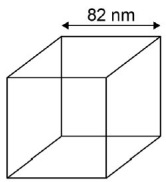
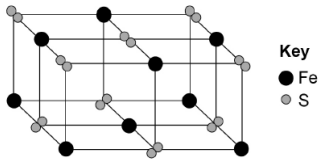
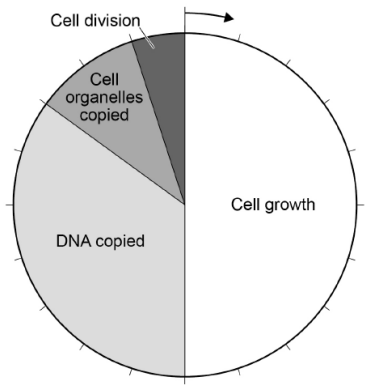
Student maths skills audit: What do I know?

Look at each of the maths skills and assessment examples: How confident are you at doing questions like the one in the example?
RAG rate yourself so you can focus your revision on the skills you still need to master.

Maths skill	How it's used in science GCSE	Example question	R	A	G
Recognise and use expressions in decimal form	The term 'decimal' refers to the part of the number which is after the decimal point. You will need to perform calculations using decimal numbers and to round a number to a given number of decimal places (dp). This is different from the term 'significant figures' (sig figs) so don't mix them up; see example below. 34.67 to 1dp = 34.7 34.67 to 1 sig figs = 30	0 3 . 2 Calculate the relative atomic mass (A_r) of element **X** using the equation: $A_r = \frac{\text{(mass number} \times \text{percentage) of isotope 1 + (mass number} \times \text{percentage) of isotope 2}}{100}$ Use **Table 2**. Give your answer to 1 decimal place. **[2 marks]** 0 3 . 2 The man has a mass of 85 kg Gravitational field strength = 9.8 N/kg Calculate the weight of the man. Use the equation: weight = mass × gravitational field strength **[2 marks]**			
Recognise and use expressions in standard form	Standard form is a different way of writing numbers. For example, 437 can be written as 4.37×10^2 It's based on using powers of 10 and is very useful for writing very large or very small numbers. In standard form, numbers are given as a number from 1 to 10 (but not 10 itself) which is then multiplied by a power of 10. In maths textbooks this tends to be written as $\alpha \times 10^n$ where $1 \leq \alpha < 10$	Zinc oxide can be produced as nanoparticles and as fine particles. 1 0 . 3 A nanoparticle of zinc oxide is a cube of side 82 nm **Figure 15** represents a nanoparticle of zinc oxide. **Figure 15**  Calculate the surface area of a nanoparticle of zinc oxide. Give your answer in standard form. **[3 marks]**			

Use ratios, fractions and percentages	A **ratio** shows the relative size of two values and is usually written in the form a:b. Some ratios are simply expressed as whole numbers, for example the ratio of carbon to hydrogen atoms in a molecule of methane is 1:4 Ratios that are not whole numbers can be expressed in the form '1:x' so that they can be easily compared with other ratios. In some ratios, the two quantities being compared are parts of a whole. For example, in Al_2O_3 the ratio of aluminium atoms to oxygen atoms is 2:3 This helps to see the total number of atoms in the molecule and calculate the percentage of the molecule that is in each element.	0 9 . 1 Iron pyrites is an ionic compound. **Figure 12** shows a structure for iron pyrites. **Figure 12**  Determine the formula of iron pyrites. Use **Figure 12**. **[1 mark]** Mitosis is part of the cell cycle. **Figure 2** shows the percentage of time taken by each stage of a cell cycle. **Figure 2**  0 2 . 3 The cell cycle shown in **Figure 2** takes 21 hours in total. Cell division takes 5% of the total time. Calculate how many hours cell division takes. **[2 marks]**			
	Fractions may be used in calculations, for example calculations of rates and probability. Pie charts are used to show fractions of different things that make up the whole of something eg the different proportion of gases that make up air or the different events in the cell cycle. You will need to interpret these and use the information in a calculation. You're expected to give answers as decimals, not fractions, especially if the numbers in the question are decimal, so make sure your calculator is set to the correct mode to do this.				

A percentage is a fraction where the denominator is 100, so 5% means 5/100

You may be asked to:

- calculate a percentage of a number, for example 7% of a mixture with a mass of 200g is salt, how much salt is there?
  7/100 × 200
- calculate one number as a percentage of another, for example 24 students out of a class of 50 had brown eyes, what percentage of students had brown eyes?
  24/50 × 100
- calculate an increase or decrease by a particular amount, for example if a mass of 50g was increased by 10% what would the new mass be?
  10% of 50g is 5 so the new mass would be 55g
- calculate % change using this formula:

$$= \frac{\text{difference between 2 values}}{\text{original value}} \times 100$$

This is often used in osmosis and rates of reaction experiments.

A student heats 2.5 g of hydrated copper sulfate in a test tube.

0.9 g of water is given off.

The remaining solid is anhydrous copper sulfate.

0 1 . 5 Calculate the percentage of water contained in 2.5 g of hydrated copper sulfate.
[2 marks]

0 6 . 5 Calculate the percentage decrease in the number of weeds on side **A** after 2 weeks.
[2 marks]

Use the following equation:

$$\text{percentage decrease} = \frac{(\text{mean at start} - \text{mean after 2 weeks})}{\text{mean at start}} \times 100$$

<table>
<tr>
<td>Make estimates of the results of simple calculations</td>
<td>In science, if you are asked to estimate a number, you need to use the information in the question to suggest a sensible number/value for a missing reading. This might be taking a reading from a line graph or determining a number missing from a table.

In GCSE Maths, it is different and means rounding numbers to 1 sig fig to make them simpler to use in a calculation, so you are giving an estimation rather than an exact answer.</td>
<td>
Table 4 shows the student's results.

Table 4
<table>
<tr><th></th><th colspan="4">Total mass of copper produced in mg</th></tr>
<tr><th>Time in mins</th><th>Experiment 1</th><th>Experiment 2</th><th>Experiment 3</th><th>Mean</th></tr>
<tr><td>1</td><td>0.60</td><td>0.58</td><td>0.62</td><td>0.60</td></tr>
<tr><td>2</td><td>1.17</td><td>1.22</td><td>1.21</td><td>1.20</td></tr>
<tr><td>4</td><td>2.40</td><td>2.41</td><td>2.39</td><td>2.40</td></tr>
<tr><td>5</td><td>3.02</td><td>X</td><td>3.01</td><td>3.06</td></tr>
</table>

0 5 . 3 Determine the mean mass of copper produced after 3 minutes.

[1 mark]
</td>
<td></td><td></td><td></td>
</tr>
<tr>
<td>Use an appropriate number of significant figures</td>
<td>Sig figs are all the digits in a number starting from the first digit which is not a zero. So when giving a number to a certain sig fig start from the first number that is not a zero.

The number of sig figs the answer should be given to depends on the number of sig figs in the data given in the question.

In this example, the numbers in the results table are given to 2 sig fig so the answer asks for 2 sig figs.</td>
<td>
0 3 . 2 The student did the test four times.

The student calculated the mass of solid on apparatus X after heating.

Table 3 shows the student's results.

Table 3
<table>
<tr><th></th><th>Test 1</th><th>Test 2</th><th>Test 3</th><th>Test 4</th></tr>
<tr><td>Mass of solid in grams</td><td>0.12</td><td>0.29</td><td>0.14</td><td>0.15</td></tr>
</table>

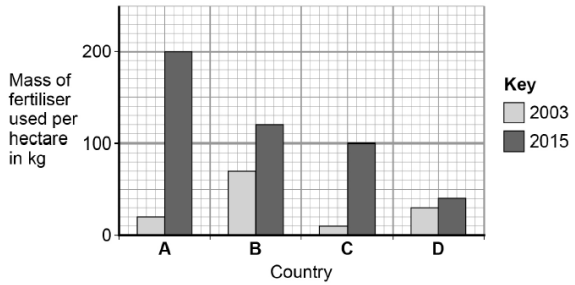
Calculate the mean mass of solid.

Do not include the anomalous result in your calculation.

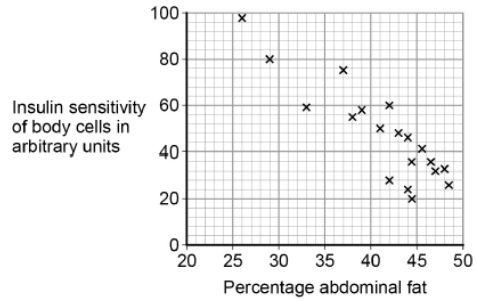
Give your answer to 2 significant figures.

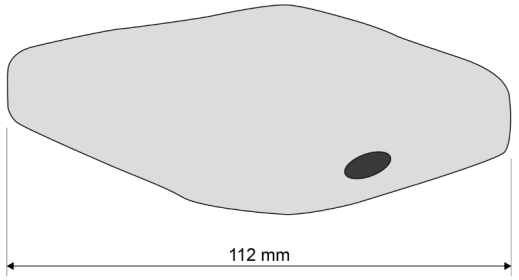
[3 marks]
</td>
<td></td><td></td><td></td>
</tr>
</table>

Find means and understand the terms mean, mode and median	Mean is the sum of the values divided by the number of values. In **science**, if there are **anomalous** results, you **should not** include the anomalous result when you work out the mean. Median is the middle value in an ordered data set. It is unaffected by anomalous results in the data set. Mode is the most commonly occurring value.	The previous question is an example of calculating the mean. **Table 5** shows the data a student collected from five areas on one leaf. **Table 5** 	Leaf area	Number of stomata	
---	---	---
	Upper surface	Lower surface
1	3	44
2	0	41
3	1	40
4	5	42
5	1	39
Mean	**2**	**X** | 0 9 . 4 What is the median number of stomata on the upper surface of the leaf? **[1 mark]**			

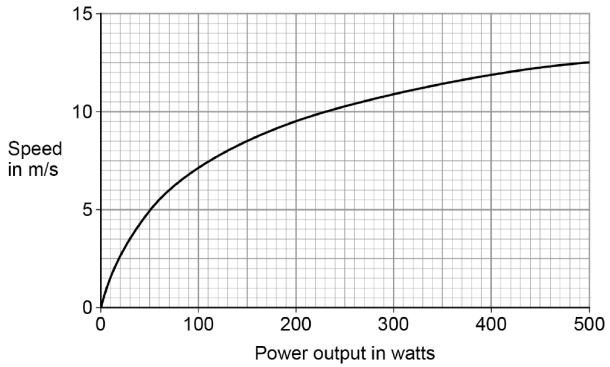
Construct and interpret frequency tables and diagrams, bar charts and histograms	A frequency table would usually be made from a tally chart with the tallies totalled in the frequency column. The data in the frequency table can be used to identify the median and mode and to calculate the range and mean. If the data is in groups, the range cannot be calculated, but it is still possible to identify the groups that contain the mode and median, and the estimated mean can be calculated. The data from the frequency table can be made into a bar chart with frequency as the vertical axis. In science, we tend to use bar charts rather than histograms but if the data is continuous then it can be presented as a histogram. In a bar chart the bars should be: • evenly spaced out • the same width • labelled clearly (use the results table for labels). (See information on plotting bar charts later.)	0 4 . 8 **Figure 9** shows the use of fertiliser in four different countries, **A**, **B**, **C** and **D**, in 2003 and 2015 **Figure 9**  A student said: '**much** more fertiliser was used in 2015 than in 2003' Is the student correct? Use data from **Figure 9** to justify your answer. **[3 marks]**			

Understand the principle of sampling as applied to scientific data (Biology questions only)	This includes: • understanding the importance of the correct sample sizes, the intervals the samples are taken at, the range and the variables that need to be controlled (kept the same) to ensure valid results or conclusions • working out the estimated population size (could use the formula in practical handbook) • understanding how a population may change in an area due to a factor changing (when using a line transect).	0 4 . 1 Why did the students place the quadrats at random positions? **[1 mark]** 0 4 . 2 Estimate the total number of dandelion plants in the field. Calculate your answer using information from **Figure 5** and **Table 2**. Give your answer in standard form. **[5 marks]**			
Understand simple probability (Combined and Separate Biology questions only)	Probability is used to describe the chance of an outcome occurring. In genetics questions, it's used to work out the probability of a characteristic (Phenotype) occurring eg probability of having brown eyes. A Punnett square might be part of the question. Probability can be expressed as a decimal number or a fraction. For example, in this question, 0.5, 50% or $\frac{1}{2}$ would all be correct.	0 5 . 4 Complete the Punnett square diagram in **Figure 8** for this man and woman. **[1 mark]** **Figure 8** **Woman** **Man** **B** **b**			

Use a scatter diagram to identify a correlation (pattern) between two variables	A scatter graph is used for comparing two sets of data where both measures belong to the same subject. For example, a given person's height and weight, or the length and resistance of a wire. If a line of best fit can be added to the scatter graph, then the data is said to be correlated ie there is a relationship between the variables.	Type 2 diabetes is another form of diabetes. Type 2 diabetes is common in obese people. People with Type 2 diabetes make enough insulin, but still cannot control their blood glucose concentration. This is because the body cells are not sensitive to the insulin. **Figure 7** shows information about abdominal fat and insulin sensitivity in body cells. **Figure 7**  0 5 . 6 What type of relationship is shown in **Figure 7**? **[1 mark]** Tick **one** box. A negative correlation ☐ No correlation ☐ A positive correlation ☐			

Make order of magnitude calculations	This is used in: • scale drawings in Biology when comparing and calculating cell sizes and in Chemistry/Physics looking at relative sizes of atoms • converting units up and down, for example kg, g, mg; km, m, mm; kJ, J • using prefixes and powers of ten for orders of magnitude for example tera, giga, mega, kilo, centi, milli, micro and nano.	0 6 . 5 The student made the necessary adjustments to get a clear image. **Figure 13** shows the student's drawing of one of the cells. **Figure 13**  The real length of the cell was 280 micrometres (μm). Calculate the magnification of the drawing. **[3 marks]**			
Understand and use the symbols: =, <, <<, >>, >, ∝, ~	= equals < less than << > more than >> ∝ proportional ~ approximately equal	0 4 . 5 Element **X** has two isotopes. Their mass numbers are 69 and 71 The percentage abundance of each isotope is: • 60% of ^{69}**X** • 40% of ^{71}**X** Estimate the relative atomic mass of element **X**. **[1 mark]** Tick **one** box. < 69.5 ☐ Between 69.5 and 70.0 ☐ Between 70.0 and 70.5 ☐ > 70.5 ☐			

Change the subject of an equation	Equations show the relationship between variables. You will need to change the subject of an equation you have recalled or been given and then calculate the value for the variable the question asks you for. You can either substitute the values then rearrange the equation, **or** rearrange the variables in the equation and then substitute in the values to calculate your answer There is a list of physics equations you need to recall and apply.	**0 3 . 1** Write down the equation that links mass, momentum and velocity. **[1 mark]** **0 3 . 2** Skater **A** travels with a velocity of 3.2 m/s and has a momentum of 200 kg m/s Calculate the mass of Skater **A**. **[3 marks]**			
Substitute numerical values into algebraic equations using appropriate units for physical quantities	Values can be: • given in the stem of the question • given in the results table • read off a graph • measured from a diagram. The units are the SI units your teacher will cover with you eg kg, m, J. When you are given values in a question, make sure that they are in the **correct units** before you do the calculation, for example you might have to convert a value given in grams to kilograms.	**0 5 . 4** The student records some measurements. The measurements are: • the colour from flower **B** moves 7.2 cm • the solvent moves 9.0 cm Calculate the R_f value for the colour from flower **B**. Use the equation: $$R_f = \frac{\text{distance moved by colour}}{\text{distance moved by solvent}}$$ **[2 marks]**			

Solve simple algebraic equations	This is everything to do with equations including recalling them and using values given to calculate the correct answer. Correct substitution, rearrangement and unit conversion may also be part of the question. Always **show your working** as there may be compensation marks, even if you don't get the calculation correct. Always use a **calculator** if needed.	**0 3 . 3** Write down the equation which links frequency, wavelength and wave speed. **[1 mark]** **0 3 . 4** The P-wave shown in **Figure 3** is travelling at 7200 m/s. Calculate the wavelength of the P-wave. **[3 marks]**			
Translate information between graphical and numeric form	Graphs are used to display the relationships between variables. You will need to be able read data off a graph to show changes between the variables and look for simple relationships between the variables, for example, direct, linear, relationship.	**Figure 6** shows how the speed changes as the power output of the cyclist changes. **Figure 6**  **0 4 . 4** Calculate the percentage increase in speed of the cyclist when the power output changes from 200 W to 300 W. **[2 marks]**			

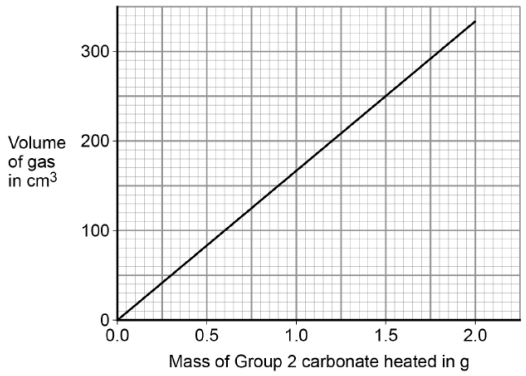
<table>
<tr>
<td>Plot two variables from experimental or other data</td>
<td>You could be asked to:
• draw a scale
• label axis
• accurately plot up to six points of data
• draw lines of best fit – straight or curved.</td>
<td>
Table 6
<table>
<tr><th rowspan="2">Time in minutes</th><th colspan="2">Heart rate in beats per minute</th></tr>
<tr><th>Person R</th><th>Person S</th></tr>
<tr><td>0 (at rest)</td><td>60</td><td>78</td></tr>
<tr><td>1</td><td>76</td><td>100</td></tr>
<tr><td>2</td><td>85</td><td>110</td></tr>
<tr><td>3</td><td>91</td><td>119</td></tr>
<tr><td>4</td><td>99</td><td>129</td></tr>
<tr><td>5</td><td>99</td><td>132</td></tr>
</table>
0 8 . 5 Complete the line graph in Figure 12 for person S.

You should:
• add the scale to the x axis
• label the x axis.

[4 marks]
</td>
<td></td><td></td><td></td>
</tr>
<tr>
<td>Understand that $y=mx+c$ represents a linear relationship and determine the slope and intercept of a linear graph</td>
<td>In science, you will need to understand what is meant by a linear relationship.

To calculate the slope (gradient of a straight line graph):
• choose two points on the line
• from these two points calculate:
$\frac{\text{difference in height}}{\text{difference in width}}$
This could be used to determine rate of reaction in Biology and Chemistry.

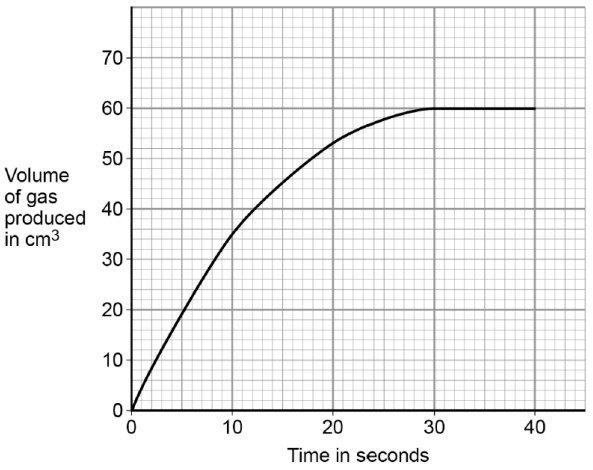
The intercept is when you extend a line of a graph beyond the data points to where it crosses the axis. This point is called the intercept. You can also extend the line beyond the data to predict a value that's not in the original data points.</td>
<td>
Figure 8 shows the volume of gas produced when a different Group 2 carbonate, W, is heated.

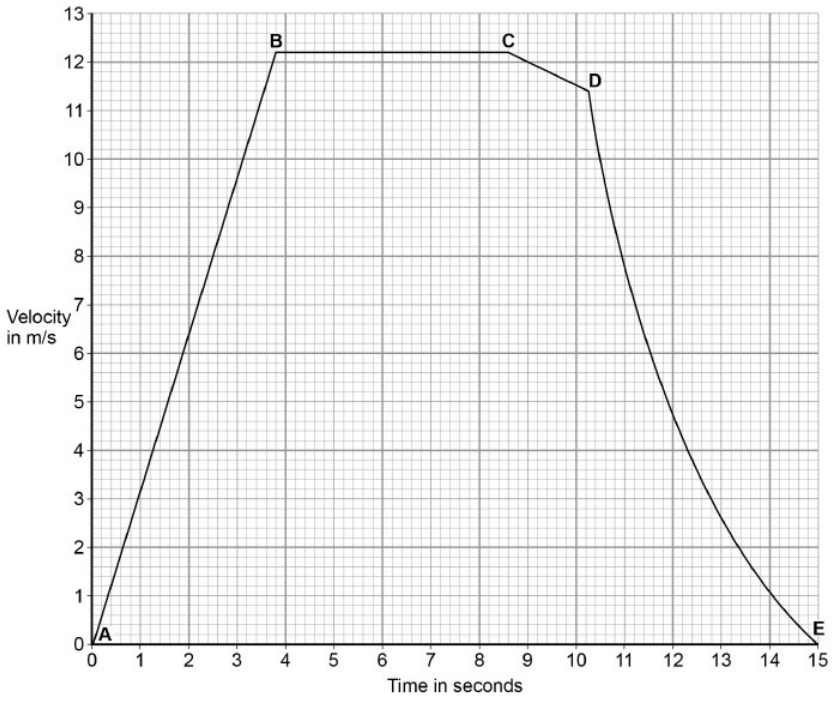
Figure 8


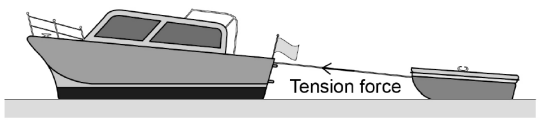
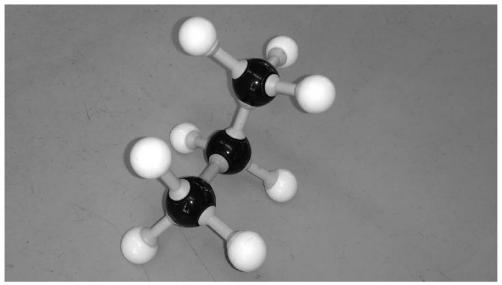
0 6 . 3 Calculate the gradient of the line in Figure 8

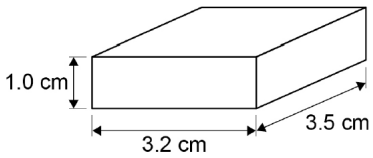
Give the unit.

[3 marks]
</td>
<td></td><td></td><td></td>
</tr>
</table>

Draw and use the slope of a tangent to a curve as a measure of rate of change (Chemistry and Physics only)	When data is non-linear, and the graph is a curve, the rate of reaction is calculated by drawing a tangent to the curve at the point you want to determine the rate at. Then, the gradient of that straight line tangent is calculated. This gives the rate of reaction at that point. It's important to be accurate when drawing the tangent; make sure it's touching the curve at the correct point, and is at the correct angle, or the calculated rate will not be correct. You may need to carry out the calculation or, as in this example, describe how you would go through the process. This type of question would be on the Higher tier only.	**Figure 5** shows the student's results. **Figure 5**  0 5 . 3 Describe how you would use **Figure 5** to find the rate of the reaction at 15 seconds. You do **not** need to do a calculation. **[2 marks]**			

Understand the physical significance of area between a curve and the x-axis and measure it by counting squares as appropriate (Physics only)	The area between the line or curve of a graph and the x-axis can be measured by counting squares. For example, you could be given a velocity-time graph that is not a straight line and asked to work out the displacement/distance travelled by finding the area under the line or curve.	 An athlete goes for a run on a straight, horizontal running track. Figure X shows the velocity-time graph for the athlete during the race. Determine the distance travelled by the athlete over the first 6.0 seconds of their run.			

Use angular measures in degrees (Physics only)	Use a protractor to measure the angles accurately in questions about: • refraction (measuring the of angle of incidence or refraction) • vector diagrams.	0 6 . 4 **Figure 10** shows the boat towing a small dinghy. **Figure 10**  The tension force in the tow rope causes a horizontal force forwards and a vertical force upwards on the dinghy. horizontal force forwards = 150 N vertical force upwards = 50 N **Figure 11** shows a grid. Draw a vector diagram to determine the magnitude of the tension force in the tow rope and the direction of the force this causes on the dinghy. **[4 marks]**			
Visualise and represent 2D and 3D forms	2D or 3D forms can be photos of molecular models as shown or chemical structural formulae diagrams or dot-and-cross diagrams used to show the electronic structure of atoms. You may be asked to interpret what these models or diagrams are showing and use them further in the question.	0 6 . 3 **Figure 14** represents an alkane molecule. **Figure 14**  Name the alkane. **[1 mark]**			

Calculating areas of a triangle , rectangle , surface area and volume of a cube	Area of a triangle = $\frac{1}{2}$ base × height Area of a rectangle = height × width Surface area of a cube = the sum of the **areas** of all faces (or surfaces) A cube has 6 faces the area of 1 face = width × height then multiply this by number of faces (6) volume of a cube = length × width × height You only need to know one side to calculate the volume of a cube as each side is the same size. You can multiply the sides in any order. Which side you call length, width or height doesn't matter. In science, you will need to understand and calculate the ratio of surface area : volume	The student makes measurements of stone **B** using a metre rule. The measurements of stone **B** are shown **in Figure 7**. **Figure 7**  Calculate the volume of the stone. **Figure 7** shows two model cells. Both models are cubes. **Figure 7**