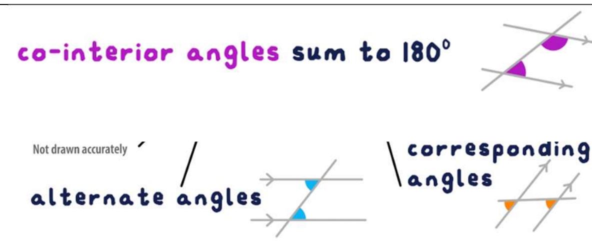
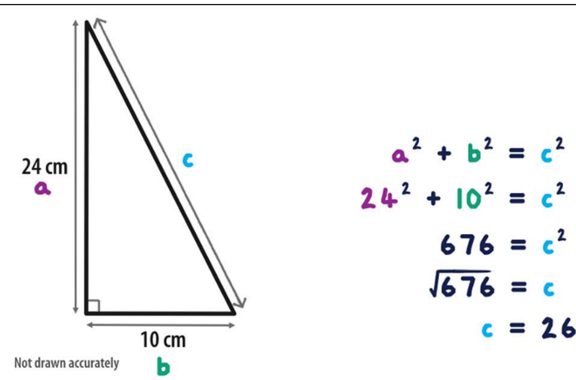
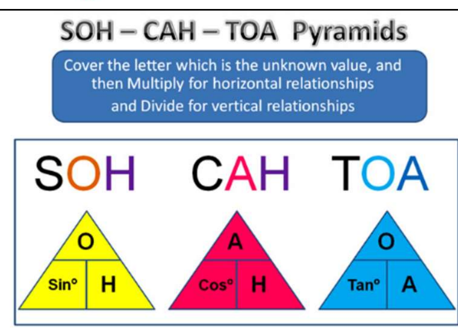
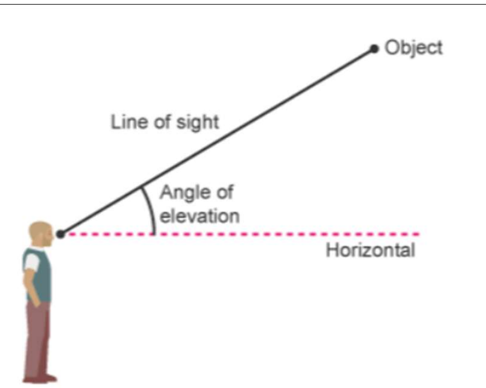
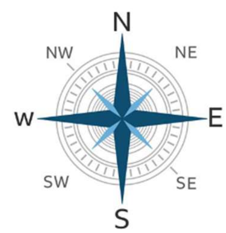
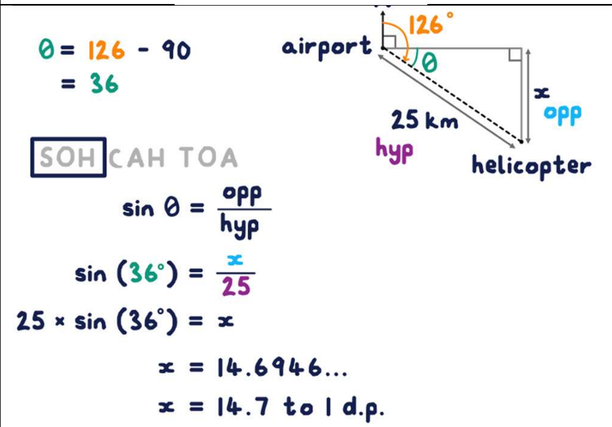
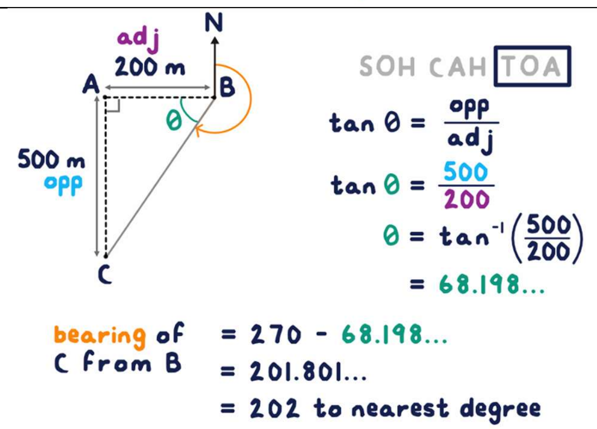
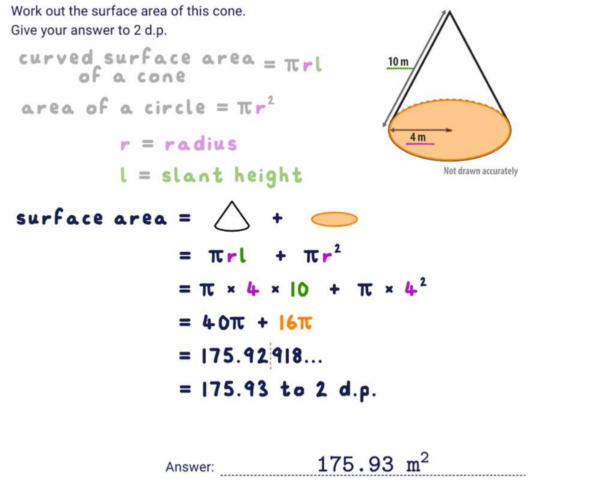
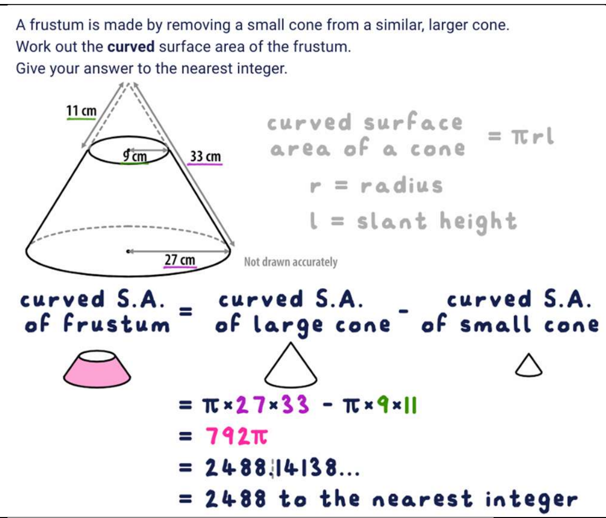
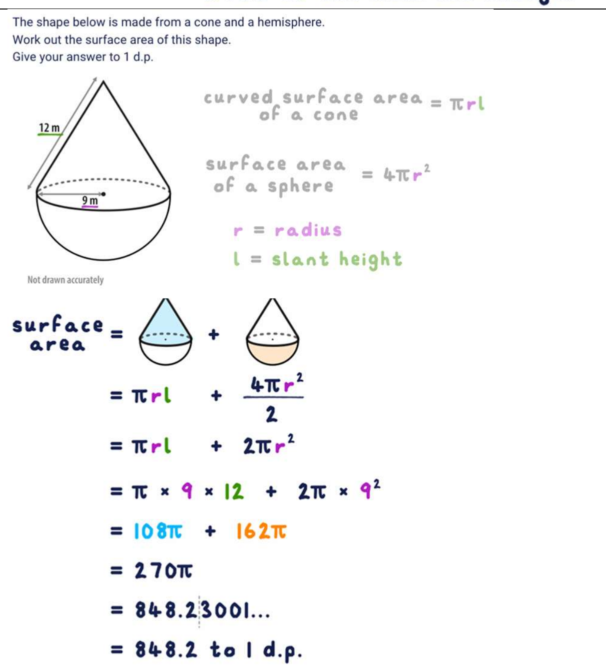
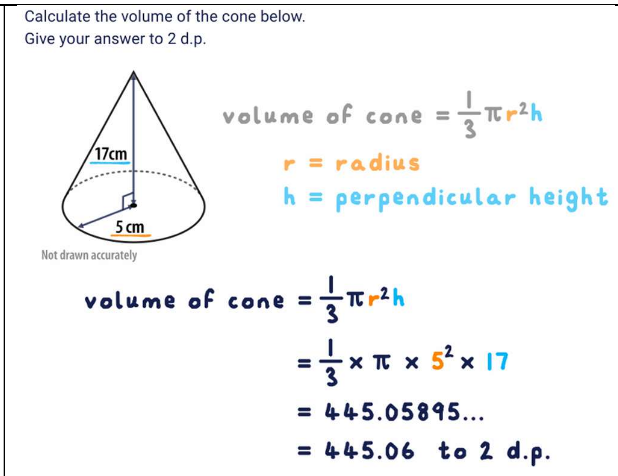
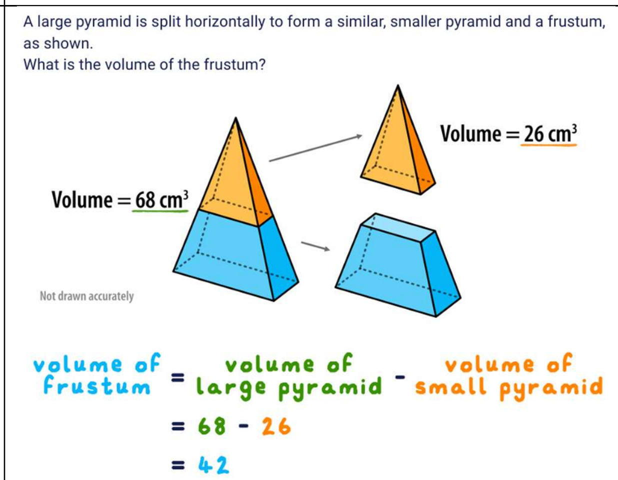
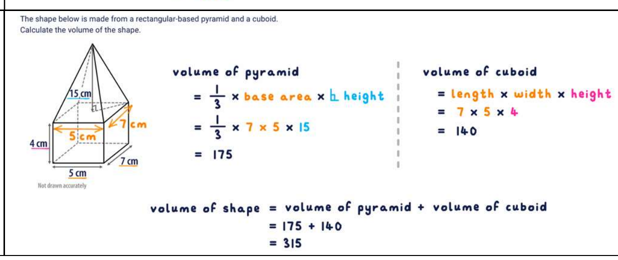
Maths Knowledge Organiser

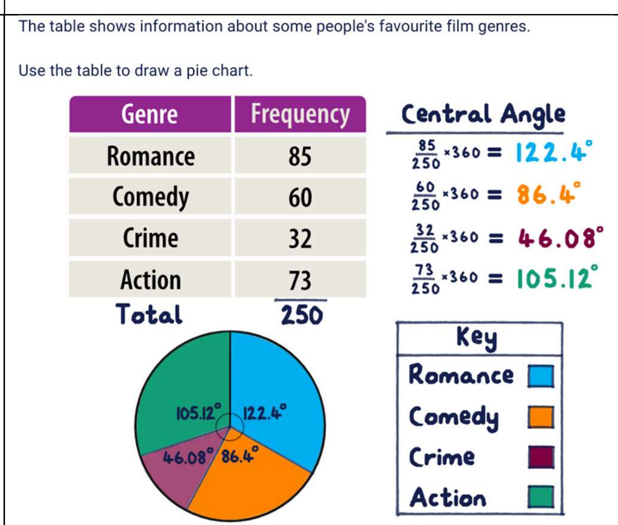
Year: 11 Term: Autumn (1 and 2)

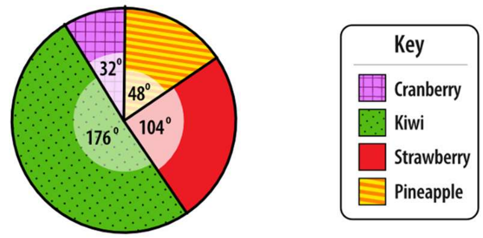
Unit	Topic/Skill	Definition/Tips	Example	Sparx Code
Angles	Combine angle facts	Learn the facts as full sentences to use in all answer reasoning.	angles in a triangle sum to 180°	U655
	Angles on parallel lines	Use the arrow notation to identify all parallel line. Extend or add extra lines to make other polygons.		U826
	Using Quadrilateral properties		angles in a quadrilateral sum to 360°	U329
	Angles in Polygons			U427
Right-angle triangles	Apply Pythagoras' Theorem in 2D shapes	Identify the longest side (Hypotenuse) which is opposite the Right angle		U385
	Apply Trigonometry to find missing angles			U545
	Apply Trigonometry to find missing sides			U283

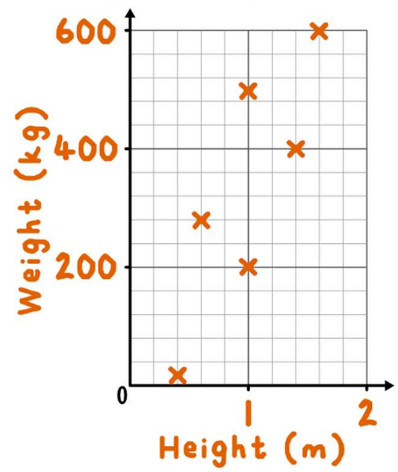
	Angles of elevations and depressions	Use the Parallel line angle rules to find corresponding and alternate angles.		U967
	Calculate bearings	Measure from North, clockwise and with 3 digits		U107
	Use trigonometry and bearings			U164
	Use exact values of Trigonometry	You can use the fingers on your hand to find them		U627

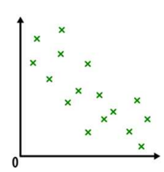
Unit	Topic/Skill	Definition/Tips	Example	Sparx Code
Surface Area	Finding the surface area of cones and spheres	The surface area of a cone is given by $\pi r l + \pi r^2$ The surface area of a sphere is given by $4\pi r^2$		U771
	Finding the surface area of frustums	Generally consider the area of the whole pyramid/cone and subtract the surface area of the piece removed from the top		U334
	Finding the surface area of composite shapes	Divide the shape and consider the surface area of each part		U561

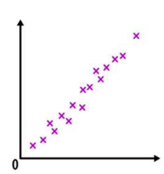
Volume	Finding the volume of cones and spheres	The volume of a cone is given by $\frac{1}{3}\pi r^2 h$ The volume of a sphere is given by $\frac{4}{3}\pi r^3$		U426
	Finding the volume of frustums	Find the volume of the whole pyramid/cone and subtract the volume of the pyramid/cone removed from the top		U350
	Find the volume of composite shapes	Divide the shape and consider the volume of each part		U543

Unit	Topic/Skill	Definition/Tips	Example	Sparx Code
Statistical diagrams	Drawing pie charts	The angles in a pie chart are proportional to the frequency		U508

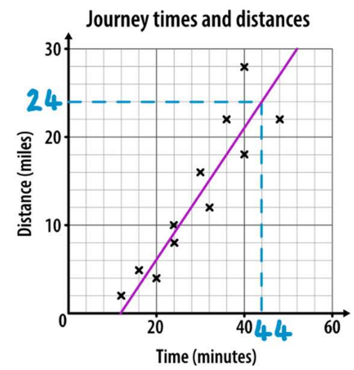
<table>
<tr>
<td></td>
<td>Interpreting pie charts</td>
<td>Pie charts are beneficial for visualising proportions</td>
<td>
45 children answered a question about their favourite fruit drink.
How many children said their favourite fruit drink was pineapple?
Favourite fruit drink


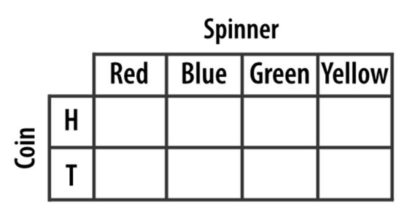
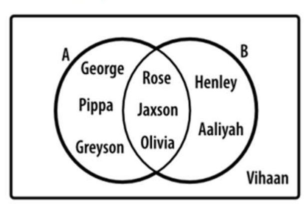
÷ 45 360° represents 45 children ÷ 45
8° represents 1 child
× 6 48° represents 6 children × 6
</td>
<td>U172</td>
</tr>
<tr>
<td></td>
<td>Plotting scatter graphs</td>
<td>Scatter graphs can be used to identify relationships and correlation between two sets of data</td>
<td>
The heights and weights of 6 farm animals are shown in the table.
<table>
<tr><td>Height (m)</td><td>0.4</td><td>0.6</td><td>1</td><td>1</td><td>1.4</td><td>1.6</td></tr>
<tr><td>Weight (kg)</td><td>20</td><td>280</td><td>200</td><td>500</td><td>400</td><td>600</td></tr>
</table>
Plot this data on a scatter graph.
Heights and weights of farm animals


</td>
<td>U199</td>
</tr>
<tr>
<td></td>
<td>Interpreting scatter graphs</td>
<td></td>
<td>
Write down the type of correlation shown in each of the scatter graphs.
a)


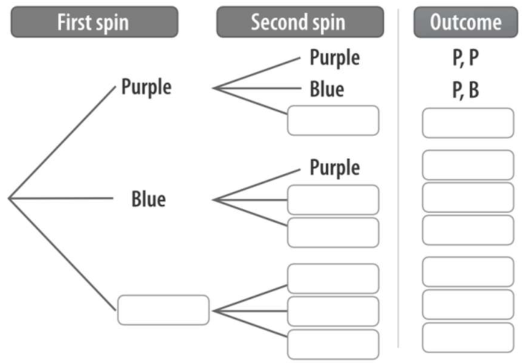
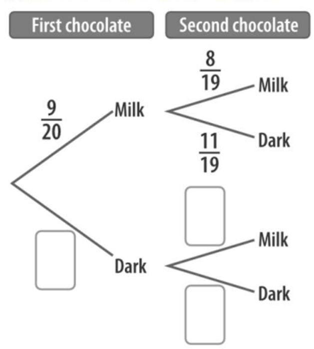
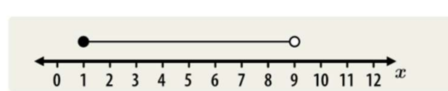
Answer: Weak negative correlation
b)


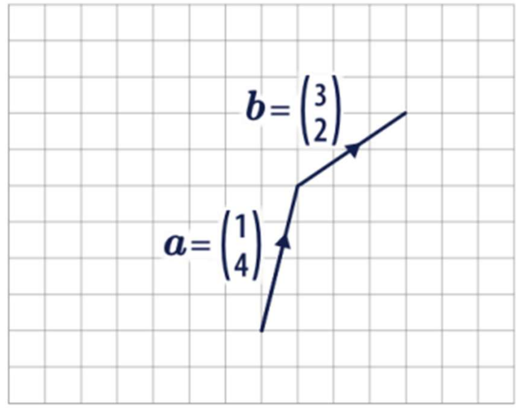
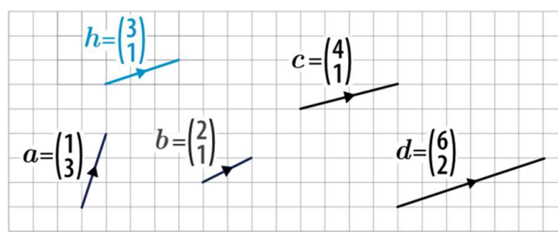
Answer: Strong positive correlation
</td>
<td>U277</td>
</tr>
</table>

	Using lines of best fit	Lines of best fit can be used to estimate values based on the relationship between sets of data	The scatter graph shows the time taken and distance travelled for 11 journeys.  a) Draw a line of best fit on the scatter graph above. b) Estimate the time it would take for a 24 mile journey. Answer: 44 minutes	U128

Unit	Topic/Skill	Definition/Tips	Example	Sparx Code
Probability	Probabilities of mutually exclusive events	Events that cannot occur at the same time.	Which of the pairs of events below are mutually exclusive? A: Winning and losing the same football match. B: Wearing a jacket and wearing glasses. C: Getting an odd number and an even number in one roll of a fair six-sided dice. D: Getting an odd number and a number less than 5 in one roll of a fair six-sided dice.	U683
	Sample space diagrams	Table that holds all possible outcomes	Anya has a fair coin and a fair four-sided colour spinner. She flips the coin and spins the spinner. a) Complete the sample space diagram to show all the possible outcomes. 	U104
	Expected results from repeated experiments	Using probability facts to inform predictions	The probability that a school lunch will include pasta is $\frac{5}{7}$. How many school lunches would you expect to include pasta if you had 21 school lunches?	U166
	Venn diagrams with set notation	Interpreting and drawing Venn	The venn diagram shows information about the students in a class. $A = \{\text{students who own a bicycle}\}$ $B = \{\text{students who own a pet}\}$  a) Describe the students in $A \cap B$	U748

<table>
<tr><td></td><td>Using set notation</td><td>Using set notation to process data.</td><td>The sets A and B are defined below.
$A = \{1, 2, 5, 9, 10, 13, 19\}$
$B = \{2, 3, 4, 5, 7, 13, 14\}$

List the members of $A \cap B$</td><td>U296</td></tr>
<tr><td></td><td>Tree diagrams for independent events</td><td>Using Tree Diagram to allocate probability for each outcome</td><td>A coloured spinner with purple, blue and yellow sections is spun twice.
Complete the tree diagram below to show all the possible outcomes.
How many possible outcomes are there?

</td><td>U558</td></tr>
<tr><td></td><td>Tree diagrams for dependent events</td><td>Allocated probability to the diagram to calculate likelihood.</td><td>A box of chocolates contains 9 milk chocolates and 11 dark chocolates.
A chocolate is selected at random, eaten, and then another chocolate is selected at random.
Complete the tree diagram to show the correct probabilities.

</td><td>U729</td></tr>
<tr><td></td><td>Calculating experimental probabilities</td><td>Using stated probability to predict outcome</td><td>Amelia spun a spinner with five coloured sections several times.
The table below shows how many times the spinner landed on each colour.<table><tr><td>Colour</td><td>Green</td><td>Red</td><td>Yellow</td><td>Black</td><td>Pink</td></tr><tr><td>Frequency</td><td>8</td><td>10</td><td>12</td><td>3</td><td>7</td></tr></table></td><td>U580</td></tr>
<tr><td>Inequalities</td><td>Solving inequalities with the unknown on both sides</td><td>Comparison of two values or expressions, showing that they are not strictly equal</td><td>Solve $5h \geq 36 - 4h$</td><td>U738</td></tr>
<tr><td></td><td>Solving double inequalities</td><td>Using number-line to show inequality</td><td>Write down the inequality shown on each of the number lines below.
a)

</td><td>U145</td></tr>
<tr><td></td><td>Constructing and solving inequalities</td><td>To use algebraic skills to solve</td><td>a) When a number, x, is added to 26, the total is greater than 64.
Write this as an inequality and solve for x.</td><td>U337</td></tr>
</table>

Vectors	Adding and subtracting column vectors	To add /sub column vectors	Calculate **a** + **b** Give your answer as a column vector. 	U903
	Multiplying column vectors by a scalar	To use algebraic knowledge to multiply vectors	$\boldsymbol{a} = \begin{pmatrix}9\\2\end{pmatrix}$ Write $3\boldsymbol{a}$ as a column vector.	U564
	Identifying parallel vectors	Focus on positive / negative direction	Which vector below is parallel to $\boldsymbol{h}$? 	U660

Maths Knowledge Organiser

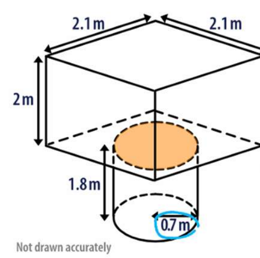
Year: 11 Term: Spring (3 and 4)

Unit	Topic/Skill	Definition/Tips	Example	Sparx Code
Percentages	Percentage change with a calculator	Definition: A percentage increase or decrease can be found using a multiplier. Tip: Increase by p% → multiply by 1 + p/100. Decrease by p% → multiply by 1 - p/100. Example: 146% = 1.46.	Increase 21 by 46% $100\% + 46\% = 146\%$ $146 \div 100 = 1.46$ 146% of $21 = 1.46 \times 21$ $= 30.66$	U671
Percentages	Finding original values in percentage calculations	Definition: To find the original value, divide the given amount by the percentage multiplier. Tip: If you know p% of the original, turn p% into a decimal first. Example: if 9% = 684, then original = 684 ÷ 0.09.	9% of a value is 684 Work out the original value. $9 \div 100 = 0.09$ 9% of original $= 684$ $\div 0.09$ | $0.09 \times$ original $= 684$ | $\div 0.09$ original $= 7600$	U286
Percentages	Finding the percentage an amount has been changed by	Definition: Percentage change = (difference ÷ original value) × 100. Tip: Always use the original value in the denominator, then say whether the change is an increase or a decrease.	percentage change $= \frac{\text{difference}}{\text{original value}} \times 100$ $= \frac{96 - 80}{80} \times 100$ $= \frac{16}{80} \times 100$ $= 0.2 \times 100$ $= 20\ \%$	U278

Percentages	Compound interest calculations	Definition: Compound interest means interest is added each time period, so you earn interest on the new total. Tip: Use amount = principal × (multiplier)^n, where n is the number of periods; or keep multiplying by the same multiplier each year.	A bank account starts with a balance of £10 000 and pays compound interest at a rate of 4% per year. Work out the balance of the account a) after 1 year. 100% + 4% = 104% 104 ÷ 100 = 1.04 balance after 1 year = 104% of 10000 = 1.04 × 10000 = 10400 Answer: £ 10 400 b) after 2 years. balance after 2 years = 104% of 10400 = 1.04 × 10400 = 10816 Answer: £ 10 816	U332
Percentages	Growth and decay	Definition: Growth and decay are repeated percentage changes. Growth has a multiplier greater than 1; decay has a multiplier between 0 and 1. Tip: In a formula such as value = 400 × 1.21^n, the original value is when n = 0.	The value of a painting n years after it was painted is given by this formula: value in pounds (£) $= 400 \times 1.21^n$ a) What was the original value of the painting? when n = 0 value = 400×1.21^0 = 400 Answer: £ 400 b) By what percentage does the value of the painting increase each year? 1.21 = 121% = 100% + 21% Answer: 21 % c) How much will the painting be worth 11 years after it was painted? Give your answer to the nearest pound. when n = 11 value = 400×1.21^{11} = 3256.109... = £3256 to nearest £1 Answer: £ 3256	U988

Compound measure	Calculating with speed	Definition: Speed = distance ÷ time. Tip: Keep units consistent. Convert minutes to hours before substituting, and rearrange carefully for distance or time.	A bus travelled $240\,\text{km}$ in 4 hours. Calculate the average speed of the bus. $\text{speed (km/h)} = \dfrac{\text{distance (km)}}{\text{time (h)}} = \dfrac{240}{4} = 60$ Peter leaves work at 16:40. He drives 45 miles from work to home at an average speed of $30\,\text{mph}$. At what time does he arrive home? $\text{speed} = \dfrac{\text{distance}}{\text{time}}$ $\text{time (h)} = \dfrac{\text{distance (miles)}}{\text{speed (mph)}} = \dfrac{45}{30} = 1.5$ 1.5 hours = 1 hour 30 minutes start time: 16:40 $\xrightarrow{+1\text{ hour}}$ 17:40 $\xrightarrow{+30\text{ mins}}$ 18:10 :end time Answer: 18:10 Rose drove from home to the shop at an average speed of $24\,\text{mph}$ for 30 minutes. She then drove from the shop to the lake at an average speed of $41\,\text{mph}$ for 2 hours. Work out how many miles Rose drove in total. $\text{speed} = \dfrac{\text{distance}}{\text{time}}$ Journey 1: 30 minutes = 0.5 hours $\underset{\text{(miles)}}{\text{distance}} = \underset{\text{(mph)}}{\text{speed}} \times \underset{\text{(h)}}{\text{time}} = 24 \times 0.5 = 12$ Journey 2: $\underset{\text{(miles)}}{\text{distance}} = \underset{\text{(mph)}}{\text{speed}} \times \underset{\text{(h)}}{\text{time}} = 41 \times 2 = 82$ Total distance: $12 + 82 = 94$ Answer: 94 miles	U151

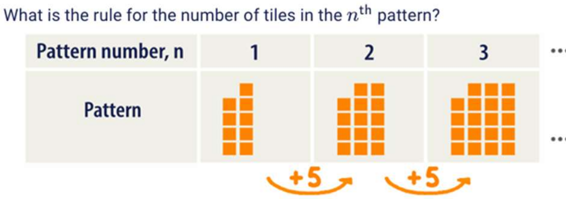
Compound measure	Calculating with rates	Definition: A rate compares one quantity with another, for example per hour, per minute or per item. Tip: rate = amount ÷ time, amount = rate × time, time = amount ÷ rate.	Janet laid 120 bricks in 3 hours. Calculate the rate at which Janet laid bricks. Give your answer in bricks per hour. $\text{rate (bricks/h)} = \frac{\text{amount (bricks)}}{\text{time (h)}} = \frac{120}{3} = 40$ Louis is paid $£12$ per hour. How much will he be paid for working 1 hours and 30 minutes? 1 hour 30 minutes = 1.5 hours $\text{rate} = \frac{\text{money paid}}{\text{time}}$ $\text{money paid (£)} = \text{rate (£/h)} \times \text{time (h)} = 12 \times 1.5 = 18$	U256
Compound measure	Calculating with density	Definition: Density = mass ÷ volume. Tip: Check the units (for example g/cm^3 or kg/m^3). Rearrange carefully: mass = density × volume and volume = mass ÷ density.	A glass statue has a volume of $42\ cm^3$ and a mass of $105\ g$. Work out the density of the statue. $\text{density } (g/cm^3) = \frac{\text{mass}(g)}{\text{volume}(cm^3)} = \frac{105}{42} = 2.5$ The density of some copper is $8.96\ g/cm^3$. What is the mass of $70\ cm^3$ of this copper? $\text{density} = \frac{\text{mass}}{\text{volume}}$ $\text{mass}(g) = \text{density}(g/cm^3) \times \text{volume}(cm^3) = 8.96 \times 70 = 627.2$ A cuboid has a length of $4\ cm$ and a width of $5\ cm$. Given that its density is $40\ g/cm^3$ and its mass is $2400\ g$, calculate the height of the cuboid. $\text{density} = \frac{\text{mass}}{\text{volume}}$ $\text{volume}(cm^3) = \frac{\text{mass}(g)}{\text{density}(g/cm^3)} = \frac{2400}{40} = 60$ volume of cuboid = length × width × height $60 = 4 \times 5 \times \text{height}$ $\div 20 \quad 60 = 20 \times \text{height} \quad \div 20$ $3 = \text{height}$ Answer: 3 cm	U910

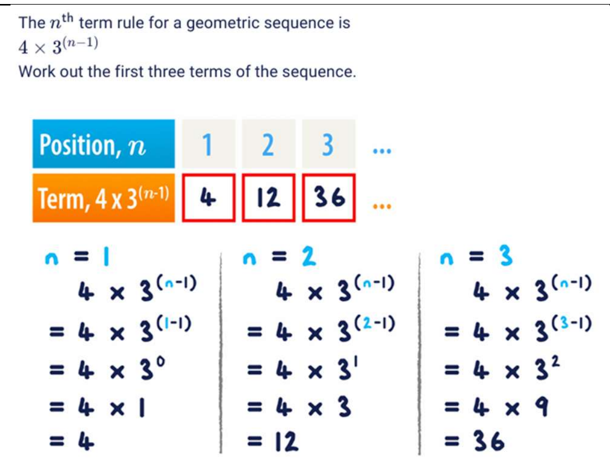
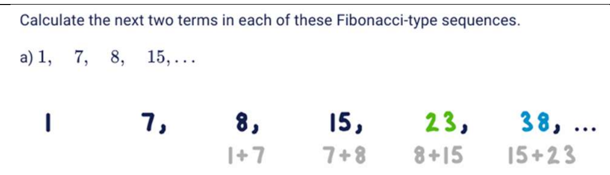
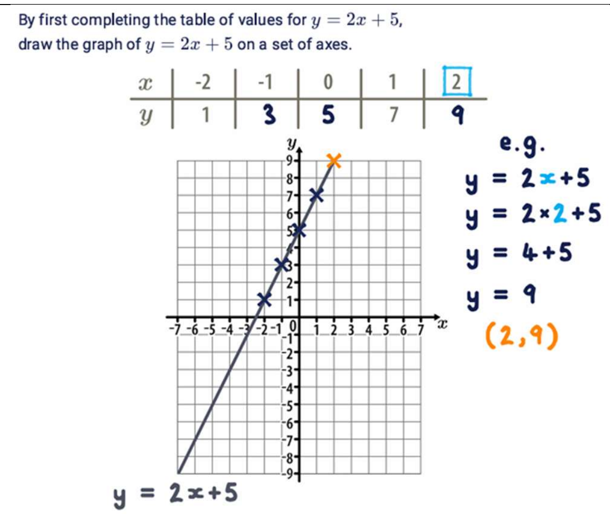
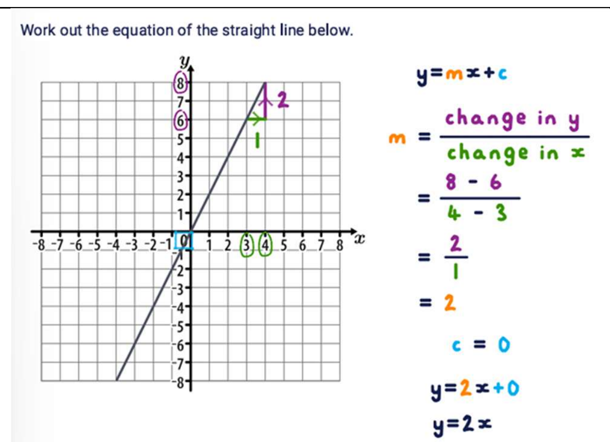
Compound measure	Calculating with pressure	Definition: Pressure = force ÷ area. Tip: Make sure area is in square units, usually m^2. Rearrangements: force = pressure × area and area = force ÷ pressure.	A block has an area of $0.6\,\mathrm{m}^2$ and a force of $240\,\mathrm{N}$ applied to it. Calculate the pressure on the block. $\text{pressure (N/m}^2) = \dfrac{\text{force (N)}}{\text{area (m}^2)}$ $= \dfrac{240}{0.6}$ $= 400$ The pressure that a robot arm exerts on a sheet of metal is $2000\,\mathrm{N/m}^2$. The force that the robot arm exerts on the sheet is $550\,\mathrm{N}$. Work out the area of the robot arm that is in contact with the sheet. $\text{pressure} = \dfrac{\text{force}}{\text{area}}$ $\text{area (m}^2) = \dfrac{\text{force (N)}}{\text{pressure (N/m}^2)}$ $= \dfrac{550}{2000}$ $= 0.275$ A cuboid shaped block sits on top of a cylindrical post as shown. The pressure exerted on the post by the block is $340\,\mathrm{N/m}^2$ Work out the force on the post due to the block. Give your answer to 3 s.f.  $\text{pressure} = \dfrac{\text{force}}{\text{area}}$ $\text{area} = \pi \times 0.7^2$ $= 0.49\pi$ $\underset{\text{(N)}}{\text{force}} = \underset{\text{(N/m}^2)}{\text{pressure}} \times \underset{\text{(m}^2)}{\text{area}}$ $= 340 \times 0.49\pi$ $= 523.389\ldots$ $= 523 \text{ to } 3 \text{ s.f.}$	U527
	Combining ratios	Definition: To combine ratios, make the shared part the same in both ratios before joining them together. Tip: Scale one or both ratios until the common term matches, then read off the combined ratio and simplify if needed.	The ratio $x : y$ is $6 : 11$ The ratio $y : z$ is $11 : 7$ What is the ratio $x : y : z$ in its simplest form? $x : y$ | $y : z$ $6 : 11$ | $11 : 7$ $x : y : z$ $6 : 11 : 7$	U921

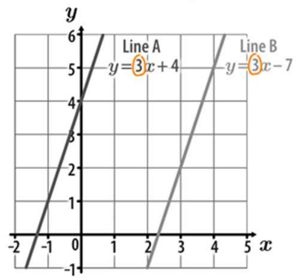
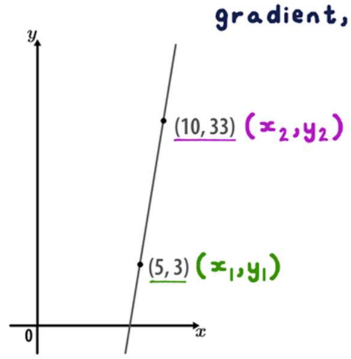
	Calculating with ratios and algebra	Definition: In algebraic ratios, each part can include a variable such as b. Tip: Add all parts to find the total, then write the required fraction as desired part ÷ total parts. Factorise if it helps simplify.	A stationary shop sells bundles containing pens, pencils and highlighters. The ratio of pens to pencils to highlighters in a bundle is $5b : 2 : b$ What fraction of the stationery items in the bundle are pencils? pens : pencils : highlighters $5b : 2 : b$ $\frac{\text{parts corresponding to pencils}}{\text{total parts}} = \frac{2}{5b+2+b}$ $= \frac{2}{6b+2}$ $= \frac{\cancel{2}^{1}}{\cancel{2}_{1}(3b+1)}$ $= \frac{1}{3b+1}$	U676
	Changing ratios	Definition: If a ratio changes, first work out the actual amounts, then adjust the changed part and simplify the new ratio. Tip: Find one part by dividing the total by the sum of the ratio parts.	White and red paint is mixed in a $7 : 2$ ratio to make 54 litres of pink paint. A further 6 litres of white paint is added to the mixture. What is the new ratio of white to red paint in its simplest form? White : Red total $7 : 2$ 9 $\times 6$ $\times 6$ $\times 6$ $42 : 12$ 54 New amount of white $= 42 + 6$ $= 48$ New white : Red $48 : 12$ $\div 12$ $\div 12$ $4 : 1$	U865
	Solving direct proportion word problems	Definition: In direct proportion, both quantities change by the same scale factor. Tip: If one value is multiplied or divided, do exactly the same to the other value. The unitary method also works well.	A recipe for 30 biscuits needs 150 g of sugar. How many biscuits can 50 g of sugar make? $\div 3$ 30 biscuits need 150g $\div 3$ 10 biscuits need 50g	U721

	Solving inverse proportion word problems	Definition: In inverse proportion, as one quantity increases, the other decreases so that the product stays constant. Tip: If one quantity is multiplied by k, the other is divided by k.	It takes 1 printer 12 minutes to print a batch of leaflets. How long would it take 3 identical printers to print the same number of leaflets? 1 printer takes 12 minutes ×3 ÷3 3 printers take 4 minutes	U357
	Currency conversion	Definition: An exchange rate tells you how much one unit of one currency is worth in another currency. Tip: If £1 = €1.16, then pounds to euros multiply by 1.16, and euros to pounds divide by 1.16. Give money to 2 decimal places.	Use the exchange rate £1 = €1.16 to work out a) how much £40 is worth in euros. £ ×1.16 € 1 1.16 ÷1.16 40 × 1.16 = 46.4 So £40 = €46.40 Answer: € 46.40 b) how much €75.40 is worth in pounds. 75.40 ÷ 1.16 = 65 So €75.40 = £65 Answer: £ 65	U610

Unit	Topic/Skill	Definition/Tips	Example	Sparx Code
Standard Form	Multiplying and dividing numbers in standard form	Multiplication is commutative so we can rearrange calculations in standard form to simplify.	Work out $(6 \times 10^7) \times (4 \times 10^9)$ Give your answer in standard form. $= 6 \times 10^7 \times 4 \times 10^9$ $= 6 \times 4 \times 10^7 \times 10^9$ $= 24 \times 10^{7+9}$ $= 24 \times 10^{16}$ $= 2.4 \times 10^1 \times 10^{16}$ $= 2.4 \times 10^{1+16}$ $= 2.4 \times 10^{17}$	U264

	Adding and subtracting numbers in standard form	Factorising by the highest common power of 10 can allow us to add and subtract standard form with ease.	Work out $4.3 \times 10^4 + 2 \times 10^3$ Give your answer in standard form. $= 4.3 \times 10^4 + 2 \times 10^3$ $= 4.3 \times 10^4 + 0.2 \times 10^1 \times 10^3$ $= 4.3 \times 10^4 + 0.2 \times 10^{1+3}$ $= 4.3 \times 10^4 + 0.2 \times 10^4$ $= (4.3 + 0.2) \times 10^4$ $= 4.5 \times 10^4$	U290
	Standard form with a calculator	Using the “× 10 ” key on your calculator allows you to input calculations in standard form.	Work out $(8.55 \times 10^{-3}) \div (2.9 \times 10^2)$ Give your answer in standard form to 3 significant figures. $(8.55 \times 10^{-3}) \div (2.9 \times 10^2)$ $= 2.94827... \times 10^{-5}$ $= 2.95 \times 10^{-5}$ to 3 s.f	U161
Sequences	Position-to-term rules for arithmetic sequences	Position to term rules can be defined by an “nth term” which identifies a position or term value at any point in the sequence.	The start of an arithmetic sequence is shown below. Work out the n^{th} term rule for this sequence. $4 \xrightarrow{+6} 10 \xrightarrow{+6} 16 \xrightarrow{+6} 22 \rightarrow$ n: 1, 2, 3, 4 sequence: 4, 10, 16, 22 6n: 6, 12, 18, 24 sequence - 6n: -2, -2, -2, -2 Rule: 6n + -2	U498
	Position-to-term rules for sequences of patterns	Pattern sequences can be interpreted by rewriting the sequence numerically and generating the nth term.	The start of a sequence of patterns using tiles is shown below. The same number of tiles are added each time. What is the rule for the number of tiles in the n^{th} pattern?  n: 1, 2, 3 Number of tiles: 9, 14, 19 5n: 5, 10, 15 Number of tiles - 5n: 4, 4, 4 Rule: 5n + 4	U978

	Position-to-term rules for geometric sequences	Geometric sequences are unlike arithmetic sequences in that they are been multiplied, rather than added, by a common ratio each time.		U958
	Special sequences	A Fibonacci-type sequences are produced by adding the two previous terms to find the next term.		U680
Equation of linear graphs	Plotting straight line graphs	By inputting values of x into our function, we produce corresponding values of y. These can be used to plot coordinates on our Cartesian plane.		U741
	Finding equations of straight line graphs	Equations of lines are generally in the form $y = mx + c$, where m represents the gradient and c represents the y intercept.		U315

	Interpreting equations of straight line graphs	By inspection, we can compare our equation of a line with the general equation $y = mx + c$ to find the gradient and y-intercept.	The equation of a line is $y = 25x - 10$. Work out the gradient and y-intercept. $y = mx + c$ $y = 25x - 10$ gradient, $m = 25$ y-intercept, $c = -10$	U669
	Equations of parallel lines	Parallel lines share the same gradient.	Two lines are shown on the grid below.  $y = mx + c$ Line A gradient, $m = 3$ Line B gradient, $m = 3$	U377
	Finding the equation of a straight line from its gradient and a point	Inputting coordinates into the general equation of a line along with its gradient will allow us to find its y-intercept and, therefore, the overall equation for our straight line.	Work out the equation of the straight line with gradient 11 that passes through point $(2, 20)$ $y = mx + c$ gradient, $m = 11$ $(2, 20)$ is a point on the line $20 = 11 \times 2 + c$ $20 = 22 + c$ $-2 = c$ $y = 11x - 2$	U477
	Finding the equation of a straight line from two points on the line	You can find the gradient of a line between two points by finding the change in y over the change in x.	What is the gradient of the line shown below?  gradient, $m = \frac{\text{change in } y}{\text{change in } x}$ $= \frac{y_2 - y_1}{x_2 - x_1}$ $= \frac{33 - 3}{10 - 5}$ $= \frac{30}{5}$ $= 6$	U848