N1 Ordering Numbers

1) 'Ascending' means we want to start with the smallest value and end with the largest. To do this, you should cross the smallest number out once you find it and write it down, and then repeat for the next smallest number and so on, until you've crossed out all values.
For this question, we can see that there are 3 numbers smaller than 1, and of those, 0.01 is the smallest. So, we start by crossing off 0.01 in our initial list and then writing it down. The next smallest of the 3 is 0.1, so we cross that off and write it down next to the first number we wrote. Continuing this, we get the list of numbers in ascending order to be

$$0.01,\ 0.1,\ 0.11,\ 1,\ 10.1,\ 11,\ 101$$

2) 'Descending' means we want to start with the biggest value and end with the smallest. To do this, you should cross the biggest number out once you find it and write it down, and then repeat for the next biggest number and so on, until you've crossed out all values.
For this question, firstly recall that with negative numbers, the higher the number after the minus sign is, the smaller the number. For example, -5 is smaller than -2.
So, we can see that there are 3 positive numbers, and of those, 30 is the biggest. So, we start by crossing off 30 in our initial list and then writing it down. The next biggest of the 3 is 10, so we cross that off and write it down next to the first number we wrote. Continuing this, we get the list of numbers in descending order to be

$$30,\ 10,\ 0.1,\ -0.1,\ -1,\ -8,\ -12$$

N2 Addition and Subtraction

1) Correct application of the column method will look like

$$\begin{array}{r} {\scriptstyle 2}\,{\scriptstyle 13}\,{\scriptstyle 9}\,{\scriptstyle 1} \\ 3405 \\ 2567 \\ \hline 838 \end{array} \quad -$$

Therefore, the solution to the problem is

$$3405 - 2567 = 838$$

2) Correct application of the column method will look like

$$\begin{array}{r} {\scriptstyle 1} \\ 1403 \\ 5519 \\ \hline 6922 \end{array} \quad +$$

Therefore, the solution to the problem is

$$1403 + 5519 = 6922$$

NOTE: if you choose to write the fiddly extra digits in other places around your calculations, that's completely fine. As long as its gets you the correct answer and your teacher can understand the working, then it's just as correct as the working above.

N3 Multiplying

a) To do the grid method, we construct a grid with 400, 30, and 3 across the top and 20 and 1 down the side. Then, we fill in the gaps in the grid by multiplying each component of 433 by each component of 21. This looks like:

×	400	30	3
20	8000	600	60
1	400	30	3

Now, we have to add the numbers inside the grid (shown in red) using whichever method you prefer. Adding along the rows, we get

$$8,000 + 600 + 60 = 8,660$$

$$400 + 30 + 3 = 433$$

Therefore, the final answer is

$$8,660 + 433 = 9,093$$

b) To do the grid method, we construct a grid with 200, 20, and 3 across the top and 40 and 4 down the side. Then, we fill in the gaps in the grid by multiplying each component of 223 by each component of 44. This looks like:

×	200	20	3
40	8000	800	120
4	800	80	12

Now, we have to add the numbers inside the grid (shown in red) using whichever method you prefer. Adding along the rows, we get

$$8,000 + 800 + 120 = 8,920$$

$$800 + 80 + 12 = 892$$

Therefore, the final answer is

$$8,920 + 892 = 9,812$$

c) To do the grid method, we construct a grid with 500, 60, and 7 across the top and 100, 20, and 3 down the side. Then, we fill in the gaps in

the grid by multiplying each component of 567 by each component of 123. This looks like:

×	500	60	7
100	50000	6000	700
20	10000	1200	140
3	1500	180	21

Now, we have to add the numbers inside the grid (shown in red) using whichever method you prefer. Adding along the rows, we get

$$50,000 + 6,000 + 700 = 56,700$$

$$10,000 + 1200 + 140 = 11,340$$

$$1,500 + 180 + 21 = 1,701$$

Therefore, the final answer is

$$56,700 + 11,340 + 1,701 = 69,741$$

N4 Dividing

a) To do the bus stop method, we first draw our "bus stop" with 768 on the inside and 8 on the outside. Then, we will ask "how many times does 8 go into each digit?", or if there is a remainder from the previous go, we form a new number by putting the remainder in front of the next digit, and we ask, "how many times does 8 go into this new number?" A correct application of the bus stop method will look like:

$$8\overline{)\,7^{7}6^{4}8}\quad 096$$

Therefore, the answer is 96.

b) To do the bus stop method, we first draw our "bus stop" with 330 on the inside and 6 on the outside. Then, we will ask "how many times does 6 go into each digit?", or if there is a remainder from the previous go, we form a new number by putting the remainder in front of the next digit, and we ask, "how many times does 6 go into this new number?" A correct application of the bus stop method will look like:

$$6\overline{)\,3^{3}3^{3}0}\quad 055$$

Therefore, the answer is 55.

c) To do the bus stop method, we first draw our "bus stop" with 1134 on the inside and 9 on the outside. Then, we will ask "how many times does 9 go into each digit?", or if there is a remainder from the previous go, we form a new number by putting the remainder in front of the next digit, and we ask, "how many times does 9 go into this new number?" A correct application of the bus stop method will look like:

$$9\overline{)\,1^{1}1^{2}3^{5}4}\quad 0126$$

Therefore, the answer is 126.

N5 Multiplying and Dividing Decimals

a) To divide decimals, we want to multiply them both by the same power of 10, such that they're no longer decimals. In this case, if we multiply both numbers by 100, we can then work out

$$286 \div 20$$

And the answer will be the same as the answer to $2.86 \div 0.2$. Now you can use your preferred method of division. Opting for the bus stop method here, we get

$$20\overline{)\,2^{2}8^{8}6^{6}.0\,0}\quad 014.3$$

Therefore, the solution is

$$2.86 \div 0.2 = 14.3$$

b) To divide decimals, we want to multiply them both by the same power of 10, such that they're no longer decimals. In this case, if we multiply both numbers by 100, we can then work out

$$1,456 \div 56$$

And the answer will be the same as the answer to $14.56 \div 0.56$. Now you can use your preferred method of division. Opting for the bus stop method here, we get

$$56\overline{)\,1^{1}4^{14}5^{33}6}\quad 0026$$

Therefore, the solution is

$$14.56 \div 0.56 = 26$$

c) 2.55×6.4
$2 \times 6 = 12$
$0.5 \times 6 = 3$
$0.05 \times 6 = 0.3$
$2 \times 0.4 = 0.8$
$0.5 \times 0.4 = 0.2$
$0.05 \times 0.4 = 0.02$
Now we need to add up our results

$$12 + 3 + 0.3 + 0.8 + 0.2 + 0.02 = 16.32$$

N6 Negative Numbers

a) Adding a minus number is equivalent to a subtraction. So, we get

$$24 + -4 = 24 - 4 = 20$$

b) Subtracting a minus number is equivalent to an addition. So, we get

$$10 - (-3) = 10 + 3 = 13$$

c) When you multiply a positive by a negative, the result should be negative:

$$13 \times 6 = 78, \text{ therefore } 13 \times -6 = -78$$

d) When you divide two negative numbers, the result should be positive:

$$45 \div 9 = 5, \text{ therefore } -45 \div -9 = 5$$

N7 Types of Numbers

a) 5 is a whole number, so it is an integer. Furthermore, all integers are also rational numbers and real numbers, so 5 falls into these categories as well. Lastly, 5 is only divisible by 1 and itself, so 5 is also a prime.

b) Real and irrational

c) $\sqrt{11}$ is not a whole number, and it cannot be written as a fraction, so it is irrational. Also, like all numbers on the number line, it is a real number.

d) 8/3 is a fraction, so it is a rational number. Like all rational numbers, it is also a real number.

N8 Factors and Multiples

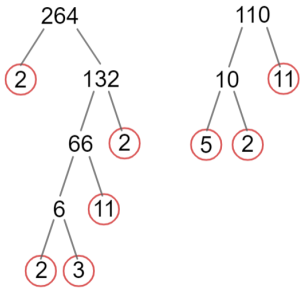
We want to look for factor pairs, i.e. pairs of numbers that multiply to make 54. We get

$$1 \times 54 = 54, \ 2 \times 27 = 54, \ 3 \times 18 = 54, \ 6 \times 9 = 54$$

Therefore, the full list of factors of 54 is: 1, 2, 3, 6, 9, 18, 27, and 54.

N9 HCF & LCM

Firstly, we need to find the prime factorisations of 264 and 110. Here, we will do this using prime factor trees.
So, we get that

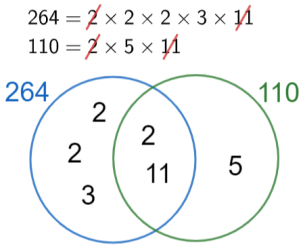


$$264 = 2 \times 2 \times 2 \times 3 \times 11$$

and

$$110 = 2 \times 5 \times 11$$

Then, we need to draw a Venn diagram with one circle for prime factors of 264 and another for prime factors of 110. Then, the first step to filling in this diagram is to look for any prime factors that 264 and 110 have in common. For each shared prime factor, we will cross it off both factor lists, and then write it once in the intersection of the two circles.
After all shared factors are crossed off, write the rest of the prime factors in their appropriate circles. The result should look something like the diagram below.



Then, we find the HCF by multiplying the numbers in the intersection:

$$\text{HCF } = 2 \times 11 = 22$$

And find the LCM by multiplying all the numbers in the Venn diagram together:

$$\text{LCM } = 2 \times 2 \times 2 \times 3 \times 5 \times 11 = 1,320$$

N10 BIDMAS

There are two sets of brackets, so our first step should be to evaluate them both. Which one we do first doesn't matter, so here we'll choose the left one first. It only contains one operation, so we get

$$13 + 2 = 15$$

Now, the bracket on the right contains two operations: an index/power, and a division. We do the index first followed by the division:

$$36 \div 3^2 = 36 \div 9 = 4$$

Therefore, we only have 1 operation left in our calculation (the multiplication between the two brackets), so we get the answer to be

$$15 \times 4 = 60$$

N11 Fractions, Decimals, and Percentages

Firstly, we we know that $\frac{1}{4} = 25\%$, so $\frac{1}{8} = 12.5\%$

Now, $\frac{5}{8} = 12.5\% \times 5 = 62.5\%$

Last we need to convert 62.5% into a decimal. We do this by dividing by 100.

$$62.5 \div 100 = 0.625$$

Final answer

$$\frac{5}{8} = 62.5\% = 0.625$$

N12 Fractions

a) 6 goes into 15 two times, with a remainder of three. Therefore, we get

$$\frac{15}{6} = 2\frac{3}{6}$$

We can simplify the 3/6, to get the final answer of

$$2\frac{1}{2}$$

b) 7 goes into 12 once, with a remainder of five. Therefore, we get

$$\frac{12}{7} = 1\frac{5}{7}$$

N13 Adding & Subtracting Fractions

To find a common denominator, multiply the denominators: $7 \times 5 = 35$. To make the denominator of the first fraction 35, we need to multiply its top and bottom by 5:

$$\frac{3}{7} = \frac{3 \times 5}{7 \times 5} = \frac{15}{35}$$

To make the denominator of the second fraction 35, we need to multiply its top and bottom by 7:

$$\frac{6}{5} = \frac{6 \times 7}{5 \times 7} = \frac{42}{35}$$

Now we can do the subtraction. We get:

$$\frac{15}{35} - \frac{42}{35} = -\frac{27}{35}$$

N14 Multiplying & Dividing Fractions

To divide these fractions, we need to keep the first fraction the same, change the ÷ to a ×, and flip the second fraction upside down. Doing so, we get

$$\frac{12}{7} \div \frac{9}{20} = \frac{12}{7} \times \frac{20}{9}$$

Then, we do the multiplication:

$$\frac{12}{7} \times \frac{20}{9} = \frac{12 \times 20}{7 \times 9} = \frac{240}{63}$$

240 and 63 both have 3 as a factor, so we can simplify our fraction to get

$$\frac{240}{63} = \frac{80}{21}$$

80 and 21 have no common factors, so we are done.

N15 Mixed Numbers and Fractions of Amounts

To find a fraction of an amount, first we need to divide by the denominator and then multiply by the numerator.
First we divide by 6

$$96 \div 6 = 16$$

Next we multiply by 5

$$16 \times 5 = 80$$

This gives our final answer as 80.

N16 Percentage

This is a 32% decrease, so the multiplier for a 32% decrease is

$$1 - \frac{32}{100} = 0.68$$

Therefore, multiplying this by the original value Matt bought the TV for, we get the price that Dave purchased it for to be

$$550 \times 0.68 = £374$$

N17 Rounding

a) In 7.789, the cut-off digit (the 1st decimal place) is the second 7. The digit after this is an 8, meaning we round the 7, and get the answer: 7.8

b) In 0.0595, the cut-off digit (the 2nd significant figure) is the 9. The digit after this is a 5, meaning that we round the 9 up to 0, and add an extra 1 to the digit before the 9. Doing so, we get the answer: 0.060. (If you just got 0.06, this is correct)

N18 Estimations

Firstly, recall that "distance = speed × time". Therefore, rounding both values to 1 significant figure, we get the estimated distance covered to be

$$50 \times 3 = 150 \text{ miles}$$

In this case, both the estimated values are bigger than the actual values. So, since we are multiplying together two bigger values, our result will be bigger. Therefore, this is an overestimate of the distance covered by Mateo during this journey.

N19 Powers

The laws of indices tell us that when you divide terms such as these, their powers are subtracted. So, dealing with the brackets first:

$$9^{13} \div 9^5 = 9^{13-5} = 9^8$$

Therefore, bringing in the last term, the calculation becomes

$$9^8 \div 9^2 = 9^{8-2} = 9^6$$

Then, by whichever method you prefer, work out that

$$9^6 = 531,441$$

N20 Square Root and Cube Root

a) $\sqrt{9}$ means "the square root of 9", or in other words, "the number that, when multiplied by itself makes 9". So, the answer is 3.

b) $\sqrt[3]{216}$ means "the cube root of 216", or in other words, "the number that when cubed gives you 216". You are expected to recognise the first few cube numbers, but if not, it's worth just trying to cube some smaller numbers until you find one that works.
In this case, the cube root of 216 is 6.

c) $\sqrt{25}$ means "the square root of 25", or in other words, "the number that, when multiplied by itself makes 25". So, the answer is 5.

N21 Standard Form

a) We need to see how many times we must move the decimal point to make the number fall between 1 and 10. If we move it 8 times,

300,950,000

then it becomes 3.0095, which falls between 1 and 10. We are moving the decimal point 8 places to the left, so the power will be positive. (If we move to the right the power is negative)

$$300,950,000 = 3.0095 \times 10^8$$

b) This is a negative power so want to end up with a small number - we must divide by 10 seven times. So, moving the decimal place 7 spaces to the left, we get

$$1.997 \times 10^{-7} = 0.0000001997$$

A1 Simplifying Terms

Firstly, collect the three like terms $3p, 3p,$ and $7p$ to get

$$3p + 3p + 7p = 13p$$

Then, collect the like terms $3pt$ and $-6pt$ to get

$$3pt - 6pt = -3pt$$

Therefore, the fully simplified expression is

$$13p - 3pt$$

A2 Expanding Single Brackets

We must multiply the term on the outside, pqr, by all the terms on the inside. To do this, we must use the law of indices that says: when you multiply terms, their powers are added. So, multiplying the terms out, we get

$$\begin{aligned} &= pqr \times 5pr + pqr \times 5r^5 + pqr \times -25pqr \\ &= 5p^2qr^2 + 5pqr^6 - 25p^2q^2r^2 \end{aligned}$$

A3 Expanding Double Brackets

We will apply FOIL, drawing red lines as we go, and then collect like terms once the expansion is done. So, we get

$$\begin{aligned} (y-2)(y-6) &= (y \times y) + (y \times (-6)) + ((-2) \times y) + ((-2) \times (-6)) \\ &= y^2 - 6y - 2y + 12 \\ &= y^2 - 8y + 12 \end{aligned}$$

A4 Factorising Single Brackets

We want to look for things that each of the two terms have in common. Firstly, they both have a factor of 4. Secondly, the both have a factor of f. That means we can take out a factor of $4fg$, and then remove the appropriate parts from each term accordingly.
Doing this, we get

$$8fg + 4fg = 4f(2g + 1)$$

A5 Simplifying & Solving Equations

We want the x terms on one side. So, adding $3x$ to both sides, we get

$$8x + 18 = 2$$

Then, subtracting 18 from both sides, we get

$$8x = -16$$

Finally, dividing both sides by 8, we get

$$x = \frac{-16}{8} = -2$$

NOTE: it's possible to take a different route but get to the same answer. As long as your steps are mathematically correct, and your answer is -2, then you get full marks.

A6 Rearranging Formulae

The aim is to get [latex]y[/latex] on its own. Firstly, we multiply both sides by 3:

$$3x = 2ay$$

Then, we divide both sides by $2a$ to get

$$\frac{3x}{2a} = y$$

All the remains is just to flip this formula left to right and we get our solution:

$$y = \frac{3x}{2a}$$

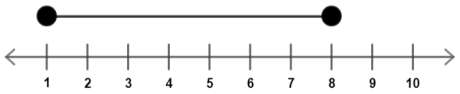
A7 Linear Sequences & the nth Term

A good first thing to check out with any sequence is the difference between each of the terms. In this case, the difference between each term is 4, so now we know the rule is
"add 4 to the previous term to get the next term"
Therefore, the 6th, 7th, and 8th terms respectively are:

$$21, 25, 29$$

A8 Inequalities on a Number Line

There are boundaries at 1 and 8, so we will draw two circles there on the number. They are both inclusive inequalities, so we will draw closed (filled-in) circles. Then, since the only numbers included in the inequality are those in between the two boundaries, we connect the two circles with a line. This looks like



G1 Coordinates and Midpoints

Point A has coordinates $(-2,-2)$.
Point B has coordinates $(0,3)$.
By taking the average of the x coordinates of A and B, the x coordinate of the midpoint is:

$$\frac{-2+0}{2} = -1$$

By taking the average of the y coordinates of A and B, the y coordinate of the midpoint is:

$$\frac{-2+3}{2} = \frac{1}{2}$$

Therefore, the coordinates of the midpoint are $\left(-1, \frac{1}{2}\right)$.

G2 Drawing Linear Graphs

Let's rearrange this equation. Subtract 1 from both sides:

$$y - 2x = -3$$

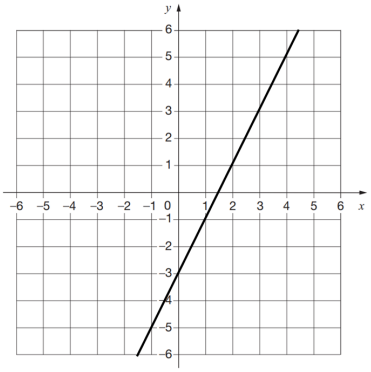
Add 2x to both sides

$$y = 2x - 3$$

Using this equation we find the value of y. To do this we create a table, show below.

x	-1	0	1	2	3
y	-5	-3	-1	1	3

Now we have the following coordinates
$(-1,-5),(0,-3),(1,-1),(2,1),(3,3)$



G3 Gradient of a Straight Line

Remember we just need to find two numbers to describe our line: the gradient (m) and the y-axis intercept (c).
It's easier if we start with the gradient.

$$m = \frac{\text{change in y}}{\text{change in x}} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7-(-2)}{4-(-2)} = \frac{9}{6} = \frac{3}{2}$$

So our equation so far is $y = \frac{3}{2}x + c$.
C is always the y-intercept which we can see from the graph is 4.
Giving the final answer to as $y = \frac{3}{2}x + 4$

G4 Gradient and $y = mc + x$

The equation of a straight line takes the form $y = mx + c$, where we need to find m, the gradient, and c, the y-intercept.
We can't see the y-intercept on the graph, so we'll have to work out the gradient first and get to c in a moment.
To find the gradient of a straight line, we draw a right-angled triangle underneath the line, and divide the change in y (the height) by the change in x (the width). This looks like:

The height of this triangle is 3, and the width is 1. The only other thing to consider is that the line is sloping downwards, so the gradient will be negative. So, we get

$$\text{gradient} = -\frac{3}{1} = -3$$

Now, to find c, we have to firstly pick a pair of coordinates that the line passes through - here we'll choose (-1, 0). Then, we have to substitute this x value and y value into the equation $y = mx + c$, along with the m that we just found.
Doing this, we get the equation

$$0 = (-3) \times (-1) + c$$

Simplifying and rearranging this equation, we get

$$0 = 3 + c$$
$$c = -3$$

So, we've found that $c = -3$ and the gradient $m = -3$, so the equation of the line is

$$y = -3x - 3$$

G5 Travel Graphs

a) We can see that the graph was flat for the duration of one big square. From the axis, we can see that two big squares total 15 minutes, therefore one big square is worth 7.5 minutes, so she was stationary for 7.5 minutes.

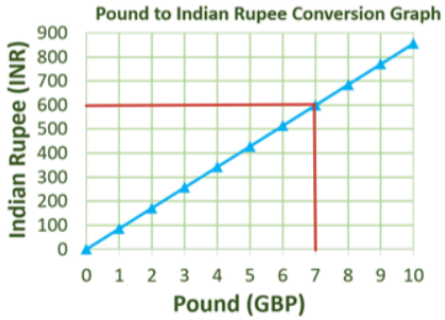
b) Valentina travelled away 25 km away from home, stopped briefly, and then travelled 25 km back home. Therefore, she travelled 50 km in total.

c) We need to calculate the gradient of the graph between 17:15 and 17:45. This period lasted for 30 minutes, which is equivalent to 0.5 hours - this is the "change in x". During this period, she increased her distance from home from 5 km up to 25 km, meaning she travelled 20 km in total - this is the "change in y". So, we get

$$\text{Gradient} = \frac{20}{0.5} = 40 \text{ km/h}$$

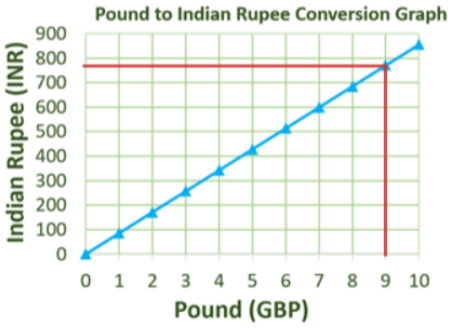
G6 Using Conversion Graphs

a) We want to find 7 on the x-axis, draw a vertical line up to the graph, and then draw a horizontal line across from the point where we meet the graph. Where that horizontal line hits the y-axis will be our value in rupees. So, this looks like



Therefore, we get that £7 is equivalent to 600 Rupees.

b) We want to find 775 on the y-axis, draw a horizontal line across to the graph, and then draw a vertical line down from the point where we meet the graph. Where that vertical line hits the x-axis will be our value in pounds. So, this looks like



Therefore, we get that 775 Rupees is equivalent to £9.

G7 Solving Simultaneous Equations

To find the solution to simultaneous equations using graphs, we want to plot both the graphs and see where they cross. The coordinates of the crossing point will be the solution. So, firstly, we want to fill out the table for equation (1) by substituting the x values in. Doing this, we get

x	-2	-1	0	1	2
y	-3	-2	-1	0	1

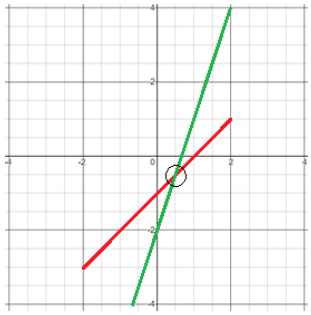
Now, for equation (2), we have to rearrange it to make y the subject before substituting any values in. So, if we divide both sides by 2, we get

$$y = x - 1$$

So, substituting x values into this equation, we get the filled out table:

x	-2	-1	0	1	2
y	-8	-5	-2	1	4

Now we want to plot each set of these coordinates, joining up the points to form a pair of lines representing our simultaneous equations.



Looking at the graph, we can see that the lines meet at (0.5, -0.5). So, the solution is

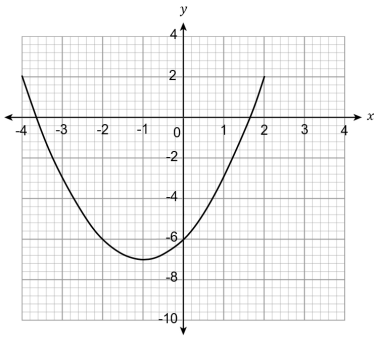
$$x = 0.5,\ y = -0.5$$

G8 Quadratic Graphs

We want to fill the table by substituting the x values into the equation.

x	-4	-3	-2	-1	0	1	2
y	2	-3	-6	-7	-6	-3	2

Now, we want to plot these points and join them together with a smooth curve (it'll become obvious when you plot them that they don't form a straight line).
Doing this, we get the graph shown below.



R1 Ratio

We know that Deborah's age is 28. Looking at the ratio, Deborah has 4 parts, meaning that 28 years constitutes 4 parts in the ratio. Therefore, we get that

$$1 \text{ part } = 28 \div 4 = 7$$

Kemah, Bob, and Deborah have 1, 2, and 4 parts in the ratio respectively. So, we get that
Kemah's age $= 1 \times 7 = 7$
Bob's age $= 2 \times 7 = 14$
Deborah's age $= 28$

R2 Proportionality

This recipe makes 6 pancakes, but Wes wants to make 21.
$21 \div 6 = 3.5$
Therefore, he needs to 3.5 times as much of every ingredient. So, we get:
flour: $100 \times 3.5 = 350$ g
eggs: $2 \times 3.5 = 7$ eggs
milk: $300 \times 3.5 = 1{,}050$ ml

R3 Direct and Inverse Proportion

30 Nurses = 2 hours
If we divide the left by 6 we need to multiple the right by 6. This gives the answer.
5 Nurses = 12 hours

R4 Reverse Percentage

We need to consider how we would calculate a 4% increase. We know that 4% = 0.04, so we get the multiplier for a 4% increase to be

$$1 + 0.04 = 1.04$$

Let H be Tom's height from two years ago. We know that the result of multiplying H by 1.04 must be 182. We can write this as an equation:

$$H \times 1.04 = 182$$

Then, if we divide both sides by 1.04 we get

$$H = 182 \div 1.04 = 175$$

So, Tom's height two years ago was 175 cm.

R5 Units and Conversions

a) Each metre is equivalent to 100 cm, so we must times the value by 100:

$$130 \text{ m } \equiv 130 \times 100 = 13000 \text{ cm}$$

b) Each kg is equivalent to 1000 g, so we must divide the value by 1000:

$$1001 \text{ g } \equiv 1001 \div 1000 = 1.001 \text{ kg}$$

c) Each tonne is equivalent to 1000 kg, so we must times the value by 1000:

$$3.3 \text{ tonnes } \equiv 3.3 \times 1000 = 3300 \text{ kg}$$

R6 Maps and Scale Drawings

First, use a ruler to measure the distance, in cm, between London and Madrid on the map.
Doing so, we learn that they are 2.6 cm apart.
1 cm is worth 500 km, so to get the real distance we must multiply by 500:

$$2.6 \times 500 = 1300 \text{ km}$$

R7 Best Buys

We will work out the cost per drink for each brand.
Brand 1:
Each bottle is 600 ml and provides 3 drinks per 100 ml. $600 \div 100 = 6$, so we get

$$\text{drinks per bottle } = 3 \times 6 = 18$$

The cost of a bottle of Brand 1 squash is £1.89, therefore we get

$$\text{cost per drink } = 1.89 \div 18 = £0.105$$

Brand 2:
Each bottle is 1300 ml and provides 7 drinks per 200 ml.
$1300 \div 200 = 6.5$, so we get

$$\text{drinks per bottle } = 7 \times 6.5 = 45.5$$

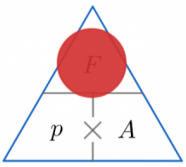
The cost of a bottle of Brand 2 squash is £5.10, therefore we get

$$\text{cost per drink } = 5.10 \div 45.5 = £0.112...$$

The cost per drink is lower for Brand 2, therefore Brand 1 is better value.

R8 Density and Speed

Covering up F on the triangle,



we see that we need to multiply p (pressure) by A (area). To do this, we need to find the area of the triangle. Before that, however, notice that the sides of the triangle are measured in centimetres which doesn't match up with the "Newtons per metres squared" in the question. So, we will convert the dimensions of the triangle into metres by dividing by 100:

$$\text{height } = 80 \div 100 = 0.8 \text{ m}$$
$$\text{base } = 150 \div 100 = 1.5 \text{ m}$$

Now we can calculate the area of the triangle:

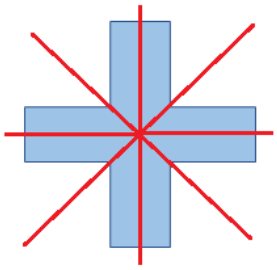
$$\text{area } = \frac{1}{2}bh = \frac{1}{2} \times 0.8 \times 1.5 = 0.6 \text{ m}^2$$

Therefore, we get that the force being applied is

$$F = p \times A = 40 \times 0.6 = 24 \text{ N}$$

M1 Symmetry

To work out the lines of symmetry, you want to try drawing straight lines through the shape such that whatever is on one side of the line is a mirror image of what's on the other side.
All possible lines of symmetry of this shape are:



Therefore, the number of lines of symmetry is 4.
As for the order of rotational symmetry, the question is: if you rotate the shape a full 360 degrees, how many times does it fit onto itself? Tracing paper is a great way to work this out.
Doing so, you would learn that the order of symmetry for this shape is 4.

M2 Areas of Shapes

We need to use the equation Area $= \frac{1}{2}(a+b)\times h$
Where $a = 5, b = 8$ and $h = 8$,
putting these into the equation gives

$$\text{Area} = \frac{1}{2}(5+8)\times 8 = 52$$

M3 Perimeters of Shapes

We can see that the side lengths of the rectangle are 4cm and 6cm however it's not immediately clear how to get the length of the curved edge joining A and B!
We can work this out using the formula for the circumference of a circle, $c = \pi d$. We can see the diameter of the circle is 4 cm, the same as the length of the shortest edge of the rectangle. The circumference of a circle with a diameter of 4 cm would be 4π. However we only have half a circumference here, so the length of the curved edge is 2π. This means the total perimeter of the shape is:

$$6+4+6+2\pi = 22.3 \text{ (1 dp)}$$

M4 Parts of the Circle

The straight line passing through A and B intersects the circumference twice and doesn't pass through the centre, so it's a chord.
The straight line BC touches the circumference of the circle just once, so it's a tangent.
There are two curved lines joining A and B: the 'big part' of the circumference and the small part of the circumference. These are both arcs.

M5 Area and Circumference of a Circle

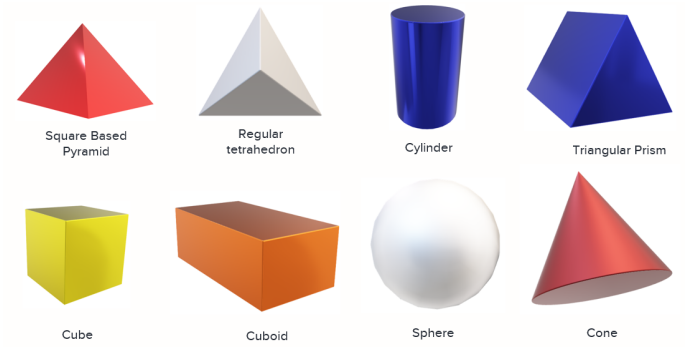
The formula for the area of a circle is πr^2. We get

$$\text{Area } = \pi \times 5^2 = 78.5 \text{ m}^2 \text{ (1 dp)}$$

The formula for the circumference is πd, where d is the diameter. The diameter is twice the radius, so we get

$$\text{Circumference } = \pi \times 10 = 31.4 \text{ m (1 dp)}$$

M6 3D Shapes

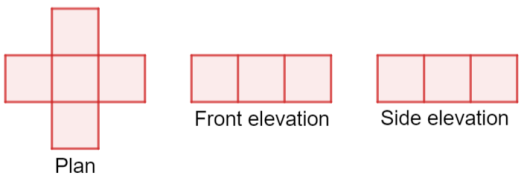


M7 Edges, Faces and Vertices

There's no real "how-to" here we just need to count them up! Here we've been given a diagram, but it always helps to draw one if not so you don't forget any "hidden" features.
There are 5 faces (2 triangles and 3 rectangles), 9 edges, and 6 vertices.

M8 Projections, Plans and Elevations

As we can see, the shape is one block high and is the shape of a cross, or letter x. As a result, the plan is going to be the shape of a cross, and both elevations will only be one block high. Furthermore, we can see that in looking both from the front and from the side, the shape in question is 3 blocks wide, so the resulting elevations will both be 3 blocks wide and 1 block high. All 3 projections are as seen below.



M9 Calculating Volume

A cylinder is a "circular prism". To find its volume, like with any other prism, we just need to multiply the cross-sectional area by the length. Because the cross-section of a cylinder is a circle, we can calculate its area using the formula for the area of a circle: $A = \pi r^2$.
So in this case, the cross-sectional area is:

$$A = \pi \times 3^2 = 28.274 \text{ cm}^2$$

Next we just multiply this by the length to get the volume:

$$V = 28.274 \times 8 = 226.19 \text{ cm}^3 \text{ (2 dp)}$$

M10 Types of Angle and Angle Facts

The angles in the diagram go all the way around a point, so they must add up to 360°. One of the angles doesn't have a measurement, but it is marked with a square which means it's a right angle (90°)
We can write the following equation:

$$63 + 57 + 62 + 68 + 90 + z = 360$$

Then we just simplify it by adding together the number on the left hand side:

$$340 + z = 360$$

Then subtract 340 from both sides of the equation to give us the answer:

$$z = 20^\circ$$

M11 Angles in Parallel Lines

Firstly, because angles BEF and EHJ are corresponding angles, we get

$$\text{angle EHJ } = 39^\circ$$

Next, because angles EDH and DHG are alternate angles, we get

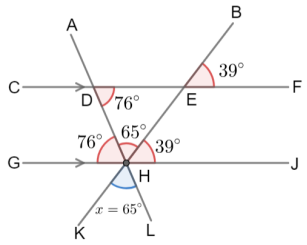
$$\text{angle DHG } = 76^\circ$$

Then, because angles DHG, DHE, and EHJ are angles on a straight line and angles on a straight line add to 180, we get

$$\text{angle DHE } = 180 - 76 - 39 = 65^\circ$$

Finally, because angle DHE and angle x are vertically opposite angles, we get

$$x = 65^\circ$$



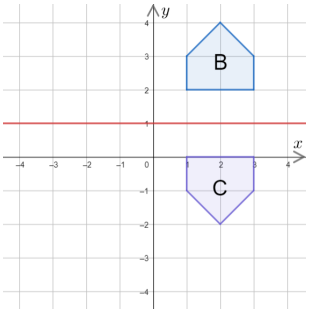
M12 Interior & Exterior Angles

This is a 4-sided shape, which we now know has interior angles that add up to $180 \times 2 = 360$. So, if we know all the interior angles other than x, then we can find x.
Currently we don't know them all, however we do have an exterior angle, and we know that exterior angles form a straight line with their associated interior angles, we get the interior angle at D to be $180 - 121 = 59°$.
Now we know all 4 interior angles, we get that

$$x = 360 - 84 - 100 - 59 = 117^\circ$$

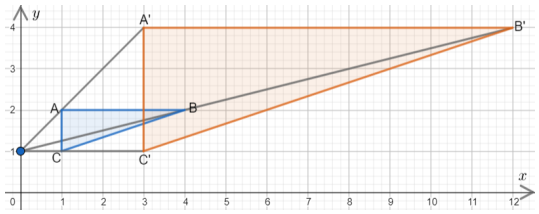
M13 Translations and Reflections

Firstly, we must draw the line $y = 1$ onto the graph. Then, you can either choose to use tracing paper or, if you're confident without it, just go right into the reflection.
Then, the trace of the shape is the result of the reflection. Draw that shape onto the original axes, mark it with a C and you should get the resulting picture below.



M14 Rotations and Enlargements

We need to draw lines from the point $(0, 1)$ to all corners of this shape. Then, since this is scale factor 3 enlargement, we need to extend these lines until they are 3 times longer. For example, the line from $(0, 1)$ to A goes 1 space to the right and 1 up. So, once we've extended it, the resulting line should go 3 spaces to right and 3 spaces up.
Then, once all these lines have been drawn, their ends will be the corners of the enlarged shape. Joining these corners up, we get the completed shape, as seen below.



M15 Congruence

Let's check each shape individually.
Shape B: it has two angles in common with A, but the side is a different length.
Shape C: this has two angles and a side-length in common with A, but to pass the ASA test the side-length needs to be between the two angles, which in C's case it isn't.
Shape D: this does what shape C didn't - all the numbers match, and the side we know is between the two angles which means that shape D is congruent to A by the ASA criteria.

The real value in being able to spot when two triangles are congruent like this is that we suddenly know that all the other angles and side-lengths must also be the same. This is useful in making quick leaps towards solving bigger problems, for example in circle theorems, so keep the definition of congruence as well as the 4 tests for congruent triangles in mind when solving all kinds of geometry problems.

M16 Similar Shapes

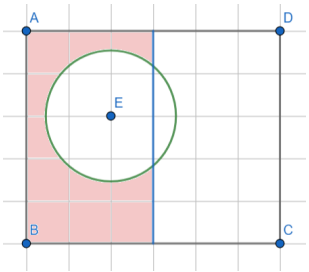
Firstly, we will determine the scale factor that relates the side-lengths

by dividing the side-length of the bigger shape by that of the smaller shape: $SF = 28 \div 7 = 4$.
Now, if the scale factor for the side-lengths is 4, then that means that the scale factor for the areas is: $SF_A = 4^2 = 16$.
Therefore, to find the area of the smaller shape, we need to divide the area of the bigger shape by the area scale factor: 16. Doing so, we get

$$\text{Area of A } = 320 \div 16 = 20 \text{ cm}^2$$

M17 Loci and Constructions

For the fountain to be at least 3 m away from his house along CD, we need to only consider the area to the left of the straight line which is parallel to CD and 3 cm away from it.
Then, the locus of points which are 1.5 m away from the tree at E will be a circle of radius 1.5 cm - for the fountain to be at least 1.5 m away, it must be outside this circle.
So, the locus of points where he could place the fountain is to the left of the (blue) line 3 m away from the house, and outside the (green) circle which is 1.5 m away from the tree. The correct region is shaded red on the picture below.



M18 Pythagoras

To do this we will need to use Pythagoras theorem $a^2 + b^2 = c^2$
We then add the numbers we know into the equation. This gives us

$$9^2 + x^2 = 13^2$$

Next, we need to rearrange to make x the subject.

$$x^2 = 13^2 - 9^2$$

Next if we then calculate the right-hand side:

$$x^2 = 169 - 81$$
$$x^2 = 88$$

Finally, we square root both sides

$$x = \sqrt{88} = 2\sqrt{22}$$

M19 Trigonometry - Finding Lengths

Here we're dealing with the opposite and adjacent sides, so we need a formula with both of those in. This means we'll have to use $\tan(x) = \frac{O}{A}$.
First we rearrange the formula: we're after the adjacent so we want to make A the subject.

$$A \times \tan(x) = O$$
$$A = \frac{O}{\tan(x)}$$

Now we've made A the subject, we just need to plug in the values given.

$$z = \frac{3.6}{\tan(52)} = 2.81 \text{ m (2 dp)}$$

M20 Trigonometry - Finding Angles

The two sides we're concerned with are the hypotenuse and the opposite (to the angle) - O and H. Therefore, we want the 'SOH' part of 'SOHCAHTOA', so will be using sin. We have $O = 13, H = 15$, and the angle is q, so we get

$$\sin(q) = \frac{O}{H} = \frac{13}{15}$$

Then, to get q, we have to apply the inverse sin function: $\sin^{-1}$ to both sides. It cancels out the sin on the left-hand side, and we get

$$q = \sin^{-1}\left(\frac{13}{15}\right)$$

Finally, putting this into the calculator we get

$$q = 60.0735... = 60.1^\circ \text{ (1 dp)}$$

P1 Probability Basics

We know their probabilities must add up to 1. To make life easier, we're going to convert them all to percentages.
Firstly, we get that

$$0.35 = 35\%$$

Then, we get

$$\frac{1}{4} = 1 \div 4 = 0.25 = 25\%$$

Now, we can takeaway these probabilities from 1, to find the probability of Amira winning the game.

$$1 - 40\% - 25\% = 35\%$$

So, the probability of Amira winning the game is 35%.

P2 Listing Outcomes

Let's consider the outcomes in which Joe comes first. We have:
JKL and JLK
Then, if Kiernan comes first, we have
KJL and KLJ
Next, if Lola comes first, we have
LJK and LKJ
Therefore, the total list of outcomes is
JKL, JLK, KJL, KLJ, LJK, and LKJ.

P3 Fairness and Relative Frequency

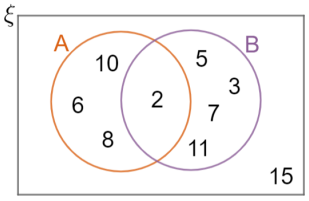
To work out the probability of a random vehicle passing Arthur's house, we need to find the relative frequency of not-black cars. Doing this, we get

$$\frac{\text{number of not-black cars}}{\text{total number of vehicles}} = \frac{56}{20+56+12+32} = \frac{7}{15}$$

Putting it into a calculator, we see that $\frac{7}{15} = 0.4666... = 46.7\%$.
Given that 50% = 0.5, we can see that the relative frequency of not-black cars is close to 50% but not exactly 50%, therefore Arthur is not correct.

P4 Venn Diagrams

a) Firstly, let's consider any number that are both even and prime. There is one: 2. This is the only number that will go in the section where the two circles cross over.
Then, the rest of the even numbers: 6, 8, and 10, will go in the section of the A circle that doesn't cross over with B. Next, the rest of the prime numbers: 3, 5, 7, and 11, will go in the section of the B circle that doesn't cross over with A.
Finally, the one number that is neither even nor prime is 15, so that goes outside the circles. The completed Venn diagram looks like the one below.



b) $A \cap B$ refers to "A and B". There is only one number in both A and B, so the answer is 1.

c) $A \cup B$ refers to "A or B". There are 8 numbers that are contained in circle A and/or circle B, and there are 9 numbers in total, so we get

$$P(A \cup B) = \frac{8}{9}$$

P5 Data

a) The data you collect on colours of cars in a parking lot - Qualitative data and primary data

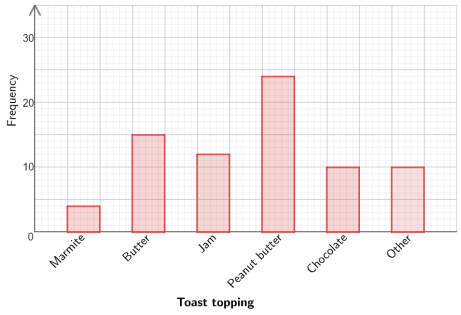
b) Show Sizes in a class which you measure in cm - Quantitative data, continuous and Primary data

c) Number of people who go to the cinema on different evenings - Quantitative data, Discrete data and Primary data

d) Global temperature data from the past 100 years - Quantitative data, Continuous data, Secondary data

P6 Bar Charts

Your bar graph should look like the one shown below. Remember, you must have gaps between the bars and everything (including the axes and the individual bars) should be clearly labelled.



P7 Pie Charts

We know that the formula for finding the angle is

$$\text{angle} = \frac{\text{number in one category}}{\text{sum of all categories}} \times 360$$

This time we know the angle (224), and the sum of all categories (1,260). So, the equation becomes

$$224^\circ = \frac{\text{paperbacks sold}}{1{,}260} \times 360$$

Divide by 360 and then multiply by 1,260 to get

$$\text{paperbacks sold} = \frac{224}{360} \times 1{,}260 = 784$$

The number of paperbacks sold is 784, so the number of other books sold is $1{,}260 - 784 = 476$. The ratio of hardbacks:audiobooks is 3:1, so audiobooks constitute 1 part out of 4 in the ratio.
Therefore, we get

$$\text{audiobooks sold} = \frac{476}{4} = 119$$