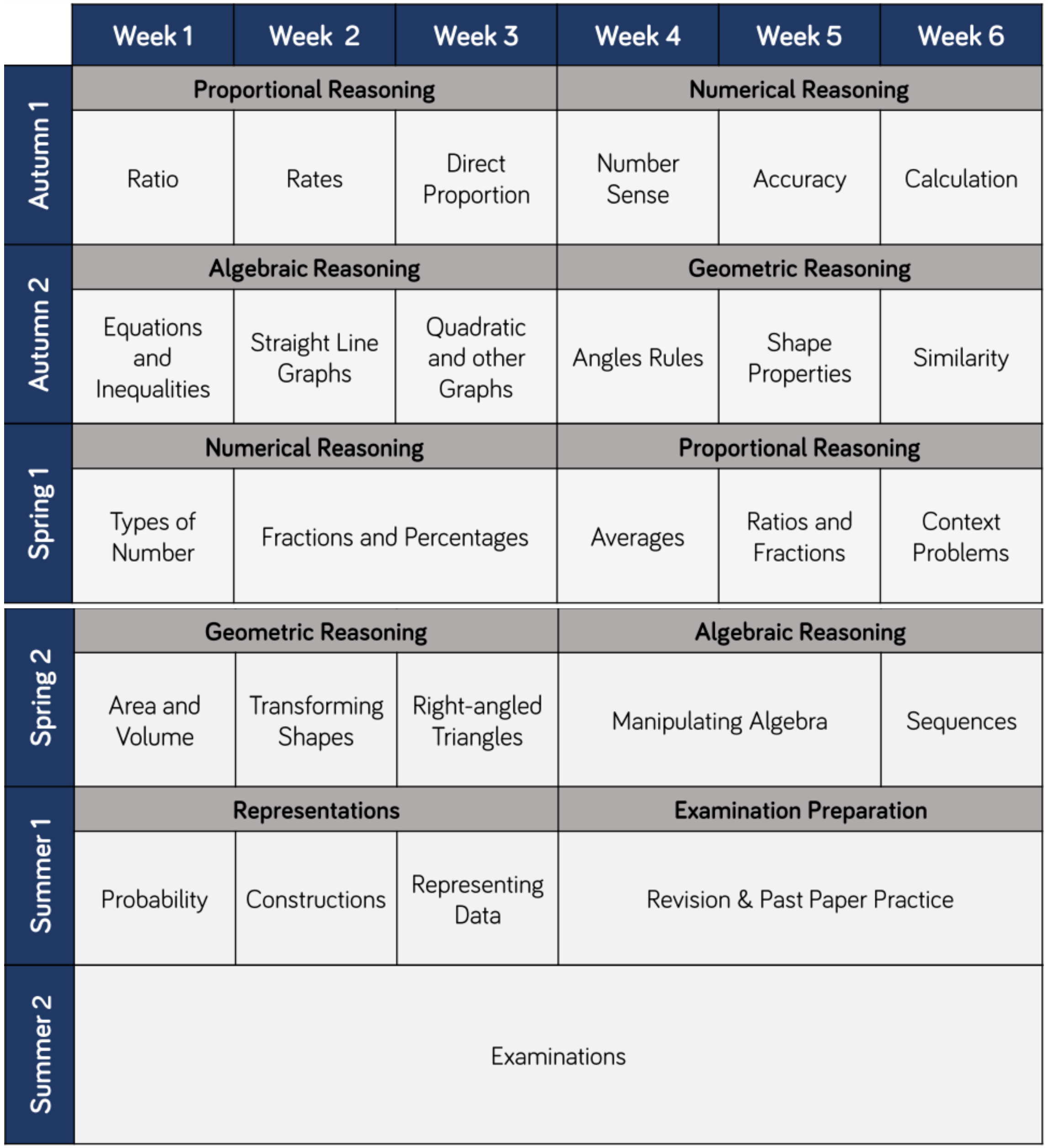
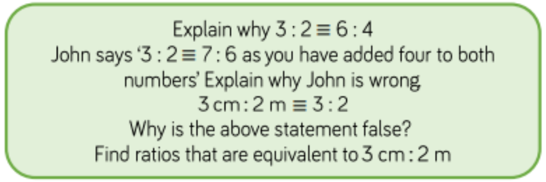
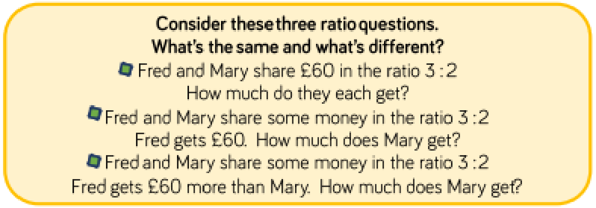
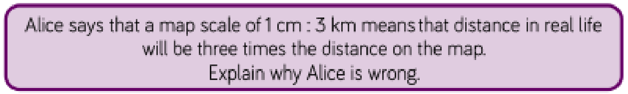
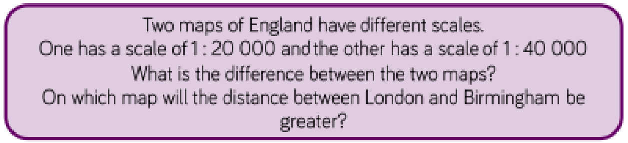
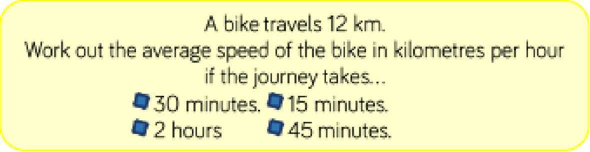
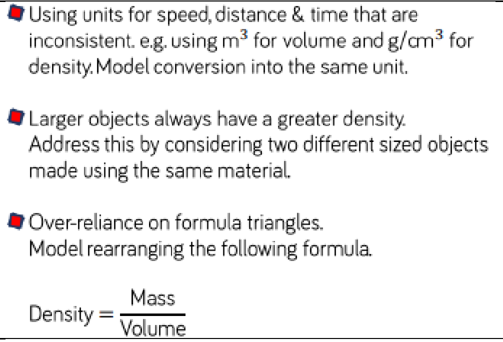
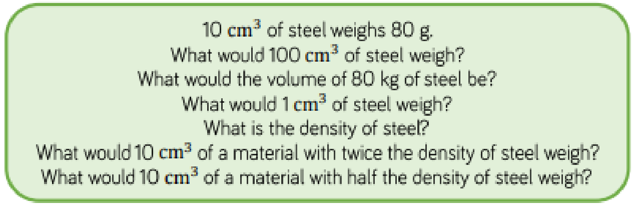
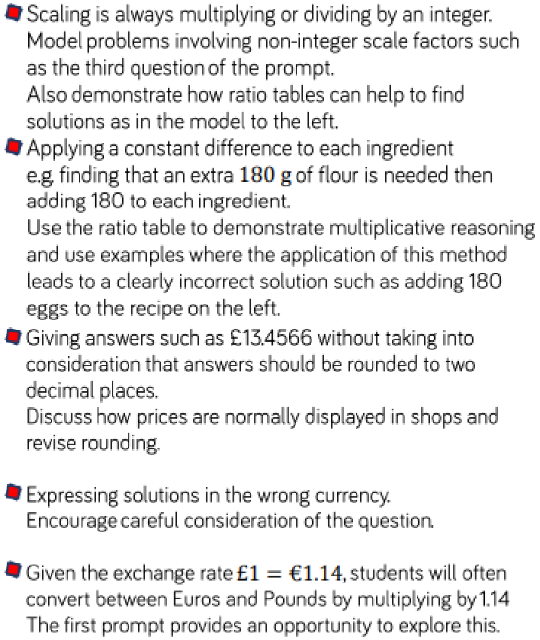
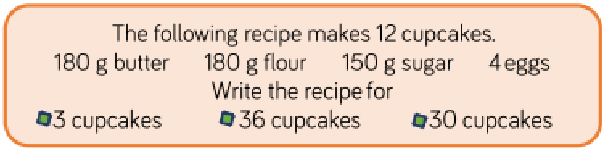
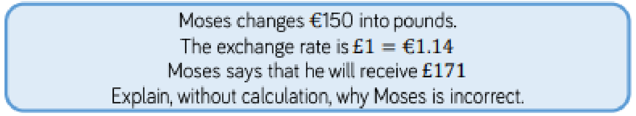
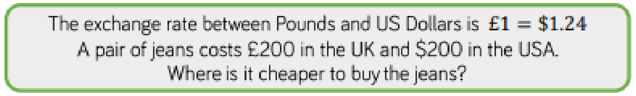
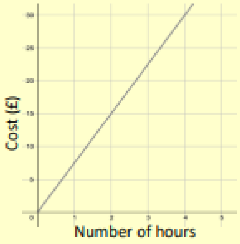
GCSE Resit Mathematics Scheme of Learning

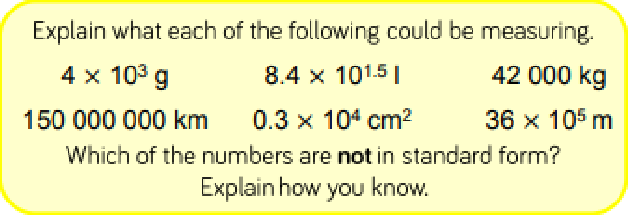
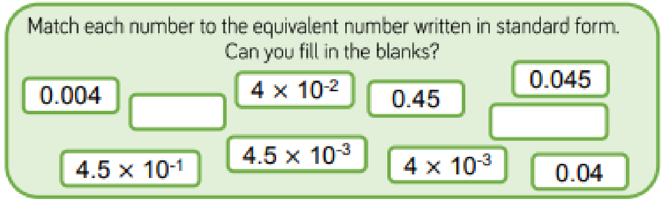
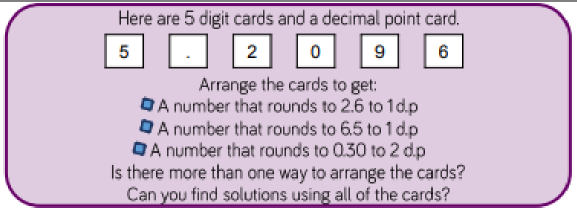
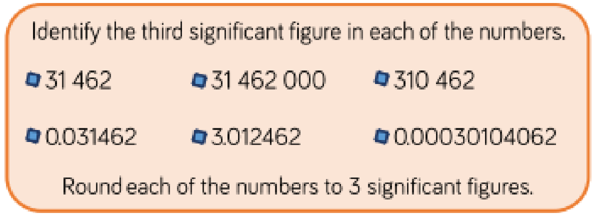


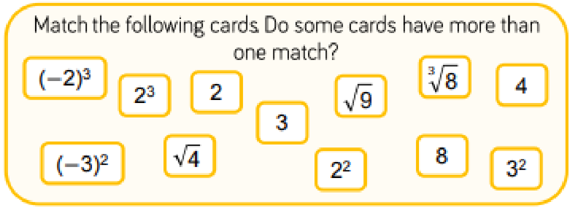
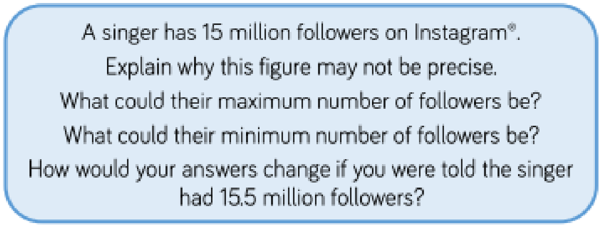
	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6
Autumn 1	**Proportional Reasoning**			**Numerical Reasoning**		
	Ratio	Rates	Direct Proportion	Number Sense	Accuracy	Calculation
Autumn 2	**Algebraic Reasoning**			**Geometric Reasoning**		
	Equations and Inequalities	Straight Line Graphs	Quadratic and other Graphs	Angles Rules	Shape Properties	Similarity
Spring 1	**Numerical Reasoning**			**Proportional Reasoning**		
	Types of Number	Fractions and Percentages		Averages	Ratios and Fractions	Context Problems
Spring 2	**Geometric Reasoning**			**Algebraic Reasoning**		
	Area and Volume	Transforming Shapes	Right-angled Triangles	Manipulating Algebra		Sequences
Summer 1	**Representations**			**Examination Preparation**		
	Probability	Constructions	Representing Data	Revision & Past Paper Practice		
Summer 2	Examinations					

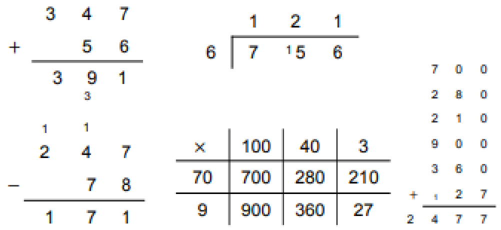
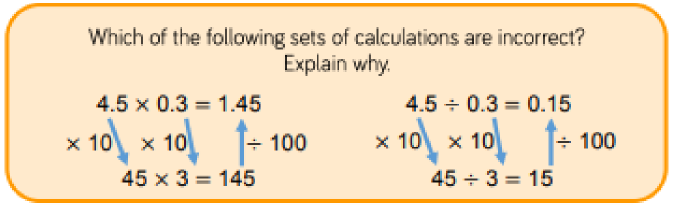
Date:	Step	Content	Misconceptions	Prompts	Hegarty Maths
6/9	Proportional reasoning **1.Ratio**	Equivalent ratios Parts & wholes	When simplifying ratios, it is usual to give them in the form $a : b$ where a and b are both integers. Students are sometimes confused by a request to express ratios in the form $1 : n$ as this can result in a non-integer n e.g. express the ratio 3 : 4 in the ratio $1 : n$ Ensure that interpretations of results in this form are discussed and exemplified. Interpreting e.g. 3 : 4 as $\frac{3}{4}$ when the context implies $\frac{3}{7}$ Use bar models to illustrate that this is not the case. Using additive rather than multiplicative thinking. Use double number lines to compare additive and multiplicative methods (see model section). Finding a single 'part' by dividing a given value by the total number of 'parts' regardless of what value is given. The prompt is designed to address this. Encourage the use of carefully labelled bar models.	 Explain why 3 : 2 ≡ 6 : 4 John says '3 : 2 ≡ 7 : 6 as you have added four to both numbers' Explain why John is wrong 3 cm : 2 m ≡ 3 : 2 Why is the above statement false? Find ratios that are equivalent to 3 cm : 2 m  **Consider these three ratio questions.** **What's the same and what's different?** Fred and Mary share £60 in the ratio 3 :2 How much do they each get? Fred and Mary share some money in the ratio 3 :2 Fred gets £60. How much does Mary get? Fred and Mary share some money in the ratio 3 :2 Fred gets £60 more than Mary. How much does Mary get?	328, 329
		Using scales and maps	Misinterpretation of the scale 1 cm : 5 miles meaning that real distances are five times the distance on the map. Discuss this when considering the first prompt. Students may think that when a ratio is expressed as 1 cm : 2000 cm its only valid for that particular unit. Demonstrate that any unit could be used possibly including a unit such as hand span. Students may not know 1 km : 1000 m Revise unit conversions.	 Alice says that a map scale of 1 cm : 3 km means that distance in real life will be three times the distance on the map. Explain why Alice is wrong.  Two maps of England have different scales. One has a scale of 1 : 20 000 and the other has a scale of 1 : 40 000 What is the difference between the two maps? On which map will the distance between London and Birmingham be greater?	864, 865
	Proportional reasoning **2.Rates**	Speed, distance, time	Not converting units when, for example, a speed uses a different unit of length to the distance e.g. speed given in m/s and the distance given in km. Model conversion into the same unit. Students often divide the wrong way round. Show students the link between units and the formula e.g. metres per second is a distance divided by a time.	 A bike travels 12 km. Work out the average speed of the bike in kilometres per hour if the journey takes… 30 minutes. 15 minutes. 2 hours 45 minutes.	716, 717

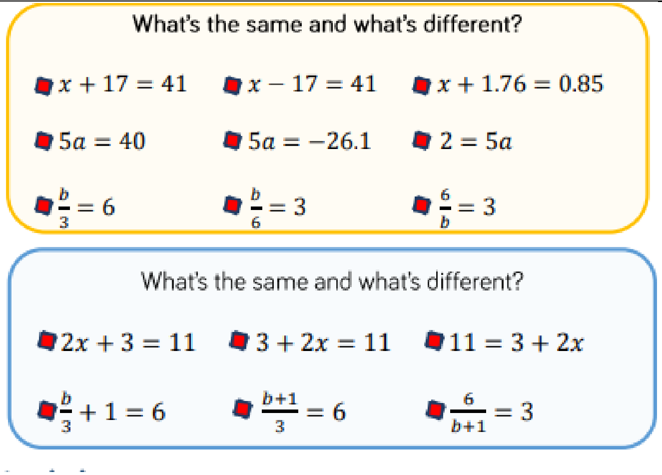
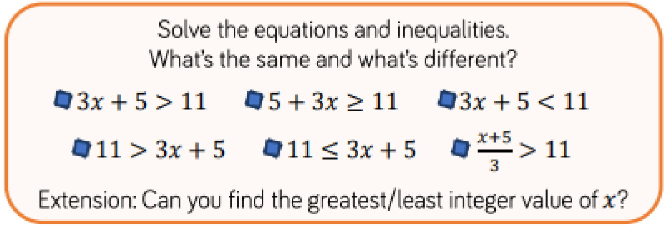
		Density Flow problems	 ■ Using units for speed, distance & time that are inconsistent. e.g. using m^3 for volume and g/cm^3 for density. Model conversion into the same unit. ■ Larger objects always have a greater density. Address this by considering two different sized objects made using the same material. ■ Over-reliance on formula triangles. Model rearranging the following formula. $\text{Density} = \frac{\text{Mass}}{\text{Volume}}$	 10 cm^3 of steel weighs 80 g. What would 100 cm^3 of steel weigh? What would the volume of 80 kg of steel be? What would 1 cm^3 of steel weigh? What is the density of steel? What would 10 cm^3 of a material with twice the density of steel weigh? What would 10 cm^3 of a material with half the density of steel weigh?	725, 726
20/9	Proportional reasoning **3.Direct proportion**	Scaling up and down Exchange rates	 ■ Scaling is always multiplying or dividing by an integer. Model problems involving non-integer scale factors such as the third question of the prompt. Also demonstrate how ratio tables can help to find solutions as in the model to the left. ■ Applying a constant difference to each ingredient e.g. finding that an extra 180 g of flour is needed then adding 180 to each ingredient. Use the ratio table to demonstrate multiplicative reasoning and use examples where the application of this method leads to a clearly incorrect solution such as adding 180 eggs to the recipe on the left. ■ Giving answers such as £13.4566 without taking into consideration that answers should be rounded to two decimal places. Discuss how prices are normally displayed in shops and revise rounding. ■ Expressing solutions in the wrong currency. Encourage careful consideration of the question. ■ Given the exchange rate £1 = €1.14, students will often convert between Euros and Pounds by multiplying by 1.14 The first prompt provides an opportunity to explore this.	 The following recipe makes 12 cupcakes. 180 g butter 180 g flour 150 g sugar 4 eggs Write the recipe for ■ 3 cupcakes ■ 36 cupcakes ■ 30 cupcakes  Moses changes €150 into pounds. The exchange rate is £1 = €1.14 Moses says that he will receive £171 Explain, without calculation, why Moses is incorrect.  The exchange rate between Pounds and US Dollars is £1 = $1.24 A pair of jeans costs £200 in the UK and $200 in the USA. Where is it cheaper to buy the jeans?	763, 764 Best buys 739, 740 Recipes

		Direct proportion graphs	All straight lines represent direct proportion. Show non-examples of straight lines that do not pass through the origin including those with positive and negative gradients. If as one increases the other increases, this is direct proportion. E.g. $y = x^2, x \geq 0$ Students could write pairs of values from these graphs into a table and check for multiplicative relationships. If there is no sequence in the values given in a table then they are not proportional. The model provides an opportunity to discuss this misconception.	The graph shows the relationship between the amount of time a boat is hired and the cost of hiring the boat. What can you find out from the graph? How can you use the graph to find the cost for 8 hours rental? What is the cost per minute?  	339, 340, 341
	Numerical reasoning **1.Number sense**	Comparing integers Additive/ Multiplicative	Making errors in adjustments e.g. for 546 – 99, replacing with 546 – 100 – 1 instead of 546 – 100 + 1 This could be averted by looking at number lines and considering how the adjustment works. Students will sometimes revert to formal methods when these are inappropriate e.g. 32 146 + 9999 They will need explicit teaching of what to look out for, and reminding of the need to look for possible alternatives before embarking on a calculation. Sometimes, students will make the wrong adjustment e.g. thinking 25 × 62 = 24 × 62 + 24 rather than 24 × 62 + 62 Using partitioning and brackets may help e.g. 25 × 62 = (24 + 1) × 62 = 24 × 62 + 1 × 62 Incorrectly applying multiplicative reasoning such as in the example below. Discuss general statements with students such as 'when dividing by a larger number, the results will be a smaller number' before looking at specific values. 186 ÷ 3 = 62 186 ÷ 3 = 62 × 2 × 2 × 2 ÷ 2 186 ÷ 6 = 124 ✗ 186 ÷ 6 = 31 ✓	Which of these are true? Explain why. 254 + 99 = 254 + 100 – 1 743 – 99 = 743 – 100 – 1 76 – 19 = 77 – 20 56 + 17 + 13 = 56 + 30 Use the fact below to find the answers to the other calculations. **24 × 62 = 1488** 48 × 62 1488 ÷ 12 31 × 48 25 × 62 24 × 61 2.4 × 62 1488 ÷ 24 14.88 ÷ 6.2 24 × 31	9 Additive 12 Multiplicative

		Standard form	■ Misinterpreting the index is the number of zeros when written as an ordinary number. Explore the validity of this statement asking is this always, sometimes or never true. ■ Only considering the first digit of a number e.g. writing 425000 as 4×10^5 rather than 4.25×10^5 Use place value counters to investigate the equivalence of numbers in ordinary and standard form. ■ Writing numbers that are equivalent to an ordinary number but not in standard form. e.g. writing 3900 as 39×10^2 rather than 3.9×10^3 Explain that this is to make the comparison of numbers easier. ■ Erroneously counting zeros to find the absolute value of the power then 'making it negative' or counting how many places the decimal point 'moves'. Encourage students to think about what the exponent's value means in relation to the place value system using a grid as shown opposite. ■ Writing numbers that are equivalent to an ordinary number but not in standard form. e.g. writing 0.00018 as 18×10^{-3} rather than 1.8×10^{-4} Explain that by always writing the number at the start between 1 and 10 makes the comparison of numbers easier.	 Explain what each of the following could be measuring. 4×10^3 g $8.4 \times 10^{1.5}$ l 42 000 kg 150 000 000 km 0.3×10^4 cm^2 36×10^5 m Which of the numbers are **not** in standard form? Explain how you know.  Match each number to the equivalent number written in standard form. Can you fill in the blanks? 0.004 4×10^{-2} 0.45 0.045 4.5×10^{-1} 4.5×10^{-3} 4×10^{-3} 0.04	122, 123
4/10	Numerical reasoning **2.Accuracy**	Decimal places, significant figures	■ Students sometimes read numbers incorrectly e.g. when rounding 14.629 to 1 d.p they may round to 14.7 as '29 is greater than 5'. Students need to be reminded to read numbers correctly e.g. 'fourteen point six two nine'. ■ Believing that rounding to decimal places does not require the use of zeros as place holders. Show examples such as 6.598 = 6.60 to 2 d.p. Here the zero is required to indicate the degree of accuracy when rounding. ■ Incorrectly labelling intervals on number lines. Give students time to practise finding and labelling intervals on decimal number lines. ■ Misinterpreting 'rounding down' e.g. 3.41 = 3.3 to 1 d.p Use the vocabulary 'rounding to the nearest' rather than 'rounding up/down'.	 Here are 5 digit cards and a decimal point card. 5 . 2 0 9 6 Arrange the cards to get: ■ A number that rounds to 2.6 to 1 d.p ■ A number that rounds to 6.5 to 1 d.p ■ A number that rounds to 0.30 to 2 d.p Is there more than one way to arrange the cards? Can you find solutions using all of the cards?  Identify the third significant figure in each of the numbers. ■ 31 462 ■ 31 462 000 ■ 310 462 ■ 0.031462 ■ 3.012462 ■ 0.00030104062 Round each of the numbers to 3 significant figures.	56 Decimals 130 Sig fig

			■ Misidentifying the first significant figure as always being the first digit. Explain that the first significant figure is the first non-zero digit in a number. This also helps with confusing significant figures and decimal places ■ Believing that zero is never a significant figure. Explain that zeros are only not significant figures when they are leading zeros. Any zero following the first non zero digit is a significant figure. ■ Forgetting to add trailing zeros as placeholders when rounding large numbers e.g. 74 723 = 75 to 2 s.f Students should ask themselves if the answer is the same order of size as the original number.		
		Roots and indices Limits of accuracy	■ Incorrectly multiplying the base by the power. Students often acquire this misconception after seeing that $1^1 = 1$ and $2^2 = 4$ Demonstrate that $6^2 = 6 \times 6 \neq 6 \times 2$ and $3^3 = 3 \times 3 \times 3 \neq 3 \times 3$ ■ Mistakenly believing that to find the square root means to divide by 2. This is often due to the square root symbol looking similar to the short division method. Explain that square root is the inverse operation of squaring and encourage the use of calculators for dealing with larger powers. ■ Students sometimes confuse the place value e.g. seeing the limits of 60 to the nearest ten as $59.5 \leq x < 60.5$ instead of $55 \leq x < 65$ They should draw number lines to identify 'halfway points'. ■ Incorrectly identifying the upper bound of 6 to the nearest whole number as 6.49999... rather than 6.5 Explain that the upper bound means less than this number, not less than or equal to. ■ Using incorrect inequality notation. Revise the meanings of inequality notation, linking to the number line as shown.	 Match the following cards. Do some cards have more than one match? $(-2)^3$ · 2^3 · 2 · 3 · $\sqrt{9}$ · $\sqrt[3]{8}$ · 4 $(-3)^2$ · $\sqrt{4}$ · 2^2 · 8 · 3^2  A singer has 15 million followers on Instagram®. Explain why this figure may not be precise. What could their maximum number of followers be? What could their minimum number of followers be? How would your answers change if you were told the singer had 15.5 million followers?	137, 138 Bounds 101 Square/cube roots

<table>
<tr>
<td rowspan="2"></td>
<td rowspan="2">Numerical reasoning
3.Calculation</td>
<td>Four operations integers and decimals</td>
<td>🟥 Not exchanging when a number greater than 9 is in a place value column. Develop conceptual understanding by using concrete resources such as place value counters alongside the abstract calculations.
🟥 Not putting zero in the right place in formal column multiplication to show multiplication of tens, hundreds etc. Use the correct vocabulary when explaining multiplication e.g. '6 lots of 4 tens' rather than '6 lots of 4'
🟥 Incorrectly finding the difference between the upper and lower digit when subtracting rather than subtracting the lower digit from the upper digit. Students should develop a sense of size through estimating values before calculating them.
🟥 Thinking that dividing decimals is not conceptually the same as dividing integers. Show students that just as we can think of 18 ÷ 3 as 'how many lots of 3 are equal to 18', we can think of 1.4 ÷ 0.2 as 'how many lots of 0.2 are equal to 1.4?'
🟥 Misusing formal column multiplication methods when multiplying decimals. Show an example to demonstrate why this method is inappropriate. Show links to derivation of facts such as the example on the right.
🟥 Mistakenly 'adding zeros' when multiplying by 10
e.g. 6.3 × 10 = 6.30
Estimation can be used to show that this is not true.</td>
<td>Spot the mistakes in the following four calculations.

Which of the following sets of calculations are incorrect? Explain why. </td>
<td>47 Add/ subtract decimals
48 Multiply decimals
50 Divide decimals</td>
</tr>
<tr>
<td>Circles exact answers</td>
<td>🟥 Mixing up the formulas for circumference and area of a circle. Encourage students to think about the units of the answer if the formula involving squaring or not.
🟥 Incorrectly using the diameter in place of the radius or vice versa. Ensure students are fluent in identifying these parts of a circle.
🟥 Students incorrectly adding integers to multiples of pi
e.g. $12 + 4\pi = 16\pi$
This can be demonstrated by finding the decimal equivalent to these using a calculator.</td>
<td>Four students were asked to find the area of a circle with a radius of 4 cm. Their answers are below.
50 cm^2 16π cm^2 50.26548246 cm^2 50.3 cm^2
Whose answers do you agree/disagree with? Explain why.
Whose is the most accurate? Explain why.</td>
<td>541 Area of circle, answers in pi</td>
</tr>
</table>

18/10	Algebraic reasoning **1.Equations & inequalities**	Solve one and two step equations	■ Believing solutions have to be integers/have to be positive. Include examples with all types of solution as demonstrated by the prompt question. ■ Not being able to deal with equations presented in different forms e.g. $17 = 8.3 + x$. Use bar model 'fact families' to derive multiple versions of the same equation, demonstrating that the solution remains constant. ■ Misunderstanding equations of the form $10 - x = 4.5$ Again a bar model is useful here. ■ Not appreciating the difference between x as a variable and solving an equation to find the value of x. Keep revisiting both expressions and equations to illustrate. ■ Being unable to access equations presented other than in the most common format ($ax + b = c$). Use the prompt to discuss this and encourage students to rewrite equations in preferred order, if necessary, being careful not to change signs etc. ■ Performing operations to solve equations in the wrong order e.g. thinking $\frac{b+1}{3} = 6$ can be simplified to $\frac{b}{3} = 5$ by subtracting one from both sides. Link to inverse operations and consider the order in which operations have been applied to the unknown value.	 What's the same and what's different? ■ $x + 17 = 41$ ■ $x - 17 = 41$ ■ $x + 1.76 = 0.85$ ■ $5a = 40$ ■ $5a = -26.1$ ■ $2 = 5a$ ■ $\frac{b}{3} = 6$ ■ $\frac{b}{6} = 3$ ■ $\frac{6}{b} = 3$ What's the same and what's different? ■ $2x + 3 = 11$ ■ $3 + 2x = 11$ ■ $11 = 3 + 2x$ ■ $\frac{b}{3} + 1 = 6$ ■ $\frac{b+1}{3} = 6$ ■ $\frac{6}{b+1} = 3$	178 One step 179,180 Two step
		Solve inequalities	■ Students sometimes believe that inequalities behave exactly in the same way as equations, and replace the given sign with = . Ensure students keep the given sign throughout their working and are careful to consider direction. ■ Some students do not understand the notion of an inequality and actively look for a single value e.g. stating $x = 6$ instead of $x < 7$. Discuss the idea of looking for a set of values, linking with number line notation if appropriate. ■ Students sometimes think solutions must always be integers – vary examples to include both looking for sets and looking for boundary values.	 Solve the equations and inequalities. What's the same and what's different? ■ $3x + 5 > 11$ ■ $5 + 3x \geq 11$ ■ $3x + 5 < 11$ ■ $11 > 3x + 5$ ■ $11 \leq 3x + 5$ ■ $\frac{x+5}{3} > 11$ Extension: Can you find the greatest/least integer value of x?	265 Inequalities on number line 269 Solve inequalities (positive x) 270 Solve inequalities (negative x)
25/10	**HALF TERM**				
1/11	2nd Nov – Paper 1 4th Nov – Paper 2 8th Nov – Paper 3				

<table>
<tr>
<td rowspan="2"></td>
<td rowspan="2">Algebraic reasoning
2.Straight line graphs</td>
<td>Use coordinates
Plot straight line graphs</td>
<td>
- Students sometimes plot the reverse of points e.g. $(4, -2)$ instead of $(-2, 4)$, especially when one of the values is 0 Reinforce the order $(x,\ y)$ including plenty of examples of points that lie on the axes, and where there are negative numbers.
- Students often assume the scales are 1 unit for 1 space on both axes. Provide a variety of axes labelled in different ways e.g. x intervals of 2 but y intervals of 1 etc.
- Some students have difficulty with setting up and using axes. Emphasise the need to start at zero and that e.g. $(2, -3)$ refers to a single **point** on the grid lines and not one of the squares on the grid.
- Sometimes students do not see the connection between the table of values and the graph. Activities such as the matching cards suggested under 'models' will help students to see that the equation generates the table which give the coordinates with which to plot the graph.
- Students do not recognise errors when plotting points. Discuss the meaning of 'linear' and support them to recognise when an equation should/should not produce a straight line. 'spot the incorrect point' activities are helpful.
- Students often forget to join points or only join in the limited range. Encourage them to consider the y values of e.g. $x = 2.5$ and verify this lies on the line. Illustrate the infinite nature by showing lines using graphical software.
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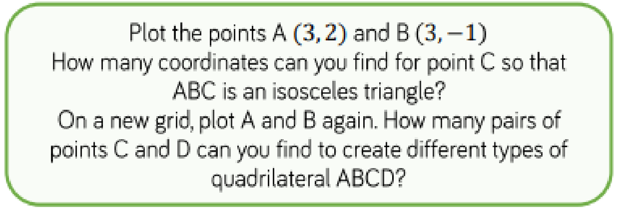

Plot the points A $(3, 2)$ and B $(3, -1)$
How many coordinates can you find for point C so that ABC is an isosceles triangle?
On a new grid, plot A and B again. How many pairs of points C and D can you find to create different types of quadrilateral ABCD?

Correct the errors in these tables of values.

<table>
<tr><td>x</td><td>-1</td><td>0</td><td>1</td><td>2</td></tr>
<tr><td>$y = 2x + 1$</td><td>-3</td><td>3</td><td>3</td><td>5</td></tr>
</table>

<table>
<tr><td>x</td><td>-1</td><td>0</td><td>1</td><td>2</td></tr>
<tr><td>$y = 1 - 3x$</td><td>-2</td><td>1</td><td>-2</td><td>5</td></tr>
</table>
</td>
<td>199 Coordinates
206, 207 Straight line graphs</td>
</tr>
<tr>
<td>Interpret y=mx+c and straight line graphs</td>
<td>
- Mistakenly thinking that gradient is always positive. Establish the difference between lines with positive and negative gradients and reinforce this by showing a series of lines and checking the sign of the gradient before moving on to do any calculations.
- Misreading scales (e.g. reading as 1 per space regardless of the actual scale) and thus finding the gradient incorrectly. When introducing gradient, illustrate with pairs of graphs that look very different because of scaling, but actually have the same gradients.
- Confusing x and y intercepts. Be sure to look at both in your examples.
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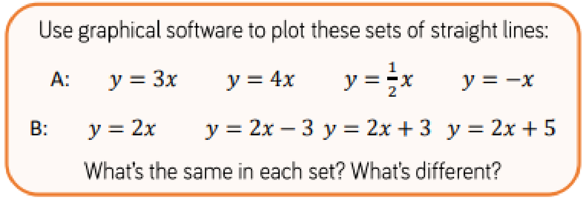
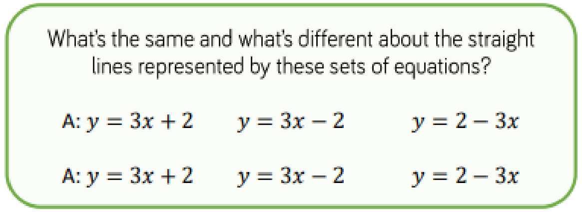


Use graphical software to plot these sets of straight lines:

A: $y = 3x$ $y = 4x$ $y = \frac{1}{2}x$ $y = -x$

B: $y = 2x$ $y = 2x - 3$ $y = 2x + 3$ $y = 2x + 5$

What's the same in each set? What's different?

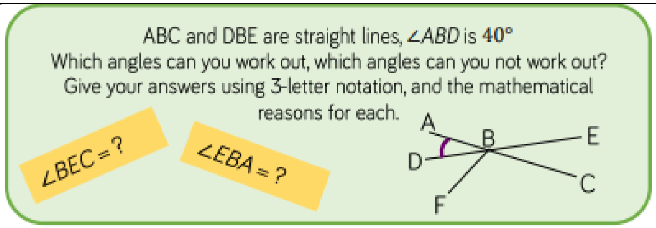
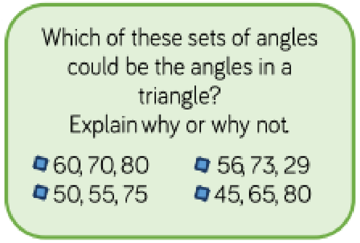
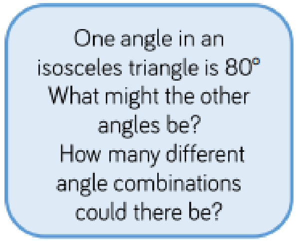
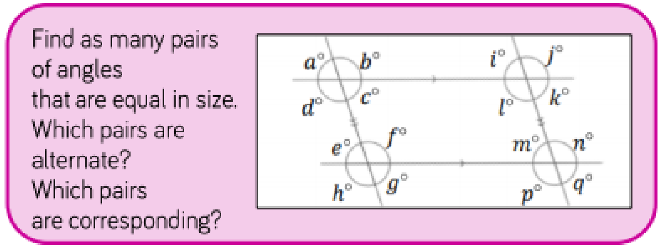


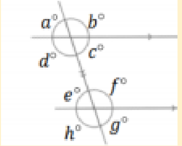
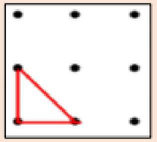
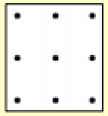
What's the same and what's different about the straight lines represented by these sets of equations?

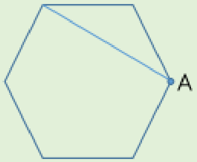
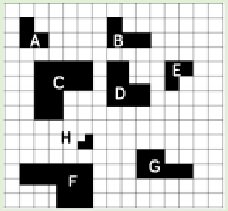
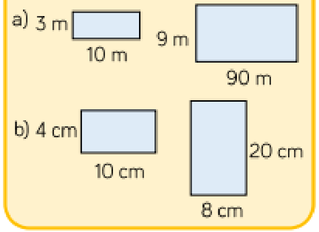
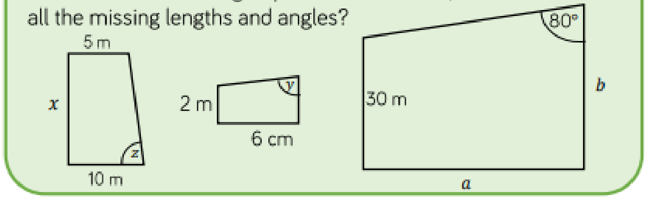
A: $y = 3x + 2$ $y = 3x - 2$ $y = 2 - 3x$

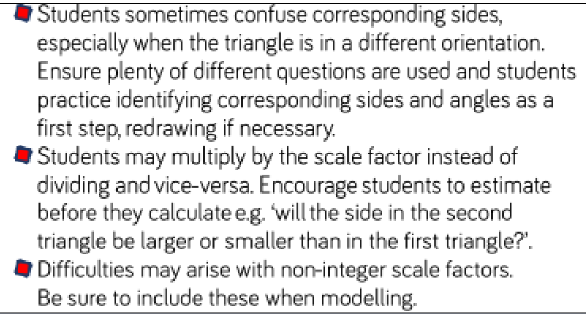
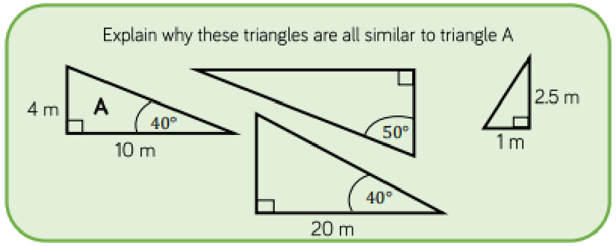
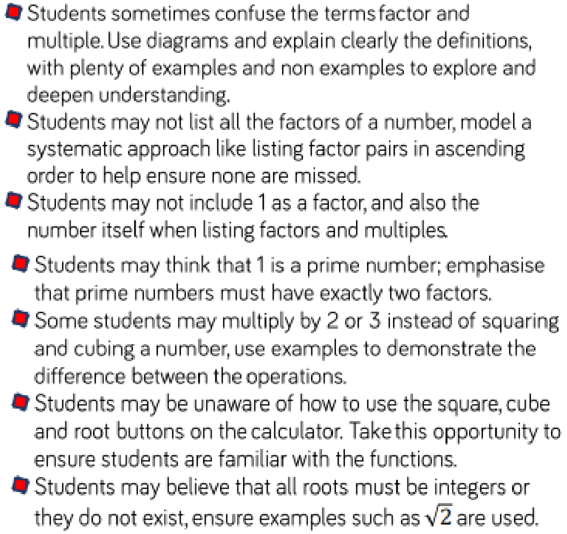
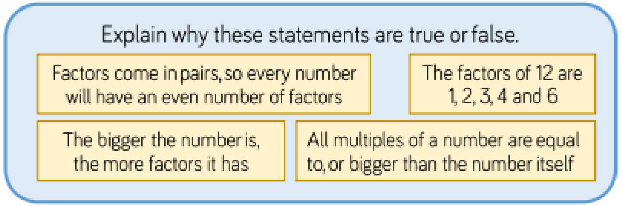
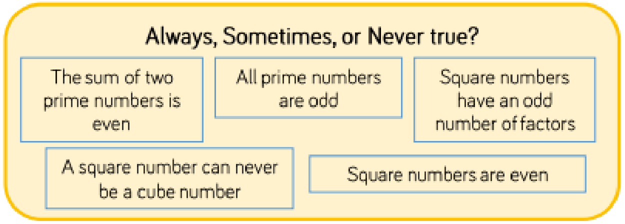
A: $y = 3x + 2$ $y = 3x - 2$ $y = 2 - 3x$
</td>
<td>208 y=mx+c</td>
</tr>
</table>

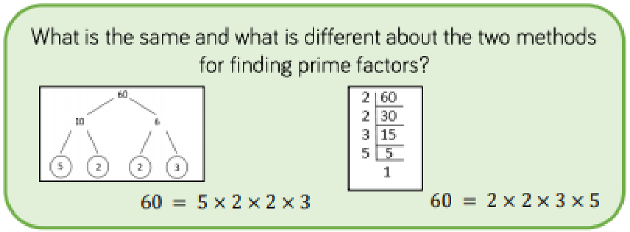
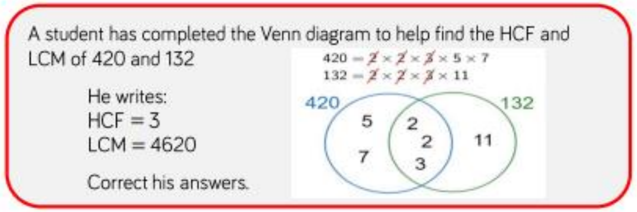
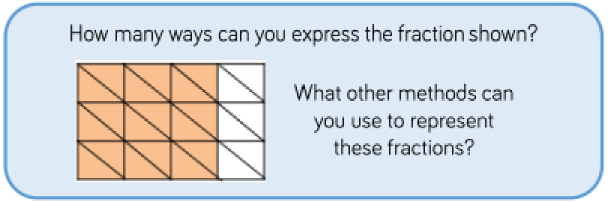
<table>
<tr><td></td><td></td><td></td><td>Students sometimes misread equations when not given in the conventional order e.g. thinking $y = 2 + 5x$ has gradient 2 and meets the y-axis at $(0, 5)$. Emphasise that m is the multiplier for x rather than the first number seen in the equation and discuss why this affects the steepness of the graph.
Even when presented in the conventional order, students can sometimes pick incorrect values and/or perform unnecessary calculations e.g. for $y = 3x + 2$, stating the gradient as $\frac{3}{2}$. Use multiple-choice diagnostic questions to identify students' errors and address these.</td><td></td><td></td></tr>
<tr><td rowspan="2">15/11</td><td rowspan="2">Algebraic reasoning
3.Quadratic & other graphs</td><td>Plot quadratic graphs</td><td>Graphs may be plotted with straight lines and a 'V' shaped turning point. Encourage students to sketch a smooth curved graph, especially at the turning point, this will produce more accurate readings.
Inaccuracy when squaring/manipulating with negative numbers. Students should be expected to check the shape of the graph for symmetry, re-calculating the co-ordinates of any anomalies.
Missing the turning point of the curve e.g. $y = x^2 + 3x + 2$ has roots at $x = 1$ and $x = 2$; sometimes students draw a flat line rather than identifying the turning point at $x = 1.5$. Emphasise that all quadratic graphs are 'U' shaped.</td><td>Spot and correct the errors in the table of values for $y = x^2$ and draw the graph of $y = x^2$.
<table>
<tr><td>x</td><td>-3</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>$y = x^2$</td><td>-9</td><td>4</td><td>-1</td><td>0</td><td>2</td><td>4</td><td>6</td></tr>
</table></td><td>251 drawing quadratics from table of values</td></tr>
<tr><td>Speed, distance, time graphs</td><td>Students sometimes do not check the scales on the axis. Reiterate time is always on the x-axis and distance is always on the y-axis and that the scales are very likely to be different.
Students may make mistakes when converting decimal hours to hours and minutes e.g. 2.5 hrs is not 2 hrs 50 minutes. Practice conversions of common intervals such as 15, 20, 30 and 45 minutes.
Students sometimes assume that a positive gradient is 'uphill' and a negative gradient is 'downhill'. Emphasise that the distance is the distance away from the starting point, and that negative slope means returning to the starting point.</td><td>Describe the journey shown by the distance-time graph.
Which part of the journey was the fastest/slowest?
Is the graph realistic?
Why or why not?
 </td><td>880, 881, 882</td></tr>
</table>

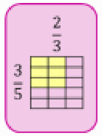
	Geometric reasoning **1.Angle rules**	Basic angle rules Angles in a triangle	- When using the 'angles on a straight line' rule, students sometimes assume this means ALL angles along that line. Emphasise that this rule only applies to adjacent angles at a shared point. - When describing angles, students sometimes only use the letter at the angle, ensure students are familiar with the different notations for angles, $\angle ABC$ and $A\hat{B}C$. - Lack of precise language when using angle rules e.g. 'angles on a line' instead of 'angles on a straight line sum to 180°'. Model using the full rule when giving reasons and give optional answers asking students which are worth the mark. - Some students may make mistakes when adding to 180 or 90 as they miscount by 10. Check written methods and number bonds to 180 and 90 - Lack of precise language when using angle rules e.g. 'angles in a triangle' instead of 'angles in a triangle add up to 180°'. Model using the full rule when giving reasons and give optional answers asking students which are worth the mark. - Mistakes in identifying the equal pair of angles in an isosceles triangle – model how to find the equal pair given the equal sides, and vice versa.	 ABC and DBE are straight lines, $\angle ABD$ is 40° Which angles can you work out, which angles can you not work out? Give your answers using 3-letter notation, and the mathematical reasons for each. $\angle BEC = ?$ $\angle EBA = ?$  Which of these sets of angles could be the angles in a triangle? Explain why or why not ▪ 60, 70, 80 ▪ 56, 73, 29 ▪ 50, 55, 75 ▪ 45, 65, 80  One angle in an isosceles triangle is 80° What might the other angles be? How many different angle combinations could there be?	485, 486, 487
		Angles in parallel lines	- Students may identify the 'Z' or 'F' angles, and state this as the reason. Ensure students are using the correct mathematical language and full reason included e.g. 'alternate angles are equal'. - Students may not be aware that the converse of the rules is also true – if a pair of corresponding angles are equal then the lines are parallel. - Students may not identify the angles if the shape is non-standard e.g. if the parallel lines have changed orientation or the alternate angles do not look like a typical Z. Model questions in a variety of orientations.	 Find as many pairs of angles that are equal in size. Which pairs are alternate? Which pairs are corresponding? 	480 Vertically opposite 481 Alternate 482 Co-interior 483 Corresponding

			■ Students may get confused if there is more than one transversal or if the parallel lines are hidden within another shape – again ensure that they see plenty of different style questions. ■ Students may sometimes assume all pairs are equal as with alternative and corresponding, look at describing angles in terms of acute/obtuse, and encourage self checking. ■ Students may identify the 'C' angle. Ensure students are using the correct mathematical language, and full reason e.g. 'co-interior angles sum to 180°'	What's different and what's the same about the following pairs of angles? *f* & *c* and *f* & *g* *d* & *e* and *d* & *f* 	
29/11	Geometric reasoning **2.Shape properties**	Triangles & quadrilaterals	■ Students sometimes think that any three lengths can make a triangle. Discuss when this is not the case e.g. 10cm, 2 cm & 4cm and establish a rule. ■ Students may make mistakes in identifying the equal pair of angles in an isosceles triangle – model how to find the equal pair given the equal sides, and vice versa. ■ Students may make assumptions about equal sides/angles based on appearance rather than the information given. Emphasise the meaning of the notation and ensure students practise both reading this and using it when sketching triangles themselves. ■ Students may be confused with the difference between a rhombus and a parallelogram. Link this to the difference between a square and a rectangle. ■ Students may not fully understand why a square is a rectangle. Explain the properties of a rectangle and that the square is a special case. ■ Students may still use the term 'diamond' to describe a rotated square. Ensure plenty of different orientations are used. ■ Students may not be confident with the terms Kite, or Arrowhead/delta – model examples of these.	How many different triangles can you make on this pin board? What's the same and what's different about each one? Are there any types of triangle we cannot make on the grid? Explain why the triangle shown is not equilateral.  How many different types of quadrilaterals can you make on this Geoboard?  What's the same and what's different about them? How can they be categorised? Are there any 'special' quadrilaterals that cannot be made?	557, 558 Triangles 824, 825 Quadrilaterals

		Angles in polygons	Students can usually identify an interior angle but may think that the exterior angle is the remainder to 360° Reinforce that the interior and exterior angles sum to 180° forming a straight line from the vertex. Students sometimes miss the link between number of sides and exterior angle in a regular polygon. Model both finding the angle and finding the number of sides. Students may think that the formula for the interior angle sum only works for regular polygons; include examples of finding missing angles in all types of polygon as this gives useful practise of forming and solving equations.	How many triangles can you make, starting from point A? What does this tell you about the sum of the interior angles of the hexagon? Will this be true for all hexagons?  	561, 562 Interior angles 563, 564 Exterior angles
	Geometric reasoning **3.Similarity**	Similar shapes Finding missing sides	Students may confuse similar and congruent. Explain that for similar shapes, the angles remain the same but the length of the sides change, whilst both sides and angles remain same when shapes are congruent. Likewise they may confuse the everyday meaning of 'similar' with the precise mathematical meaning; this needs reinforcing. Assuming that shapes are not similar if they are not in the same orientation – ensure students are exposed to a variety of examples. Students may assume that the shapes are not similar if the scale factor is not a whole number. Some students may use an additive relationship rather than a multiplicative. Use a number of examples with non-integer scale factors to show that the additive approach is not useful. If the shapes are in a different orientation, the students may confuse the corresponding sides or angles. Students sometimes also multiply/divide angles by the scale factor. Remind students that shapes with a given number of sides have a constant angle sum, e.g. the angles of an enlarged trapezium must still add to 360° Confirm by measuring angles of similar shapes.	Identify all the shapes that are similar to A  Are these pairs of shapes similar? Why or why not?  Given that the following trapeziums are similar, how can we find all the missing lengths and angles?  	608 Similar shapes 611 similar triangles
		Enlarging shapes Similar triangles	Students may get confused with the terminology, thinking that enlarging always makes a shape bigger. Ensure enlarging by a fraction such as $\frac{1}{2}$ and $\frac{1}{3}$ are also modelled. Students may think that the shape is always mapped smaller to larger. Emphasise that questions should be read carefully and the starting point identified. When describing enlargements students use words such as 'bigger' and 'smaller'. Stress the importance of using correct mathematical vocabulary every time i.e. 'enlargement by scale factor ___ about___'	Explain what the words mean. Draw examples to show the meanings. Enlarge Similar Scale factor Congruent Is it possible to enlarge by a scale factor of $\frac{1}{4}$? Why or why not?	611,612, 613 Similar triangles

			 - Students sometimes confuse corresponding sides, especially when the triangle is in a different orientation. Ensure plenty of different questions are used and students practice identifying corresponding sides and angles as a first step, redrawing if necessary. - Students may multiply by the scale factor instead of dividing and vice-versa. Encourage students to estimate before they calculate e.g. 'will the side in the second triangle be larger or smaller than in the first triangle?'. - Difficulties may arise with non-integer scale factors. Be sure to include these when modelling.	 Explain why these triangles are all similar to triangle A 	
13/12	Consolidation week				
20/12	**CHRISTMAS HOLIDAYS**				
3/1	Numerical reasoning **1.Types of number**	Factors, multiples, primes, squares and cubes	 - Students sometimes confuse the terms factor and multiple. Use diagrams and explain clearly the definitions, with plenty of examples and non examples to explore and deepen understanding. - Students may not list all the factors of a number, model a systematic approach like listing factor pairs in ascending order to help ensure none are missed. - Students may not include 1 as a factor, and also the number itself when listing factors and multiples. - Students may think that 1 is a prime number; emphasise that prime numbers must have exactly two factors. - Some students may multiply by 2 or 3 instead of squaring and cubing a number, use examples to demonstrate the difference between the operations. - Students may be unaware of how to use the square, cube and root buttons on the calculator. Take this opportunity to ensure students are familiar with the functions. - Students may believe that all roots must be integers or they do not exist, ensure examples such as $\sqrt{2}$ are used.	 Explain why these statements are true or false. Factors come in pairs, so every number will have an even number of factors The factors of 12 are 1, 2, 3, 4 and 6 The bigger the number is, the more factors it has All multiples of a number are equal to, or bigger than the number itself  Always, Sometimes, or Never true? The sum of two prime numbers is even All prime numbers are odd Square numbers have an odd number of factors A square number can never be a cube number Square numbers are even	27 Factors 33 Multiples 28 Primes 101 square and cubes

		HCF & LCM Prime factorisation	• Students may think that they can only start prime factorisation if the number is divisible by two. Ensure examples include odd numbers. • They may not understand the terminology. Ensure students are exposed to the term 'express as a product' and 'index form'. • Students often use 1 as a prime factor and include this in their prime factor decomposition. Emphasise that prime numbers need two factors so 1 is not prime. • Students sometimes complete a 'prime factor tree', but do not then give the actual answer, or do not give the answer in index form as indicated in the question. • Students may get confused with the terms Highest Common Factor (HCF) and Lowest Common Multiple (LCM) • Some students may use factors to create the Venn diagram, ensure students are completing prime factorisation before starting the Venn diagram. • Duplicating the common factors when filling in the intersection of the Venn diagram is a common error – encourage students to cross off the common factors in both lists. • Students may multiply all prime factors of both numbers when finding the LCM – demonstrate with e.g. 10 and 20 why this is unnecessary.	 What is the same and what is different about the two methods for finding prime factors? $60 = 5 \times 2 \times 2 \times 3$ $60 = 2 \times 2 \times 3 \times 5$  A student has completed the Venn diagram to help find the HCF and LCM of 420 and 132 $420 = \cancel{2} \times \cancel{2} \times \cancel{3} \times 5 \times 7$ $132 = \cancel{2} \times \cancel{2} \times \cancel{3} \times 11$ He writes: HCF = 3 LCM = 4620 Correct his answers. 	29, 30 Prime factorisation 31, 32 HCF 34,35 LCM
10/1	Numerical reasoning **2.FDP**	Equivalent fractions Key fractions & decimals	• Students often believe that to compare fractions they must make the denominator the same, however sometimes it is easier to make the numerator the same, so model examples of this. • Students may believe that fractions are any part of a whole, however emphasise the importance of 'equal parts', and explore this with examples and non-examples. • When writing equivalent fractions students will sometimes add the same to the numerator and denominator. Model the multiplicative relationship. • Students sometimes believe that a fraction is in its simplest form if it cannot be halved – give examples with odd numbers such as $\frac{5}{15}$ that can be simplified to $\frac{1}{3}$	 How many ways can you express the fraction shown? What other methods can you use to represent these fractions?	59 Equivalent fractions

			Students may assume that fractions follow a multiplicative pattern, e.g. $\frac{1}{10} = 0.1$, so $\frac{2}{10} = 0.2$ etc. Give plenty of non-examples and demonstrate on a number line and/or bar model. Students may believe that 'the bigger the denominator' the bigger the fraction. Give plenty of examples such as $\frac{1}{10}$ and $\frac{1}{3}$. Show these on a number line. Sometimes students think $0.3 = \frac{1}{3}, 0.5 = \frac{1}{5}$ etc. Use a place value chart to emphasise the importance of tenths and hundredths when working with decimals.	Huan says that if $\frac{1}{10} = 0.1$, then $\frac{1}{20} = 0.2$ and $\frac{1}{30} = 0.3$ Explain his mistake. Write the multiples of $\frac{1}{5}$ as decimals.	
		Fractions with all four operations	Students may try to add/subtract the numerators and denominators. Stress the importance of finding a common denominator and practise the key skill of finding equivalent fractions. Students sometimes assume that to find the common denominator that they always multiply both numbers. This can give unnecessarily large numbers and can lead to errors. Ensure students see plenty of examples where the lowest common multiple of the denominators is one of the numbers e.g. $\frac{3}{4} + \frac{5}{8}$ When multiplying students sometimes only multiply the numerators and leave the denominators the same. Use pictorial representation to help visualise the multiplication. Some students may 'cross-multiply' instead of multiplying numerators and denominators. Students can get confused when multiplying by an integer, and multiply both the numerator and denominator, model writing integers as 'fractions over 1' e.g. $3 \times \frac{2}{5}$ as $\frac{3}{1} \times \frac{2}{5}$ Students may be unaware that finding a fraction of a number is the same operation as multiplying e.g. $\frac{1}{3}$ of $\frac{1}{4}$ is the same as $\frac{1}{3} \times \frac{1}{4}$. Ensure a variety of examples are seen.	What is $\frac{3}{10} + \frac{3}{5}$? $\frac{6}{15}$ $\frac{9}{10}$ $\frac{6}{10}$ $\frac{45}{50}$ Draw a diagram to convince me your answer is correct. Identify the mistake in each wrong answer. Is there more than one correct answer? Which method is most effective to work out $\frac{2}{3} \times \frac{3}{5}$? $\frac{2 \times 3}{3 \times 5} = \frac{2 \times 3}{5 \times 3} = \frac{2}{5}$ $\frac{2 \times 3}{3 \times 5} = \frac{6}{15} = \frac{2}{5}$ Rewrite the question as $2 \times 3 \times \frac{1}{3} \times \frac{1}{5}$ 	66 Add/subtract fractions 68, 69 Multiply fractions 70 Divide fractions

			Students may attempt to follow rules such as 'KFC' (keep, flip, change) without fully understanding why this works; they frequently misuse this procedure as they forget which one to keep and which to flip. It is useful to learn through investigation that the division of a number is equivalent to the multiplication of its reciprocal. A conceptual misunderstanding of the rule above may lead students to 'flip' both or the wrong fraction. Students are often unaware of the alternative method of finding common denominators which can help when dividing fractions, this is useful to explore.	What is the same and what is different with the following methods for calculating $\frac{2}{5} \div \frac{3}{4}$? $\frac{2}{5} \div \frac{3}{4}$ $= \frac{8}{20} \div \frac{15}{20}$ $= \frac{8}{15}$ $\frac{2}{5} \div \frac{3}{4}$ $= \frac{2}{5} \times \frac{4}{3}$ $= \frac{8}{15}$	
		Percentage of amounts	Students may think that because 10% is the same as dividing by 10, then 20% is the same as dividing by 20. Give plenty of examples using values, number lines and bar models. Students often follow a rule like 'divide by 100 and multiply by the number' without actually understanding why. Use pictorial representation alongside number calculations. Students may revert to 'build up' methods when a calculator method would be more appropriate. Practise both use of calculator and choosing when to use which method.	Explain why it is that when we divide an amount by 10 it gives 10%, but if you divide by 20 it does not give 20% Is it true that 45% of 60 is equal to 60% of 45? Does this work for other pairs of numbers?	84, 85, 86, 87 Cal and non cal
		Percentage increase and decrease	Students sometimes get confused with single digit percentages e.g. for 5% they use 0.5. Refer back to pictorial representation to embed understanding. Students may be unable to access the questions as they are unsure of the terminology used, explicitly discuss the meaning of words such a VAT, interest and depreciation. Often students may work out the required percentage then forget to add/subtract from the original amount. Stress the importance of reading and checking the question. Students may have seen the multiplier method but lack the understanding to use it effectively. Practice using the bar model to represent the question, this helps understand what calculations are necessary.	In a sale, a coat is reduced by 20%, then for one day only a further 20% is taken off. Annie says that the coat is now 40% cheaper. Use a numerical example to show that Annie is not correct.	88 non cal 90 cal

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<td rowspan="2">24/1</td>
<td rowspan="2">Proportional reasoning
1.Averages</td>
<td>Mean, median, mode</td>
<td>
- Students sometimes think about ‘average’ as being ‘okay’ or ‘in the middle’. Explicitly state what ‘average’ means as a mathematical term. Linked to this, students already understand ‘mean’ in a different context to that used in maths. Again, the mathematical meaning may need explicitly stating.
- Students often think that the mean is “the best” representation of a set of data. Discuss situations where the mean may be misleading, or not the most useful average - use examples of extreme outliers.
- Students may not always order the data before finding the middle value. Ensure students write the data set in order and cross off the highest/lowest vales until they reach the middle value. Reviewing ordering decimals may also be necessary.
- When faced with an even amount of data in a set students may write both numbers. Model finding halfway.
- When finding the mode students may get confused if there isn't an obvious answer. Use questions that show there can be more than one, or no mode. Also use qualitative data (e.g. favourite food) when finding the mode.
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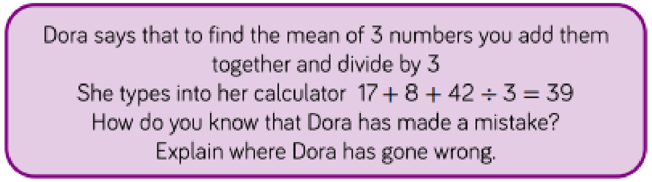
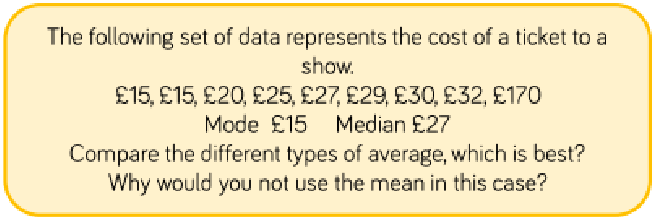
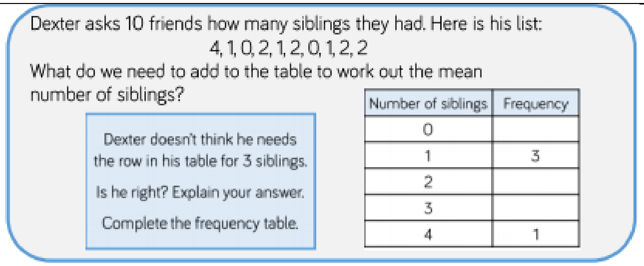
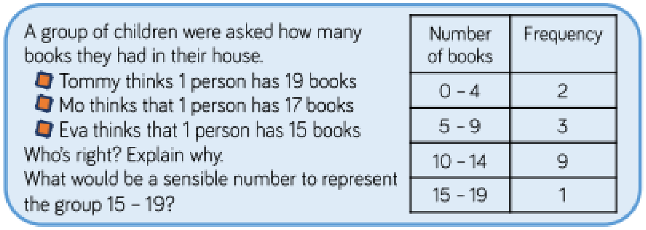
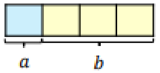
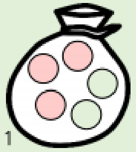
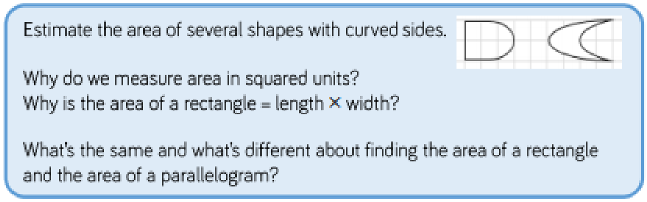
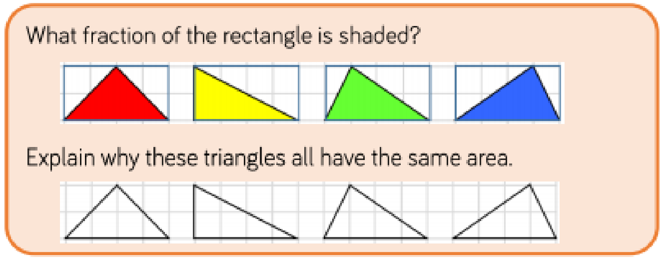
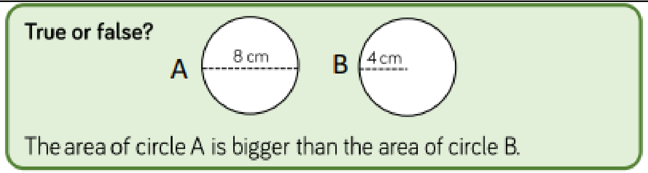
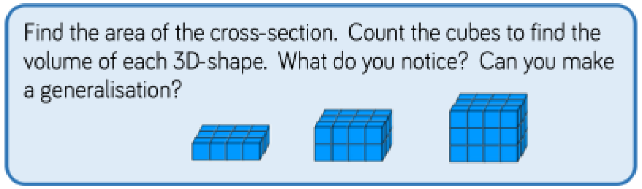
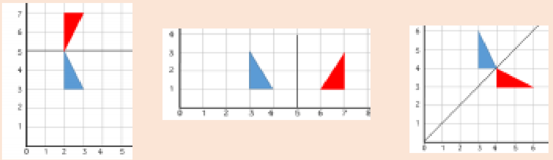
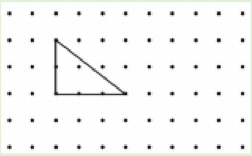
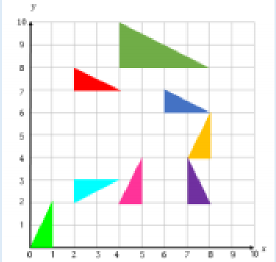
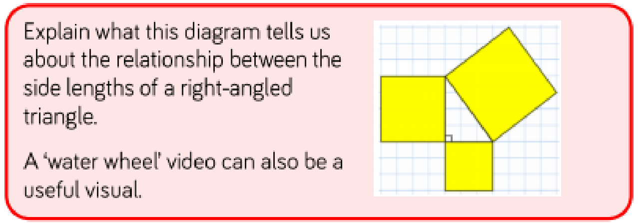
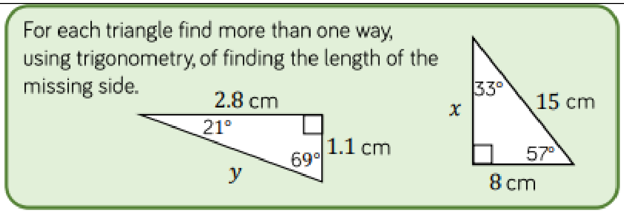
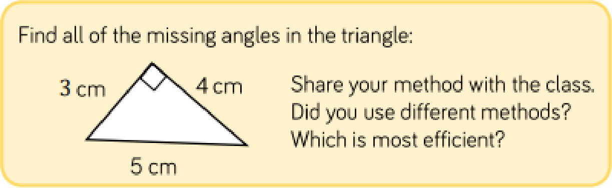
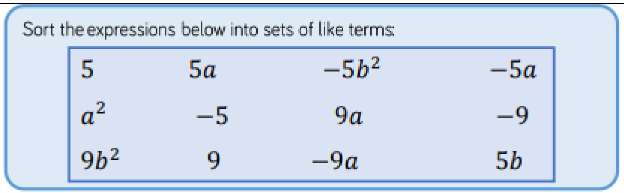
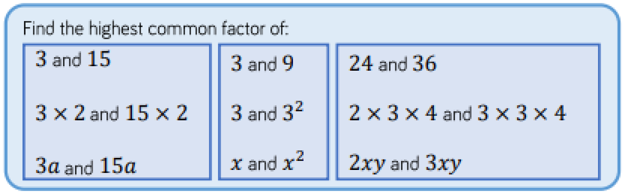

Dora says that to find the mean of 3 numbers you add them together and divide by 3
She types into her calculator $17 + 8 + 42 \div 3 = 39$
How do you know that Dora has made a mistake?
Explain where Dora has gone wrong.

The following set of data represents the cost of a ticket to a show.
£15, £15, £20, £25, £27, £29, £30, £32, £170
Mode £15 Median £27
Compare the different types of average, which is best?
Why would you not use the mean in this case?
</td>
<td>405, 406 Mean
409 Median
404 Mode</td>
</tr>
<tr>
<td>Mean from frequency table</td>
<td>
- Students sometimes ignore the ‘zero’ in columns in a table. Ensure students see examples and discuss the importance of including the zero calculation.
- Some students may not fully understand the term frequency and total frequency in this context. Model by writing out the data as a list so the frequency can be seen.
- A common misconception is for students to think that the total frequency is the number of rows in the table. To overcome this, students must complete frequency tables from lists of data.
- Students may be confused with the wording ‘estimate the mean’ from a grouped frequency table. Spend time explaining how the data is grouped into classes and why we have to use an estimate.
- Students may be unfamiliar with the inequality signs used in the class intervals and may need a recap on these.
- Students may get confused about which number to use to represent a group. Discuss which number might be suitable so that there is an understanding of why the mid-value is used.
</td>
<td>

Dexter asks 10 friends how many siblings they had. Here is his list:
4, 1, 0, 2, 1, 2, 0, 1, 2, 2
What do we need to add to the table to work out the mean number of siblings?
Dexter doesn't think he needs the row in his table for 3 siblings.
Is he right? Explain your answer.
Complete the frequency table.
<table>
<tr><th>Number of siblings</th><th>Frequency</th></tr>
<tr><td>0</td><td></td></tr>
<tr><td>1</td><td>3</td></tr>
<tr><td>2</td><td></td></tr>
<tr><td>3</td><td></td></tr>
<tr><td>4</td><td>1</td></tr>
</table>

A group of children were asked how many books they had in their house.
- Tommy thinks 1 person has 19 books
- Mo thinks that 1 person has 17 books
- Eva thinks that 1 person has 15 books
Who's right? Explain why.
What would be a sensible number to represent the group 15 – 19?
<table>
<tr><th>Number of books</th><th>Frequency</th></tr>
<tr><td>0 - 4</td><td>2</td></tr>
<tr><td>5 - 9</td><td>3</td></tr>
<tr><td>10 - 14</td><td>9</td></tr>
<tr><td>15 - 19</td><td>1</td></tr>
</table>
</td>
<td>417, 418</td>
</tr>
</table>

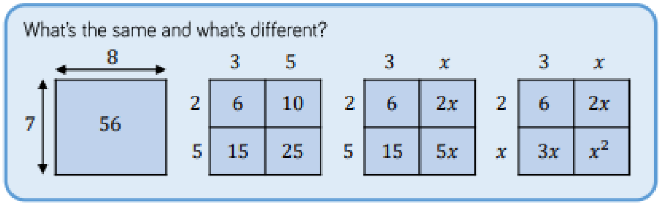
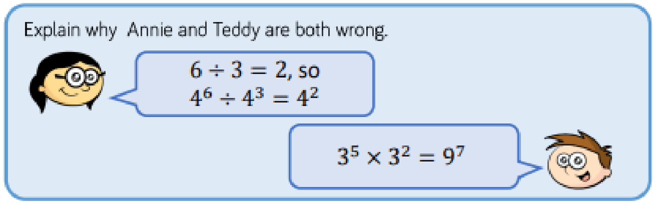
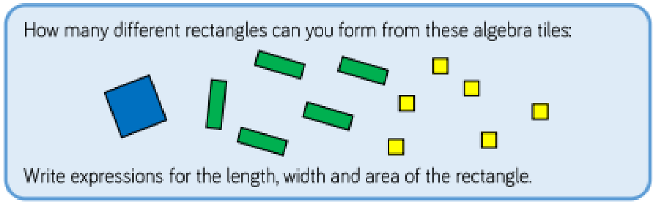
	Proportional reasoning **2. Ratios & fractions**	Link and compare fractions and ratios	Students may not consider whether they are looking at the relationship between the parts, or the relationship between a part to the whole. Emphasise the language of 'part' and 'whole' by using bar models: e.g. in the ratio $a : b = 1 : 3$ a is $\frac{1}{3}$ of b, a is $\frac{1}{4}$ of the whole  Students consider fractions and ratios to be separate concepts. To embed the link, use questions containing fractions, (e. g. $\frac{1}{5}$ of the balls in a bag are yellow, the rest are red. Write down the ratio of red balls to yellow balls.) When comparing $3 : 2$ with $\frac{3}{4}$, students sometimes just compare the 'first' numbers in each (in this case '3') rather than considering proportions. Bar modelling helps students to see the proportions in the same way for both fractions and ratios. Even with bar models, some students then struggle to say which fraction is larger/smaller. Teachers might want to prepare students by reviewing this prior to comparing ratios with fractions. A reminder of LCM may be the first step.	The ratio of green counters to red counters is $2 : 3$ Rosie says that the fraction of green counters in the bag is $\frac{2}{3}$ What do you think? Is Rosie right? Discuss.  Bag 1 Blue and yellow paint is mixed together to make tins of green paint. Ⓐ $B : Y = 3 : 2$ Ⓑ $\frac{3}{4}$ of the green paint is blue Which tin is darkest green? How do you know?	330 fractions as ratios
		Unit pricing "best buy"	Students are aware that they need to × or ÷ numbers, but may be unable to interpret their answer. They struggle to interpret the calculator answer in terms of money and they sometimes think that the smallest answer always represents the cheapest one. Ensure students write units on their answers. Also complete lots of matching activities such as: Which answer indicates best buy? 1.33 2kg of carrots cost £1.50 1.4 0.71 How much does 1 kilo cost? How many kilos does £1 buy? 0.75 7kg of carrots cost £5.00	Shop A: 20 pencils cost £4.00 What do 10 pencils cost? How about 5 pencils? What else can you find out? Shop B: 15 pencils cost £3.75 What strategies can you use to compare prices in Shop A with those in Shop B? Is there more than one way of finding out in which shop pencils are cheapest?	763, 764, 765, 766 Best buys

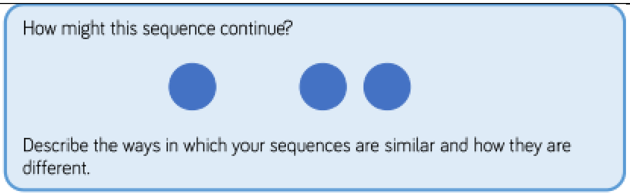
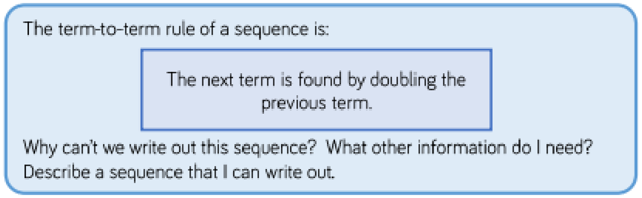
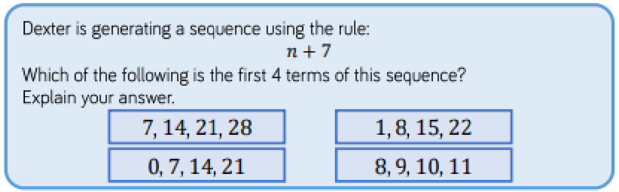
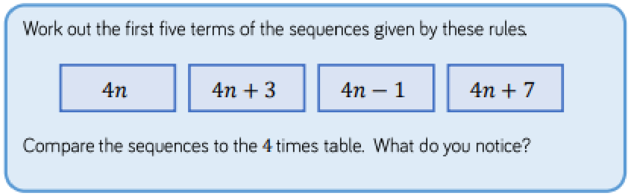
7/2	Proportional reasoning **3.Context problems**	Modelling problems	- Students sometimes misunderstand command words. e.g 'show workings' on a calculator paper, where some students think this means they cannot use a calculator. - Regularly share command word meanings with students (document containing this information is available from exam boards). - Students sometimes struggle to interpret an answer in the context of the question (e.g. rounding a calculator display to 2dp when dealing with money). Model calculator use and ensure class practise using calculators.	Model solutions to questions which contain different command words (e.g. 'show', 'give a reason'). Ensure that students gain a sense of ownership by '**live modelling**' solutions that incorporate their ideas. For every step, ensure students consider the thought process behind them. Ask students to reflect on each problem: How did you feel at the start? What was most challenging? How did we overcome this?	
		Goal-free, break down, financial maths problems	- Sometimes students are overwhelmed by the multitude of different contexts problems are posed in. By modelling similar types of mathematical problems together (e.g. those which can be answered using bar models, then those using two-way tables, then those using number-lines etc.) it highlights to students that no matter the context, the mathematical structure might be similar. - Students often struggle to get started! By asking students what they know, and what they can find out, they become more confident at taking that first step. - When reading, for example, electricity bills, students are often unaware of the fact that all units in the previous reading have been paid for. This needs to be made explicit. - Some terminology (e.g. mortgage) is unfamiliar to students and so highlighting and reinforcing the meaning of terms is crucial. - Interpreting the calculator display is key. Students often struggle to know what, for example, 4.5 means. They also sometimes forget to check whether answers are reasonable.	Use old GCSE questions and remove the specific mathematical question, giving students only the context. Ask: **What do you know?** (could ask students to discuss this in pairs and write down as many different ideas down on a whiteboard) **What can you find out?** (this then builds resilience as students start to consider their own next steps) Work in pairs to research financial mathematics by searching for examples of the following on the internet: - Bills – gas/electricity/phone - Invoices - Bank Statements Make a list of the vocabulary used and make sure you understand them all e.g. interest, standing charge, VAT etc.	757, 758 Financial statements

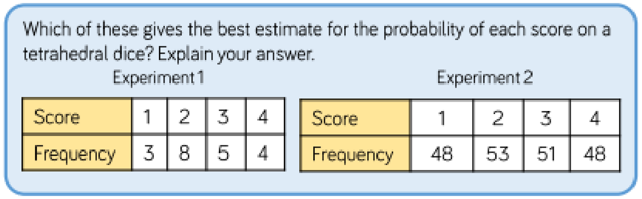
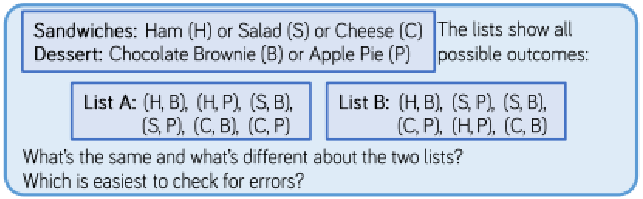
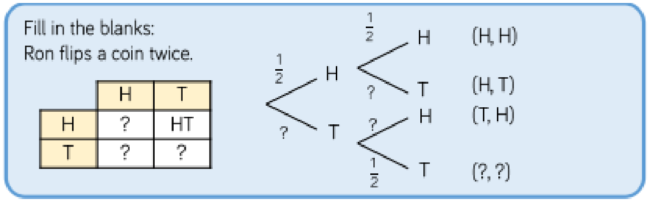
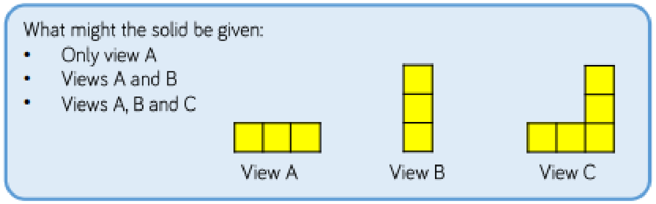
	Geometric reasoning **1.Area & volume**	Area of rectangles, parallelograms and triangles	Students can confuse area with perimeter. Teachers might discuss both concepts exploring similarities and differences to overcome this. Posing questions in context (e.g. length of perimeter fence, tiles required for a wall) can also help. Students also confuse units, and so return to conceptual understanding of area (counting squares) to reinforce square units. Include different units such as mm^2 and m^2. Students struggle to identify perpendicular height in parallelograms. Orientate the parallelograms differently so that students can practise this. Students can struggle to identify the correct dimensions to multiply. Ensure that they have a conceptual understanding of the area of a triangle by drawing a rectangle around the triangle. Also, provide practice where triangles are in different orientations. Students sometimes think that if the triangle is not right-angled, then there is a different formula for finding the area of it. Students often think that, for example, an isosceles triangle is made of two triangles and so they need to double their answer. Provide plenty of practice.	 Estimate the area of several shapes with curved sides. Why do we measure area in squared units? Why is the area of a rectangle = length × width? What's the same and what's different about finding the area of a rectangle and the area of a parallelogram?  What fraction of the rectangle is shaded? Explain why these triangles all have the same area.	554 Rectangles 556 Parallelograms 557 Triangles
		Area of circle Volume of prism	Students can sometimes have a confused understanding of the language around circles and so select incorrect dimensions when calculating area. Recap on language regularly throughout the year. Ask students to label circles. Students can misinterpret the formula. Practise squaring numbers before using the formula. Ensure students understand that the difference between πr^2 and $(\pi r)^2$ The symbol π can cause confusion. Ensure that students understand that this symbol represents a number. Ensure students understand how to enter π into their calculator. Students sometimes think that if a length is labelled on a diagram, then it must be used. Model selecting the correct lengths to find volume. Students sometimes try to apply the formula for finding the volume of a cube/cuboid (height × width × depth) to all 3-D shapes. Model different prisms. Students sometimes think that a cube/cuboid is not a prism and don't relate the formula for the volume of a cube/cuboid to that of a prism. Make this connection explicit.	 **True or false?** The area of circle A is bigger than the area of circle B.  Find the area of the cross-section. Count the cubes to find the volume of each 3D-shape. What do you notice? Can you make a generalisation?	539, 540, 541 Area of circle 570, 571 prisms
21/2	**HALF TERM**				

28/2	Geometric reasoning **2.Transforming shapes**	Reflection and rotation	Students can overlook a 'diagonal' mirror line and instead assume that the shape reflects as it would if the line were vertical and horizontal. Using actual mirrors to investigate the effect of a diagonal mirror line might be useful. Students confuse labelling of horizontal and vertical lines. Use co-ordinates on the lines to emphasise whether it is the x-value or the y-value which remains the same. Link this to the equation of the line. Ensure students understand that the x-axis is also named $y = 0$ and the y-axis, $x = 0$ Students are sometimes confused by the centre of rotation. They can 'ignore' this and either rotate the shape using the centre of the shape or one of the vertices. Ensure students have experience of centres of rotation that are within the shape, on an edge of the shape, and outside of the shape. Students sometimes describe rotations using the language of reflections and translations. Emphasise the idea of a *single* transformation.	The blue triangle has been reflected in the mirror line to give the red image. What's the same and what's different?  Investigate rotating the triangle by 90, 180 and 270 degrees about each of its vertices. What's the same and what's different? Investigate points outside the shape. 	639, 640 Reflections 648, 649 Rotations
		Translation and vectors Describing transformations	Students mix up the word 'translation' with 'transformation'. It's important that students understand translation as one type of transformation. Return to this language frequently throughout the year to recap and embed. Students sometimes struggle to ensure that vertices correspond to each other when translating a shape; they forget which vertex they started at. Also, students forget to use the scale of the graph and associate one square with one unit. Use 'spot the mistake' type questions to overcome this. The main issue students experience is using a series of transformations to describe what should be a **single** transformation. In addition, students often use non-mathematical language such as 'turns' or 'flips'. Emphasise 'single' transformation and model the correct language regularly. Encourage students to be concise. Students are often unaware that tracing paper is available to assist them with describing a rotation. Support this. Students can miss out part of the description. Ask students to perform the transformation using their description.	What's the same and what's different about the vectors? $\begin{pmatrix}1\\2\end{pmatrix}$ $\begin{pmatrix}2\\1\end{pmatrix}$ $\begin{pmatrix}-1\\2\end{pmatrix}$ $\begin{pmatrix}1\\-2\end{pmatrix}$ $\begin{pmatrix}-1\\-2\end{pmatrix}$ Draw diagrams to support your answers. How many **single** transformations can you describe from one triangle to another? Use precise mathematical language in your descriptions. 	637, 638 Translations 650, 651, 652 Describing transformations

	Geometric reasoning **3.Right-angled triangles**	Pythagoras' Theorem	Sometimes students are unaware of the need to identify the hypotenuse. They may need practice of this as a starting step, especially if the triangle is drawn in a non-standard orientation. Provide plenty of examples of this. Students mix up the idea of squaring with multiplying by 2. Similarly, they sometimes mix up 'square root' with dividing by 2. Playing games such as bingo where roots and squares of numbers are given can help overcome this.	 Explain what this diagram tells us about the relationship between the side lengths of a right-angled triangle. A 'water wheel' video can also be a useful visual.	498, 499
		Trig- finding a side Trig- finding an angle	Students can fail to label the sides in relation to the angle that they are using. Ensure students practise labelling sides when all three angles of the triangle are known, and one is highlighted as being integral to the question. Students can struggle to use their calculator correctly. For example, they might forget to close the bracket in a calculation such as tan(30) x 8. Again, pointing this out and doing 'spot the mistake' questions can help. Students struggle to rearrange the equation to find the missing length. Practise solving one step equations first before trigonometry. Students are sometimes confused about how to use their calculators to find missing angles. They are unaware of the concept that $\sin^{-1} x$ is the inverse of $\sin x$. They need practice in rearranging the equation so that the angle is the subject. Students are sometimes unsure of which angle to find as they are confused by notation. Ensure they have opportunities to label angles such as angle ABC.	 For each triangle find more than one way, using trigonometry, of finding the length of the missing side.  Find all of the missing angles in the triangle: Share your method with the class. Did you use different methods? Which is most efficient?	509, 510 Side 511, 512 Angle
14/3	Algebraic reasoning **1.Manipulating algebra**	Collecting like term Expand & factorise single brackets	Students often identify terms such as x and x^2, or $5y$ and 5 as being 'like terms'. Model why this isn't the case using algebra tiles. Students can then use algebra tiles/diagrams to support understanding. Students confuse negative terms. They sometimes think that an expression such as $3x-2-4x+4$ simplifies to $7x+2$. Ask questions such as 'what's the coefficient of x in the term $-4x$?' to overcome this. Students can also misinterpret expressions such as $7y-y$, thinking that this simplifies to 7. Use of algebra tiles can again help here.	 Sort the expressions below into sets of like terms: 5 · $5a$ · $-5b^2$ · $-5a$ a^2 · -5 · $9a$ · -9 $9b^2$ · 9 · $-9a$ · $5b$  Find the highest common factor of: 3 and 15 · 3 and 9 · 24 and 36 3×2 and 15×2 · 3 and 3^2 · $2\times3\times4$ and $3\times3\times4$ $3a$ and $15a$ · x and x^2 · $2xy$ and $3xy$	156,157 Collecting like terms 160, 161 Expand 168, 169 Factorise

			- Students often expand a bracket if the coefficient of the bracket is known (e.g. 3), but struggle if it is a variable (e.g. x). Ensure multiplying by x, for example, becomes familiar. - Students are sometimes unsure of why multiplication is used to expand a bracket. Link multiplications like this to the area model. - Students sometimes do not link the word 'factorise' with 'factor' and so are unsure of what this command word means. Ensure students practice finding HCF before factorising to emphasise this link.		
		Expand a pair of binomials	- Students sometimes struggle with the procedural method as they have no conceptual understanding of expanding a pair of binomials. Start with known values, e.g. $8 \times 7 = (3+5)(2+5)$ and draw an area model to represent this. Then start replacing values with unknowns. - Students can struggle with negatives. Remind students of 'zero pairs' and then use the algebra tiles to highlight negative terms. - Ensure students understand that $(x+1)^2$ means $(x+1)(x+1)$. Linking to the area model helps.	 What's the same and what's different? 	162, 163 Double brackets
		Laws of indices	- Students sometimes observe the multiplication sign and then apply this to the indices, e.g. $2^6 \times 2^2 \neq 2^{12}$. It's helpful to include and discuss examples like this. Students sometimes multiply the bases e.g. $2^3 \times 3^4 \neq 6^7$Again, discussing this can help students to avoid this. - Sometimes students don't realise that a is the same as a^1 and mistakenly treat the exponent as 0 Ensure that students experience questions with single powers. - To overcome the issue of students applying rules of indices to the base, ask "What's the difference between a base and an index?"	 Explain why Annie and Teddy are both wrong. 	173, 174, 175
		Factorise quadratic expressions	- Students often get confused with the procedural method. Creating rectangles with algebra tiles (or by drawing pictures) helps to embed a conceptual understanding. - Students can get confused when negatives are involved. Again, use algebra tiles to represent factorisations using negatives. - Students don't make the links between factorising and factors. A reminder of area (e.g. how many rectangles can you find with an area of 24cm^2) can reinforce the link between factorising and factors (e.g. 24 = 6 ×4)	How many different rectangles can you form from these algebra tiles:  Write expressions for the length, width and area of the rectangle.	223, 224

<table>
<tr>
<td>28/3</td>
<td>Algebraic reasoning
2.Sequences</td>
<td>Recognise and continue patterns</td>
<td>- Students can struggle if the pattern is not ‘adding on a constant’ each time. Ensure a variety of examples are used so that students become familiar with different ways of creating patterns (e.g. adding together the two previous terms, multiplying by a constant each time). Open ended questions can also be useful here (see prompt).
- Students may not recognise when a sequence is non-linear. Link lists of sequences to tables of values and the corresponding graphs, and use the vocabulary of linear and non-linear.
- Students may struggle to write down a rule in words. Sentence stems can be used in the short term to support students with this.
- When describing a rule in words, students often forget to give the first term. Give examples of this and ask students to generate the sequence. When they are unable to do so it emphasises the importance of giving the first term.
- Students do not recognise Fibonacci sequences – this is often just lack of familiarity, so include these in your examples.</td>
<td>How might this sequence continue?
Describe the ways in which your sequences are similar and how they are different.
The term-to-term rule of a sequence is:
The next term is found by doubling the previous term.
Why can’t we write out this sequence? What other information do I need?
Describe a sequence that I can write out.</td>
<td>196 Linear sequences from pictures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Find the nth term
Generate sequences</td>
<td>- Students sometimes struggle to connect a rule to term positions and so don’t understand the need to substitute, for example, $n = 1$ for the 1st term. Sometimes using a table can reinforce this connection :
<table>
<tr><td>Position Number</td><td>1</td><td>2</td></tr>
<tr><td>Term</td><td></td><td></td></tr>
</table>
- Students struggle to generate sequences from ‘non-standard rules’ (e.g. $10 - n$ or n^2). Ensure students have lots of practice substituting into various expressions.
- Students confuse the term-to-term rule with the position-to-term rule. This means that they sometimes find a difference (such as $+ 4$ each time) and assume the rule is $n +$ difference (such as $n + 4$). Comparing sequences generated by $n + 4$ with sequences generated by $4n$ helps to overcome this. In addition, reinforce what n represents by regularly asking this question. Also reinforce understanding of what makes a sequence linear. Ask “what is the constant difference in this sequence?”, “How does this relate to the coefficient of n?”</td>
<td>Dexter is generating a sequence using the rule:
$n + 7$
Which of the following is the first 4 terms of this sequence?
Explain your answer.
7, 14, 21, 28
1, 8, 15, 22
0, 7, 14, 21
8, 9, 10, 11
Work out the first five terms of the sequences given by these rules.
$4n$
$4n + 3$
$4n - 1$
$4n + 7$
Compare the sequences to the 4 times table. What do you notice?</td>
<td>197 term to term rule
198 nth term</td>
</tr>
</table>

	Representations **1.Probability**	Experimental & theoretical probability	Students sometimes identify bias when there isn't enough information e.g. flip a coin 5 times with the outcome of H,T,H,H,H. This misconception stems from assuming that theoretical and experimental probabilities are the same. Use examples to highlight that these probabilities can be different and ask students to explain why. Students can find calculating expected frequency using experimental data confusing. Provide examples in different contexts, sometimes using experimental and sometimes using theoretical probability to find expected frequency.	 Which of these gives the best estimate for the probability of each score on a tetrahedral dice? Explain your answer. Experiment 1 Score: 1, 2, 3, 4 Frequency: 3, 8, 5, 4 Experiment 2 Score: 1, 2, 3, 4 Frequency: 48, 53, 51, 48	351, 352 single events 356 Experimental
		Sample space Tree diagrams	Students sometimes fail to consider the sample space e.g. students make mistakes such as P(total score of 12) on two dice is $\frac{1}{12}$ Ensure students practise writing down sample spaces when there is more than one event. Students sometimes think they have a complete list for a sample space when they have missed outcomes. Encourage students to be systematic in their approach, exploring different approaches. Students can assume that e.g. "a red and a blue" means getting a red first and then a blue second. Ask students to explain why it actually means getting these colours in any order. Students are sometimes confused by the multiple sets of branches in trial 2. This stems from a failure to understand that once trial 1 is complete, they need to then consider resulting pathways. Students should be encouraged to write down the overall outcomes for each 'pathway', listing these next to the tree diagram.	 Sandwiches: Ham (H) or Salad (S) or Cheese (C) Dessert: Chocolate Brownie (B) or Apple Pie (P) The lists show all possible outcomes: List A: (H, B), (H, P), (S, B), (S, P), (C, B), (C, P) List B: (H, B), (S, P), (S, B), (C, P), (H, P), (C, B) What's the same and what's different about the two lists? Which is easiest to check for errors?  Fill in the blanks: Ron flips a coin twice. 	359 More than one event 361, 362 Probability trees
11/4	**EASTER HOLIDAYS**				
25/4	Representations **2.Constructions**	Plans, elevations, constructing triangles	Students sometimes lack an understanding of the terms side elevation, front elevation and plan. Reinforce these regularly. Whilst students can be confident in drawing the different views of a 3-D shape, they sometimes struggle to start with the viewpoints and give information about the solid they represent. Ask questions based on the viewpoints e.g. 'How many cubes were used to build the solid?' Students are often unable to draw views on isometric paper, treating this in the same way as squared paper. Provide plenty of practice.	 What might the solid be given: • Only view A • Views A and B • Views A, B and C 	837, 838 Plans and elevations 683 Constructing triangles

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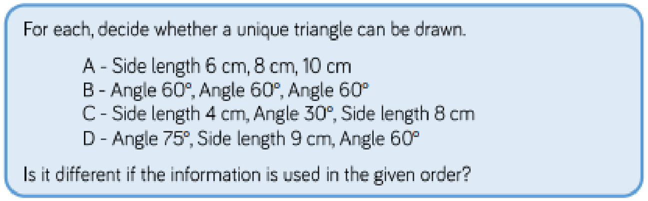
<td>Students think that a construction without using a pair of compasses is ‘good enough’. Ask students to draw a triangle with given side lengths (without a pair of compasses) and then to construct this (with a pair of compasses) to illustrate why the latter is more accurate.
Students sometimes view construction marks as ‘messy’ and rub these out. Emphasise why they need to be left.
Students make errors such as reading from the wrong scale on a protractor, or placing the pair of compasses at the wrong vertex. Ensure students draw a sketch of the triangle before they attempt to construct it.</td>
<td>For each, decide whether a unique triangle can be drawn.
A - Side length 6 cm, 8 cm, 10 cm
B - Angle 60°, Angle 60°, Angle 60°
C - Side length 4 cm, Angle 30°, Side length 8 cm
D - Angle 75°, Side length 9 cm, Angle 60°
Is it different if the information is used in the given order?</td>
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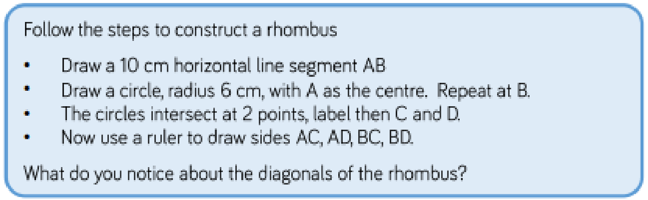
<td>Bisectors</td>
<td>Some students think that they can bisect an angle/line ‘by eye’ and don’t realise the importance of using a pair of compasses. Emphasise why a pair of compasses is used (accuracy).
Students sometimes misinterpret the word bisector and so constructions may not be equidistant from two points/lines. They should be encouraged to measure each angle/part of a line segment after each construction to emphasise the meaning of the word ‘bisect’.</td>
<td>Follow the steps to construct a rhombus
• Draw a 10 cm horizontal line segment AB
• Draw a circle, radius 6 cm, with A as the centre. Repeat at B.
• The circles intersect at 2 points, label then C and D.
• Now use a ruler to draw sides AC, AD, BC, BD.
What do you notice about the diagonals of the rhombus?</td>
<td>660 Line bisector
661 Angle bisector</td>
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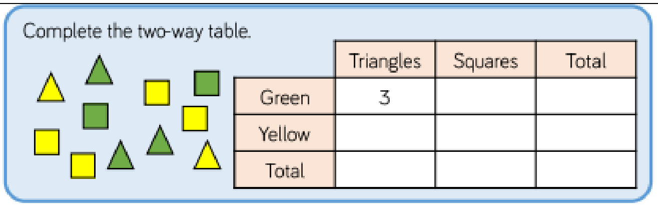
<td>Representations
3.Representing data</td>
<td>Two way tables</td>
<td>Students can find setting up a two-way table challenging. They may need support initially to identify the two categories and then to identify the two subsets within each. Emphasise each overall category e.g. colour/shape, and then each subset (yellow, green/triangle, square). Then provide tables that are partially completed with headings and ask students to complete these.
Students can make mistakes when calculating the overall total. Sometimes they add up the total from the columns with the total from the rows. Use pictures/concrete resources to illustrate why this is.</td>
<td>Complete the two-way table.
<table>
<tr><th></th><th>Triangles</th><th>Squares</th><th>Total</th></tr>
<tr><td>Green</td><td>3</td><td></td><td></td></tr>
<tr><td>Yellow</td><td></td><td></td><td></td></tr>
<tr><td>Total</td><td></td><td></td><td></td></tr>
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<td>422, 423, 424</td>
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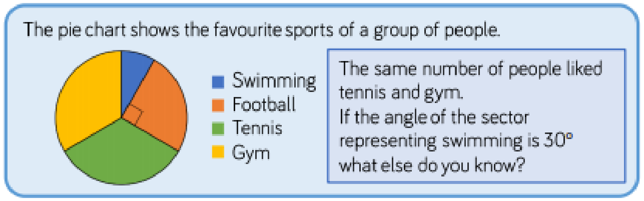
<td>Pie charts
Scatter graphs</td>
<td>When comparing pie charts students sometimes state that ‘more people in town A prefer…’ when it’s impossible to know whether this is true. It should be reinforced that when no frequencies are given, only proportional comparisons can be drawn. Ask questions such as, ‘if two pie charts are identical, do they represent identical frequencies?’
Students can also confuse the frequency with:
- Pie chart angle
- Percentage of pie chart
Model finding the pie chart angle carefully, comparing all the different types.</td>
<td> The pie chart shows the favourite sports of a group of people.
The same number of people liked tennis and gym.
If the angle of the sector representing swimming is 30° what else do you know?</td>
<td>427, 428, 429 Pie charts
453, 454 Scatter graphs</td>
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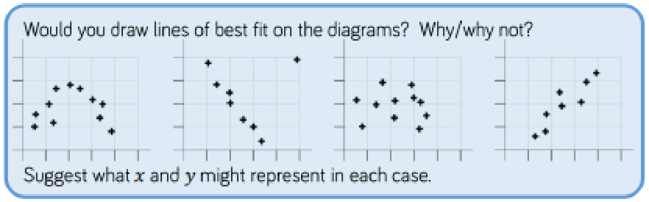
			Students sometimes think that the line of best fit: • has to go through the origin and/or the points with the lowest x-value the highest x-value • always has a positive gradient • can be curved Ensure these misconceptions are highlighted through examples and non-examples. Model how to draw a line of best fit (using a visualiser), demonstrating that you are drawing a line that represents the values in the best possible way. Ensure they understand that a line of best fit must be straight.	 Would you draw lines of best fit on the diagrams? Why/why not? Suggest what x and y might represent in each case.	
9/5	Revision, past paper practice and examinations				
23/5					
30/5	**HALF TERM**				
6/6					
20/6					
4/7					
SUMMER HOLIDAYS					