not possible $2\sqrt{6} + 8\sqrt{13} + 9\sqrt{6}$ Collect terms which have the same number inside their roots $= 2\sqrt{6} + 9\sqrt{6} + 8\sqrt{13}$ $= 11\sqrt{6} + 8\sqrt{13}$ Side working $\begin{aligned}2^2 &= 4 \\ 3^2 &= 9 \\ 4^2 &= 16 \\ &\dots\end{aligned}$ answer: $11\sqrt{6} + 8\sqrt{13}$	U872
	Expanding brackets with surds	Expressions with brackets including surds can be multiplied out or expanded	Expand and fully simplify $\sqrt{11}(\sqrt{11} + \sqrt{10})$ Expand the brackets Multiply the term outside the brackets by each term inside $\sqrt{11}(\sqrt{11} + \sqrt{10})$ Simplify each term $\sqrt{a} \times \sqrt{a} = a$ $\sqrt{a} \times \sqrt{b} = \sqrt{a \times b}$ Check if we can simplify further $= 11 + \sqrt{110}$ answer: $11 + \sqrt{110}$	U499
	Rationalising denominators	A fraction with a surd in the denominator can be simplified so that the denominator is an integer	Rationalise the denominator of $\frac{\sqrt{15}}{\sqrt{15} + 3}$ Give your answer in its simplest form. Step 4: Expand any remaining brackets and simplify $\frac{\sqrt{15}(\sqrt{15} - 3)}{6} = \frac{\sqrt{15} \times \sqrt{15} - 3\sqrt{15}}{6}$ $\sqrt{a} \times \sqrt{a} = a$ $= \frac{15 - 3\sqrt{15}}{6}$ Factorise the numerator $= \frac{3(5 - \sqrt{15})}{6}$ and simplify, we get 5 minus root 15 all over 2. answer: $\frac{5 - \sqrt{15}}{2}$	U707, U281
Algebraic fractions	Simplifying algebraic fractions by factorising	Factorising the numerator and denominator will help to identify any common factors	Write $\frac{7d(11h+9)}{84d}$ as a fraction in its simplest form. $\frac{7d(11h+9)}{84d} = \frac{7 \times d \times (11h+9)}{84 \times d}$ Cancel the coefficients Divide by the highest common factor 7 $\frac{7 \times d \times (11h+9)}{84 \times d} = \frac{1 \times d \times (11h+9)}{12 \times d}$ Cancel the powers of d $\frac{d \times (11h+9)}{12 \times d} = \frac{1 \times (11h+9)}{12 \times 1}$ Multiplying an expression by 1 doesn't change it $= \frac{11h+9}{12}$ answer: $\frac{11h+9}{12}$	U437, U294
	Adding and subtracting algebraic fractions	Just like with ordinary fractions, you need a common denominator when adding or subtracting	Write $\frac{y+3}{6} - \frac{2y}{7}$ as a single fraction in its simplest form. Convert the fractions to equivalent fractions with the same denominator Use the lowest common multiple (LCM) of 6 and 7 for the common denominator LCM (6, 7) = 42 $\frac{y+3}{6} - \frac{2y}{7} = \frac{7(y+3)}{42} - \frac{12y}{42}$ Numerators can be added and subtracted when they are over the same denominator $= \frac{7(y+3) - 12y}{42}$ Expand the brackets $= \frac{7y + 21 - 12y}{42}$ Simplify the numerator $= \frac{21 - 5y}{42}$ Can the fraction be simplified further? No Side working $\frac{y+3}{6} \times \frac{7}{7} = \frac{7(y+3)}{42}$ $\frac{2y}{7} \times \frac{6}{6} = \frac{12y}{42}$ answer: $\frac{21 - 5y}{42}$	

		algebraic fractions		
	Multiplying algebraic fractions	Multiply the numerators and denominators and simplify if necessary	Write the expression below as a fraction in its simplest form. $\frac{7f}{10(f-11)} \times \frac{f-11}{4}$ $\frac{7f}{10(f-11)} \times \frac{f-11}{4} = \frac{7f \times (f-11)}{10(f-11) \times 4}$ Cancel any <u>common factors</u> that appear in both the numerator and denominator $= \frac{7f \times \cancel{(f-11)}}{10 \cancel{(f-11)} \times 4}$ $= \frac{7f}{10 \times 4}$ $= \frac{7f}{40}$ Check the answer is fully simplified ✓ $\frac{7f}{40}$ <u>ans</u>	U178
	Dividing algebraic fractions	When dividing fractions, multiply by the reciprocal, i.e. multiply by the second fraction 'flipped'	Work out $\frac{7y^{13}}{z^9} \div \frac{12}{y^{11}z^{20}}$. Give your answer as a fraction in its simplest form. Write the division as a multiplication Change the $\div$ to $\times$ Flip the second fraction $\frac{7y^{13}}{z^9} \div \frac{12}{y^{11}z^{20}} = \frac{7y^{13}}{z^9} \times \frac{y^{11}z^{20}}{12}$ Simplify the fraction if possible Cancel the <u>variables</u> $x^a \div x^b = x^{(a-b)}$ $x^a \times x^b = x^{(a+b)}$ Side working $z^{20} \div z^9 = z^{(20-9)}$ $= z^{11}$ $y^{13} \times y^{11} = y^{(13+11)}$ $= y^{24}$ $= \frac{7 \times y^{13} \times y^{11} \times \cancel{z^{20}}}{1 \times 12 \times \cancel{z^9} \times z^{11}}$ $= \frac{7 \times y^{13} \times y^{11} \times z^{11}}{12}$ $= \frac{7y^{24}z^{11}}{12}$ Check that the answer is fully simplified ✓ $\frac{7y^{24}z^{11}}{12}$ <u>ans</u>	U858