

# GCSE Science: Summer 2022 examples and commentaries

Published: Spring 2023



The following examples are all taken from summer 2022 GCSE Combined Science Trilogy papers

## Example 1 Physics 1H question 5.4

When the flash unit is used there is a mean potential difference of 200 V across the fluorescent tube.

The flash of light lasts for  $2.8 \times 10^{-4}$  s time

1.4 J of energy is transferred. ~~from~~  $E$

$$\frac{E}{P \cdot t}$$

Calculate the mean current.  $W = V \cdot I \cdot t$

$$\frac{P}{V \cdot I}$$

Use the Physics Equations Sheet.

[6 marks]

$$\frac{1.4}{2.8 \times 10^{-4}} = 5000$$

5000 W = power

$$\frac{5000 \text{ W}}{200 \text{ V}} = 25 \text{ A}$$

Mean current = 25 A A

## Mark scheme

05.4	$1.4 = Q \times 200$		1
	$Q = \frac{1.4}{200}$		1
	$Q = 0.0070$ (C)		1
	$0.0070 = I \times 2.8 \times 10^{-4}$	allow a correct substitution of their calculated value of $Q$	1
	$I = \frac{0.0070}{2.8 \times 10^{-4}}$	allow a correct re-arrangement using their value of $Q$	1
	$I = 25$ (A)	allow an answer consistent with their value of $Q$	1
	OR		
	$1.4 = P \times 2.8 \times 10^{-4}$ (1)		
	$P = \frac{1.4}{2.8 \times 10^{-4}}$ (1)		
	$P = 5000$ (W) (1)		
	$5000 = 200 \times I$ (1)	allow a correct substitution of their calculated value of $P$	
	$I = \frac{5000}{200}$ (1)	allow a correct re-arrangement using their value of $P$	
	$I = 25$ (A) (1)	allow an answer consistent with their value of $P$	

## Marks awarded

This actually gains all 6 marks.

The student has followed the second method in the mark scheme.

The final answer on the answer line is correct, but we have a quick look at the working out, just to make sure they've done the right sort of thing.

Although we lay the steps out separately in the mark scheme, the student has done all three of the first steps in one calculation so immediately gains MP1, 2 and 3.

They have done the same thing in their second calculation: all three steps in MP4, 5 and 6 in one step.

There is sufficient working to show a correct method has been used so scores all 6 marks.

# Areas of weakness in practical questions

Example 2 Chemistry 1F Q5.1 RP8: Understanding key steps

0	5	This question is about <u>salts</u> <i>crystallisation</i>	
Green copper carbonate and sulfuric acid can be used to produce blue copper sulfate crystals.			
0	5	1	<b>Excess</b> copper carbonate is added to sulfuric acid.
Give <b>three</b> observations you would make.			[3 marks]
1 There is residue left at bottom of beaker.			
2 The product would turn blue.			
3 Excess is added to use up all the sulfuric acid.			

## Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	any three from: <ul style="list-style-type: none"> <li>• green solid / powder</li> <li>• colourless solution</li> <li>• blue solution formed</li> <li>• copper carbonate disappears</li> <li>• fizzing / effervescence or bubbles (of gas)</li> <li>• stops fizzing</li> <li>• solid / powder left at the end or copper carbonate left at the end</li> </ul>	ignore green copper carbonate  allow colour (of solution) changes  allow solid disappears  ignore gas  allow fizzing slows down  allow (container) gets hot or allow temperature increases	3	AO2 AO3 5.4.2.2 5.4.2.3 RPA8

## Comments and marks awarded

1. Correct
2. Incorrect – product rather than solution
3. Incorrect

Total: 1 mark awarded

## Example 3 Biology 2F Q2.1: Correct use of equipment

02.1

Describe how a quadrat can be used to measure the size of the buttercup population on the wet soil area.

1

[4 marks]

- place the quadrat randomly on the wet soil

- count how many buttercups there are in the quadrat

- repeat with dry soil

### Mark scheme

Question	Answers	Mark	AO / Spec. Ref.
02.1	<b>Level 2:</b> The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	3–4	AO1 4.7.2.1 RPA 7
	<b>Level 1:</b> The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	No relevant content	0	
	<b>Indicative content</b> <ul style="list-style-type: none"> <li>place quadrat randomly / systematically</li> <li>description of how randomness is achieved or description of how systematic placement is achieved</li> <li>count number of buttercups in quadrat</li> <li>record number</li> <li>repeat quadrat (in another location in the same wet soil area)</li> <li>(repeat) at least 5 times</li> <li>calculate a mean number of buttercups per quadrat</li> <li>the area of the wet soil area is 100 m<sup>2</sup></li> <li>estimate the buttercup population using the area of the quadrat</li> </ul>		

### Comments and marks awarded

The method would not lead to a valid outcome, so the response cannot be in Level 2.

The student has identified a couple of relevant steps and attempted to link them.

The comment about repeating with dry soil does not address the question.

Response was considered just sufficient to be awarded 2 marks.

## Example 4 Physics 2F Q2.1: risks and hazards

0 2 . 1 The student poured hot water into each flask.

What should the student do to reduce the risk of burning herself with the hot water? [1 mark]

Wear gloves

### Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	any one from: <ul style="list-style-type: none"><li>• stand up</li><li>• use a funnel</li><li>• pour water slowly</li><li>• pour at arms-length</li><li>• wear heat-proof gloves</li></ul>	gloves on its own is insufficient allow do not touch hot objects (with bare hands)	1	AO3 6.6.2

### Comments and marks awarded

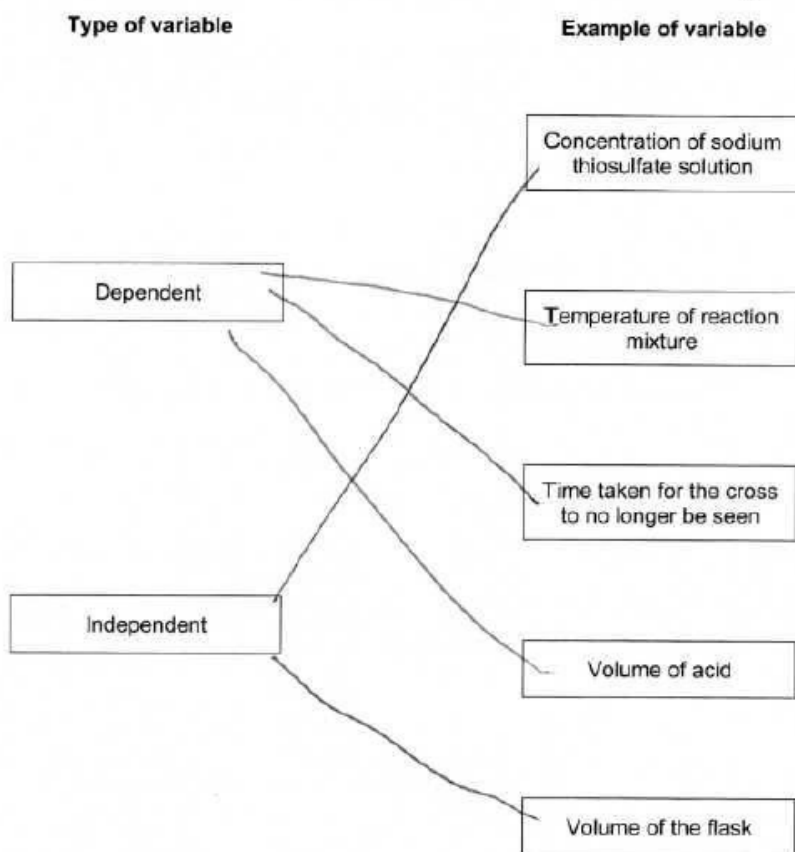
Gloves on its own is not sufficient, so the student does not gain the mark here.

## Example 5 Chemistry 2F Q4.1: Variables

0 4 1

Draw **one** line from each type of variable to the correct example of the variable in this investigation.

[2 marks]





## Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	<p>Type of variable</p> <p>Example of variable</p> <div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <div style="border: 1px solid black; padding: 2px; margin-bottom: 10px;">Dependent</div> <div style="border: 1px solid black; padding: 2px;">Independent</div> </div> <div style="text-align: center;"> <div style="border: 1px solid black; padding: 2px; margin-bottom: 10px;">Concentration of sodium thiosulfate solution</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 10px;">Temperature of reaction mixture</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 10px;">Time taken for the cross to no longer be seen</div> <div style="border: 1px solid black; padding: 2px; margin-bottom: 10px;">Volume of acid</div> <div style="border: 1px solid black; padding: 2px;">Volume of the flask</div> </div> </div> <p>do <b>not</b> accept more than one line from a box on the left</p>		<p>1</p> <p>1</p>	<p>AO2 5.6.1.1 RPA11</p>

## Comments and marks awarded

No marks gained.

Even though the student has linked the Independent and dependent variable to the correct answer because they have added all the other lines these incorrect answers negate the correct ones

## Example 6 Physics 2H Q5.1: Improvements

0 5

A student investigated how the colour of a surface affects the amount of infrared radiation the surface absorbs.

Figure 7 shows the equipment used.

The two flasks are painted different colours.

Figure 7



This is the method used.

1. Pour water at 20 °C into each flask.
2. Place a bung and thermometer into each flask.
3. Place each flask in front of the infrared lamp.
4. Measure the temperature of the water every 30 seconds for 10 minutes.

0 5 1

Explain **two** improvements to the method the student used.

[4 marks]

1. Have sure that each flask is at equal distance from the infrared lamp - measure this (e.g. 20cm) → in order for the results to be more accurate.
2. Use same <sup>amount / volume of water in both</sup> ~~flasks~~ ~~flasks~~ ~~to ensure the same~~ ~~results~~ ~~flasks~~ (e.g. - measure it (e.g. 30cm<sup>3</sup> of water)) → in order for it to have <sup>fair</sup> accurate results and to make the test a

## Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	<p>any two pairs from</p> <ul style="list-style-type: none"> <li>place each flask the same distance from the infrared lamp</li> <li>so the intensity of infrared radiation incident on each flask is the same</li> <li>use flasks of the same shape and size</li> <li>so the surface area is the same</li> <li>use equal volumes of water</li> <li>because volume of water affects the rate at which the water temperature increases</li> </ul>	<p>allow use two lamps at an equal distance from each flask</p> <p>allow use equal masses of water</p>	4	<p>AO3</p> <p>AO1</p> <p>AO3</p> <p>AO1</p> <p>6.6.2.2</p>

## Comments and marks awarded

Response gained 2 marks for each of the improvements but didn't gain the marks for the explanation.

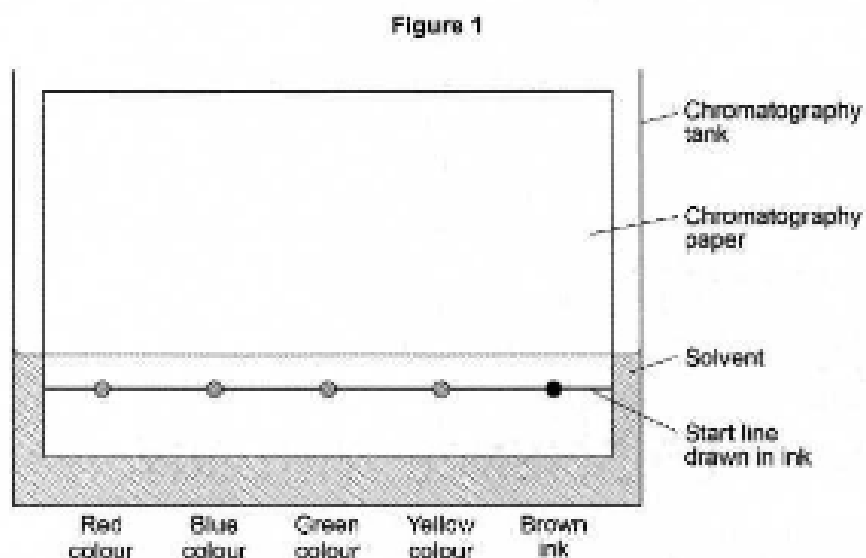
Need to explicitly explain what that improvement achieves

- Distance = so the intensity of infrared radiation incident on each flask is the same
- Volume = because volume of water affects the rate at which the water temperature increases .
- flask shape / size = so surface area is the same

It is not about changing the method; introducing new apparatus will change the experimental method so gains no marks. Likewise, mentioning Leslie's cube or digital thermometers would be changing the experimental method so would not gain any marks.

## Example 7 Chemistry2F Q6.1/C2H Q1.1: Recognising errors

0 1 . 1 Figure 1 shows the apparatus used.



Give two errors made by the student.

Describe the problem each error would cause.

[4 marks]

Error 1 The solvent is too high up.

Problem 1 It could spread anywhere and not just up the paper.

Error 2 The start line is drawn in ink

Problem 2 The line would also be effected by the solvent and spread too.

## Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	any <b>two</b> pairs from:  (start) line drawn in ink (1) (so ink) will mix with solvent (1)  the solvent is above the (start) line (1) (so) colours / ink will dissolve (1)  no lid on tank (1) (so) solvent will evaporate (1)	allow (start) line should be drawn in pencil allow the ink will move up the paper  allow the solvent should be below the (start) line	4	AO3 5.8.1.3 RPA12

## Comments and marks awarded

1 mark

Error 1 = no marks gained as 'too high up' is too vague – needs to be linked to the start line. The word 'start' is not needed.

The explanation gained no mark: 'it could spread anywhere' again too vague. It is unclear what 'it' is referring to; it could be the solvent but the answer is unclear.

The student has correctly identified the second error but the explanation does not gain any marks as 'spread' is not an acceptable alternative to dissolve.

## Example 8 Biology 1H Q4.3: Drawing conclusions

0 4 . 3

A student investigated the effect of different colours of light on the rate of photosynthesis at room temperature.

The student used pondweed in water.

A piece of pondweed was placed in red light, then in blue light and then in green light.

Each colour of light was the same intensity.

Describe how the student should make accurate measurements to obtain valid results for the rate of photosynthesis.

[4 marks]

~~Use a gas syringe~~  
use a gas syringe to measure the amount of oxygen being released while timing how long it takes for a certain amount of gas to be released. Repeat this using different lights, and ~~no~~ change light intensity by distancing the pondweed by 5cm intervals.

## Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	allow the pondweed to equilibrate in the light	allow leave the pondweed in the light (for a few minutes) before taking measurements  allow use the same concentration of sodium hydrogen carbonate solution ignore control carbon dioxide concentration unless method described  ignore use same intensity / distance of light ignore control temperature ignore use same pondweed	1	AO3
	use a gas syringe or use a (measuring) cylinder to measure / collect the oxygen / gas produced	do <b>not</b> accept carbon dioxide ignore references to counting bubbles	1	AO1
	measure time oxygen / gas is collected for using a timer / stopwatch / stopclock		1	AO1
	repeat the measurements <b>and</b> calculate a mean	allow repeat the measurements <b>and</b> discard anomalies	1	AO1  4.4.1.1 4.4.1.2 RPA5

## Comments and marks awarded

1 mark

Using a gas syringe gains a mark for MP2.

The question asks how **accurate measurements** should be made, to obtain valid results. Only MP1 on the mark scheme relates to control variables 'allow the pondweed to equilibrate in the light' as most are given in the stem of the question. MP2 and MP3 are about what equipment should be used to make an accurate measurement of the volume of gas produced and of time. Using a (wall) clock would be insufficient. For MP4 just saying 'repeat the measurements' is insufficient. There must be a reference to then calculating a mean or discarding anomalies.

## Example 9 Chemistry 2H Q3.5: Applying the science

0 3 . 5 The student determined the **rate** of the reaction at regular time intervals during an experiment.

Explain why the **rate** decreased during the reaction.

You should give your answer in terms of particles.

[2 marks]

[2 marks]

The particles of sodium thiosulfate have already ~~off~~ reacted meaning that there were less particles to collide with hence, lowering the rate.

### Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	(as reaction proceeds) fewer (sodium thiosulfate) particles per unit volume	allow (as reaction proceeds) concentration (of sodium thiosulfate) decreases	1	AO2 5.6.1.2 5.6.1.3 RPA11
	(so) frequency of (particle) collisions decreases	allow (so) probability of collision decreases	1	

### Comments and marks awarded

No marks gained.

Although they have the right idea of fewer particles the student hasn't expressed themselves clearly. There is no mention of "per unit volume".

The student has written about collisions happening but they haven't qualified this by stating that it is the 'frequency' of collisions that decreases



## Example 10 Physics 1F Q4.6: Key terms

Table 3 shows the results.

Table 3

Equipment	Length in cm		
	Measurement 1	Measurement 2	Measurement 3
Micrometer	0.581	0.557	0.576
Ruler	0.6	0.6	0.6

0 4 . 6 Complete the sentence.

Choose the answer from the box.

[1 mark]

calibration

precision

reproducibility

resolution

The results show that compared to the ruler the micrometer has a higher

precision.

0 4 . 6 Complete the sentence.

Choose the answer from the box.

[1 mark]

calibration

precision

reproducibility

resolution

The results show that compared to the ruler the micrometer has a higher

calibration.

## Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	resolution		1	AO3 6.3.1.1 RPA17

## Comments and marks awarded

Incorrect answers in both examples.

## Example 11 Chemistry 2H Q3.3: Plotting and Lines of best fit

**0 3 . 3** Table 1 shows the results.

Table 1

Temperature in °C	Time in seconds
19	82
32	48
45	43
52	15
63	7
73	3

Complete **Figure 4**.

You should:

- plot the data from **Table 1** on **Figure 4**
- draw a line of best fit.

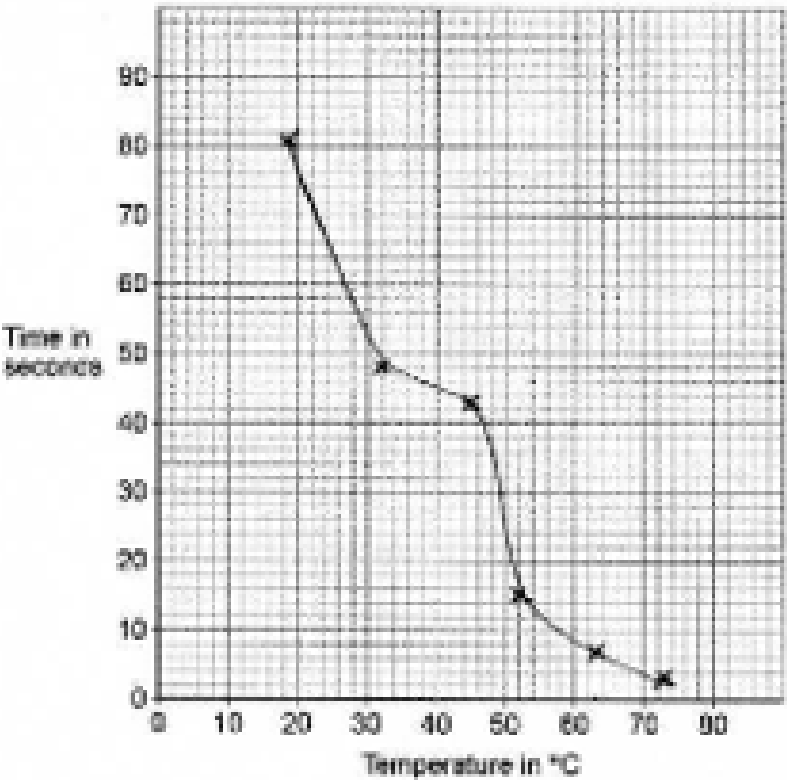
[3 marks]

Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	all points correctly plotted	allow 1 mark for 3, 4 or 5 points correctly plotted	2	AO2
	line of best fit	allow a tolerance of $\pm \frac{1}{2}$ a small square © 2023 AQA and its licensors. All rights reserved.	1	AO3 5.6.1.1

Student A

Figure 4

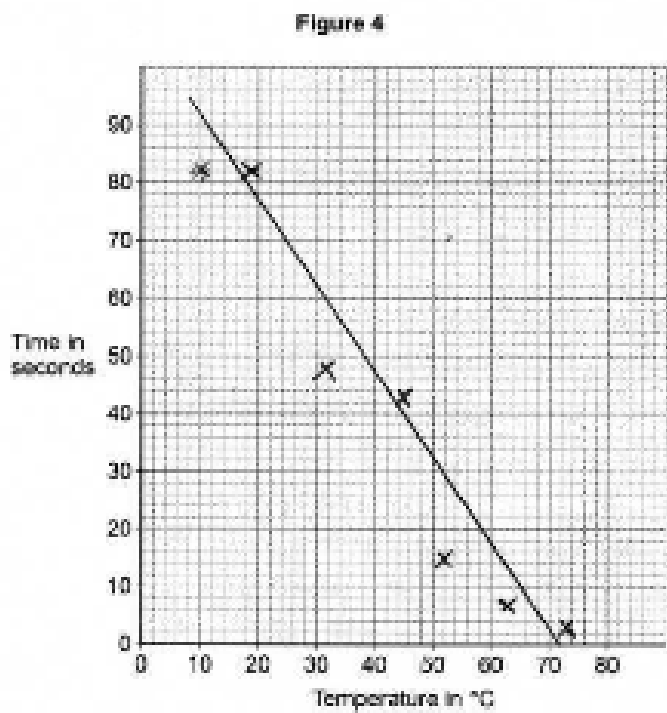


Comments and marks awarded

2 marks gained as all 6 points plotted correctly  
The points must be plotted within a tolerance of  $\pm \frac{1}{2}$  a small square.  
Students who correctly plot only 3, 4 or 5 points can still gain 1 mark

A line of best fit needs to be a smooth curve (or a reasonable attempt at a smooth curve).

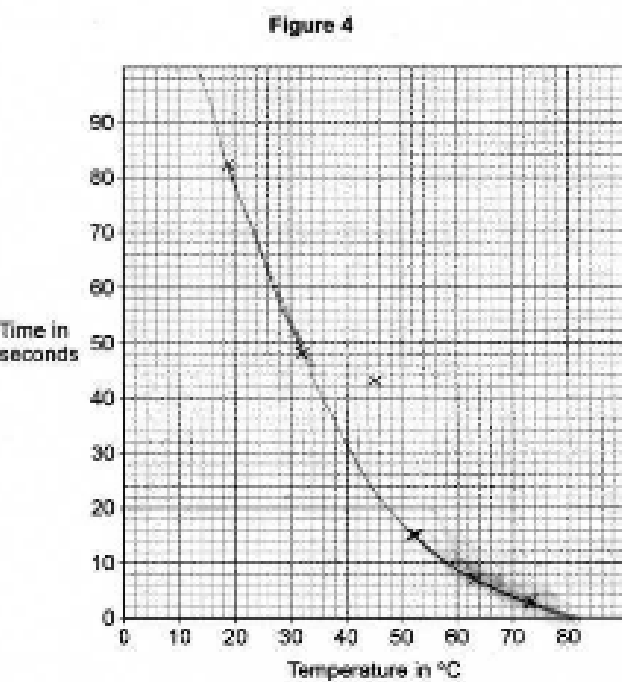
Student B



Comments and marks awarded

2 marks all 6 points plotted correctly

Student C



## Comments and marks awarded

2 marks. All 6 points plotted correctly, but the line of best fit is not credited.

Credit is not given if double lines, very thick lines or 'dot to dot' lines. Examiners are mindful that the candidates may be drawing their lines of best fit whilst sitting at a 'rickety' exam desk. This answer was considered to be 'rubbing out' so mark no awarded

## Example 12 Physics 1F Q5.1/1H Q1.1 Using information from graphs

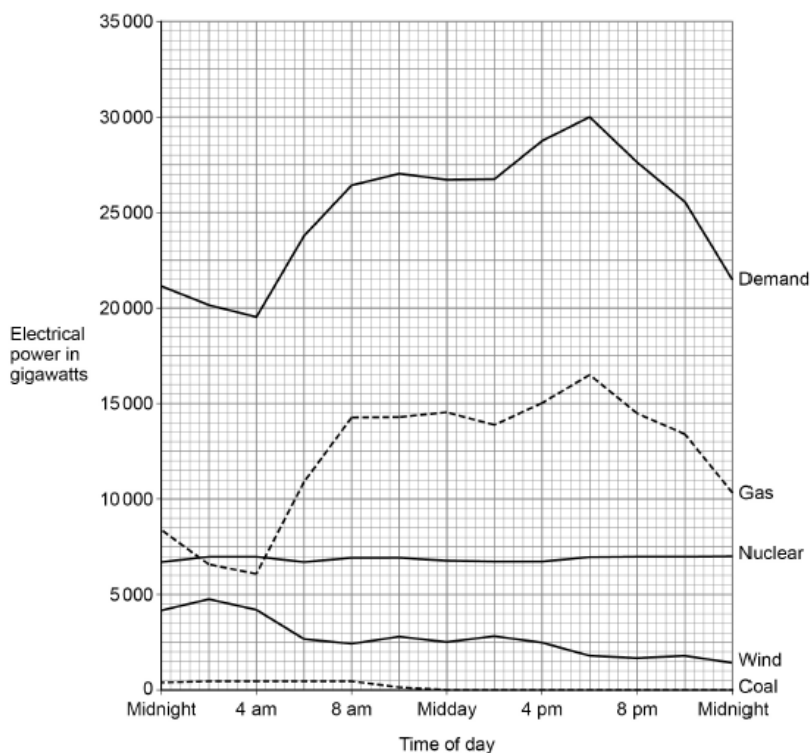
0 5

**Figure 9** shows some of the energy resources used to meet the demand for electrical power in the UK on one day in 2020.

0 5

**Figure 9** shows some of the energy resources used to meet the demand for electrical power in the UK on one day in 2020.

**Figure 9**



## Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	16 500(GW) and 30 000 (GW) read from graph		1	AO3 6.1.3
	percentage = $\frac{16500}{30000} (\times 100\%)$ <small>© 2022 AQA and its licensors. All rights reserved.</small>	allow a correct substitution using a value of 15300 or 18000 for gas	1	
	percentage = 55 (%)	allow an answer consistent with a value of 15300 or 18000 for gas	1	

## Student A

0 1 . 1 The maximum demand for electrical power on that day was at 6 pm.  
 Determine the percentage of the maximum demand for electrical power that was  
 generated using gas. [3 marks]

30,000

$$30000 - 16500 = 13500$$


---


$$\frac{13500}{30000} \times 100 = 45$$


---


$$\frac{13500}{16500}$$


---

Percentage = 81.81 %

## Comments and marks awarded

1 mark

The student gained MP1 for reading the correct values off the graph, subsequent calculations are incorrect as the student has found the difference between the two 'demand' readings and used this to calculate the percentage

## Student B

**0 1 . 1** The maximum demand for electrical power on that day was at 6 pm.

Determine the percentage of the maximum demand for electrical power that was generated using gas.

[3 marks]

15300  
35000

$\frac{15300}{35000} \times 100 = 43.7\%$

15300  
30000

$\frac{15300}{30000} \times 100 = 51\%$

Percentage = 51 %

## Comments and marks awarded

2 marks

The student has taken incorrect reading from the graph so MP1 is not gained. However the reading they took was one of the two allowed on the mark scheme if 16500 had been misread (either 15300 or 18000), so the subsequent marking points can be gained as. Any other incorrect reading would lead to a total mark of zero for this question.


A reading of 15300 leads to 51%; a reading of 18000 leads to 60%.

Two marks was also allowed if the correct answer was without working as students must have read figure from graph MP1 and correct calculation gains MP3

# Weaknesses in maths skills

## Example 13 Physics 1F Q4.7 & 4.8: Physics equations


0 4 . 7 Write down the equation that links density ( $\rho$ ), mass ( $m$ ) and volume ( $V$ ). [1 mark]

density  
 $\text{Volume} = \text{volume} \times \text{mass}$  

0

The vast majority of students did gain the recall marks for equations on both Foundation and Higher tier but unfortunately some students still didn't gain the marks .

0 4 . 7 Write down the equation that links density ( $\rho$ ), mass ( $m$ ) and volume ( $V$ ). [1 mark]

density =  $\frac{\text{mass}}{\text{volume}}$  //  $\rho = \frac{m}{V}$  

1

$V \times \rho = m$

However, students still found applying the equation to calculate a value difficult.

0 4 . 8 The student calculated the volume of the cube of wetsuit material to be  $0.186 \text{ cm}^3$   
 The density of the cube was  $0.300 \text{ g/cm}^3$   
 Calculate the mass of the cube.  
 Give your answer in grams. [3 marks]

mass = volume  $\times$  density

mass =  $\frac{\text{density}}{\text{volume}}$  mass =  $\frac{0.300}{0.186} = 1.612903226$

Mass = ~~1.612903226~~

Mass = 1.612903226 g

This student did not gain any marks on this linked question

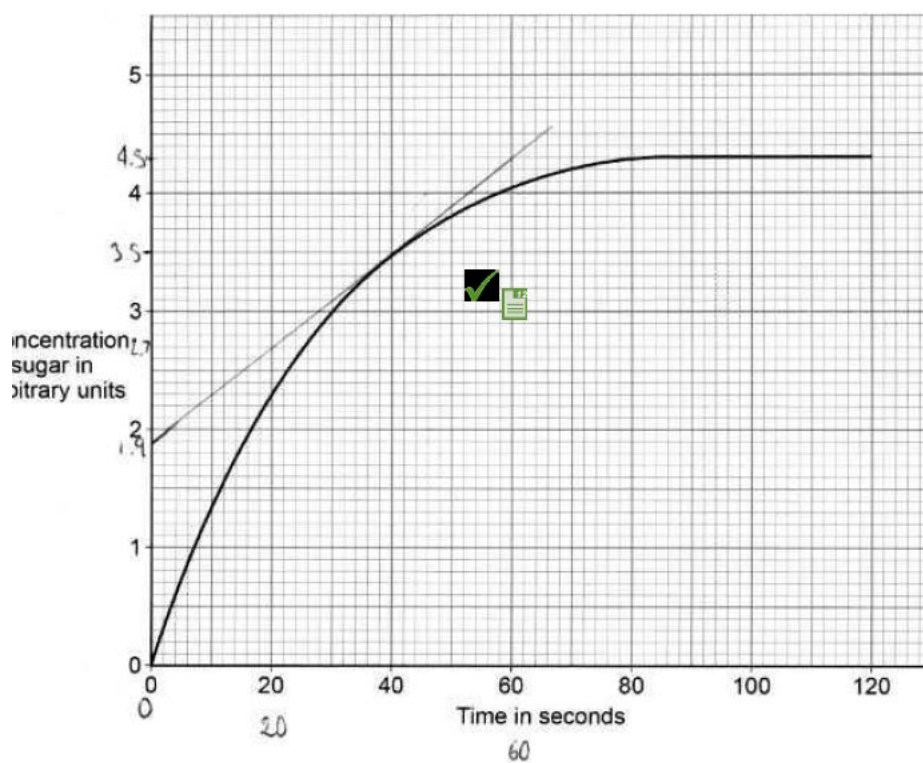


## Example 14 Biology 1H Q3.6: Tangents to a curve

### Mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<b>03.6</b> View with <b>Figure 7</b>	tangent drawn at 40 seconds		1	AO2 4.2.2.1 RPA4
	(rate =) $\frac{\text{value for dy}}{\text{value for dx}}$	eg (rate =) $\frac{2.25}{60}$	1	
	calculation of rate at 40 seconds	(rate =) 0.0375 (arbitrary units per second) allow an answer in the range 0.035 to 0.042 (arbitrary units per second)	1	
	(0.0375 × 60 =) 2.25 (arbitrary units per minute)	allow an answer in the range 2.1 to 2.5 (arbitrary units per minute)  if no other marks awarded allow 1 mark for $\left(\frac{3.5}{40} \times 60 =\right)$ 5.25 (arbitrary units per minute) allow an answer in the range 5.175 to 5.25 (arbitrary units per minute) for this mark only	1	

Figure 7



0 3 . 6 Determine the rate of sugar production per minute at 40 seconds.

[4 marks]

$$\frac{\Delta y}{\Delta x}$$

$$\Delta y = 4.3 - 1.9 = 2.4$$

$$\Delta x = 60 - 20 = 40$$

$$\frac{2.4}{40} = 0.06$$

$$0.06 \times 60 = 0.04$$

Rate = 0.04 arbitrary units per minute

3

### Comments and marks awarded

3 Marks

MP1 correctly drawn the tangent at 40 seconds

MP2 and MP3 within the correct range.

MP4 not awarded as the student has not finished the calculation by multiplying by 60.

A large number of students only gained the fallback mark awarded as their answer was within the range of 5.175 - 5.25, as evidenced in this final example:

**0 3 . 6** Determine the rate of sugar production per minute at 40 seconds.

**[4 marks]**

40 seconds = 3.49 arbitrary units (sugar)

1 minutes = 60 seconds

$$3.49 \times \left(\frac{60}{40}\right) =$$

5.235



Rate = 5.235 arbitrary units per minute