GCSE Science

Hub schools network

Autumn update

Accompanying materials

Published: Autumn 2018

Contents

AQA results statistics 2018

GCSE results 2018: cumulative percentage attaining each grade

The figures in brackets are for the equivalent grades in last year's subjects. Grade 9 is above A* so there is no comparable data. For Combined Science: Trilogy and Combined Science: Synergy the grades are 1-1, 4-4, 7-7 and 9-9.

Predicted outcomes for this summer were based on the outcomes for 2017. More data on how these were calculated is available here https://www.aqa.org.uk/about-us/what-we-do/policy/gcse-and-a-level-changes/9-to-1/gcse-combined-science-new-grading-system

GCSE	Total entries	Grade 1 (G)	Grade 4 (C)	Grade 7 (A)	Grade 9
Combined Science: Trilogy	284,212 (NA)	98.4	55.2	7.6	0.9
Combined Science: Synergy	5814 (NA)	96.6	42.0	3.7	0.4
Biology	129,521 (84,896)	99.2 (99.9)	89.3 (90.3)	41.7 (43.2)	12.1
Chemistry	124,584 (83,800)	99.4 (99.9)	90.0 (89.6)	43.6 (43.3)	12.8
Physics	123,628 (84,533)	99.3 (99.9)	90.6 (91.1)	42.9 (42.4)	12.4

GCE results 2018: cumulative percentage attaining each grade

Figures in brackets are for 2017. Note that the decline in entries for AS continues following the decoupling from A-level.

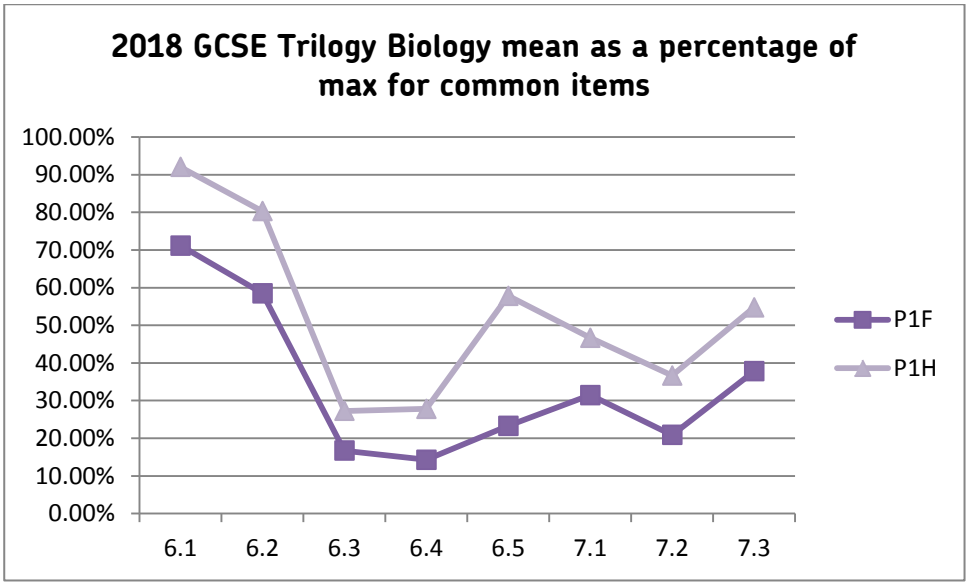
There are no comparative figures for the new AS Environmental Science as this is the first time through. Nearest equivalent specification for comparison is the outgoing AS Environmental Studies.

	Total entries	Grade E	Grade C	Grade A
AS Biology	7812 (16,480)	80.7 (83.5)	44.7 (49.0)	15.2 (17.1)
A-level Biology	29 569 (26,409)	96.5 (96.8)	69.6 (71.3)	25.8 (26.7)
AS Chemistry	5788 (11,959)	80.7 (83.2)	46.8 (49.9)	16.6 (18.8)
A-level Chemistry	21,941 (19,472)	96.7 (96.7)	73.1 (73.3)	30.9 (31.8)
AS Physics	5061 (11,822)	81.8 (83.0)	47.2 (52.6)	20.0 (21.8)
A-level Physics	19,323 (17,802)	95.9 (95.8)	68.6 (68.7)	29.6 (30.0)
AS Environmental Science	471	76.9	38.0	7.4
AS Environmental Studies	202 (1229)	93.1 (80.2)	70.8 (48.8)	18.3 (11.3)
A-level Environmental Studies	657 (791)	91.3 (91.4)	55.1 (53.6)	11.4 (11.1)

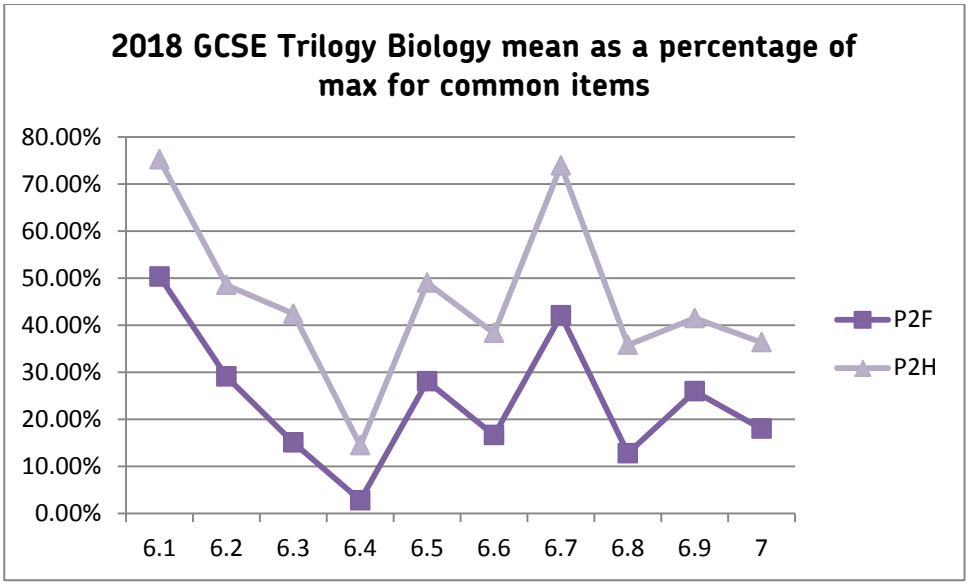
Analysis of common items

Performance of common items for Foundation and Higher Combined Science: Trilogy papers

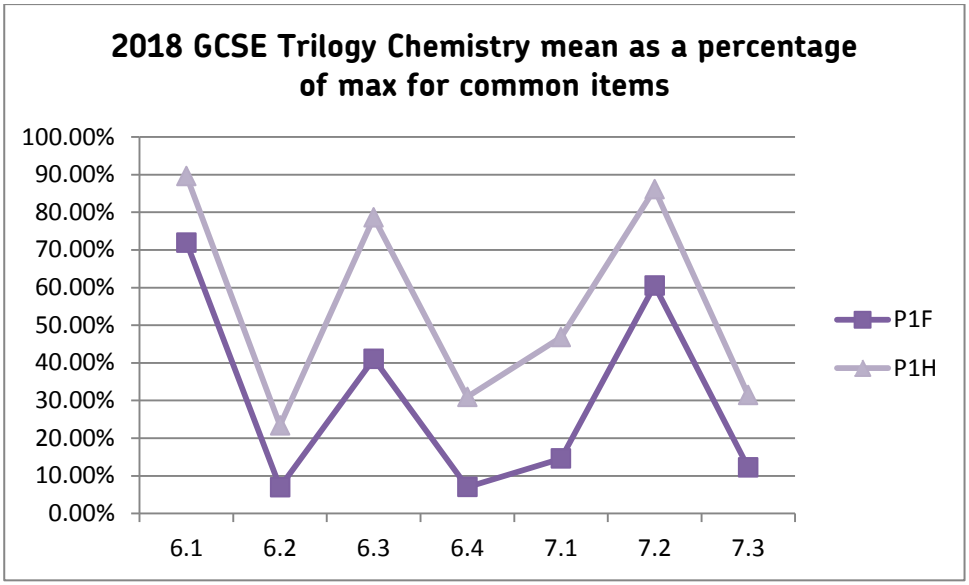
Trilogy Biology Paper 1



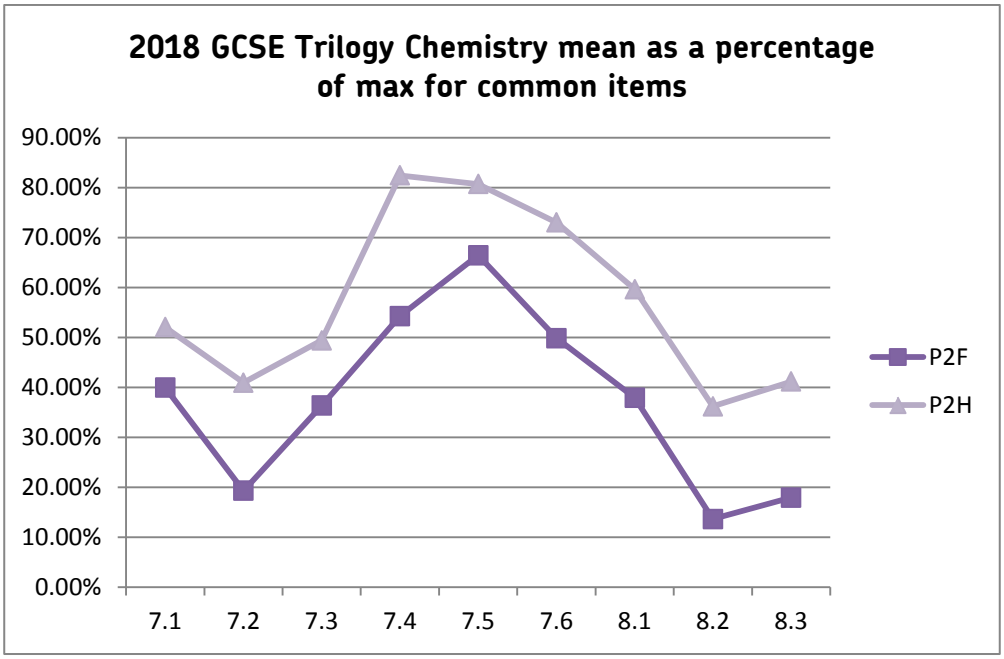
Trilogy Biology Paper 2



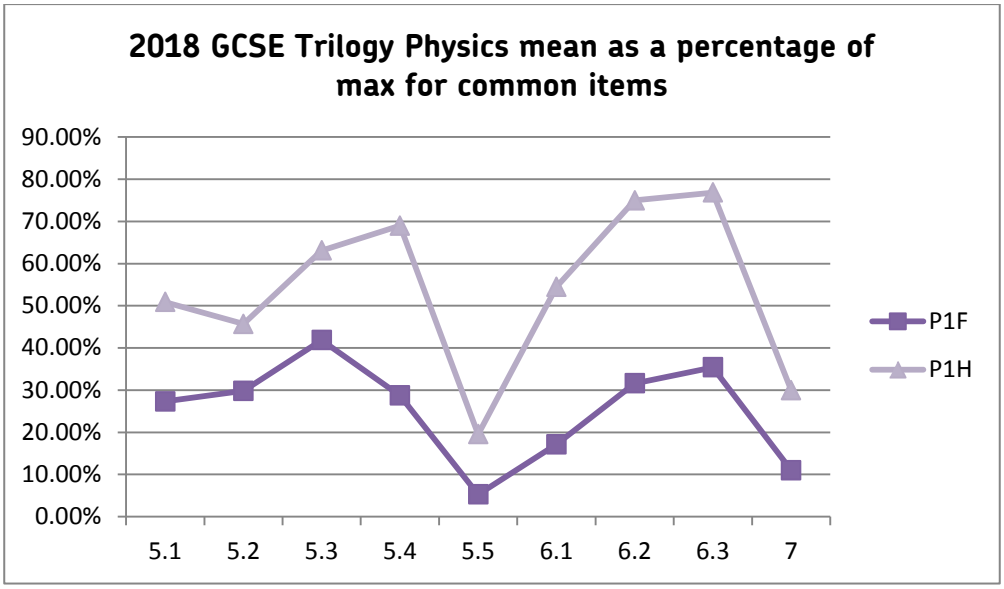
Trilogy Chemistry Paper 1



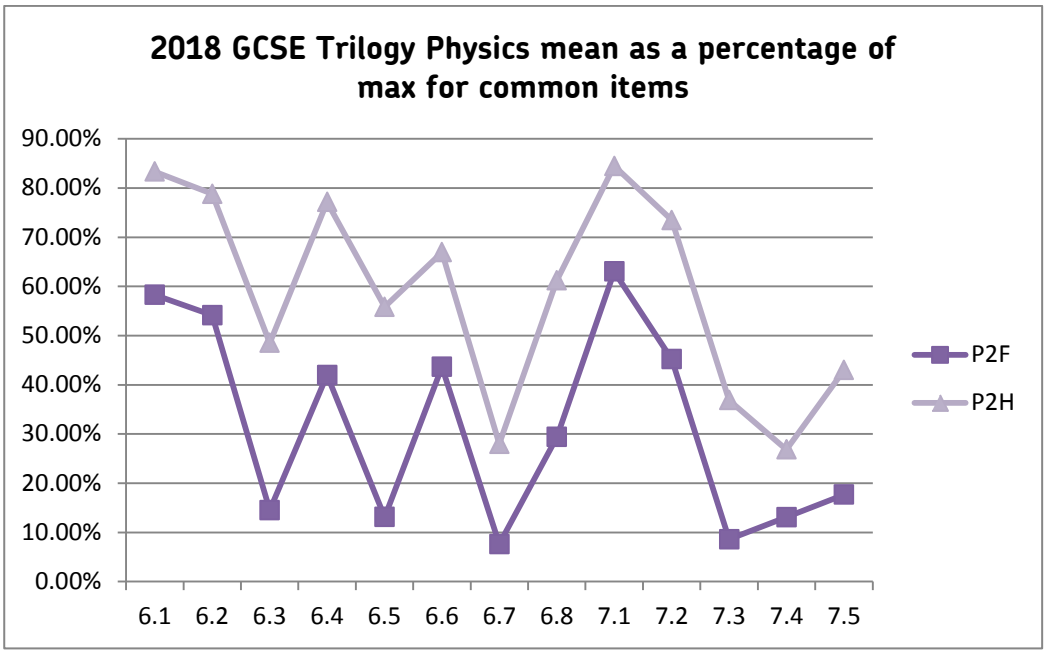
Trilogy Chemistry Paper 2



Trilogy Physics Paper 1



Trilogy Physics Paper 2



Complex calculations

8464/P/1H: question 5.4

Question

0 5 . 4 To heat the house, the boiler transfers 15 MJ of energy in 10 minutes.

Calculate the power of the boiler.

Write any equation that you use.

[4 marks]

Power = _____ W

Mark scheme

05.4	E = 15 000 000 (J) t = 600 (s) $p = \frac{15\,000\,000}{600}$ P = 25 000 (W)	an answer of 25 000 scores **4** marks allow a correct substitution of incorrectly / not converted values of E and / or t allow a correct calculation using incorrectly / not converted values of E and / or t	1 1 1 1	AO2 6.1.1.4

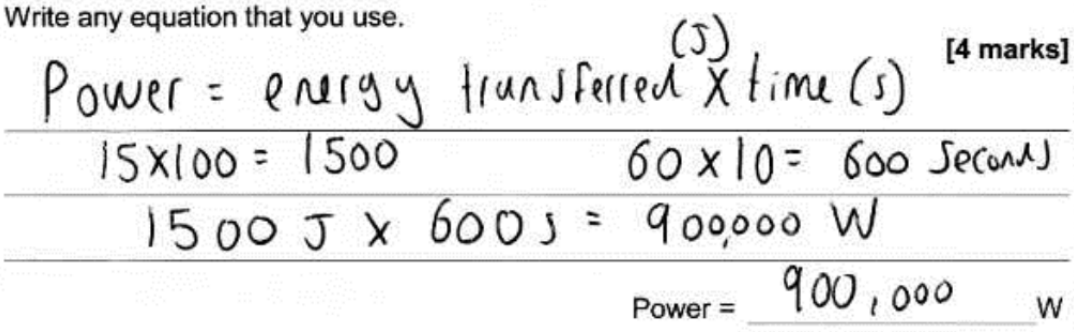
Example 1

0 5 . 4 To heat the house, the boiler transfers 15 MJ of energy in 10 minutes.

Calculate the power of the boiler.

Write any equation that you use.

[4 marks]



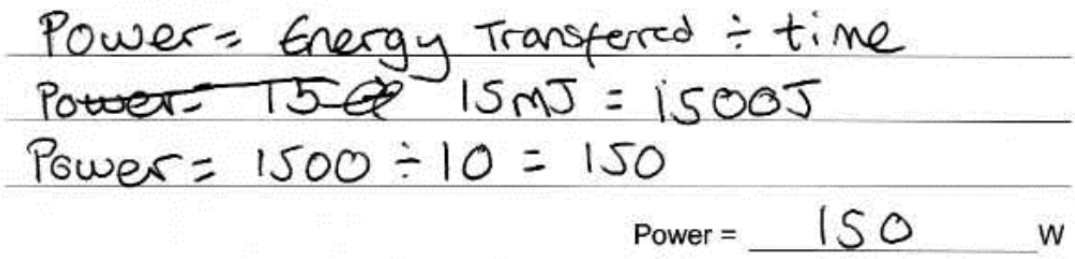
Example 2

0 5 . 4 To heat the house, the boiler transfers 15 MJ of energy in 10 minutes.

Calculate the power of the boiler.

Write any equation that you use.

[4 marks]



Commentary and marks awarded

Example 1

This student wrote the equation and units (good practice) but unfortunately, recalled the equation incorrectly.

They made a mistake converting the value for the energy, but did convert time correctly, scoring 1 mark.

If they had recalled the correct equation, but made the same mistake converting the energy, they could have scored 3 marks.

Example 2

The student recalled the equation and attempted to convert energy from MJ to J (unfortunately incorrectly). However, they did do the substitution and calculation correctly.

This scores 2 marks for the substitution and evaluation.

Examiner report

75% of students gained at least one mark. Just over a tenth of students correctly carried out both conversions and achieved four marks. The most common mistake was in the conversion of 15 MJ into J but most students knew the equation and could substitute their sometimes incorrect conversions into the equation and calculate it correctly. A very simple answer saw 15 / 10 = 1.5 often written down and this gave the student two marks. Unfortunately a few students calculated energy × time and could only obtain the conversion marks if done correctly.

8464/P/2H: question 5.2

Students need to:

1. Substitute values into the equation v = fλ (1)
2. Calculate a value for λ correctly (1)
3. Correctly round their final answer to 2 sig figs (1)

Students can score the mark for the substitution if they make a mistake converting the standard form values. Students can also access the mark for the significant figures step if they show evidence of correctly rounding their calculated value for wavelength, even if that value is not the correct final answer (eg they made a mistake evaluating the calculation).

Example 3

0 5 . 2 The radio waves have a frequency of 4.8×10^9 Hz

Wave speed of electromagnetic waves = 3.0×10^8 m/s

Calculate the wavelength of the radio waves.

Give your answer to 2 significant figures.

[3 marks]

$4.8 \times 10^9 = 4800000000$

$3.0 \times 10^8 = 300000000$ $= 16$

Wavelength = 16 m

Example 4

0 5 . 2 The radio waves have a frequency of 4.8×10^9 Hz

Wave speed of electromagnetic waves = 3.0×10^8 m/s

Calculate the wavelength of the radio waves.

Give your answer to 2 significant figures.

[3 marks]

wavelength = velocity / frequency = $\frac{3.0 \times 10^8}{4.8 \times 10^9}$

Wavelength = 6.25×10^{16} m

Mark scheme

05.2		an answer of 0.063 (m) scores 3 marks		AO2 6.6.1.2
	$3.0 \times 10^8 = 4.8 \times 10^9 \times \lambda$	allow $\lambda = \frac{3.0 \times 10^8}{4.8 \times 10^9}$ this mark may be awarded if the standard form values are incorrectly converted	1	
	$\lambda = 0.0625$ (m)		1	
	$\lambda = 0.063$ (m) **or** $\lambda = 6.3 \times 10^{-2}$ (m)	allow an answer to 2 sig figs that is consistent with their calculated value of λ and has required rounding	1	

Commentary and marks awarded

Example 3

This student scored no marks. It was quite common for students to divide the bigger number by the smaller number.

Examiners can award a mark for correct use of significant figures, providing there is evidence that the student has had to round their answer. In this case the student performed the wrong calculation and produced a number to 2 significant figures so could not be credited for demonstrating this skill.

Example 4

This response scored 1 mark. The student has made the correct substitution with the correct rearrangement of v =f λ.

What the student has done wrongly (and this was fairly common) is to have added the indices during the division rather than subtract them, so they are out by several orders of 10.

If this student had rounded to 6.3 x 10^{16}, they would have scored a second mark, for correct significant figures.

Examiner report

> 25% gained full marks, and a further 18% gained two marks, usually not giving the answer to two significant figures. There were a large number of responses using an incorrect rearrangement of the equation and generally the use of standard form was not the cause of the errors.

8463/P/1H Question 9.3

Higher-tier only, but content is common to Combined Science Trilogy, so this question could appear on the Combined Science papers as well. Around a third of students scored zero, but this high demand question proved to be fairly accessible for the cohort.

Students need to:

1. Convert kW into W and E = Pt substitution (1) – this mark could be awarded if the student did not convert – or if they made a mistake in converting – the power.
2. Calculate value for E (1)
3. Substitute into E = mcΔθ (1)
4. Rearrange to m = E/(cΔθ) (1)
5. Calculate final value of m = (1)

Many students did P/t = E and got a mass of 0.0006 kg. Many others did not convert kW into W, or calculated a value for energy, resulting in a mass of water up to 1600 kg. That's a lot of coffee.

Many made mistakes rearranging E = mcΔθ, putting E and cΔθ the wrong way up.

Many did not do E = Pt at all, putting a power directly into E =mcΔθ, thus scoring zero. If they had made it clear they had calculated a mass heated per second, they may have received marks for their working.

Example 5

0 9 . 3 The coffee machine heats water from 20 °C to 90 °C. 70°C

The power output of the coffee machine is 2.53 kW – 2530W

The specific heat capacity of water is 4200 J/kg °C.

Calculate the mass of water that the coffee machine can heat in 14 seconds.

[5 marks]

$\Delta E = mc\Delta\theta$ Power = Joules/second Energy = Power × time

$\Delta E = m(4200)(70)$

$181 = m(4200)(70)$ $E = \frac{2530}{14}$

$\frac{181}{(4200 \times 70)} = m = 0.000615...$ $E = 180.714285$

≈ 0.0006

Mass = 0.0006 kg

Example 6

0 9 . 3 The coffee machine heats water from 20 °C to 90 °C.

The power output of the coffee machine is 2.53 kW.

The specific heat capacity of water is 4200 J/kg °C.

Calculate the mass of water that the coffee machine can heat in 14 seconds.

[5 marks]

$E = mc\Delta T$ $m = \frac{E}{c\Delta T}$

$m = E \div c\Delta T$

$P = \frac{e}{t}$ $2530 = \frac{x}{14}$ $x = 35420\,J$

$35420 \div (4200 \times (90 - 20))$

$35420 \div 294000 = 0.12$ (2dp)

Mass = 0.12 (2dp) kg

Mark scheme

09.3		an answer of 0.12 (kg) **or** an answer that rounds to 0.12 (kg) scores **5** marks		AO2 4.2.4.2 4.1.1.3
	E = 2530 × 14	this mark may be awarded if P is incorrectly / not converted	1	
	E = 35 420 (J)	this answer only	1	
	35 420 = m × 4200 × 70	allow their calculated E = m × 4200 × 70	1	
	$m = \frac{35\,420}{4200 \times 70}$	allow $m = \frac{\text{their calculated E}}{4200 \times 70}$	1	
	m = 0.12 (kg)	allow an answer that is consistent with their calculated value of E	1	

Commentary and marks awarded

Example 5

In this example, the student scored 3 marks.

There are two marks available for calculating a value for E. This student made a mistake with the rearrangement of E = Pt, but because they wrote E = 180.75… they were able to access marks for the second part of the calculation.

Students should try to make intermediary values clear to the examiner. If this student had written the final answer without showing their working, they would have scored zero.

Example 6

In this response, the student scored 5 marks.

They have broken their working clearly into stages and indicated where they have rounded their answer. As it happens, students did not need to round to 2 significant figures, so this student would have received credit for giving a final answer of 0.120476 or to any number of significant figures as read from the calculator, provided that answer correctly rounds to 0.12 kg.

Examiner report

This question was a challenging two-step calculation. 50% of the students scored all 5 marks. Many students failed to calculate the energy transferred using E=Pt, but if they attempted to calculate an energy, even if incorrect, they could score the last 3 marking points in the calculation. Some students calculated the mass of water that could be heated per second and then multiplied by 14 (seconds).

Language in responses

8462/1F Question 2.4

Question

A student mixes solutions of halogens with solutions of their salts.

Table 1 shows the student's observations.

Table 1

	Potassium chloride (colourless)	Potassium bromide (colourless)	Potassium iodide (colourless)
Chlorine (colourless)		Solution turns orange	Solution turns brown
Bromine (orange)	No change		Solution turns brown
Iodine (brown)	No change	No change	

0 2 . 4 Explain how the reactivity of the halogens changes going down Group 7.

Use the results in **Table 1**.

[3 marks]

Mark scheme

02.4	the reactivity decreases (going down Group 7)	allow the reactivity decreases from chlorine to iodine	1	AO1 4.1.2.6
	(because) chlorine displaces bromine and iodine	allow (because) chlorine has two reactions allow (because) neither bromine nor iodine can displace chlorine	1	AO3 4.1.2.6
	(and) bromine displaces iodine **or** iodine does not react	allow (and) bromine has one reaction **or** iodine has no reactions allow (and) iodine cannot displace bromine	1	AO3 4.1.2.6

Example 7

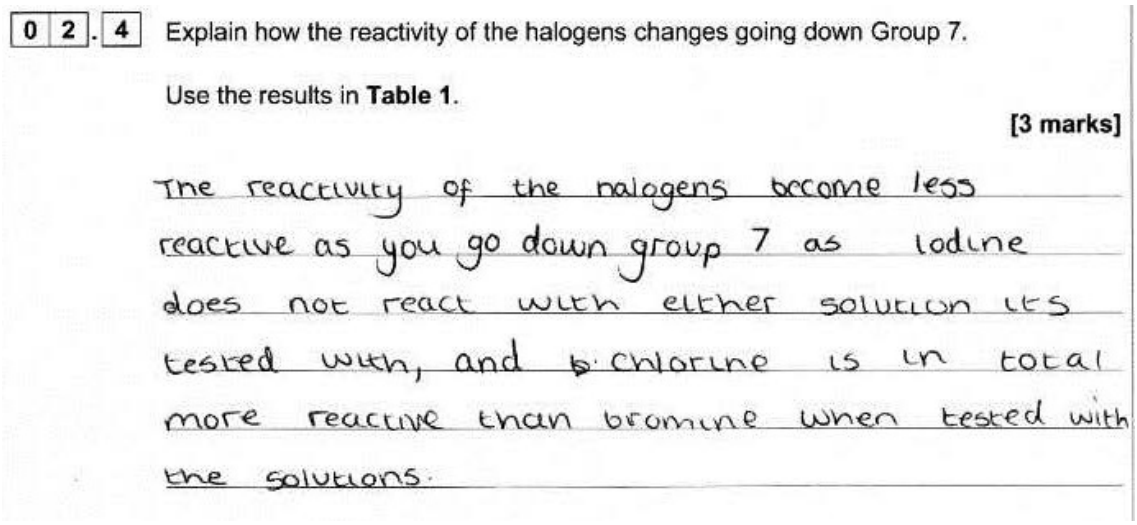
0 2 . 4 Explain how the reactivity of the halogens changes going down Group 7.

Use the results in **Table 1**.

[3 marks]

the solutions of halogens with solutions of their salts seem to stay the same as for example Bromine and iodine in the potassium Chloride (colourless) section seem to both not have any change.

Example 8



0 2 . 4 Explain how the reactivity of the halogens changes going down Group 7.

Use the results in **Table 1**.

[3 marks]

The reactivity of the halogens become less reactive as you go down group 7 as iodine does not react with either solution it's tested with, and ~~b~~ chlorine is in total more reactive than bromine when tested with the solutions.

Commentary and marks awarded

Example 7

The student has not indicated how the reactivity changes, so does not gain the first marking point. They appear to have attempted some comparison of the results in the table, but it is very unclear as to what they are actually trying to achieve. There is nothing of any credit and the student scored 0 marks.

Example 8

The student has answered in terms of the reactions in the table, not in terms of displacement as hoped. However, this approach was accepted.

The answer is not clearly expressed. However, the student has stated that the reactivity decreases as you go down the group ('the reactivity … become less reactive'), so gains the first marking point. They have also stated that iodine does not react, so gains the third marking point. There is an attempt at putting chlorine in place in the reactivity from the results, but the wording is too vague to allow the second marking point.

The student gains 2 marks.

Examiner report

02.4 26% of students scored two or more marks, usually for giving the correct trend in reactivity and stating that iodine had no reactions or no changes.

Very few students could articulate their reasoning in terms of displacement. Several tried to answer in terms of reactivity of the potassium halides rather than the halogens, or were misusing the term 'halide' instead of 'halogen', making it difficult to gain any credit. Others thought that darkness of colour was an indication of reactivity, whilst some referred to melting or boiling points, which were not relevant.

Some students tried to answer in terms of ease of gaining an electron, rather than by using the information in the table as intended. Those who did so were given credit, with the most common mark being for a description of the iodine atom being larger than the chlorine atom.

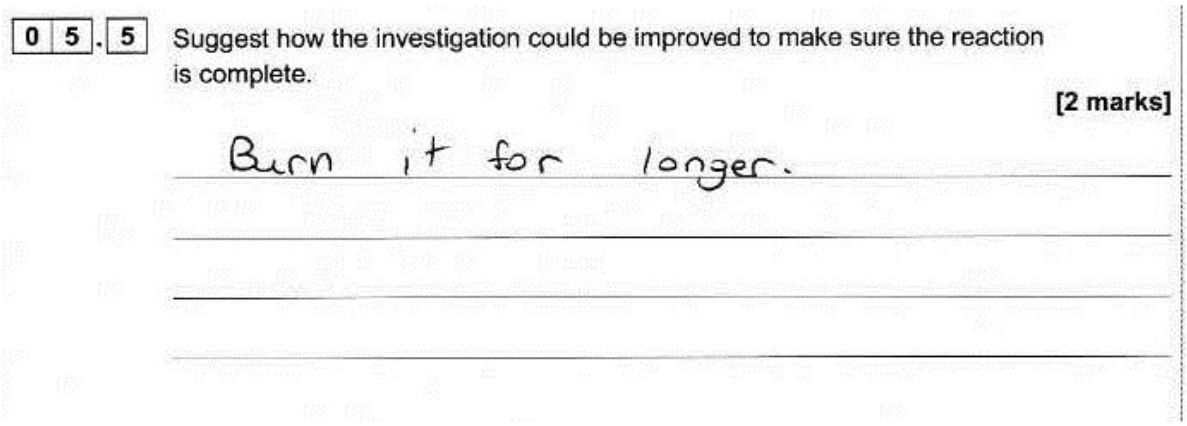
8462/1F: Question 2.4

Students needed to use their knowledge of thermal decomposition of a metal oxide (Section 4.3.1.3), along with the information given in the earlier part of the question, to understand that the reaction will be complete when the mass is no longer changing. So they needed to indicate:

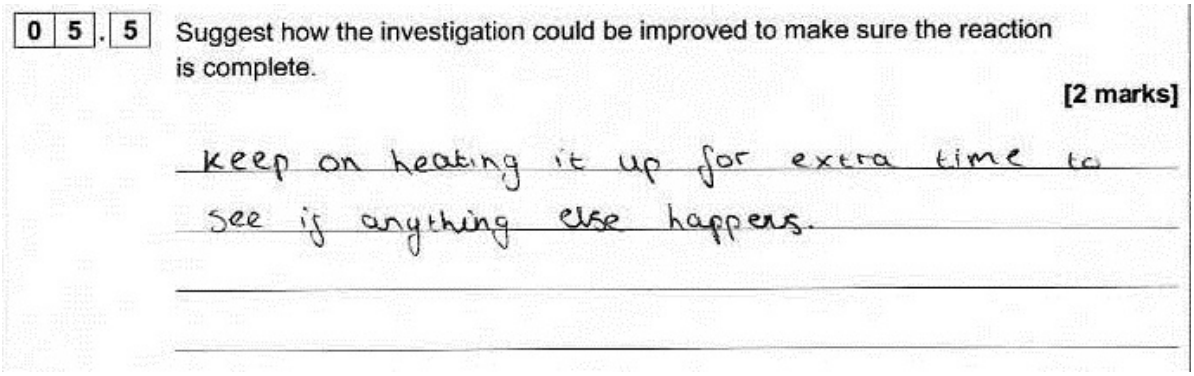
- that the reactants needed to be reheated (or heating continued)
- until the mass no longer changed (which would indicate no further reaction).

Inability to express the answer clearly seemed to hamper access to marks. In this question, at this level of demand, 'it' was taken to refer to the reacting mixture.

Example 9



Example 10



0 5 . 5 Suggest how the investigation could be improved to make sure the reaction is complete.

[2 marks]

keep on heating it up for extra time to see if anything else happens.

Mark scheme

05.5	reheat (and reweigh) until constant mass	 an answer of heat to constant mass scores **2** marks if no other mark scored allow for **1** mark heat for longer **or** (heat at a) higher temperature **alternative approach**: (1) continue heating and pass gas through limewater (1) until the (lime)water stops bubbling **or** until the limewater no longer turns cloudy	1 1	AO3 4.3.1.3

Commentary and marks awarded

Example 9

The student's use of 'burn' instead of 'heat' here is too imprecise to be allowed a mark (burning and heating are not the same). If the student had said 'heat it for longer' they would have gained 1 mark.

Example 10

'To see if anything else happens' is too vague to allow the second marking point, but 'keep on heating it up for extra time' is sufficient for the 'allow' of heat for longer, so this student received 1 mark.

Examiner report

05.5 This was not answered very well with 0.6% of students achieving both marks here. 12% of students achieved a single mark, usually for eating for longer'. 10% of students did not attempt an answer at all.

A lack of precision of expression proved costly, for example, 'leave it for longer' does not mean the same thing as 'heat it for longer'. Some students suggested putting in a bung to prevent any gas escaping, missing the entire reason for the investigation.

Some students suggested heating until no more gas was given off, with no indication as to how they would know when that was the case. Credit was given to those who could do so, for example by testing with lime water until it no longer turned cloudy or no more bubbles were seen. No credit was given for stating the test for carbon dioxide.

8462/2H: Question 9.4

Students needed to:

- use the equation to identify that there are fewer molecules on the product side of the equilibrium
- use their knowledge that increasing pressure will cause the equilibrium to shift to the side with fewer molecules, to explain why the yield increases in this example
- apply their understanding of collision theory to explain why the rate of this particular reaction increases.

Example 11

0 9 . 4 A pressure of 100 atmospheres is used instead of atmospheric pressure.

The higher pressure gives a greater yield of methanol **and** an increased rate of reaction.

Explain why.

[4 marks]

As he Chatelelie's principle follows, if the pressure ~~decreases~~ increases, ~~to reach equilibrium again,~~ the position of equilibrium shifts to the side with the less amount of molecules, and an increase of pressure means the particles are closer, therefore collide together more often, which lead to successful collisions more and an increased rate of reaction.

Example 12

0 9 . 4 A pressure of 100 atmospheres is used instead of atmospheric pressure.

The higher pressure gives a greater yield of methanol **and** an increased rate of reaction.

Explain why.

[4 marks]

An increase in pressure increases the yield as the reactants are working faster in order to produce the products and the rate of reaction increases due to the pressure increasing the rate of collisions between the reactants. More collisions means more successful collisions which increases the rate of reaction.

Mark scheme

09.4	(yield) equilibrium position moves to the product side	allow converse arguments allow equilibrium / reaction moves to the right allow equilibrium / reaction shifts to reduce the pressure	1	AO2 4.6.1.3 4.6.2.4 4.6.2.7
	(because) fewer molecules / moles / particles on product side	allow (because) fewer molecules / moles / particles on the right allow (because) smaller volume on product side	1	
	(rate) more collisions per unit time	allow increases collision frequency / rate ignore more collisions alone ignore faster collisions do **not** accept any indication of more energetic / forceful collisions	1	
	(because) more molecules / particles per unit volume	allow (gas) molecules / particles closer together ignore more molecules / particles alone	1	

Commentary and marks awarded

Example 11

The student has indicated that the equilibrium will shift to the side with fewer molecules, but has not gone on to say that this is the product side, so only gains one mark for the explanation pf yield increase.

They have, however, been able to articulate sufficiently well an explanation of why the rate of reaction increases to gain both marks here. A total of 3 marks.

Example 12

There is nothing coherent here that explains why the yield increases: ‘the reactants are working faster in order to produce the products’ is too vague to gain any merit.

About half way through, the student does identify that increasing the pressure increases the rate of collisions, which matches the 'allow' for marking point three. There is nothing else of any merit: 1 mark.

Examiner report

09.4 While many students did well, there were many others who demonstrated partial knowledge or who did not express themselves clearly. Many thought that an increase in pressure caused an increased yield of methanol because it was an exothermic reaction, rather than because the equilibrium moved to the position of fewer moles / molecules / particles.

The increased rate of reaction was better understood; students usually gave some indication that the particles are closer or there are **more particles** in a **fixed** volume or there are the **same number of particles** in a **smaller** volume. Simply saying there were more particles was insufficient.

In addition, students needed to link collisions **and** time to gain credit, usually by saying that the particles collide more often or there are more frequent collisions. Simply saying **more collisions** alone was insufficient. The idea that an increase in pressure supplied energy (and therefore increased the speed of the particles) was discounted.

73% of students were able to achieve some credit, with 12% of students achieving full marks.

Assessing content at different levels of demand

Example 1: Trilogy Biology 2F and 2H

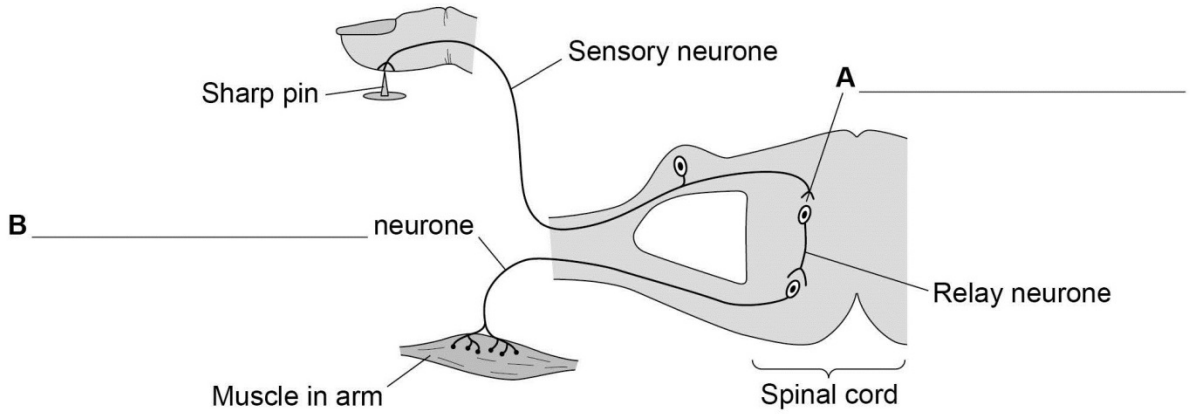
Comparing Foundation 3.3 and Higher 4.1

The questions cover the same Assessment Objective (AO1) and the same area of content (4.5.2). They use the same diagram, but in the Foundation paper there is more labelling, which acts as a prompt for the lower demand (grades 1-3). The task is more demanding on the Higher paper (grades 4-7), as students are not writing directly on the diagram and there are no prompts to help them.

Foundation question

0 3 . 3 **Figure 3** shows the nerve pathway when a person touches a sharp pin.

Figure 3



Name structures **A** and **B** on **Figure 3**

[2 marks]

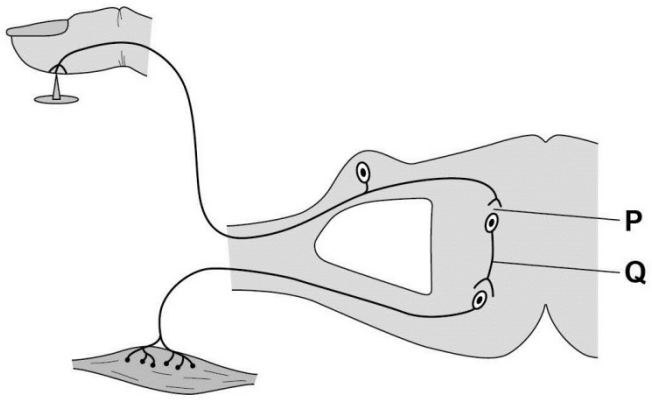
03.3	A = synapse B = motor (neurone)	in this order only	1 1	AO1 4.5.2

Higher question

0 4 This question is about the nervous system.

Figure 3 shows a reflex arc.

Figure 3



0 4 . 1 Name parts **P** and **Q** shown on **Figure 3**

[2 marks]

P _____

Q _____

04.1	(P) synapse	allow phonetic spelling	1	AO1 4.5.2
	(Q) relay neuron(e)	allow intermediate neuron(e)	1	

Comparing Foundation 3.4 and Higher 4.2

Both questions cover AO1 and the same subject content (4.5.2).

The Foundation tier question (grades 1-3) is very straightforward knowledge straight from the specification (known as AO1 in isolation), and scaffolded by making it multiple choice. The Higher tier question (grades 6-7) is more difficult as it requires students to think about how two parts of the pathway are different, so really needing to understand what's happening (AO1 understanding rather than straight recall of knowledge).

Foundation question

0 3 . 4 When the finger touches the sharp pin, the muscle in the arm contracts to pull the arm away.

What type of action is this?

[1 mark]

Tick **one** box.

- A conscious action ☐
- A delayed action ☐
- A reflex action ☐

03.4	a reflex action		1	AO1 4.5.2

Higher question

0 4 . 2 Compare how information is transferred along a neurone with how information is transferred across gap **P**.

[2 marks]

04.2	(in neurone) as electrical impulse (across synapse / gap P) as diffusion / movement of chemical / neurotransmitter	allow electrical potential ignore signal / message if no mark awarded allow **1** mark for mention of electrical and chemical in that order	1 1	AO1 4.5.2

Comparing Foundation 3.5 and Higher 4.5

These two questions both assess AO2, application of knowledge and understanding, in the context of Section 4.5.2, using data analysis.

The Foundation question (grades 1-3) uses a low demand, straightforward maths question to do this, with a range of data to look at and a unit conversion.

The Higher question (grades 6-9) uses the same context (time taken for muscle to contract at different ages) but asks students to apply their knowledge in a different way: to look at a wider range of data and to describe a relationship rather than a simple calculation.

Foundation question

0 3 . 5 Doctors tested people of different ages to time how long it took between touching a sharp pin and the arm muscle contracting.

At each age they tested five men and calculated a mean value for the time.

Table 1 shows the results.

Table 1

Age in years	Mean time for muscle to contract in milliseconds
20	18
40	20
60	23
80	30

How much longer does it take for the muscle to contract at 80 years of age compared to at 20 years of age?

Give your answer in seconds.

[2 marks]

Time = _____ s

03.5	12 (ms) 0.012 (s)	an answer of 0.012 (s) scores **2** marks	1 1	AO2 4.5.2

Higher question

0 4 . 5 Doctors tested people of different ages to time how long it took between touching a sharp pin and the arm muscle contracting.

Table 3 shows the results.

Table 3

Age in years	Time for muscle to contract in milliseconds
30	18.9
40	20.2
50	23.1
60	26.7
70	31.3
80	37.0

Describe the relationship between age in years and time for the muscle to contract.

[2 marks]

04.5	as age (in years) increases the time for the muscle to contract increases at an increasing rate	do **not** accept directly proportional allow correct description of 'at an increasing rate'	1 1	AO2 4.5.2

Example 2: Trilogy Biology 1F and 1H

Based around same practical – RPA 2

Context will change level of demand

Foundation question is low demand (grades 1-3) so uses (probably) familiar context of potato. Higher (grades 6-9) uses the (probably) unfamiliar context of carrot, immediately upping the challenge.

Compare F3.1 and 4.1

Both assess understanding of control measures and what's happening in the practical and why. Foundation 3.1 is much more straightforward and linked very directly to the practical; Higher 4.1 needs more in-depth understanding of what's going on in the practical, especially in the unfamiliar context.

Compare F3.2/3.3 and H4.4

Two questions on the F paper cover the knowledge of osmosis and understanding of the practical and AOs tested in H 4.4 – F much more scaffolded, and assessing simpler level of application and understanding.

Compare 3.4 and 4.5

Both assess AO3 analysing information to make judgements and draw conclusions. F question is making a simple conclusion from the observations given. The H question (targeted at grades 8-9) required more in-depth thinking and understanding of the underlying science

Didn't include any maths skills in the F paper, but if we had these would have been simpler demand – probably not including plotting of negative values. We would also have given the scales at the low level of demand.

Foundation Tier question

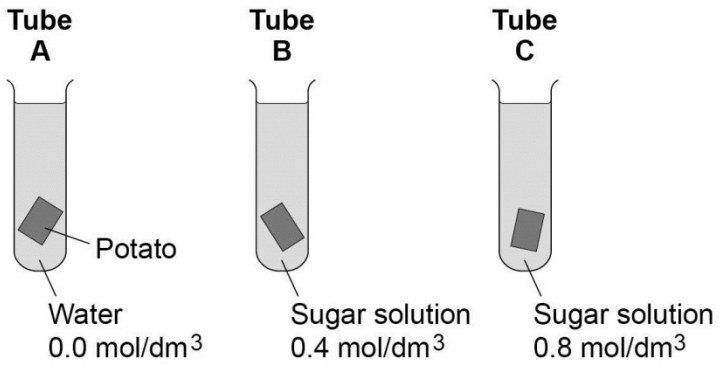
0 3 A student investigated the effect of different concentrations of sugar solution on pieces of potato.

This is the method used.

1. Cut three pieces of potato to the same length.
2. Dry each piece on a paper towel.
3. Weigh each piece.
4. Place each piece in a different concentration of sugar solution.
5. Leave all three pieces for 2 hours.
6. Remove the three pieces of potato from the solutions.
7. Dry each piece on a paper towel.
8. Measure the length and mass of each piece of potato.

Figure 6 shows how the investigation was set up.

Figure 6



0 3 . 1 Why did the student dry each piece of potato before weighing it?

[1 mark]

0 3 . 2 What **two** changes would you expect in the potato in **tube A** after 2 hours?

[2 marks]

Tick **two** boxes.

Breaks into pieces ☐

Decrease in hardness ☐

Decrease in size ☐

Increase in mass ☐

Increase in length ☐

0 3 . 3 Complete the sentences.

[3 marks]

Water moves into and out of cells by a process called _____ .

Water would move _____ the potato cells in **tube A**.

The solution outside the potato in **tube A** is at a _____ concentration than the solution inside the potato cells.

0 3 . 4 The potato in **tube B** did **not** change.

Give **one** conclusion that can be made from this observation.

[1 mark]

_____

_____

Foundation Tier mark scheme

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	any **one** from: • water on potato would increase mass • to control amount of water on potato	allow so only the mass of the potato is measured allow to remove water from outside of potato allow liquid / solution / sugar solution for water allow so you get the correct (starting) mass of the potato do **not** allow so that all the pieces of potato weighed the same	1	AO3 4.1.3.2
03.2	increase in mass increase in length	extra ticks negate marks	1 1	AO2 4.1.3.2
03.3	osmosis into lower	in this order only allow diffusion allow inside do **not** allow through allow low / more dilute / dilute	1 1 1	AO1 4.1.3.2 AO2 AO2
03.4	any **one** from: • the concentration (of sugar solution) in the cells is 0.4(mol/dm^3) • the concentration (of sugar solution) in the cells is the same as the solution (in the tube)	allow reference to potato instead of cells	1	AO3 4.1.3.2

Higher Tier question

0 4 A student investigated the effect of different concentrations of sugar solution on pieces of carrot.

This is the method used.

1. Weigh five pieces of carrot.
2. Place each piece into a different tube.
3. Into each tube add 20 cm^3 of water or one of the sugar solutions as shown in **Figure 6**
4. Leave the apparatus for 2 hours.
5. Remove the carrot and dry each piece on paper towel.
6. Reweigh each piece.
7. Calculate the percentage (%) change in mass of each piece.

Figure 6 shows how the investigation was set up.

Figure 6

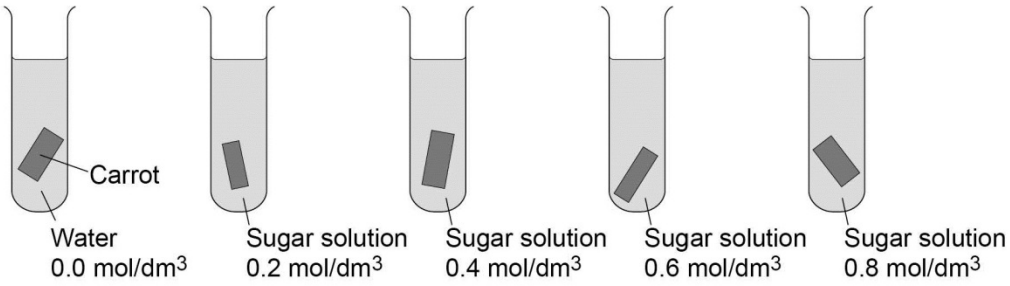


Table 2 shows the results.

Table 2

Concentration of sugar solution in mol/dm^3	Percentage (%) change in mass
0.0	+24
0.2	+12
0.4	+1
0.6	–8
0.8	–15

0 4 . 1 Suggest why the student calculated the percentage (%) change in mass of each piece of carrot.

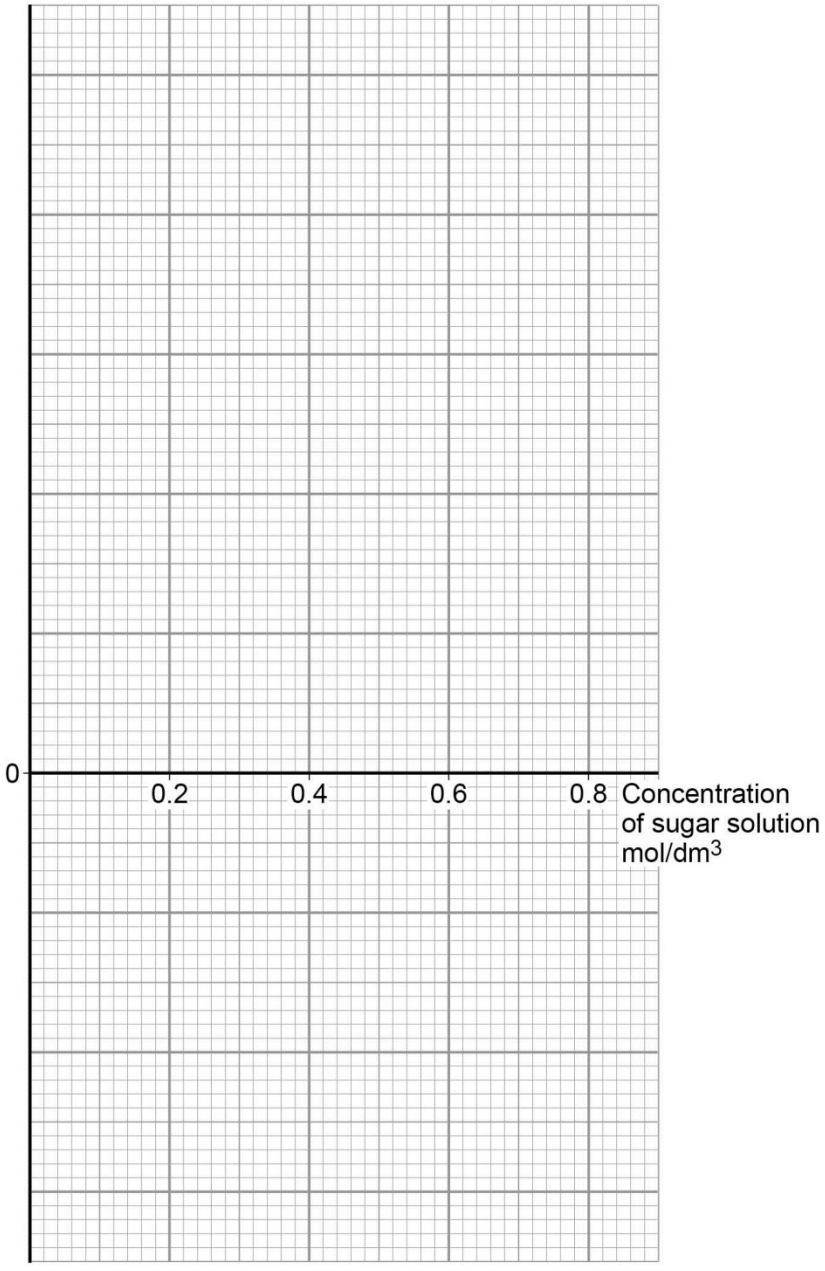
[1 mark]

0 4 . 2 Complete **Figure 7** using the results in **Table 2**

- Choose a suitable scale and label for the y-axis.
- Plot the results.
- Draw a line of best fit.

[4 marks]

Figure 7



0 4 . 3 Estimate the concentration of sugar solution inside the carrot cells.

Use your completed graph on **Figure 7**

[1 mark]

Concentration = _____ mol/dm^3

0 4 . 4 Explain why the mass of the carrot in the 0.6 mol/dm^3 sugar solution changed.

[4 marks]

0 4 . 5 The student repeated the investigation using boiled pieces of carrot.

The pieces of carrot did **not** change in mass.

Suggest why.

[1 mark]

Higher Tier mark scheme

<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO / Spec. Ref.</th></tr>
<tr><td>04.1</td><td>to control for the starting mass (of the pieces of carrot)</td><td>allow because the pieces of carrot were not all the same mass at the start
do not allow were not all the same size
do not allow as a control variable</td><td>1</td><td>AO3
4.1.3.2
RPA2</td></tr>
<tr><td>04.2</td><td>suitable scale and label for y-axis

all points plotted correctly

line of best fit</td><td>allow 5 or 6 per 2cm
do not allow 5 per 1cm

allow +/- ½ a square
allow 1 mark for 4 correct points

<table><tr><th>Concentration ...</th><th>Percentage (%) change...</th></tr><tr><td>0.0</td><td>+ 24</td></tr><tr><td>0.2</td><td>+ 12</td></tr><tr><td>0.4</td><td>+ 1</td></tr><tr><td>0.6</td><td>- 8</td></tr><tr><td>0.8</td><td>- 15</td></tr></table></td><td>1

2

1</td><td>AO2
4.1.3.2
RPA2</td></tr>
<tr><td>04.3</td><td>value from student's line of best fit</td><td>allow +/- ½ a square</td><td>1</td><td>AO3
4.1.3.2
RPA2</td></tr>
</table>

04.4	mass decreased		1	AO2
	(due to) **loss of water** by **osmosis**	ignore diffusion	1	AO1
	through a partially / selectively / semi permeable membrane		1	AO1 AO2
		a clear reference to concentration of water or concentration of sugar is required for the fourth mark		4.1.3.2 RPA2
	(as) concentration of sugar solution is greater than concentration of sugar (solution) inside cells / carrot **or** (as) the concentration of water is less outside the cells / carrot than the concentration inside the cells / carrot	allow (as) concentration of sugar solution inside cells / carrot is lower than the concentration of sugar solution (in the tube or around the carrot) allow answers in terms of dilute and concentrated solutions	1	

04.5	the (partially permeable / cell) membrane was damaged	allow idea that cell membrane is no longer intact **or** is **more** permeable / leaky allow the membrane is denatured ignore cells are dead	1	AO3 4.1.3.2 RPA2

Total			**11**

Notes

Notes

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