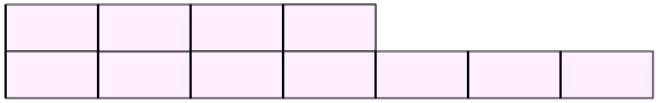
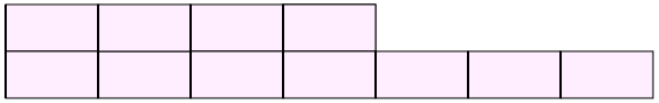
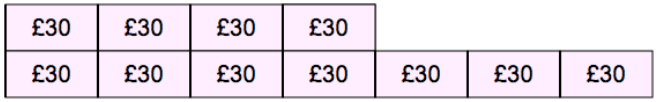
Stage 8 Knowledge Organiser (Corbett Maths video numbers in brackets)

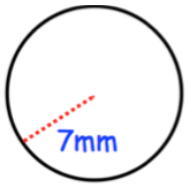
1. Solve a sharing problem involving ratio (either total, one side or difference) (170, 271, 271b)
2. Calculate with speed, distance and time triangle (299)
3. Simplify expressions by multiplying or dividing including powers (18, 11)
4. Factorise a single bracket (including quadratics) (117)
5. Change the subject of a simple formula (2 step) (7)
6. Reverse a percentage change (240)
7. Solve equations with unknowns on both sides (113)
8. Calculate the area and circumference of a circle (59, 60)
9. Find the volume of a prism (including cylinders) (356, 357, 358)
10. Find theoretical simple probability (245)
11. Plot a straight-line graph (186)
12. Express a number as the product of its prime factors (223)
13. Use a Venn diagram to find HCF and LCM of large numbers (234)
14. Identify and use alternate and corresponding angles (25)
15. Find the size of an exterior and interior angle of a polygon (32)
16. Draw an enlargement with a centre (104a)
17. Read and write numbers in standard form (300)
18. List outcomes and find probability (253)
19. Plot and Understand a scatter graph (165, 166)
20. Calculate mean from grouped data (55)

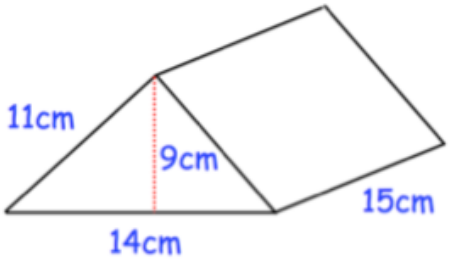
Skill	Method	Keywords/Definitions
801	Solve a Ratio Sharing Problem Draw out your blocks then decide which blocks in the diagram represent the value you are given in the question. Use this to find what one block is worth and then fill every block in and count up your rows to get your answer. Example: James and Paul share some money in the ratio 4:7. Paul gets £90 more than James. How much does James get?  Start by drawing your blocks out. The top row represents James and the bottom represents Paul. The question does not give us a total, but says that Paul gets £90 ***more*** than James, so Paul's extra blocks must be worth the £90  £90 So if we divide the £90 into these blocks we can see that each block is worth £30 and we can count up James' row to find our answer.  James was the top row so £30 + £30 + £30 + £30 = £120	The trick to these questions is deciding which divide sum to do by looking and the diagram and deciding which blocks represent the number given in the question. In this case is the £150 a total? Is it one of the boys totals? Or is it the difference between them?
802	Calculate with Speed Distance Time Triangle Speed, distance and time are compound units that are connected by the triangle below.  This shows that Speed=Distance ÷ Time, Distance = Speed x Time and Time = Distance ÷ Speed To use the triangle, fill in the values you are given and it will leave you with the sum to do. Example: Calculate the distance travelled in 3 hours if you travel at 60mph	Compound units are where one unit is the relationship between two other units. In this case, speed is measured as the relationship between the change in time and change in distance.

	3hours is a time and 60mph is a speed so fill these into the triangle:  This leaves us with 60mph multiplied by 3hours which gives us 180 miles travelled.	
803	Simplifying Expressions by Multiplying or Dividing Multiplying Multiply the coefficients and write the letters together afterwards, using the laws of indices (add the powers when multiplying) where necessary. Examples: Simplify $8x \times 4y = 32xy$ $4a^3 \times 5a^2b = 20a^5b$ Dividing Divide the coefficients and cancel any letters that appear in both terms (can be written as fractions and best to write out any powers as a list so x^3 should be written as xxx to help with cancelling) Examples: Simplify $12x^5y \div 4x^3y$ $\frac{12xxxxxy}{4xxxy}$ Divide the coefficients $(12 \div 4)$ $\frac{3\cancel{xxxxxy}}{\cancel{xxxy}}$ Then write out the powers as lists and cancel any common factors (this can also be done using the law of indices to subtract powers when dividing) $3xx = 3x^2$ This leaves a 3 as coefficient and the two xs which gives us x squared	Expression – something with letters and numbers but no equals sign. Remember that we don't write multiply signs so 6xyz means 6 multiplied by x multiplied by z. Coefficient – the number in front of the letter: in 7y 7 is the coefficient of y

804	Factorising a Single Bracket Look for the Highest Common Factor of both terms, write this in front of the bracket then divide both terms by the HCF and write the answers inside the bracket. Examples: Factorise $20x - 16$ The highest common factor of 20x and -16 is 4 $4($ $)$ Write the 4 outside the brackets then divide both terms by 4 $4(5x - 4)$ writing the answers inside the bracket Factorise $9x^2y - 12xy$ The highest common factor of both terms here is 3xy. If this is hard to spot do it in parts: the HCF of 9 and 12 is 3 and one x and one y are common to both terms $3xy($ $)$ Dividing both terms by 3xy will divide the coefficients by 3 and cancel one x and one y from each term $3xy(3x - 4)$	Factorise – put into brackets. You can always check your answer by multiplying out the bracket and seeing if it matches the initial expression. HCF – the biggest thing that will divide into both terms.
805	Changing the Subject of a Formula Use inverse operations to isolate the subject on its own on one side of the equals sign. When deciding which term to get rid of first use the opposite order to BIDMAS (add and subtract go first, then multiply and divide) Example: Make x the subject $y = 7x - 5$ The x is on the right-hand side here so we're going to leave it there and get rid of the 7 and -5. The 7 is multiplying and the -5 is subtracting so the -5 will go first (opposite of BIDMAS) so add 5 to both sides. $y = 7x - 5$ $+5 \quad +5$ this will delete the -5 on the right and add 5 to the y on the left (have to write this as y + 5) $y + 5 = 7x$ we now need to get rid of the 7 so we divide both sides by 7. This will delete the 7 on the right and We'll need to write the left-hand side as a fraction to do the y+5 all divided by 7 $\div 7 \quad \div 7$ $\frac{y+5}{7} = x$ As x is now on its own on one side of the equals sign it is now the subject of the formula.	The subject of a formula is what the formula equals. In y=5x+2 y is the subject in 6a+7c=t t is the subject Inverse operations – doing the opposite to what a number is doing (multiply becomes divide, add becomes subtract)

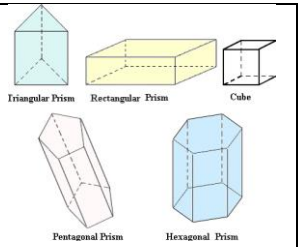
806	Reverse a Percentage Change Find the multiplier that has been used to do the percentage change, then divide your value by the multiplier Example: John gets a 17% pay rise and is now paid £35 100 a year. What was his original salary? To increase by 17% the original by 17% it must have been multiplied by 1.17. So, to find the original salary divide the new salary by 1.17 $35\ 100 \div 1.17 = 30\ 000$ So, the original salary was £30 000 a year. Example: In a 15% off sale a top now costs £72.25. What was the original price? To decrease something by 15% it must have been multiplied by 0.85 To find the original price divide the £72.25 by 0.85 $72.25 \div 0.85 = 85$ So, the original price was £85	Multiplier – used to increase or decrease by a given percentage (1.12 increases by 12% 0.97 decreases by 3%) Salary – yearly pay Original – first/earlier Increase – make bigger Decrease – make smaller
807	Solve Equations with Unknowns (letters) on Both Sides Get rid of the smallest letter term first, then solve the two step equation you're left with. Example: Solve $3x + 8 = 8x - 10$ The two x terms here are the 8x and the 3x, so we'll get rid of the 3x as it's the smallest by -3x from $-3x \quad -3x$ Both sides. This will delete the 3x on the left and subtract 3x from the 8x on the right $8 = 5x - 10$ We now get rid of the -10 by adding 10 to both sides, deleting the -10 and adding 10 to the 8 +10 +10	Letters represent unknown or missing numbers so are sometimes called 'unknowns'

	$18 = 5x$ We now divide by 5, and as 18 won't divide equally by 5 we'll have to write out answer as a fraction $\div 5 \quad \div 5$ $\frac{18}{5} = x$	
808	Calculate the Area and Circumference of a Circle You need to learn these two formulae!!! Area $= \pi r^2$ Circumference$= \pi d$ Write down the radius and diameter for your circle, so you don't use the wrong length when working each one out. Example: Calculate the area and circumference of this circle  The radius here is 7mm so the diameter is 14mm Area = $\pi \times 7^2$ Circumference = $\pi \times 14$ $49\pi = 153.9\text{mm}^2$ $14\pi = 44.0\text{mm}$	Radius – distance from the centre of a circle to the outside. Diameter – the distance across a circle going through its centre The radius is half the diameter Circumference – the distance around the outside of a circle (its perimeter)
809	Calculating the Volume of a Prism Volume = Area of cross section x length Example: Find the volume of this prism	A prism is a 3D shape that has the shape running right through it (this shape is known as the cross-section)

<table>
<tr>
<td></td>
<td> 

This prism has a triangle as its cross-section, so we need to find its area by doing base x height ÷2. Then multiply by the length of the prism (15cm)

Area of triangle = 14cm x 9cm ÷2 =63cm^2

Volume = 63cm^2 x 15cm =945cm^3</td>
<td> 

So a pyramid is NOT a prism, but a cylinder is.
Volume units are always cubed to show it is 3D</td>
</tr>
<tr>
<td>810</td>
<td>Calculating Theoretical Probability

Probability = $\frac{ways\ \ something\ \ could\ \ happen}{total\ \ \ outcomes}$

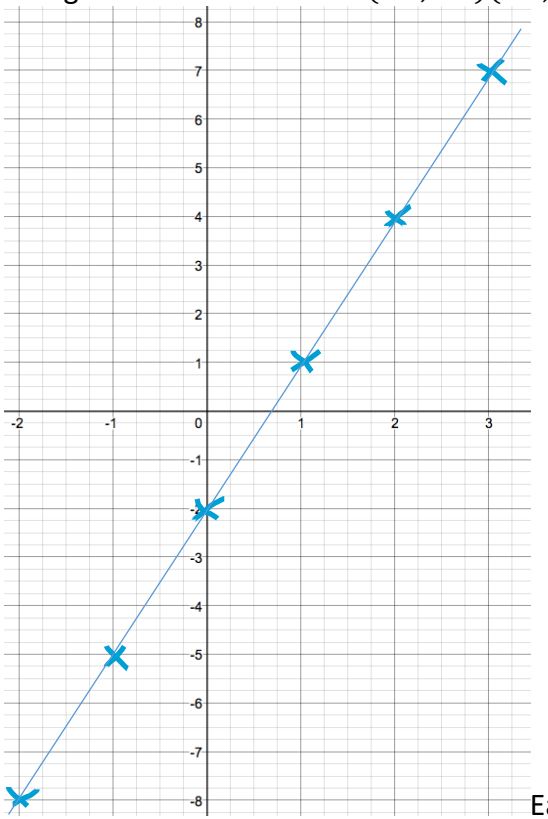
Example:
In a bag there are 5 red counters 3 blue and 2 white.
Calculate the probability of picking a blue counter at random.

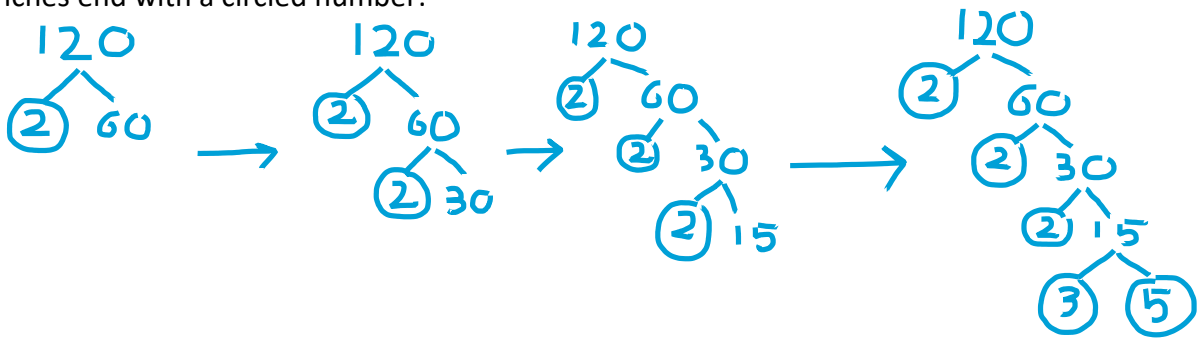
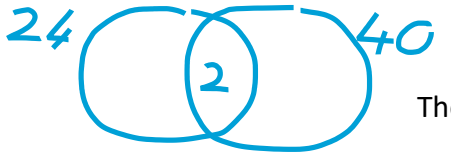
There are 3 blue counters and 10 counters in total, so the probability of choosing a blue one is $\frac{3}{10}$</td>
<td>Probability is a way of looking at how likely something is to happen.
An outcome is something that could happen.
Random means each counter has the same chance of being chosen.</td>
</tr>
<tr>
<td>811</td>
<td>Plot a Straight-Line Graph

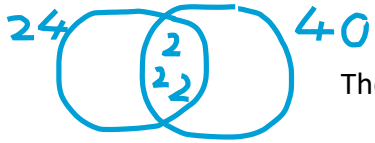
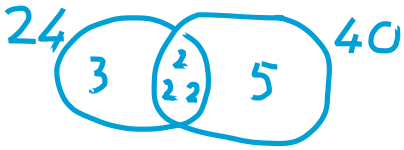
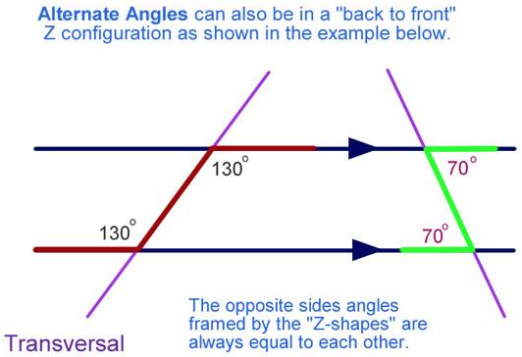
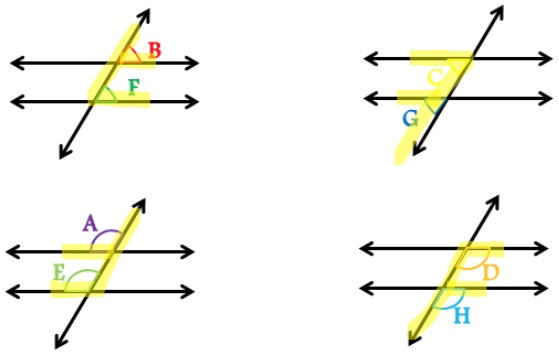
Substitute the values you are given for x into the equation of the line and then plot the coordinates it gives you on your graph and join the points up

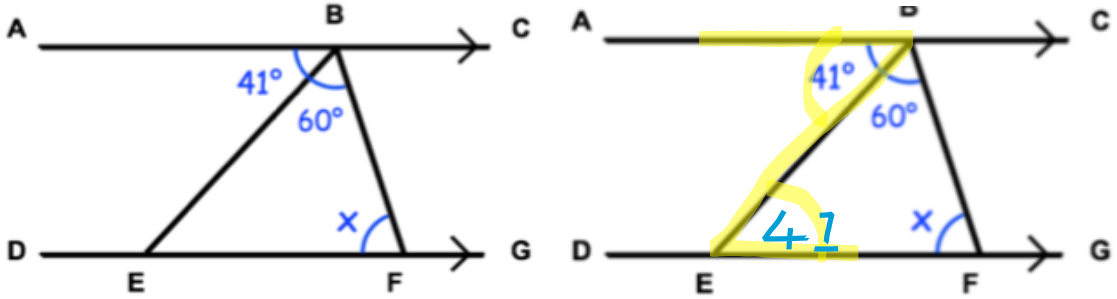
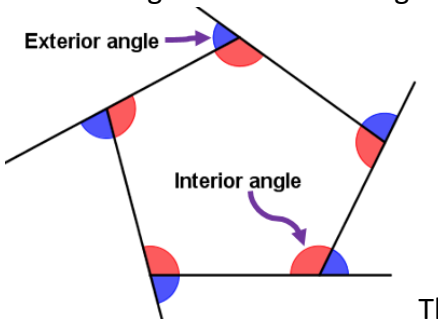
Example: Plot the graph of $y = 3x - 2$ for values of x such that $-2 \leq x \leq 3$

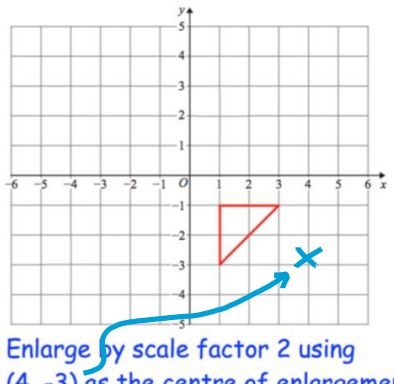
The inequality at the end here tells us to sub in all the numbers from -2 up to 3 into the equation we are given so set up a table of values containing these numbers as the values for x
<table>
<tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td></tr>
<tr><td>y</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td>
<td>Equation – has letters and numbers and an equals sign
Substitute – replace letters with given numbers.
Table of values contain the x values and their corresponding y values</td>
</tr>
</table>

	To fill int the y values we need to put the numbers on the top row into the equation we were given: $y = 3x - 2$ which means we need to multiply them by 3 then subtract 2: | x | -2 | -1 | 0 | 1 | 2 | 3 | | y | -8 | -5 | -2 | 1 | 4 | 7 | This gives us 6 coordinates: $(-2,-8)(-1,-5)(0,-2)(1,1)(2,4)(3,7)$ so we now need to plot these on our graph.  Each cross here represents one of the coordinates we worked out, make sure the line goes as far across the grid as it can and doesn't stop at the last cross!	
812	Express a Number as a Product of its Prime Factors Use a factor tree to show all the prime numbers that make up the number then make sure you write out your answer using multiply signs (and powers if asked)	Factors of a number can divide equally into that numbers. Prime numbers have exactly two factors; themselves and one.

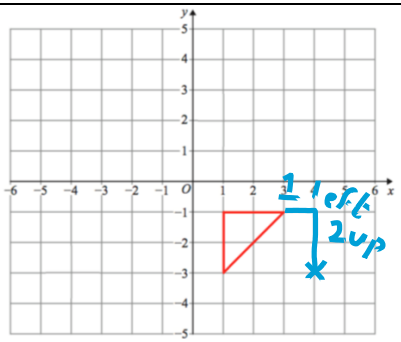
	Example: Express 120 as a product of its prime factors using index notation Write out 120 and try to divide it by the prime numbers in turn in a factor tree, circling any primes you find until all the branches end with a circled number:  So, our answer is $2 \times 2 \times 2 \times 3 \times 5$ Which simplifies to $2^3 \times 3 \times 5$ using index notation	Index notation means using powers.
813	Finding HCF and LCM from Prime Factors This requires you to have the prime factor list for both numbers already Example find the HCF and LCM of 24 and 40 Work out or write down the list of prime factors $24 = 2 \times 2 \times 2 \times 3$ $40 = 2 \times 2 \times 2 \times 5$ Draw a Venn diagram out, letting one circle represent one number and the other circle represent the other  Try to pair up all the numbers in the top list with a number in the bottom list. If you can write one number in the centre of the Venn diagram $24 = \cancel{2} \times 2 \times 2 \times 3$ $40 = \cancel{2} \times 2 \times 2 \times 5$  The 2 in the intersection here represents a 2 from both numbers Continue to pair numbers up until you have no more pairs:	HCF = Highest common factor which means the biggest whole number that will divide equally into both numbers. LCM = Lowest Common Multiple which means the smallest thing that would appear in both the nunbers' times tables.

	$24 = 2 \times 2 \times 2 \times 3$ $40 = 2 \times 2 \times 2 \times 5$  The 3 will go in the left circle for the 24 and the 5 in the right one for 40 $24 = 2 \times 2 \times 2 \times 3$ $40 = 2 \times 2 \times 2 \times 5$  This is the completed diagram. So the numbers in the intersection multiplied together give us the HCF and all the numbers in the diagram give us the LCM HCF$= 2 \times 2 \times 2 = 8$ LCM$=3 \times 2 \times 2 \times 2 \times 5=120$	
814	Identify and use Alternate and Corresponding Angles These appear on parallel lines. Alternate angles form a Z shape and Corresponding angles form an F shape and the angles inside the shapes are always equal. Alternate angles  Corresponding angles  Notice that the Z and F shapes can be upside down and back to front.	Parallel lines are lines that never meet and are always the same distance apart. They are shown on diagrams by having little arrows on the lines. Transversal – the lines cutting the parallel lines.

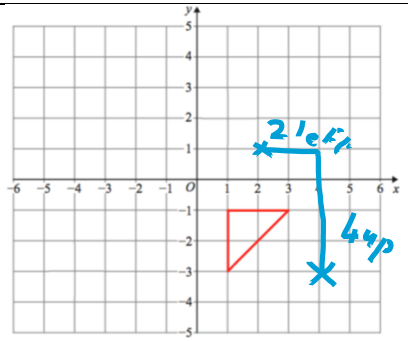
	Example: Calculate the angle x  Using alternate angles we can see Angle BEF is also 40° Now we can use angles in triangles add to 180° to find out x. 41+60=101 180-101=79	
815	Finding the Size of an Exterior and Interior Angle on a Polygon Exterior Angles always add up to 360° Exterior angles are NOT the big reflex angles around the corners, but are made by continuing one of the lines on the polygon:  This also means that an interior angle and exterior angle form a straight line so add up to 180 Example: find the size of an exterior and interior angle on a regular octagon Exterior angle of an octagon $= 360 \div 8 = 45$ Interior angle $= 180 - 45 = 135$	Exterior means outside. Interior means inside. Polygon just means shape. Regular shapes are where all the sides and angles are the same.
816	Draw an Enlargement with a Centre of Enlargement Example:	Scale factor – what you multiply each side length by the enlarge a shape.



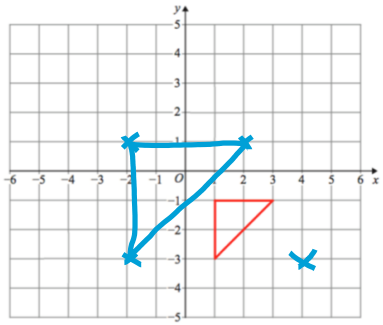
Mark the centre on the grid



Count squares from the centre
To the nearest corner



Multiply these distances by the
scale factor and mark new point



Repeat for each corner and join to for enlarged shape.

817 Read and Write Numbers in Standard Form

Standard form is a way of writing both huge numbers (lots of zeros) and tiny numbers (lots of decimal places) in a simpler way. It is always written in the form $a \times 10^b$ where the number a is between 1-10. IF the power (b) is positive it will be a big number, its negative it means it will be a small number.

Examples:

Write these numbers in standard form:

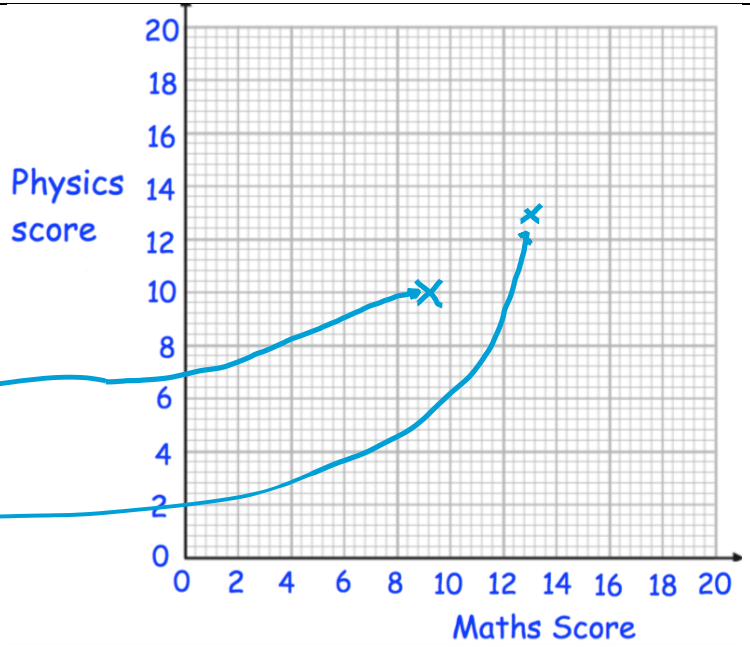
$43\,500$

$4.3\,500$ Put a decimal point in the number so that you create a value between 1 and 10 (4.3500) this is a

$4.3\,500$ Count how many columns the decimal point has moved to get there (4 columns) this is b

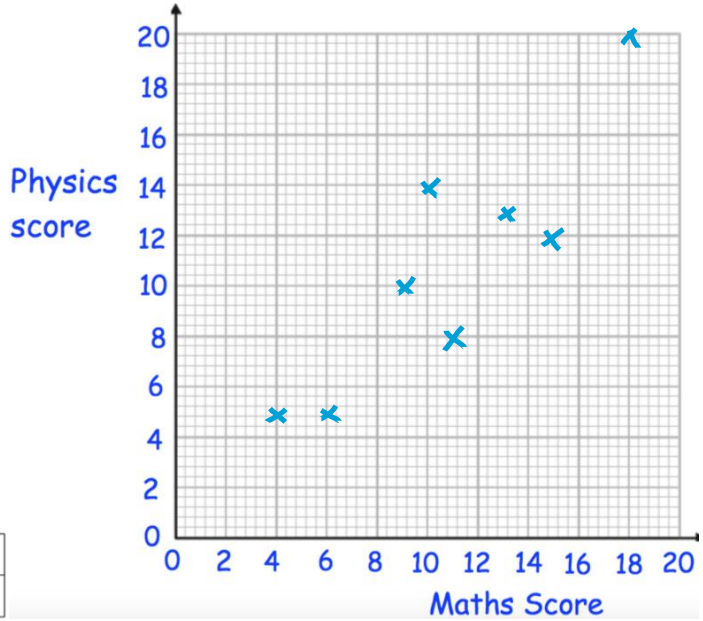
4.35×10^4 Write out in Standard Form.

	0.00702 0007.02 Put a decimal point in so that you create a value between 1 and 10 (7.02) this is a 0007.02 Count how many columns the decimal point has moved to get there (3 columns) this is b and will be negative 7.02×10^{-3} Write out in Standard Form Write out the number 8.602×10^{5} 8.602 The 10^{5} means this will be a big number (power is positive) so 'hop' the decimal point 5 columns to the right 860200 fill in any blank 'hops' with zeros. Write out the numbers 3.209×10^{-4} 3.209 The 10^{-4}means this will be a small number (power is negative) so 'hop' the decimal point 4 places left 0.0003209 Where the point stops is where the decimal point stays, then fill in zeros in any blank 'hops' and one in front of the decimal point	
818	List Outcomes and Find Probability Listing outcomes means list all the combinations that can occur in the situation you're looking at. Example: In bag one there are two counters; red and pink. In bag two there are three counters; blue, yellow and white.  If a counter is chosen at random from each bag, list all possible outcomes: Red Blue, Red Yellow, Red White, Pink Blue, Pink Yellow, Pink White. This shows there are 6 possible outcomes, so for example the probability of picking a red and white combination would be $\frac{1}{6}$	Outcomes – things that can happen
819	Plot and Understand a Scatter Graph Scatter graphs show Bivariate data. This means it shows variables at once (for example: height and weight, maths score and science score etc) It allows us to see relationships between variables. Example: Plot the following data on the scatter graph	A variable is something we can measure. Bivariate means two variables.



Maths score	9	13	6	18	11	4	15	10
Physics score	10	13	5	20	8	5	12	14

Plot each of the pieces of data on the graphs similar to coordinates. The first two have been done above.



Maths score	9	13	6	18	11	4	15	10
Physics score	10	13	5	20	8	5	12	14

We can see from this that in general as maths score increase (going left to right), Physics scores also increase (going bottom to top)

820

Calculate an Estimated Mean from Grouped Data

When we group data it makes it easier to read, but it loses its accuracy. If we know that someone's height is in the group $150cm \leq h < 160cm$ we do not know ***exactly*** what their height is, just that it is between 150cm and 160cm. This means that when we try to calculate the mean $(\frac{total}{count})$ we have an issue in calculating the total as we can't add the number up if we don't know exactly what they are. Therefore we use the midpoint of the group as an estimate, so we would estimate that the person's height would be 155cm.

Example: Find and estimate for the mean length

Length (cm)	Frequency	mp
0 ≤ L < 30	8	15
30 ≤ L < 60	43	45
60 ≤ L < 90	25	75
90 ≤ L < 120	4	105

Add a column for the midpoints

Length (cm)	Frequency		mp	
0 ≤ L < 30	8	×	15	120
30 ≤ L < 60	43	×	45	1935
60 ≤ L < 90	25	×	75	1875
90 ≤ L < 120	4	×	105	420
	80			4350

Multiply the midpoints by the frequencies

Add these to get the overall total and divide that by the total frequency (the 80 is the 'count' and the 4350 is the 'total')
Divide the total by the count $\frac{4350}{80} = 54.375$ so the estimated mean is around 54cm. This makes sense as if we look at the groups in the table, they go from 0 up to 120 so 54 would seem to be a decent value for the mean.

$$mean = \frac{total}{count}$$

Mid-point is the number in the middle of the group.
Total means all the data added up.
Count is how many pieces of data you have.
If you are stuck finding a midpoint for a group add the top and bottom number and half the answer. For example $50 \leq x < 90$ would be 50+90=140÷2=70