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June 2023

GCSE Chemistry 1CH0 2F

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Introduction

This examination paper was part of the continuing series of the 9-1 Chemistry specification. The paper consisted of 10 questions of which 6 questions were common with the 1SC0_2CF paper – Foundation Tier GCSE Combined Science (Chemistry). Much of the last three questions (Qs 8 – 10) were common with the 1CH0_1H paper (Qs 2 – 4 of the Higher tier Chemistry paper).

As is seen with all the other Chemistry papers, a variety of question styles were used to test the specification including multiple-choice, short open response, linking lines, plotting a graph, calculations, extended open response and, as would be expected on a Chemistry paper, use of chemical formulae and balancing equations. The paper targeted grades 5 to 1 with about half the marks targeted for grades 4 and 5.

This year saw a further move in cumulative percentages at each grade to pre-pandemic levels. As in previous years, there were the significant number of blank responses seen, as well as the poor response to the assessment of mathematical and practical skills. Equally disappointing was seeing that the candidates' knowledge of some basic areas was not particularly strong. However, the 6-mark questions showed an improved performance over previous years.

Question 1 (a)

The greater majority of the candidates gave the correct formula of methane.

The errors frequently made by candidates included writing the formula incorrectly as CH^4, $C + H^4$, $C + H_4$ or writing it with the wrong number of hydrogen atoms as CH_2 and as CH_3.

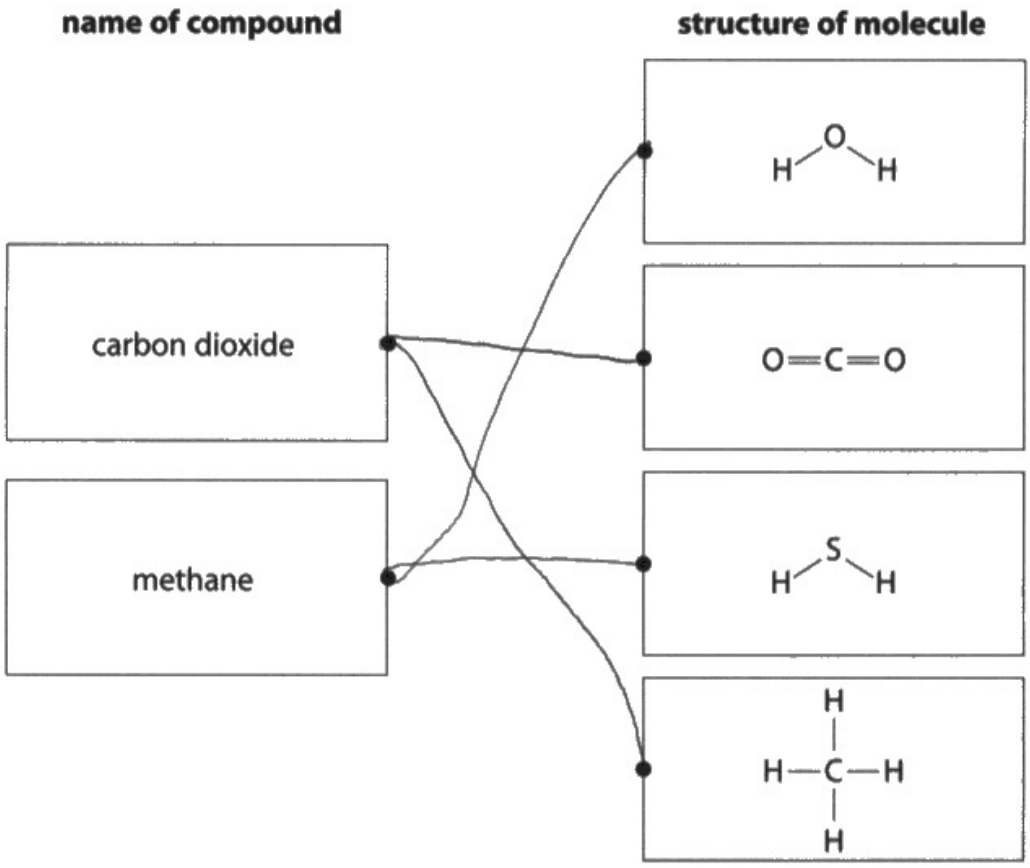
Question 1 (b)

Most candidates matched the name of the compound with its correct formula in both cases. However, there were some who did not follow the instructions by using more than one line to link the name of a substance on the left to two or more structures of molecules on the right.

(b) The names of two of the compounds in Figure 1 are shown below.

Draw one straight line from each name to the structure of a molecule of that compound.

(2)



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Examiner Comments

0 marks.

Each compound on the left has been joined to two structures on the right.

Question 1 (c)

The response seen here was quite positive with a little under half the candidates able to complete the dot and cross diagram for this relatively unfamiliar compound. Just over a quarter of the candidates scored a mark for a correct shared pair, but the rest of the dot and cross diagram was not correct as often candidates included too many electrons to complete the molecule.

The common errors seen were drawing in additional hydrogens or putting 10 electrons in the electron shell for sulfur.

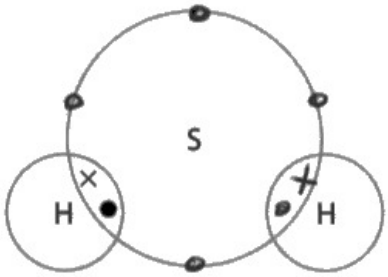
(c) Figure 2 shows information about the number of electrons in the outer shell of each of the different atoms in a molecule of compound **C**.

symbol of element	number of electrons in outer shell of the atom
H	1
S	6

Figure 2

Use the information in Figure 2 to complete the dot and cross diagram for a molecule of compound **C**.

(2)



ResultsPlus
Examiner Comments

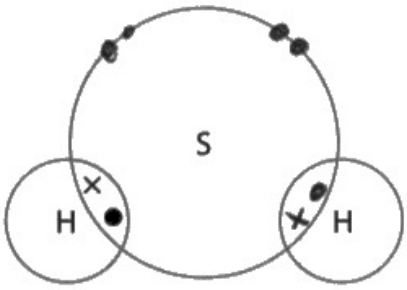
2 marks.

The shared pair between the hydrogen and sulfur scored the first mark and the completion of the full sets of electrons around the sulfur scored the second mark.

Unpaired electrons can be shown as single electrons (as here) or in pairs.

Use the information in Figure 2 to complete the dot and cross diagram for a molecule of compound C.

(2)



ResultsPlus
Examiner Comments

2 marks.

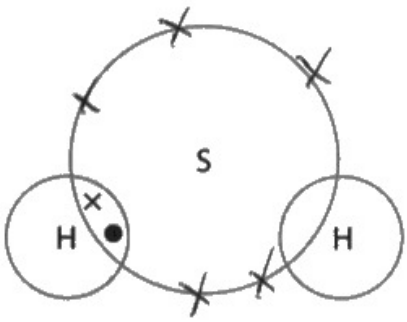
A well-drawn dot and cross diagram with the electrons around the sulfur shown in pairs.

ResultsPlus
Examiner Tip

Electrons can be shown as all dots, as all crosses or as a mixture of both.

Use the information in Figure 2 to complete the dot and cross diagram for a molecule of compound **C**.

(2)



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Examiner Comments

0 marks.

The first mark was for the shared pair of electrons between hydrogen and sulfur, which was missing.

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Examiner Tip

Practise drawing dot and cross diagrams for a variety of molecules of substances.

Question 1 (d)

The greater majority of the candidates had varying success with the question; a good number managed to give the correct number of protons, neutrons and electrons in that atom of phosphorus. However, there were many who only scored for the correct number of one of the sub atomic particles. Some candidates did score a mark for having the same number of electrons as for the number of protons.

The common error was to reverse the number of neutrons and electrons.

(d) The atomic number of phosphorus, P, is 15.

One atom of phosphorus has a relative atomic mass of 31.

Give the number of protons, neutrons and electrons in this atom of phosphorus.

(3)

number of protons = 15

number of neutrons = 15.5

number of electrons = 15

ResultsPlus Examiner Comments

2 marks.

The number of protons and the number of electrons were both correct, scoring the 2 marks.

It is most likely that the candidate divided the relative atomic mass number by 2 to give the number of neutrons, which is incorrect.

ResultsPlus Examiner Tip

It is not possible to have half a particle in an atom.

(d) The atomic number of phosphorus, P, is 15.

One atom of phosphorus has a relative atomic mass of 31.

Give the number of protons, neutrons and electrons in this atom of phosphorus.

(3)

31 − 15 = 16

number of protons = 15

number of neutrons = 15

number of electrons = 16

ResultsPlus
Examiner Comments

1 mark.

Only the number of protons scored here.

(d) The atomic number of phosphorus, P, is 15.

One atom of phosphorus has a relative atomic mass of 31.

Give the number of protons, neutrons and electrons in this atom of phosphorus.

(3)

number of protons = 15

number of neutrons = 16

number of electrons = 15

ResultsPlus
Examiner Comments

3 marks.

All 3 numbers were correct.

(d) The atomic number of phosphorus, P, is 15.

One atom of phosphorus has a relative atomic mass of 31.

Give the number of protons, neutrons and electrons in this atom of phosphorus.

(3)

number of protons = 6

number of neutrons = 19

number of electrons = 6

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Examiner Comments

1 mark.

All 3 numbers were incorrect, but 1 mark was given if the number of electrons was the same as the number of protons.

ResultsPlus
Examiner Tip

Remember:

- atomic number = number of protons.
- relative atomic mass/mass number = number of protons + number of neutrons.
- number of protons = number of electrons.

Question 2 (a)(i)

Most candidates managed to calculate the mass of the salt from the information given.

The main error here was seen to be where candidates added the masses together rather than calculating the difference.

Question 2 (b)(i-ii)

Q2(b)(i): The majority of candidates gave the correct temperature rise with a '+' sign showing the temperature rise. However, just under a third failed to score the second mark by missing out the + sign or by using a – sign.

Q2(b)(ii): Based on their answer to part (i), many scored both marks here by answering with the correct salt and that it produced the largest temperature rise when dissolved in water.

The main errors here were:

- Candidates just repeating the stem of the question eg 'Salt C produced the biggest exothermic change' – this scored just the 1 mark for identifying salt C.
- The value of – 0.7 showed the biggest exothermic change, as candidates thought the minus sign linked to energy being released rather than temperature decreasing.

(b) The student repeated the method for three different salts, **A**, **B** and **C**.

The same mass of each salt was used.

Figure 5 shows the temperature readings obtained for the three different salts.

salt	starting temperature of the water in °C	temperature of the mixture after 2 minutes in °C	temperature change in °C
A	20.5	25.6	+5.1
B	20.5	19.8	–0.7
C	20.5	29.2	

Figure 5

(i) Calculate the temperature change for salt **C**.

Include a sign to show if the temperature change is an increase or a decrease.

(2)

+ 8.7 29.2 − 20.5 = 8.7

temperature change = +8.7 °C

(ii) Explain which salt produces the biggest exothermic change.

(2)

C has the biggest exothermic change as the most heat is leaving in Salt C making it the most exothermic

ResultsPlus
Examiner Comments

Q2(b)(i) – 2 marks; Q2(b)(ii) – 2 marks.

This was a well-executed answer scoring maximum marks.

Q2(b)(i) – both value and sign were correct.

Q2(b)(ii) – the correct salt was chosen (salt C) along with a correct reason.

(i) Calculate the temperature change for salt **C**.

Include a sign to show if the temperature change is an increase or a decrease.

(2)

~~A~~ ~~20.5~~ 29.2 - 20.5 = 8.7

temperature change = + 8.7 °C

(ii) Explain which salt produces the biggest exothermic change.

(2)

B has the biggest exothermic change as the temperature is the only one that decreased ~~since~~ and lost thermal energy.

ResultsPlus
Examiner Comments

Q2(b)(i) – 2 marks; Q2(b)(ii) – 0 marks.

Q2(b)(i) – showed the correct value and sign of the temperature change.

Q2(b)(ii) – salt B was chosen, and the reason given shows the candidate's misunderstanding of what is happening – the temperature fall for salt B was linked to heat energy being lost.

ResultsPlus
Examiner Tip

Remember:

- Exothermic changes – temperature rises as heat energy needs to be lost.
- Endothermic changes – temperature falls as heat energy needs to be gained.

(i) Calculate the temperature change for salt **C**.

Include a sign to show if the temperature change is an increase or a decrease.

(2)

29.2 - 20.5 = 8.7

temperature change = + 8.7 °C

(ii) Explain which salt produces the biggest exothermic change.

(2)

Salt C. rises in temperature by 8.7°C whereas Salt B decreases by 0.7°C & Salt A increases by *5.1°C

ResultsPlus
Examiner Comments

Q2(b)(i) – 2 marks; Q2(b)(ii) – 1 mark.

Q2(b)(ii) – salt C was identified as the one with the biggest exothermic change, but no reason was given for choosing salt C The use of the 'whereas' had set salt C separate from the other two. If there had just been a list of salts with their temperature change, then no mark would have been scored.

(i) Calculate the temperature change for salt **C**.

Include a sign to show if the temperature change is an increase or a decrease.

(2)

20.5 − 29.2.

temperature change = −8.7 °C

(ii) Explain which salt produces the biggest exothermic change.

(2)

Salt A is the biggest exothermic reaction as it gave out the gratest temperature.

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Examiner Comments

Q2(b)(i) – 1 mark; Q2(b)(ii) – 2 marks.

Q2(b)(i) – correct value, but incorrect sign for the temperature change.

Q2(b)(ii) – with the error carried forward from Q2(b)(i), salt A is now the one with the biggest exothermic change with the temperature rise of 5.1 °C.

Question 2 (c)

Many candidates explained that polystyrene was more suitable as a container as it is an insulator. Reduced heat loss or keeping the heat in the container scored the second mark.

The main errors here were:

- Polystyrene keeps the temperature.
- The same polystyrene does not break when dropped.
- Polystyrene absorbs heat, but glass does not.

(c) **Explain why a polystyrene cup is a better container to use for this investigation than a glass beaker.**

(2)

Polystyrene is an insulator so it maintains the temperature in the cup during the investigation

ResultsPlus
Examiner Comments

1 mark.

Although the candidate scored the mark for polystyrene being an insulator, there was no reason why the temperature in the cup remains the same.

(c) Explain why a polystyrene cup is a better container to use for this investigation than a glass beaker.

(2)

a polystyrene cup is an insulator therefore less heat will be lost to surroundings and ~~there~~ it'll be slower. (~~good~~ Polystyrene cup provides good insulation) ~~to keep~~ glass beaker wouldn't prevent heat loss.

(Total for Question 2 = 7 marks)

ResultsPlus
Examiner Comments

2 marks.

A complete understanding of why a polystyrene cup is a better container for the investigation.

(c) Explain why a polystyrene cup is a better container to use for this investigation than a glass beaker.

(2)

A polystyrene cup is a better Conductor than a glass beaker

ResultsPlus
Examiner Comments

0 marks.

Hopefully the candidate has just mixed up the words conductor and insulator.

Question 3 (a)(i)

Judging by the low number of candidates who scored both or no marks, it seemed that many candidates have limited experience of carrying out a flame test. The first marking point of putting the flame test wire back into the acid (or water) (to help the metal ion compound fix to the wire) was rarely seen. However, just under a half of the candidates did give the answer that the flame test wire should be dipped into the metal salt / metal ion solution for the second marking point.

The errors seen most often here included:

- Let the flame test wire cool down.
- Put the flame test wire back into the Bunsen flame.
- Dip the flame test wire into a metal.

3 Chemical tests are used to identify unknown substances.

(a) A flame test can be used to identify metal ions in a substance.

(i) Complete step 2 of how to carry out a flame test.

(2)

step 1 dip a flame test wire in dilute hydrochloric acid and then hold the wire in a roaring Bunsen flame until the flame is colourless

step 2 See which colour is presented in the roaring flame and then you can know which metal you have.

step 3 hold the wire with the substance in a roaring Bunsen burner flame.

ResultsPlus
Examiner Comments

0 marks.

This answer said nothing about putting the wire back into the acid and then into the substance being tested.

3 Chemical tests are used to identify unknown substances.

(a) A flame test can be used to identify metal ions in a substance.

(i) Complete step 2 of how to carry out a flame test.

(2)

step 1 dip a flame test wire in dilute hydrochloric acid and then hold the wire in a roaring Bunsen flame until the flame is colourless

step 2 than dip your wire into the metal ion, onto the bunsen burner, then wait for a colour change from the flame.

step 3 hold the wire with the substance in a roaring Bunsen burner flame.

ResultsPlus
Examiner Comments

1 mark.

Just the second marking point was given here dipping the wired in the 'metal ion'. The term 'metal ion' was taken as meaning the substance used in the test.

The rest of answer focussed on then putting the wire into the Bunsen flame which is what was happening in step 3.

3 Chemical tests are used to identify unknown substances.

(a) A flame test can be used to identify metal ions in a substance.

(i) Complete step 2 of how to carry out a flame test.

(2)

step 1 dip a flame test wire in dilute hydrochloric acid and then hold the wire in a roaring Bunsen flame until the flame is colourless

step 2 Then dip the wire in the hydrochloric acid and then dip into the substance. The hold over roaring bunsen flame to see the colour.

step 3 hold the wire with the substance in a roaring Bunsen burner flame.

ResultsPlus
Examiner Comments

2 marks.

A well described answer that scored both marking points.

Question 3 (a)(ii)

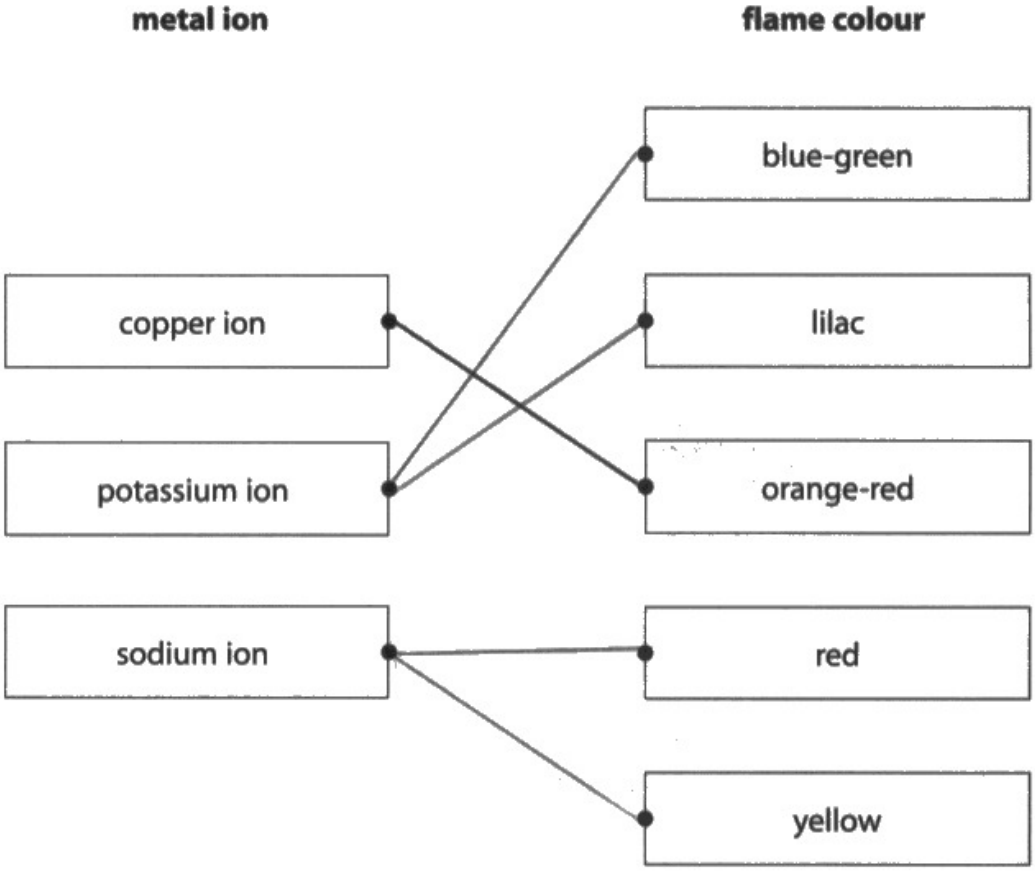
Most candidates scored by linking at least one metal ion with its correct flame colour. Only 20% of the candidates scored for all three flame colours. There were a sizeable number who scored 0 for either choosing the incorrect flame colours or not completing the question.

There were some who drew two lines (or more) from a metal ion to different flame colours. For each metal ion where this occurred, no marks were given.

(ii) Many metal ions produce a coloured flame in a flame test.

Draw one straight line from each metal ion to its flame colour in a flame test.

(3)



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Examiner Comments

0 marks.

The instructions are: 'Draw one straight line from each metal ion to its flame colour ...'.

Drawing two lines from a metal ion did not score a mark even if one of the linked lines was correct.

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Examiner Tip

Follow the instructions – drawing two lines from a metal ion here will mean 0 marks for that metal as one of the lines will be incorrect.

Question 3 (c)(i)

A good number identified the gas here as carbon dioxide, but there were many candidates who overlooked the clues. The test was being carried out to identify carbonate ions, where an acid was added to the carbonate. Another clue appeared in next part – the use of limewater.

Question 3 (c)(ii)

This question had the lowest number of candidates scoring the mark on this paper by somehow indicating that the stopper on the limewater tube needed to be removed/loosened/described somehow to show that the sealed system prevented the gas from passing into the limewater. Most candidates either did not understand the question or spot that there was a bung in both tubes.

The errors seen here most often included:

- The straw [delivery tube] should go into the liquid with the bubbles.
- The straw [delivery tube] should be straight.
- The test tubes should be vertical.
- The test tubes need heating with a Bunsen burner.

(ii) Figure 6 shows the apparatus that a student set up to test for this gas.

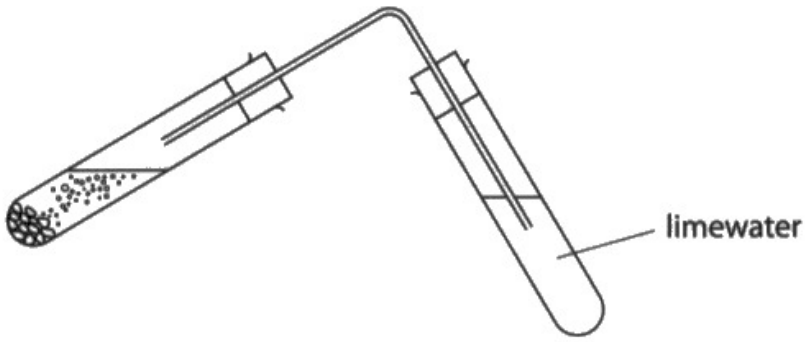

Figure 6

This apparatus will not work.

State what change is needed so that bubbles of the gas can pass through the limewater.

(1)

The limewater tube can't be airtight so remove the bung.

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Examiner Comments

1 mark.

This was one of the few correct answers.

(ii) Figure 6 shows the apparatus that a student set up to test for this gas.

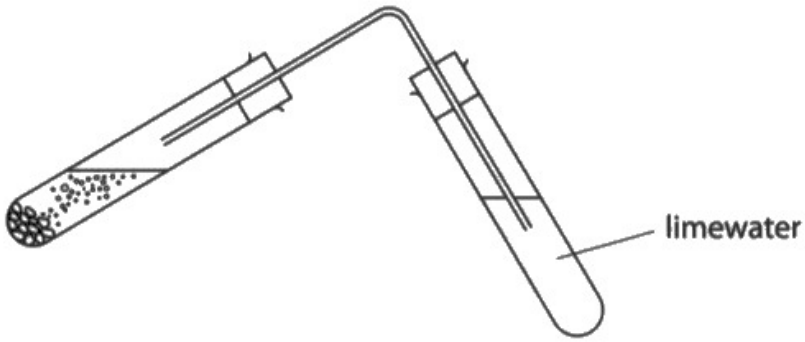


Figure 6

This apparatus will not work.

State what change is needed so that bubbles of the gas can pass through the limewater.

(1)

the lime water needs a place for gass to leave such as a hole

ResultsPlus
Examiner Comments

1 mark.

This was an acceptable way to ensure that the apparatus would work.

(ii) Figure 6 shows the apparatus that a student set up to test for this gas.

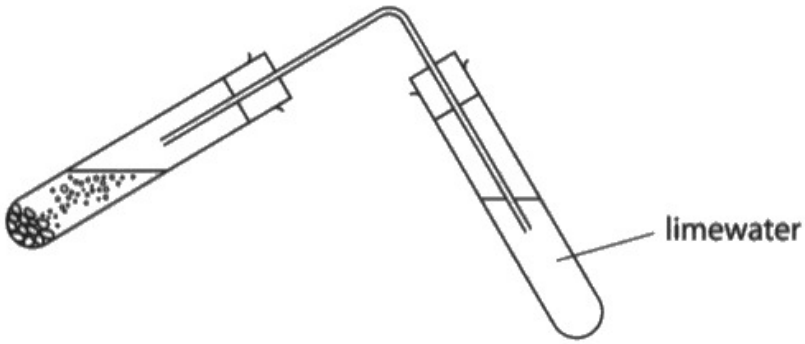


Figure 6

This apparatus will not work.

State what change is needed so that bubbles of the gas can pass through the limewater.

(1)

the straw needs to be in the liquid at both ends

ResultsPlus
Examiner Comments

0 marks.

This was a common misunderstanding of why the apparatus did not work. Many candidates used the term 'straw' in place of 'delivery tube'.

Question 3 (d)

Even though this question was asking about the test for ammonia gas, few candidates could name that gas. Probably the majority gave the answer as 'hydrogen'.

Question 4 (a)

Most candidates were able to add a suitable bar for the percentage of carbon dioxide to the bar chart. Somewhat surprising were the number who drew a bar at a height that was nowhere near the 95% as the figure given in the data table about the Earth's early atmosphere.

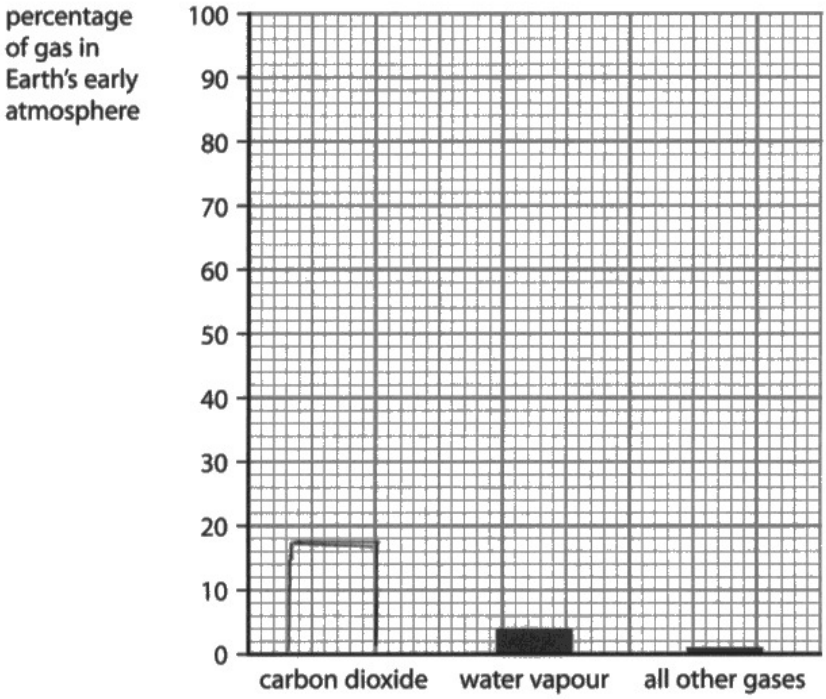
4 A scientist produced the information in Figure 7 about the Earth's atmosphere and the Earth's average surface temperature.

Earth's atmosphere 3 billion years ago		Earth's atmosphere today	
gas	**%**	**gas**	**%**
carbon dioxide	95	nitrogen	78.00
water vapour	4	oxygen	21.00
all other gases	1	carbon dioxide	0.04
	1	all other gases including water vapour	0.96
average surface temperature 3 billion years ago		**average surface temperature today**	
above 400 °C		20 °C	

Figure 7

(a) Complete the bar chart showing the composition of the Earth's atmosphere 3 billion years ago by adding a bar to show the percentage of carbon dioxide.

(1)



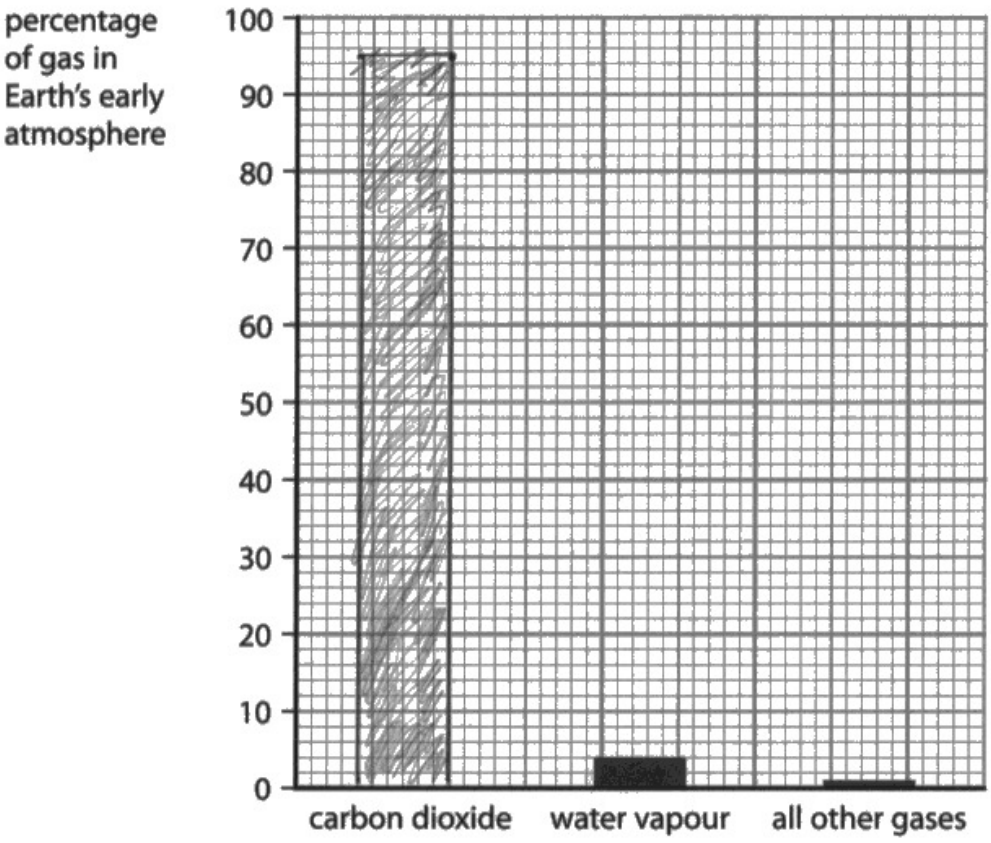
ResultsPlus
Examiner Comments

0 marks.

There is no apparent reason for the bar to be drawn at 17%. There were several candidates who had drawn their bar much lower than the 95% as given in the table.

(a) Complete the bar chart showing the composition of the Earth's atmosphere 3 billion years ago by adding a bar to show the percentage of carbon dioxide.

(1)



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Examiner Comments

1 mark.

A correctly drawn bar at the correct value of 95%.

Question 4 (b)(i)

About three-quarters of the candidates could interpret the information given in the data table to select the correct answer in this question: 'has decreased'.

Question 4 (b)(ii)

Even though the majority had answered part (i) by giving the answer that the average surface temperature of the Earth had decreased over the past 3 billion years, about half the candidates could not suggest what happened to the water vapour present in the atmosphere in that time period. Of those that gained marks, most answered in terms of the water vapour condensing and causing rain to fall and/or forming various water bodies.

The most common error here was that the Earth was getting hotter, and water evaporated.

(ii) The Earth's atmosphere 3 billion years ago contained much more water vapour than today's atmosphere.

Explain what happened to the water vapour.

(2)

as the earths temperature decreased the watervapour in the atmosphere condensed forming bodys of water on the earths surface.

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Examiner Comments

2 marks.

Marks were given for water vapour condensing and forming bodies of water.

(ii) The Earth's atmosphere 3 billion years ago contained much more water vapour than today's atmosphere.

Explain what happened to the water vapour.

(2)

The percentage of water vapour decreased as the earth grew older and the surface temperature decreased

ResultsPlus
Examiner Comments

1 mark.

The idea that the surface temperature (or the Earth) had decreased was an allowed mark.

(ii) The Earth's atmosphere 3 billion years ago contained much more water vapour than today's atmosphere.

Explain what happened to the water vapour.

(2)

Water vapour increcid due to global warming.

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Examiner Comments

0 marks.

The candidate had not understood the question where it states that the atmosphere 3 billion years ago contained more water vapour than today's atmosphere.

(ii) The Earth's atmosphere 3 billion years ago contained much more water vapour than today's atmosphere.

Explain what happened to the water vapour.

(2)

The earth cooled down and the water vapour condensed, into a liquid so it is mainly in ~~sea~~ the ocean

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Examiner Comments

2 marks.

This answer contains many marking points, but the maximum that could be given was 2.

Question 4 (c)(i)

Most gave the correct answer as ‘photosynthesis’, but a sizeable number gave ‘respiration’ as their answer.

Question 4 (d)(i)

This was a straightforward question testing mathematical skills, which forms 15% of the marks on any Chemistry examination paper at GCSE. About 70% gave the answer correct to the nearest whole number, but disappointingly about 20% of the candidates left the answer to two decimal places. Several candidates were confused between approximating to a number of decimal places or to a number of significant figures. By asking candidates to give an answer to the nearest whole number, in general, candidates tend to perform better at this level.

Common errors included:

- Adding together or multiplying the values, or carrying out further processing.
- Not doing rounding the value to the nearest whole number; some candidates rounded up rather than down.

(d) Many people are concerned by the increasing amount of carbon dioxide in the atmosphere.

(i) The amount of carbon dioxide in the atmosphere is measured in parts per million (ppm).

Figure 8 shows the amount of carbon dioxide in the atmosphere in June 2001 and in June 2021.

	amount of carbon dioxide in ppm
June 2001	371.17
June 2021	416.56

Figure 8

Calculate the increase in the amount of carbon dioxide, in ppm, from June 2001 to June 2021.

Give your answer to the nearest whole number.

(2)

416 − 371 = 46

increase in amount of carbon dioxide = 46 ppm

ResultsPlus
Examiner Comments

0 marks.

The candidate had erroneously rounded the numbers before doing any calculation and, in addition, the numerical answer from the sum given was also incorrect.

Calculate the increase in the amount of carbon dioxide, in ppm, from June 2001 to June 2021.

Give your answer to the nearest whole number.

(2)

416.86 - 371.17 = 45.39

increase in amount of carbon dioxide = 48.39 **ppm**

ResultsPlus
Examiner Comments

1 mark.

The calculation was correct scoring 1 mark, but the candidate had missed rounding the answer to the nearest whole number so missed out on the second mark.

Calculate the increase in the amount of carbon dioxide, in ppm, from June 2001 to June 2021.

Give your answer to the nearest whole number.

(2)

416·56 - 371·17 = 45·39 → 45

increase in amount of carbon dioxide = 45 ppm

ResultsPlus
Examiner Comments

2 marks.

Calculation and rounding were both correct.

Question 4 (d)(ii)

Given everything that's been in the news about climate change and global warming over the past several years, it was disappointing to see that only about 40% of the candidates gave an acceptable answer – acceptable answers included 'global warming', 'climate change', 'loss of habitats'. In this question, the answer '**enhanced** (or **increased**) greenhouse effect' was also acceptable, but 'greenhouse effect' (alone) was not.

The majority of candidates who answered this question, however, answered a different question. They were answering a question about what CAUSED the increasing amount of carbon dioxide in the atmosphere, rather than the actual question which was about the EFFECT of increasing amount of carbon dioxide in the atmosphere. So there were many answers about increased number of road vehicles, factory emissions, deforestation and several others, all of which did not gain credit.

(ii) State **one** possible effect that could be caused by the increasing amount of carbon dioxide in the atmosphere.

(1)

Enhanced greenhouse effect

ResultsPlus
Examiner Comments

1 mark.

It was very pleasing to see that a candidate on this paper had given the correct answer of 'Enhanced greenhouse effect'.

(ii) State **one** possible effect that could be caused by the increasing amount of carbon dioxide in the atmosphere.

(1)

Burning fossil fuels

ResultsPlus
Examiner Comments

0 marks.

The question was about the EFFECT of increasing amounts of carbon dioxide in the atmosphere, rather than the CAUSE, which this answer contains.

(ii) State **one** possible effect that could be caused by the increasing amount of carbon dioxide in the atmosphere.

(1)

Polar Ice caps could melt

ResultsPlus
Examiner Comments

1 mark.

A relevant consequence of increased carbon dioxide levels in the atmosphere.

(ii) State **one** possible effect that could be caused by the increasing amount of carbon dioxide in the atmosphere.

(1)

global warming

ResultsPlus
Examiner Comments

1 mark.

Global warming was a popular choice given by many candidates.

(ii) State **one** possible effect that could be caused by the increasing amount of carbon dioxide in the atmosphere.

(1)

The increase of POPULATION AND FOSSIL FUEL

ResultsPlus
Examiner Comments

0 marks.

The increase of population is the one of the causes of increased carbon dioxide levels in the atmosphere.

Question 5 (a)

It was disappointing to see that only about half the candidates could correctly identify the piece of glassware shown in the diagram. Flask and conical flask were acceptable, but other descriptors such as measuring flask were not. There were several candidates who labelled this as a boiling tube or as a beaker.

Question 5 (b)

Calculating the concentration of a solution has been asked on previous papers and should be a relatively straightforward mathematical exercise, so it was disappointing to see so few candidates able to obtain the final concentration as 300 g dm^{-3}. Those who were successful either divided the mass of glucose by the volume of solution as their first step and then converted that answer from g cm^{-3} to g dm^{-3} by multiplying by 1000. The other method of converting the volume of solution to g dm^{-3} as the first step was also seen. It was sometimes seen that candidates were multiplying by 100 rather than by 1000, so only 1 mark could be awarded in these instances.

Several candidates made the error of multiplying the mass of glucose by the volume of solution to give a numerical answer of 6750, which was not leading to anything useful. However, some candidates divided the volume of solution by the mass of glucose. This first step was incorrect, but it was possible for a second step to gain credit.

(b) The student dissolved 45 g of glucose in water to make 150 cm^3 of glucose solution.

Calculate the concentration of this solution in g dm^{-3}.

(2)

conc = mol / vol = 45 / 0.15 = 300 g dm^{-3}

150 cm^3 → 0.15 dm^3

concentration of glucose solution = 300 g dm^{-3}

ResultsPlus
Examiner Comments

2 marks.

Both the conversion from cm^3 to dm^3 and the division of (mass in g)/(volume in dm^3) clearly shown with the correct answer scored this the 2 marks.

(b) The student dissolved 45 g of glucose in water to make 150 cm^3 of glucose solution.

Calculate the concentration of this solution in g dm^{-3}.

(2)

~~150 x~~ 150 ÷ 1000 = 0.15 dm^{-3}

45 x 0.15 = 6.75 g dm^{-3}

concentration of glucose solution = 6.75 g dm^{-3}

ResultsPlus
Examiner Comments

1 mark.

The candidate had correctly converted the volume from cm^3 to dm^3 for 1 mark, but then made the mistake of multiplying the mass of glucose by the volume.

Question 5 (c)

Yeast was not well known as something that needed to be added to glucose solution to cause fermentation to take place. Only a little over 10% of the candidates scored the mark here for 'yeast' as the popular answer but 'enzyme' was an alternative acceptable answer.

Question 5 (e)

There were five different ways that the answer could be achieved in this calculation using proportions. However, in two of the ways, there was the potential for a first stage answer to be incorrectly approximated. Incorrect approximation was penalised, but a second step was still possible for a mark.

For example:

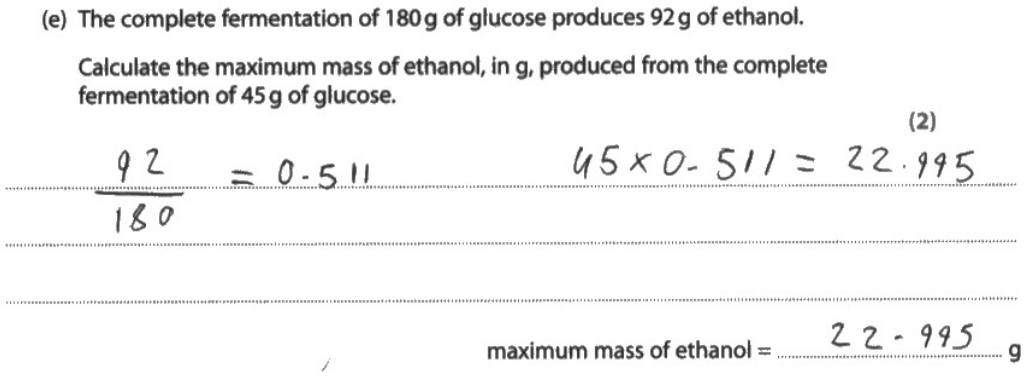
1st step: $\frac{\text{mass of ethanol}}{\text{mass of glucose}} = \frac{92}{180}$ =

2nd step: 0.5111111 × 45 (new mass of glucose) = 23 g

If the answer to the first step was incorrectly rounded to 0.5 (scored 0 marks), the answer of 22.5 g was then obtained (scored 1 mark for a correct 2nd step). Examiners reported that most candidates showed their working which helped greatly to ensure that both marking points could be identified if the final answer was not correct.

Candidates should be deterred from approximating part way through a calculation.

The main error seen in this calculation was where candidates added or subtracted numbers given in the question.



(e) The complete fermentation of 180 g of glucose produces 92 g of ethanol.

Calculate the maximum mass of ethanol, in g, produced from the complete fermentation of 45 g of glucose.

(2)

$\frac{92}{180} = 0.511$ $45 \times 0.511 = 22.995$

maximum mass of ethanol = 22.995 g

ResultsPlus Examiner Comments

2 marks.

The 1st step 92/180 is correct, but the answer was rounded incorrectly to 0.511.

The 2nd step in this method is to multiply by 45. This gave the answer as 22.995 (g). Which was correct.

(e) The complete fermentation of 180 g of glucose produces 92 g of ethanol.

Calculate the maximum mass of ethanol, in g, produced from the complete fermentation of 45 g of glucose.

(2)

÷4 (180 : 92 / 45 : 23) ÷4 180 ÷ 45 = 4

maximum mass of ethanol = 23 g

ResultsPlus
Examiner Comments

2 marks

The scaling taking place is clearly shown in the candidate's answer:

To go from 180 to 45, need to divide by 4.

So, the same is done to the 92, to give the answer 23 (g).

Question 5 (g)

Despite the very strong clue of universal indicator being placed in some acid; only about 40% of the candidates gave a colour that would represent a suitable pH value for an acid.

Errors seen included:

- Just stating ‘a colour change’ without being specific.
- An incorrect colour being given (most often was blue).
- Confusion with test for chlorine by stating the indicator paper was bleached/turned white.

Question 6 (b)(i)

The greater majority of candidates could put together the correct word equation for the reaction. The main error seen was where candidates erroneously included a second product, usually water. There were just a few who attempted a balanced equation, but everything had to be correct for both marks; there was no one mark available in this case.

(b) Chlorine reacts with sodium to form sodium chloride.

(i) Write the word equation for this reaction.

(2)

Chlorine + Sodium → Sodium chloride + water.

ResultsPlus
Examiner Comments

1 mark.

The left side (reactants) was correct and scored a mark, but the right side (products) contained an extra substance.

This only scored 1 mark for the left side.

(b) Chlorine reacts with sodium to form sodium chloride.

(i) Write the word equation for this reaction.

(2)

Sodium + chloride → Sodium chloride

ResultsPlus
Examiner Comments

1 mark.

Unfortunately, the candidate has used the word 'chloride' in place of chlorine on the reactants side, so only the right side – sodium chloride – scores here.

ResultsPlus
Examiner Tip

Know the difference between chlor**ine** and chlor**ide**.

As the element it is chlor**ine** but in a compound, it is chlor**ide**.

(b) Chlorine reacts with sodium to form sodium chloride.

(i) Write the word equation for this reaction.

(2)

~~Sodium + Chloride~~ Chlorine + Sodium

~~Chlorine + Sodium~~ → Sodium Chlorine

ResultsPlus
Examiner Comments

1 mark.

After the 3rd attempt, the candidate gets the left side correct, for 1 mark. Unfortunately, the product was written as 'sodium chlor**ine**' which does not score.

Question 6 (b)(ii)

It was surprising to see how many candidates could not describe the meaning of the term 'molecule'. Of the few that scored marks on this, most obtained the first marking point about a number of atoms being somehow joined together; the second mark was only seen in a small number of responses where the candidate had to indicate how the atoms were joined – covalent bond, shared pair of electrons, etc.

There were many errors seen within the candidates' understanding:

- Atoms are made up of molecules.
- Molecules are small parts of atoms.
- Molecules are protons, neutrons and electrons.

(ii) Chlorine, Cl_2, is made of simple molecules.

Describe what is meant by the term **molecule**.

(2)

Molecule is the tiny piece of matter that creates something / chemical.

ResultsPlus
Examiner Comments

0 marks.

There was nothing to credit in answers such as this. Many candidates showed, with similar answers, that they did not fully understand what a molecule actually is.

(ii) Chlorine, Cl_2, is made of simple molecules.

Describe what is meant by the term **molecule**.

(2)

when a group of atoms is chemically bonded together through strong forces

ResultsPlus
Examiner Comments

2 marks.

A complete answer that was given by a small number of candidates.

Marks were given for 'a group of atoms' (that were somehow joined together) and (those atoms) were covalently bonded together (or some other suitable alternative). 'Chemically bonded' was considered to be acceptable at this level.

(ii) Chlorine, Cl_2, is made of simple molecules.

Describe what is meant by the term **molecule**.

(2)

A molecule is a group of atoms which form together to make a structure.

ResultsPlus
Examiner Comments

1 mark.

This answer did have the groups of atoms which 'form together' for the 1st mark, but there was no indication of a covalent bond being formed, so no 2nd mark.

(ii) Chlorine, Cl_2, is made of simple molecules.

Describe what is meant by the term **molecule**.

(2)

molecule is ~~some~~ ~~are~~ ~~unit~~ what makes up an atom. They are single things

ResultsPlus
Examiner Comments

0 marks

Many candidates had a similar understanding of the term molecule, which unfortunately is incorrect.

Question 6 (b)(iii)

The idea of how metals conduct electricity has been assessed several times in the past. In this case, sodium was used as the metal. Nearly a quarter of the candidates could produce a full 2-mark answer involving electrons being able to move through the metal structure. The mention of electrons in their answer scored the first mark and indication that they moved which created the flow of an electrical current scored the second mark.

Some of the errors seen included:

- Sodium conducts because it's a metal.
- It contains free electrons (only scored 1 mark and this did not indicate that the electrons moved).
- Electricity flows between the atoms/ions.

(iii) Sodium, like all metals, conducts electricity.

Explain how sodium conducts electricity.

(2)

Sodium only conducts electricity when soluble.

ResultsPlus
Examiner Comments

0 marks.

Over half the candidates did not score a mark on this question. Many candidates had no concept of what makes up an electrical current.

(iii) Sodium, like all metals, conducts electricity.

Explain how sodium conducts electricity.

(2)

The particles are able to move and so a current can pass through them.

ResultsPlus
Examiner Comments

0 marks.

This answer did not specify that electrons move and so could not score any marks.

(iii) Sodium, like all metals, conducts electricity.

Explain how sodium conducts electricity.

(2)

Sodium has a sea of delocalised electrons, allowing electricity to pass through and move freely.

ResultsPlus
Examiner Comments

2 marks.

About a quarter of the candidates had knowledge that it was electrons that moved that caused an electrical current to flow. The answer of delocalised electrons alone would have scored both marks.

(iii) Sodium, like all metals, conducts electricity.

Explain how sodium conducts electricity.

(2)

Electricity passes through sodium by sending electrical signals.

ResultsPlus
Examiner Comments

0 marks.

There were many similar weak answers such as this with no mention of electrons in the answer.

Question 6 (b)(iv)

Most candidates could put together the formula of a simple ionic compound from its constituent ions, although many did leave the charges showing as in Na^+Cl^-, but this was acceptable.

Errors seen here included:

- $NaCl_2$
- Na^+Cl

(iv) Sodium chloride contains sodium ions, Na^+, and chloride ions, Cl^-.

Use this information to state the formula of sodium chloride.

(1)

$Na^+ + Cl^-$

ResultsPlus
Examiner Comments

0 marks.

Quite a few candidates added the ions together as here, but left the + sign between the ions, so this did not score.

(iv) Sodium chloride contains sodium ions, Na^+, and chloride ions, Cl^-.

Use this information to state the formula of sodium chloride.

(1)

$Na + Cl_2 \longrightarrow NaCl_2$

ResultsPlus
Examiner Comments

0 marks.

The candidate has not used the formulae of the ions that were provided.

(iv) Sodium chloride contains sodium ions, Na^+, and chloride ions, Cl^-.

Use this information to state the formula of sodium chloride.

(1)

NaCl⁻ NaCl⁻

ResultsPlus Examiner Comments

0 marks.

Many candidates gave the answer as $NaCl^-$ or as Na^+Cl.

(iv) Sodium chloride contains sodium ions, Na^+, and chloride ions, Cl^-.

Use this information to state the formula of sodium chloride.

(1)

Na⁺Cl⁻

ResultsPlus Examiner Comments

1 mark.

This was allowed for the mark.

ResultsPlus Examiner Tip

Practise writing the formula of chemical substances from a list of ions for groups 1, 2, 6 and 7 of the periodic table.

Question 6 (b)(vi)

Many candidates could name a piece of apparatus that could be included with a circuit to show that an electrical current was flowing: ammeter and lightbulb/lamp were commonly seen.

Errors included:

- Voltmeter.
- Battery.
- Switch.
- Arrows to show the current.

(vi) Sodium chloride solution conducts electricity.

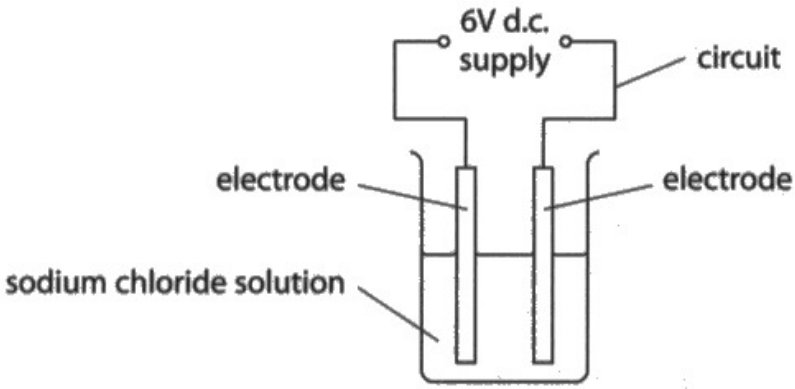


Figure 11

State what can be put into the circuit in Figure 11 to show that a current is flowing.

(1)

Voltmeter.

ResultsPlus
Examiner Comments

0 marks.

One of the many errors seen on this question. This was probably the error most frequently seen.

State what can be put into the circuit in Figure 11 to show that a current is flowing.

(1)

arrows

ResultsPlus
Examiner Comments

0 marks.

Another of the errors seen.

State what can be put into the circuit in Figure 11 to show that a current is flowing.

(1)

a battery cell →

ResultsPlus
Examiner Comments

0 marks.

... and another error seen quite often.

Question 6 (c)(i)

About 2/3 of the candidates balanced the equation correctly. Incorrect answers involved altering the formula of the HCl or '4' in front of the HCl.

(c) Figure 12 shows a flow diagram of how hydrochloric acid can be made.

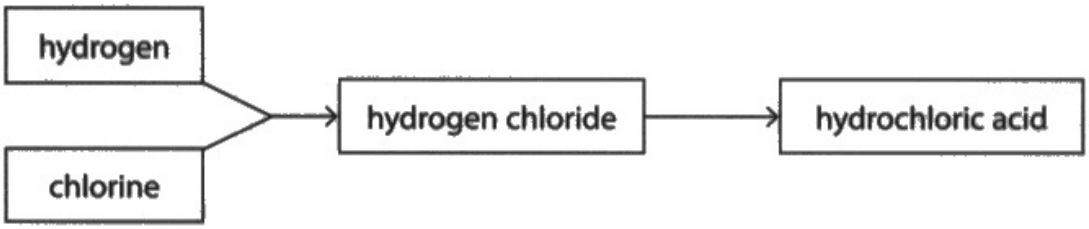


Figure 12

(i) Balance the equation for the reaction between hydrogen and chlorine to form hydrogen chloride.

(1)

$H_2 + Cl_2 \rightarrow$ .....4..... HCl

ResultsPlus
Examiner Comments

0 marks.

Of those candidates who scored 0 for this question, this error was given by many of them.

(c) Figure 12 shows a flow diagram of how hydrochloric acid can be made.

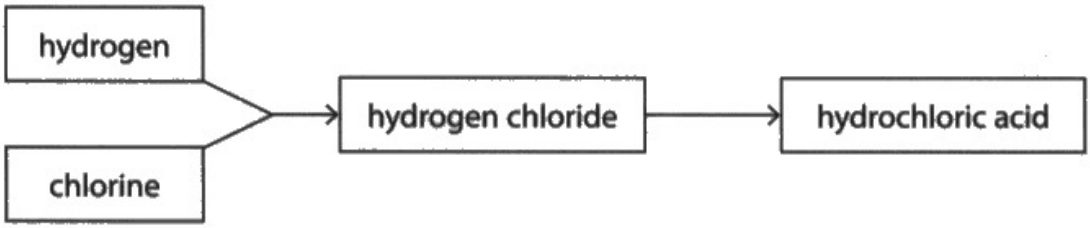


Figure 12

(i) Balance the equation for the reaction between hydrogen and chlorine to form hydrogen chloride.

(1)

$H_2 + Cl_2 \rightarrow$ H+Cl HCl

ResultsPlus
Examiner Comments

0 marks.

Another error seen on those that score 0 marks was adding the atomic symbols as here, showing a misconception about what balancing an equation involves.

Question 6 (c)(ii)

Despite this question assessing a statement that is straight from the specification (spec statement 6.10: Recall the halogens ... form hydrogen halides which dissolve in water to form acidic solutions ...') only a few could give a correct answer of add to water or dissolve in water. Examiners reported that about half the candidates left this blank.

Common errors seen included:

- Dissolve in acid.
- Freeze it.

(ii) State how hydrogen chloride can be converted into hydrochloric acid.

(1)

by changing the name

ResultsPlus Examiner Comments

0 marks.

This was quite a novel attempt at answering this question.

(ii) State how hydrogen chloride can be converted into hydrochloric acid.

(1)

It can be put into water, as it [redacted] is soluble and will turn into HCl.

ResultsPlus Examiner Comments

1 mark.

This was one of the few that scored the mark.

(ii) State how hydrogen chloride can be converted into hydrochloric acid.

(1)

mix the hydrogen chloride with a dilute acid.

ResultsPlus
Examiner Comments

0 marks.

An example of one the main errors seen by examiners.

Question 7 (b)(iii)

In comparison with previous examples of 6-mark questions that assessed a core practical, this question performed quite well. Of those that attempted the question, most achieved Level 2 with up to 4 marks as they would either miss out a control variable or their method would not lead to a valid outcome.

Many candidates included the instruction to find the mass of the burner heating the water, but missed mentioning to measure its initial mass. Many candidates who gained 2 to 3 marks stated to add the alkanes to the water and then to heat it. Many candidates stated to time how long it took for the water to reach 30 ^{O}C or to wait until thermometer **reached** 30 ^{O}C instead of a **rise of** 30 ^{O}C. Those that reached 5 to 6 marks had a control variable (volume of water was the most common answer here, few stated height of flame) and a valid outcome. Very few answers scored 5 or 6 marks.

Most incorrect answers did not have a logical sequence of events, and incorrectly used apparatus, using the measuring cylinder to measure the volume of alkane, for example. Finding the mass of the alkanes at the start and the end was rarely seen, as was repeating with both alkanes. Many candidates did not connect the spirit burner with the alkanes, suggesting it was used to heat the alkanes in the beaker. However, as a result, many candidates did present an incomplete practical method that gave them 4 marks. A great many candidates did not attempt the question.

Common errors included:

- Adding the alkane to the water.
- Not actually lighting the burner.
- Timing rather than weighing the sprit burner.
- Having instructions but no controls.
- Having controls but no instructions.
- Measuring the volume of the alkane not its mass.
- Heating the alkanes rather than burning the alkane to heat the water.
- Having little concept of volume.
- Add a mass, check how hot it gets, if not 30 ^{O}C, add more mass.
- Not using both alkanes.

*(iii) A student is asked to compare the amount of energy released during the combustion of two alkanes, hexane and octane.

The student is given the apparatus shown in Figure 14.

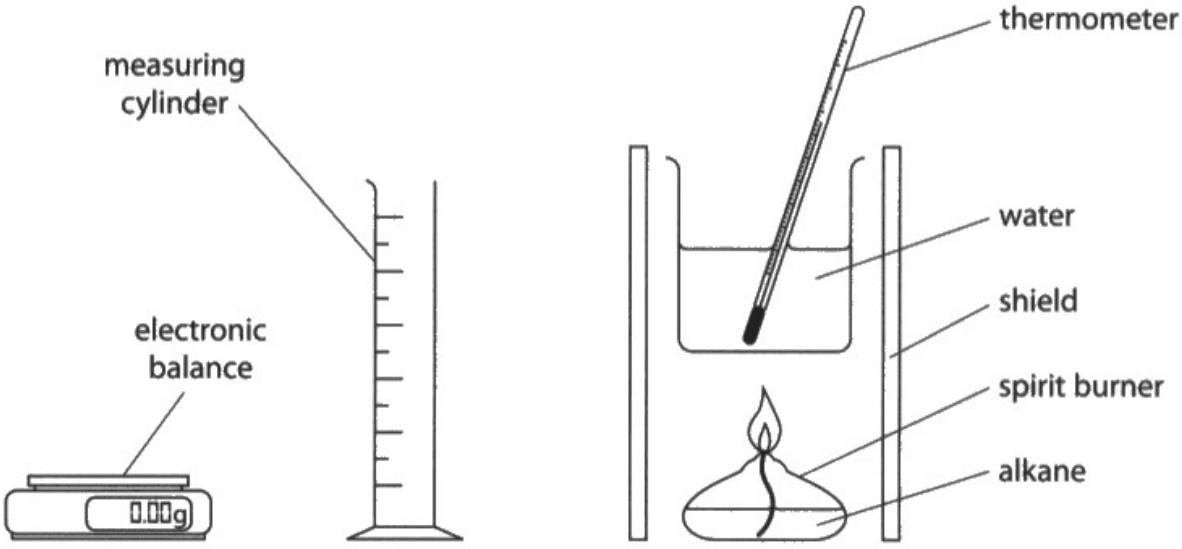
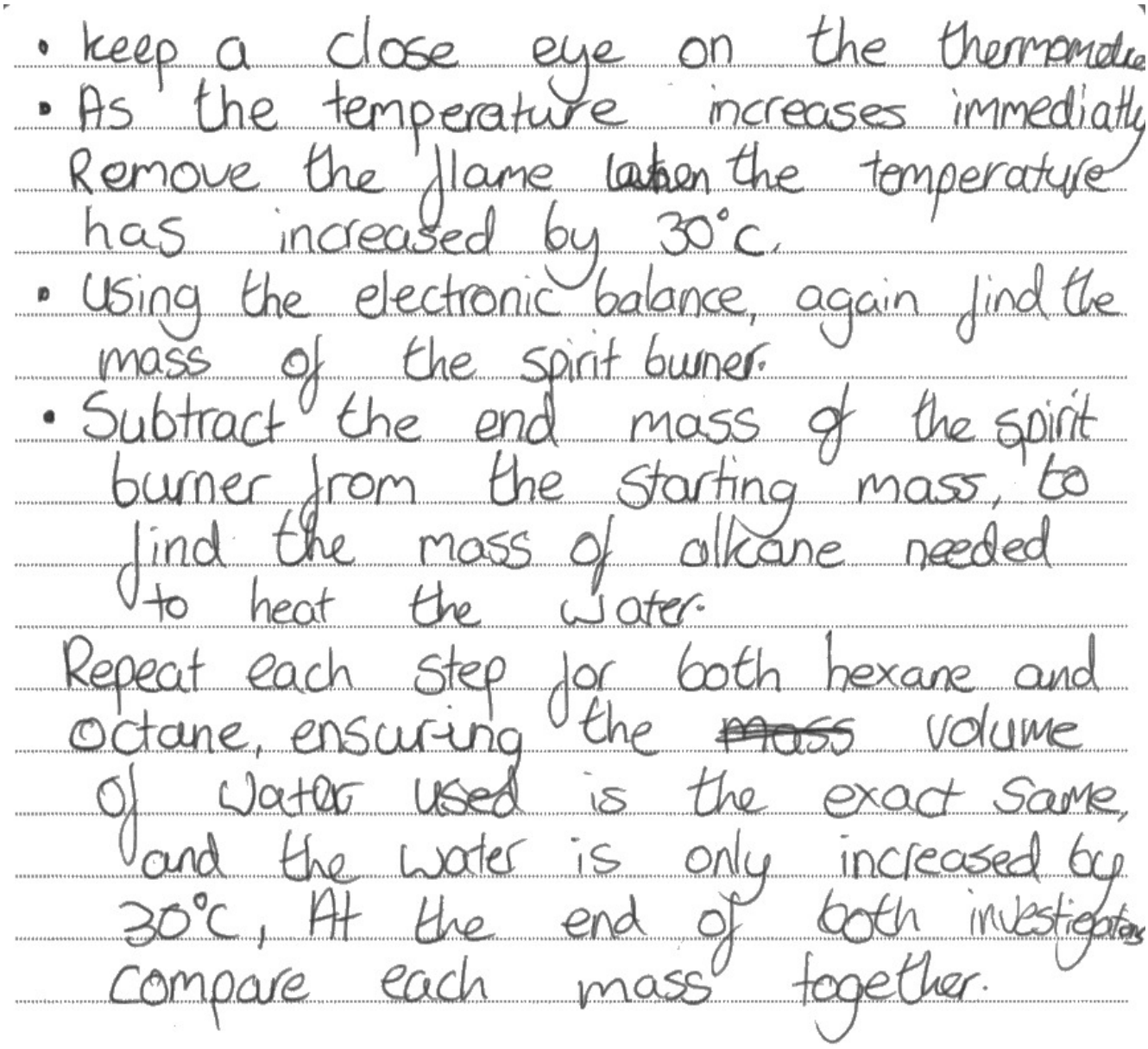


Figure 14

Using the apparatus shown, devise a plan for the student to compare the masses of hexane and octane required to raise the temperature of water by 30 °C, describing how any variables in the experiment can be controlled to make a fair comparison.

(6)

- Using a measuring cylinder poor 300ml of water into a beaker
- using the electronic balance, find the mass of the spirit burner with the alkane.
- place the spirit burner between the Sheilds.
- find the temperature of the water
- place beaker above the spirit burner
- ~~Light the spirit burner~~ place thermometer in the beaker.
- light the spirit burner



ResultsPlus
Examiner Comments

6 marks.

This answer had a full set of instructions in a logical order. Although it did not specify a particular volume of water that would be in the beaker, later on in the answer it did state that the volume of water should be the same for both alkanes. It also mentioned that the water should be heated until there was a 30 ^{o}C temperature rise.

It wasn't a perfect answer, but for 6 marks a perfect answer is not expected.

*(iii) A student is asked to compare the amount of energy released during the combustion of two alkanes, hexane and octane.

The student is given the apparatus shown in Figure 14.

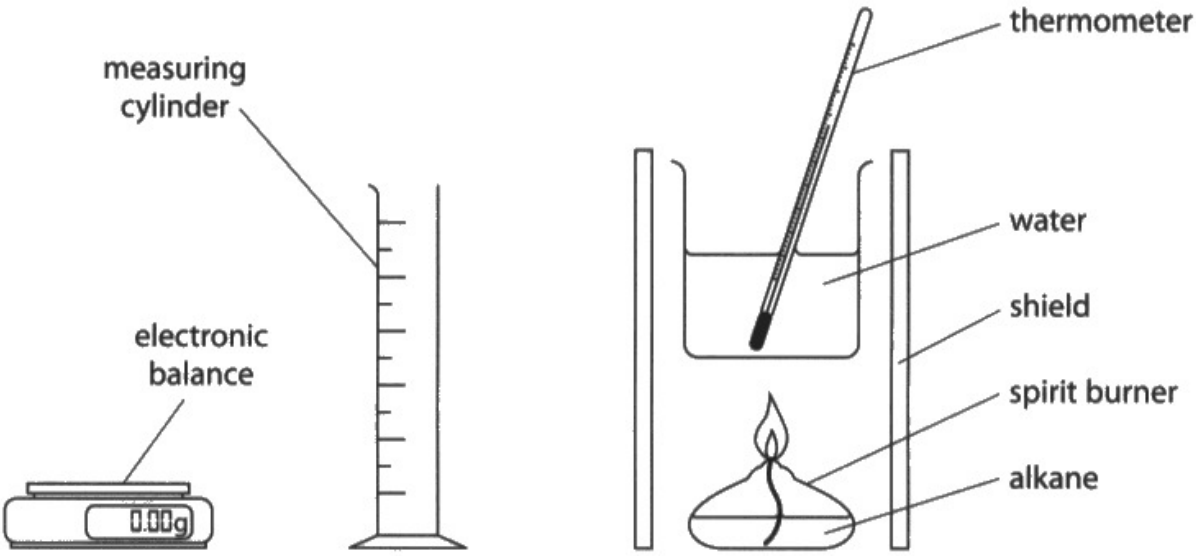


Figure 14

Using the apparatus shown, devise a plan for the student to compare the masses of hexane and octane required to raise the temperature of water by 30 °C, describing how any variables in the experiment can be controlled to make a fair comparison.

(6)

To make a fair Comparison they will need both elements and weigh them equally then use an equal amount of water with the measuring cylinder then use the Spirit burner and put an alkane in make Sure temperature is equal and that its insulated then if it gaes Colorless its an alkene if not it an alkane

ResultsPlus
Examiner Comments

2 marks.

Here a control variable was mentioned – using the same volume of water, and a relevant instruction of putting the alkane into the spirit burner.

There was clearly something to credit here, but it would not be possible to carry out the investigation by following these instructions.

*(iii) A student is asked to compare the amount of energy released during the combustion of two alkanes, hexane and octane.

The student is given the apparatus shown in Figure 14.

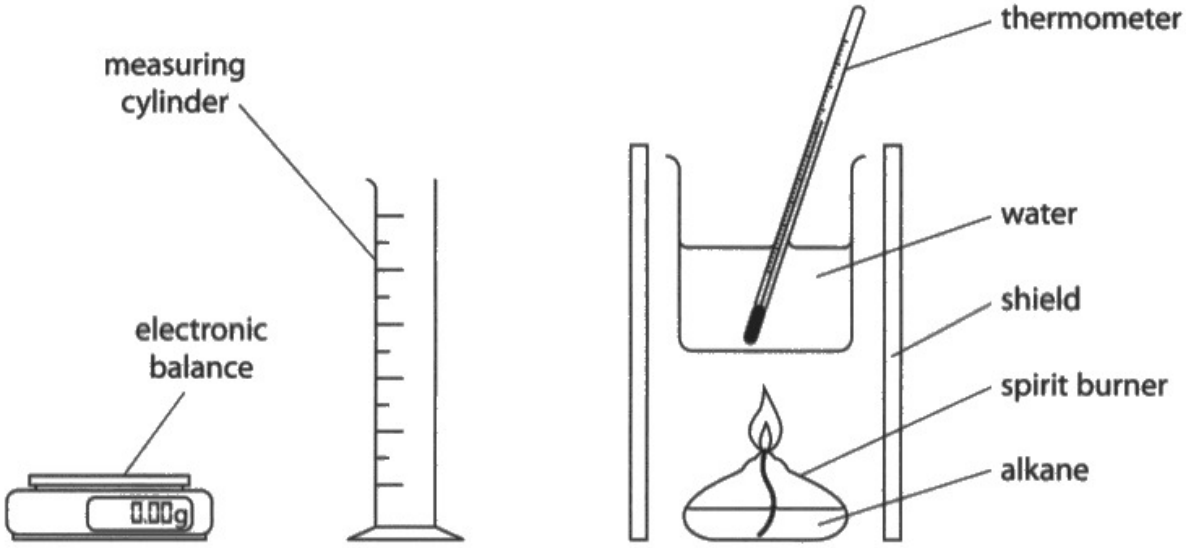


Figure 14

Using the apparatus shown, devise a plan for the student to compare the masses of hexane and octane required to raise the temperature of water by 30 °C, describing how any variables in the experiment can be controlled to make a fair comparison.

(6)

Pour some hexane into the measuring cylinder to where you need it, and then put it onto a balance. Next, pour the hexane into a spirit burner after measuring its mass and noting it down. Put the spirit burner under the water, and wait for a few minutes. After waiting, look at the thermometer and note down the reading temperature. After doing all of this, you would repeat the experimented process again, but this time with the octane. You note down all the results, and then compare them at the end; ~~and making sure~~ To make sure that

you get the most accurate results, you may want to repeat the experiment, making sure that you keep note of the time waited so it is the exact same for both alkenes.

ResultsPlus
Examiner Comments

4 marks.

There is an incomplete method here, which limited it to Level 2. There were also several errors – putting the hexane into the measuring cylinder, finding its mass then transferring it to the spirit burner, not lighting the spirit burner, not finding the final mass of the spirit burner + remaining hexane. There was no control variable mentioned.

*(iii) A student is asked to compare the amount of energy released during the combustion of two alkanes, hexane and octane.

The student is given the apparatus shown in Figure 14.

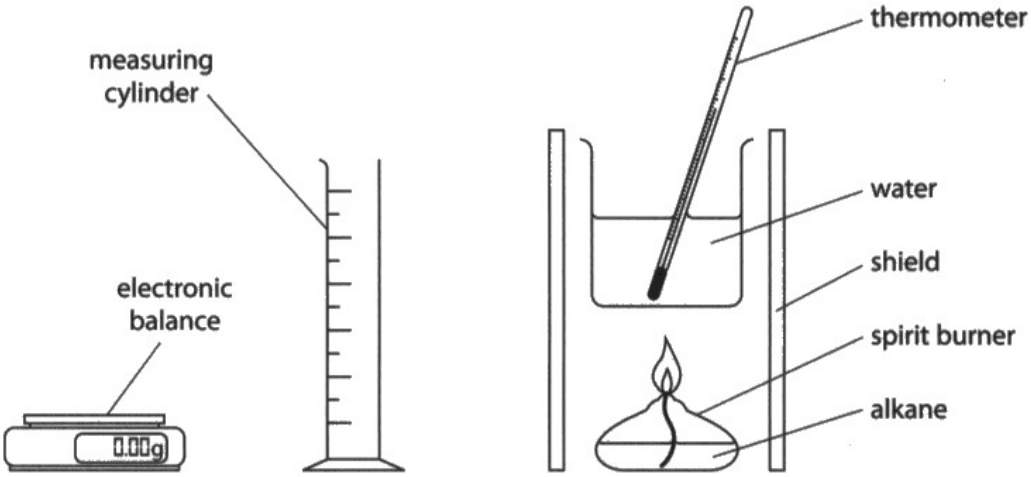


Figure 14

Using the apparatus shown, devise a plan for the student to compare the masses of hexane and octane required to raise the temperature of water by 30 °C, describing how any variables in the experiment can be controlled to make a fair comparison.

(6)

start

To make is fair that temperature should be one same for each expriement the same amount of grams of each product should be put in. the same amount of time for each expriement. Same apperatus for each expriement.

ResultsPlus
Examiner Comments

0 marks.

The answer contained no useful instructions and no control variables were mentioned. Unfortunately, this answer contained nothing that could be credited.

Question 7 (b)(i-ii)

Q7(b)(i): Most candidates followed the pattern of the alkanes and drew the correct structure of a propane molecule and the correct formula of the butane. A few errors were seen in drawing the propane structure where inadvertently the bonds were missing.

Q7(b)(ii): Unfortunately, only about 14% could give the empirical formula for hexane having been given the molecular formula.

Errors here included:

- Restating the molecular formula for hexane.
- Giving the relative mass of hexane (86).
- Giving the general formula for alkanes – C_nH_{2n+2}

(b) Figure 13 shows some information about four alkanes.

(i) Complete Figure 13 to show the structure of one molecule of propane and the formula of butane.

(2)

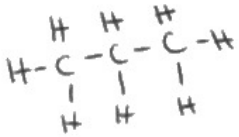
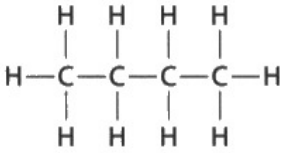
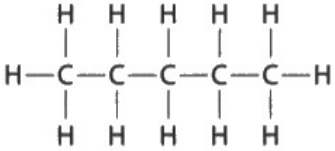
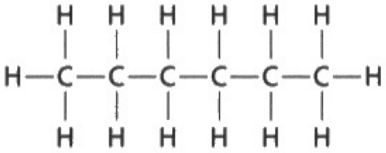
alkane	formula	structure of one molecule
propane	C_3H_8	
butane	C_4H_{10}	
pentane	C_5H_{12}	
hexane	C_6H_{14}	

Figure 13

(ii) Using the information in Figure 13, give the empirical formula of hexane.

(1)

C_3H_7

ResultsPlus
Examiner Comments

Q7(b)(i): 2 marks; Q7(b)(ii): 1 mark.

The structure of propane and the formula of butane were correct in Q7(b)(i).

The empirical formula of hexane was correct in Q7(b)(ii).

(b) Figure 13 shows some information about four alkanes.

(i) Complete Figure 13 to show the structure of one molecule of propane and the formula of butane.

(2)

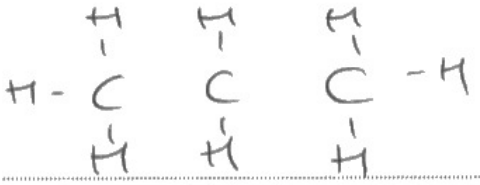
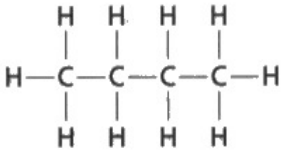
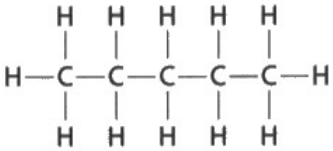
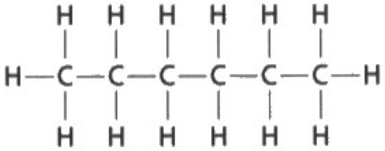
alkane	formula	structure of one molecule
propane	C_3H_8	
butane	C_4H_{10}	
pentane	C_5H_{12}	
hexane	C_6H_{14}	

Figure 13

(ii) Using the information in Figure 13, give the empirical formula of hexane.

(1)

C_6H_6

ResultsPlus
Examiner Comments

Q7(b)(i): 1 mark; Q7(b)(ii): 0 marks.

Q7(b)(i) – the structure of propane was missing the bonds between the carbon atoms, so this did not score, but the formula of butane was correct.

Q7(b)(ii) – not sure how this formula was obtained.

(b) Figure 13 shows some information about four alkanes.

(i) Complete Figure 13 to show the structure of one molecule of propane and the formula of butane.

C_nH_{2n+2} ~~C_nH_{2n+2}~~ C_4H_{10} (2)

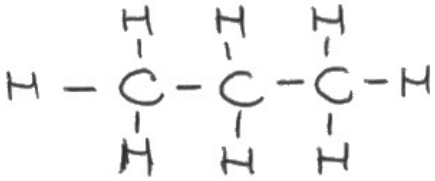
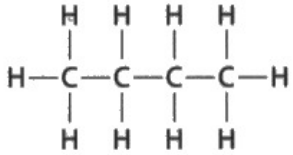
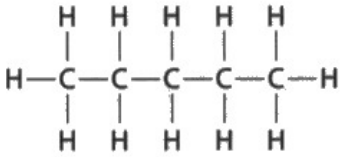
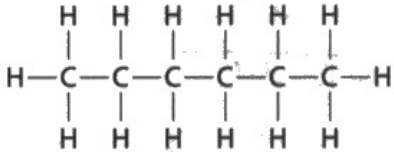
alkane	formula	structure of one molecule
propane	C_3H_8	
butane	C_4H_{10}	
pentane	C_5H_{12}	
hexane	C_6H_{14}	

Figure 13

(ii) Using the information in Figure 13, give the empirical formula of hexane.

(1)

C_nH_{2n+2}

ResultsPlus
Examiner Comments

Q7(b)(i): 2marks; Q7(b)(ii): 0 marks.

Q7(b)(i): Both the structure of propane and the formula of butane were correct – 2 marks.

Q7(b)(ii): The general formula for alkanes was frequently seen but is not the empirical formula of hexane, so 0 marks here.

Question 8 (a)

Overall, this was answered well by the candidates. Over half scored full marks and only a small percentage failed to score even one mark. Marks were awarded for accurate plotting of the points and for drawing a best fit curve through the points. Most candidates were accurate in their plotting, but it would be preferred if candidates were to plot points with 'x' rather than ' · ' as often the points are then covered with the best fit line (straight or curved) and it is then difficult to check for plotting accuracy.

In this question, the candidates were asked to draw a best fit curve. Several candidates did not complete this part, leaving just the plotted points, while others drew a series of straight lines from point to point, for this candidates were not given a mark. Other errors seen included sketching a line rather than drawing a single curved line and going over (significantly) the 100 cm^3 line at the top of the graph.

The student recorded the volume of gas every minute as shown in Figure 16.

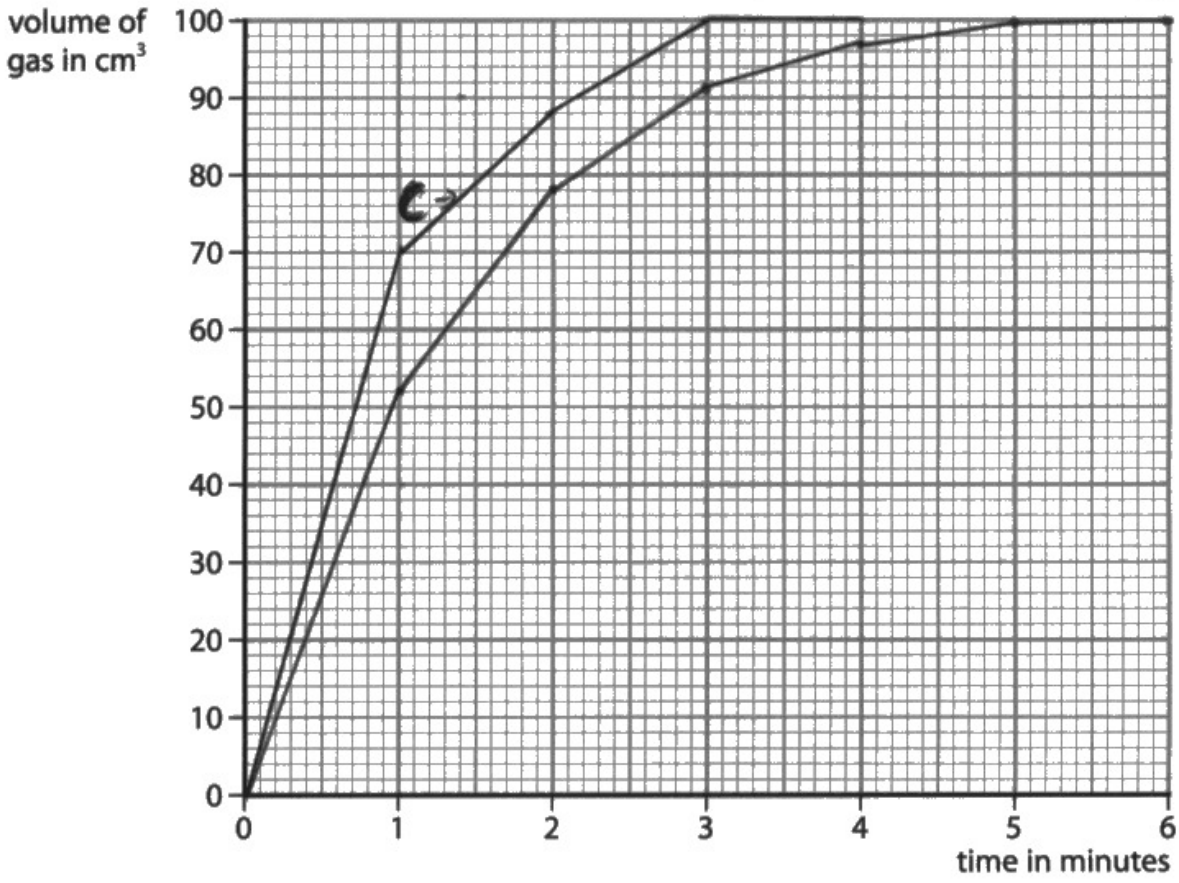
time in minutes	0	1	2	3	4	5	6
volume of gas in cm^3	0	52	78	91	97	100	100

Figure 16

(a) On the grid, plot the results shown in Figure 16.

Draw a curve of best fit.

(3)



ResultsPlus
Examiner Comments

2 marks.

The points have been plotted accurately, but it would be preferred if the points were shown as 'x' rather than as '·' as sometimes the dot is very small and difficult to check the plotting accuracy. The plotted points scored 2 marks.

'Draw a curve of best fit.' The line drawn is a series of straight lines joining the plotted points. This did not score.

ResultsPlus
Examiner Tip

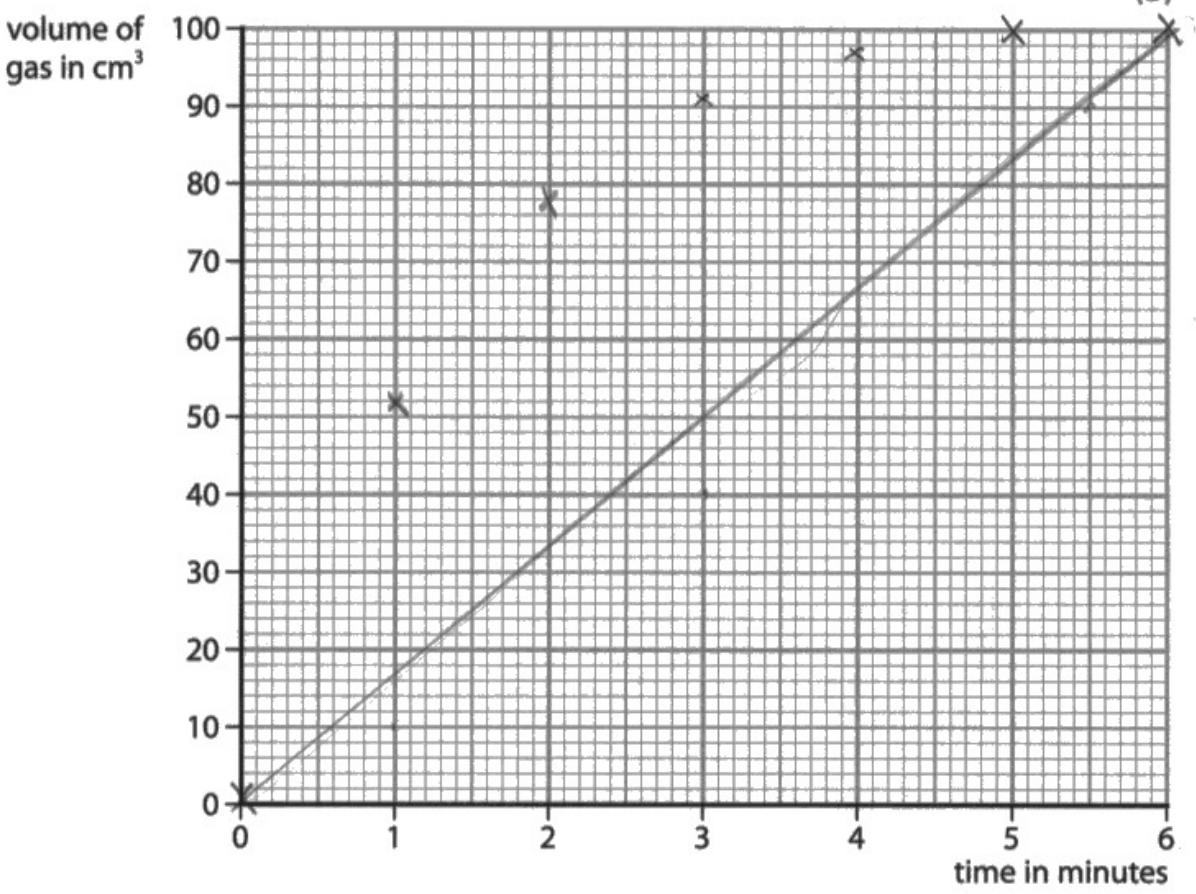
Show plotted points on graphs as 'x' rather than as '•'.

If a best fit curve is asked for, then that's what should be drawn.

(a) On the grid, plot the results shown in Figure 16.

Draw a curve of best fit.

(3)



ResultsPlus
Examiner Comments

2 marks.

The points were accurately plotted and these scored 2 marks.

There was the instruction 'Draw a curve of best fit.' This was not present, so no 3rd mark.

The straight line is probably the answer to Q8(c).

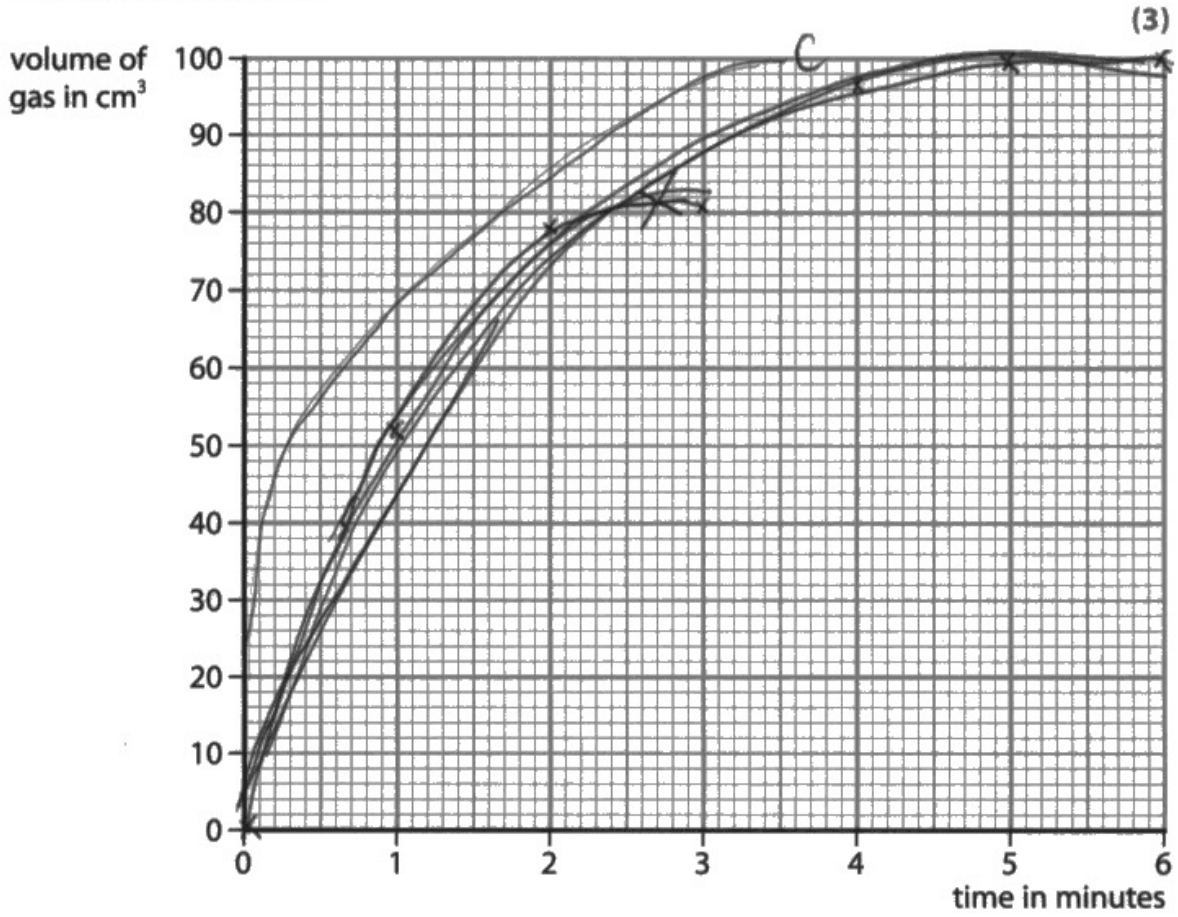
ResultsPlus
Examiner Tip

On graphs for Chemistry, a best fit line or a best curve also needs to be drawn.

(a) On the grid, plot the results shown in Figure 16.

Draw a curve of best fit.

(3)



ResultsPlus
Examiner Comments

2 marks.

The points were plotted accurately – 2 marks.

However, the best fit curve did not score. A single curved line going through all the points would have scored a mark.

Question 8 (b)(i)

Most candidates scored the mark here for the correct value of the rate reaction. Some candidates used the existing data going from 0-1 minutes, then 1-2 minutes and realised it was down by a half then from 2-3 minutes would be half again with the answer of 13 (cm^3 min^{-1}). The other method candidates used was to use the volume of gas at 2 minutes and at 3 minutes to work out the difference with the answer again at 13 (cm^3 min^{-1}). Many had the correct value of 13 in the table, but had an incorrect method or an incorrect answer on the answer line which stopped the answer in the table from being given the mark.

Errors seen included:

- Dividing the volume of gas given off in the 3rd minute by 60 – effectively calculating the rate in cm^3 s^{-1}
- Dividing the volume of gas given off at 2 minutes by 2 or dividing the volume given off at 3 minutes by 3 – effectively calculating an average rate over 2 minutes or 3 minutes.

(b) Rate of reaction can be calculated using

$$\text{rate of reaction} = \frac{\text{volume of gas produced in 1 minute}}{\text{1 minute}}$$

Figure 17 shows the rates of reaction calculated from the results of this experiment.

The rate of reaction for the time interval 2 to 3 minutes is missing.

time interval	0 to 1 minute	1 to 2 minutes	2 to 3 minutes	3 to 4 minutes	4 to 5 minutes
rate of reaction in $cm^3\ min^{-1}$	52	26	13	6	3

Figure 17

(i) Calculate the rate of reaction for the time interval 2 to 3 minutes.

(1)

52 ÷ 3 = 17.3

rate of reaction = 17.3 $cm^3\ min^{-1}$

ResultsPlus
Examiner Comments

0 marks.

The candidate had written the correct answer of 13 in the space in the table.

However, the calculation shown and answer on the answer line were incorrect. It is the answer on the answer line that counts.

The rate of reaction for the time interval 2 to 3 minutes is missing.

time interval	0 to 1 minute	1 to 2 minutes	2 to 3 minutes	3 to 4 minutes	4 to 5 minutes
rate of reaction in $cm^3 min^{-1}$	52	26	13	6	3

Figure 17

(i) Calculate the rate of reaction for the time interval 2 to 3 minutes.

(1)

26 ÷ 2 = 13

rate of reaction = 13 $cm^3 min^{-1}$

ResultsPlus
Examiner Comments

1 mark.

This was another way of arriving at the answer.

The rate of reaction for the time interval 2 to 3 minutes is missing.

time interval	0 to 1 minute	1 to 2 minutes	2 to 3 minutes	3 to 4 minutes	4 to 5 minutes
rate of reaction in $cm^3\ min^{-1}$	52	26		6	3

Figure 17

(i) Calculate the rate of reaction for the time interval 2 to 3 minutes.

(1)

91 − 76 = 15

rate of reaction = 15 $cm^3\ min^{-1}$

ResultsPlus
Examiner Comments

0 marks.

Unfortunately, the candidate has used the incorrect volume at two minutes – it should have been 78 rather than 76, which gave the incorrect answer of 15 ($cm^3\ min^{-1}$).

The rate of reaction for the time interval 2 to 3 minutes is missing.

time interval	0 to 1 minute	1 to 2 minutes	2 to 3 minutes	3 to 4 minutes	4 to 5 minutes
rate of reaction in $cm^3 min^{-1}$	52	26		6	3

78 - 52 = 26

Figure 17

(i) Calculate the rate of reaction for the time interval 2 to 3 minutes.

(1)

91 - 78 = 13 = 13
1

rate of reaction = 13 $cm^3 min^{-1}$

ResultsPlus
Examiner Comments

1 mark.

A correct calculation using the correct volume of gas at 2 and at 3 minutes.

Question 8 (b)(ii)

Most candidates had used the information in Figure 17 to state that the rate of reaction decreased. Fewer candidates linked this to reactants being used up and very few went on to relate this to the frequency of successful collisions. Despite the information given, many candidates wrote the opposite and clearly didn't understand the question. Examiners reported that scientific terminology was often poor, with some reference in the answer to the acid, but not in relation to it being used up.

Common errors included:

- Rate of reaction increased.
- Referring to the volume of gas and not rate of reaction.

(ii) State and explain what happens to the rate of reaction as the acid reacts with the marble chips in this experiment.

(3)

the rate of reaction ~~increases~~ decreases as there is a ~~larger~~ smaller surface area to react with so therefore ~~more~~ less frequent ~~collisions~~ and less successful collisions. most would have reacted when the rate of reaction was higher.

ResultsPlus
Examiner Comments

3 marks.

Only about 0.6% of the candidates scored full marks on the paper:

- Rate decreasing – 1 mark.
- Smaller surface area – 1 mark.
- 'Less frequent and less successful collisions' – 1 mark.

This was a really good answer at this level.

(ii) State and explain what happens to the rate of reaction as the acid reacts with the marble chips in this experiment.

(3)

The rate of reaction slowly decreases as the acids reacts with the marble chips. This could be because the size of the marble chips has decreased during the time interval of the experiment. It could also be because the dilute hydrochloric acid has changed.

ResultsPlus
Examiner Comments

2 marks.

- Rate decreases – 1 mark.
- Particle size of the marble chips decreases – 1 mark.

Unfortunately, there was nothing about collisions to explain the decrease in rate.

(ii) State and explain what happens to the rate of reaction as the acid reacts with the marble chips in this experiment.

(3)

rate of reaction reduces due to the reaction running out and being used up.

ResultsPlus
Examiner Comments

1 mark.

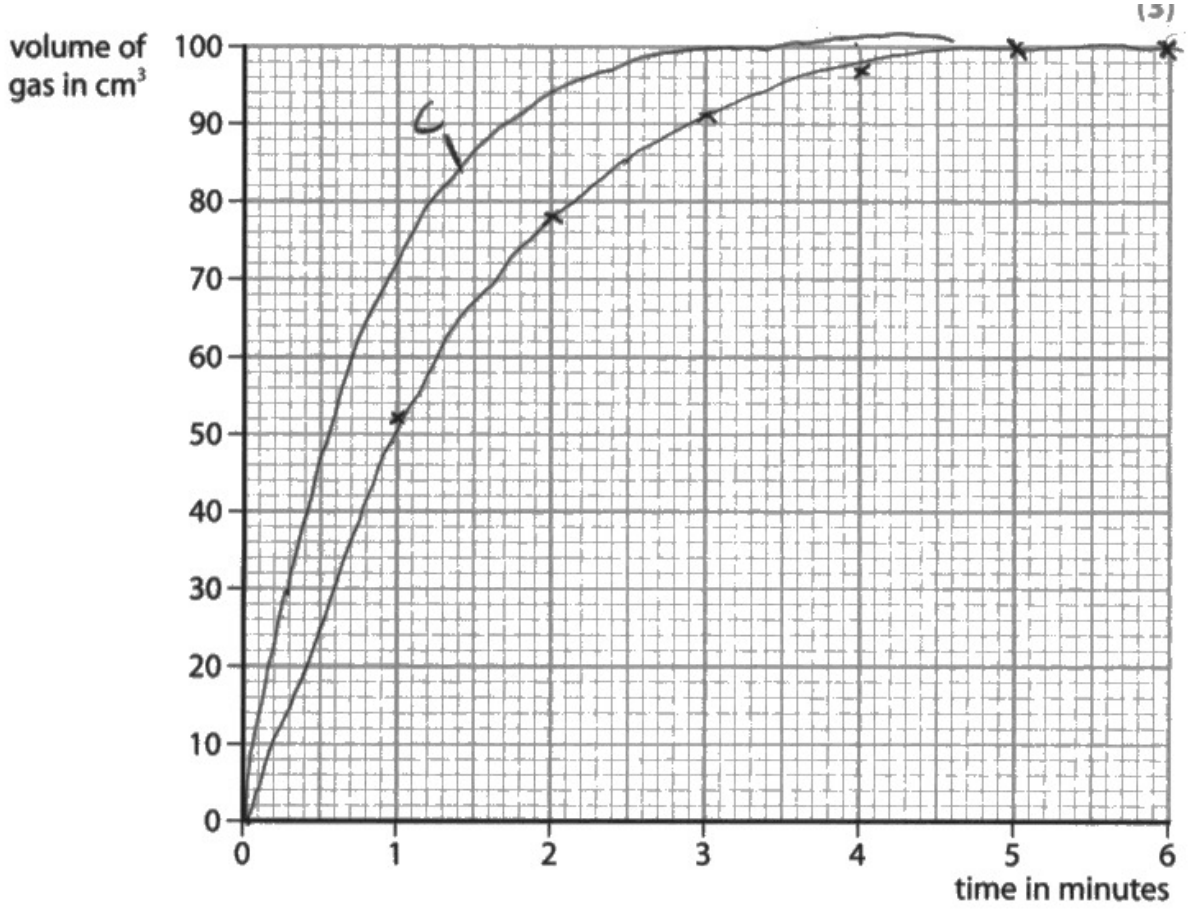
1 mark was scored for the rate reducing. Unfortunately, the candidate had used the word reaction instead of reactant which would have scored a 2nd mark.

Question 8 (c)

This question was often found to be not answered. It is difficult to judge whether it was due to not being understood by the candidates or just overlooked because it was at the bottom of the page with no answer lines. Under half the candidates answered by adding an appropriate line to the graph in part (a), with the majority of those scoring both marks.

Where candidates went wrong:

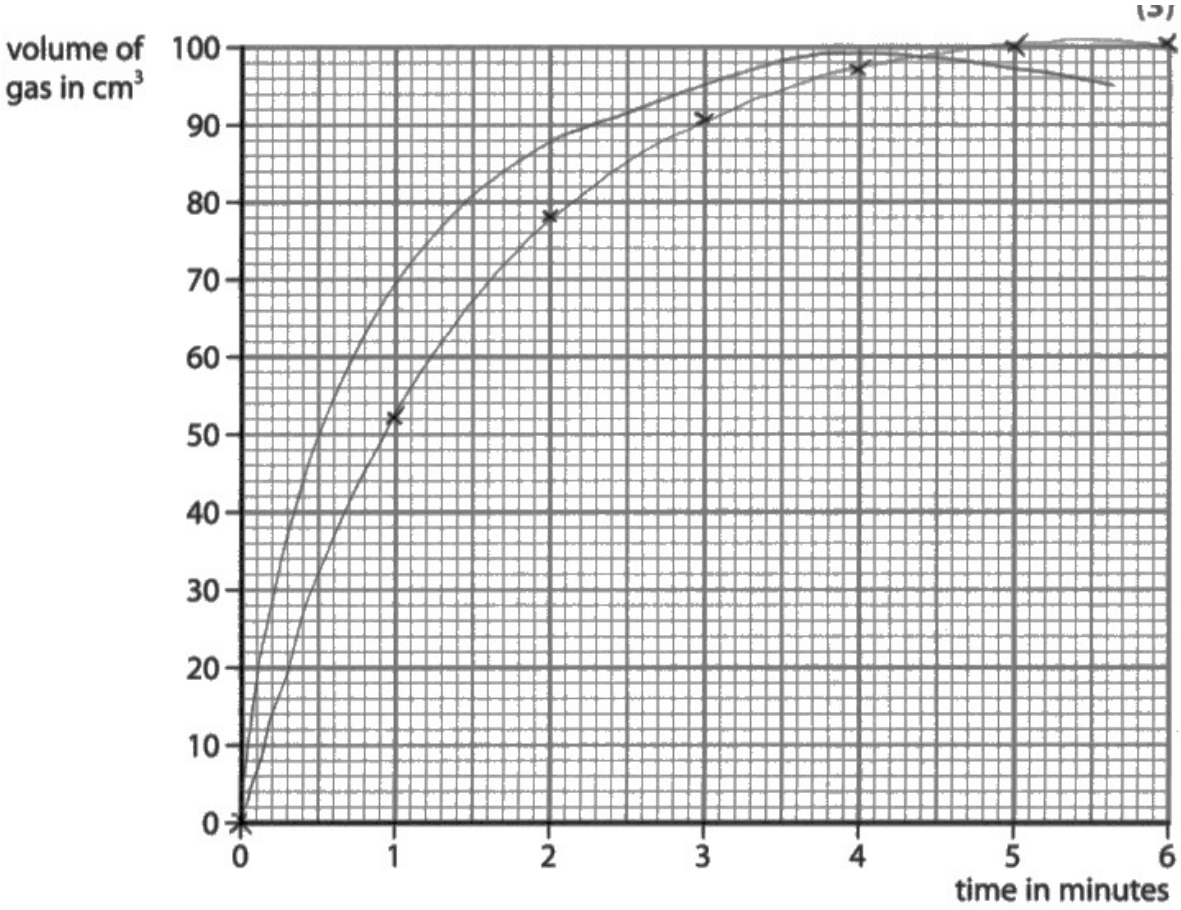
- Drawing a straight diagonal line from the origin across to the opposite corner.
- Drawing a line that went above the 100 cm^3 maximum volume.



ResultsPlus
Examiner Comments

1 mark.

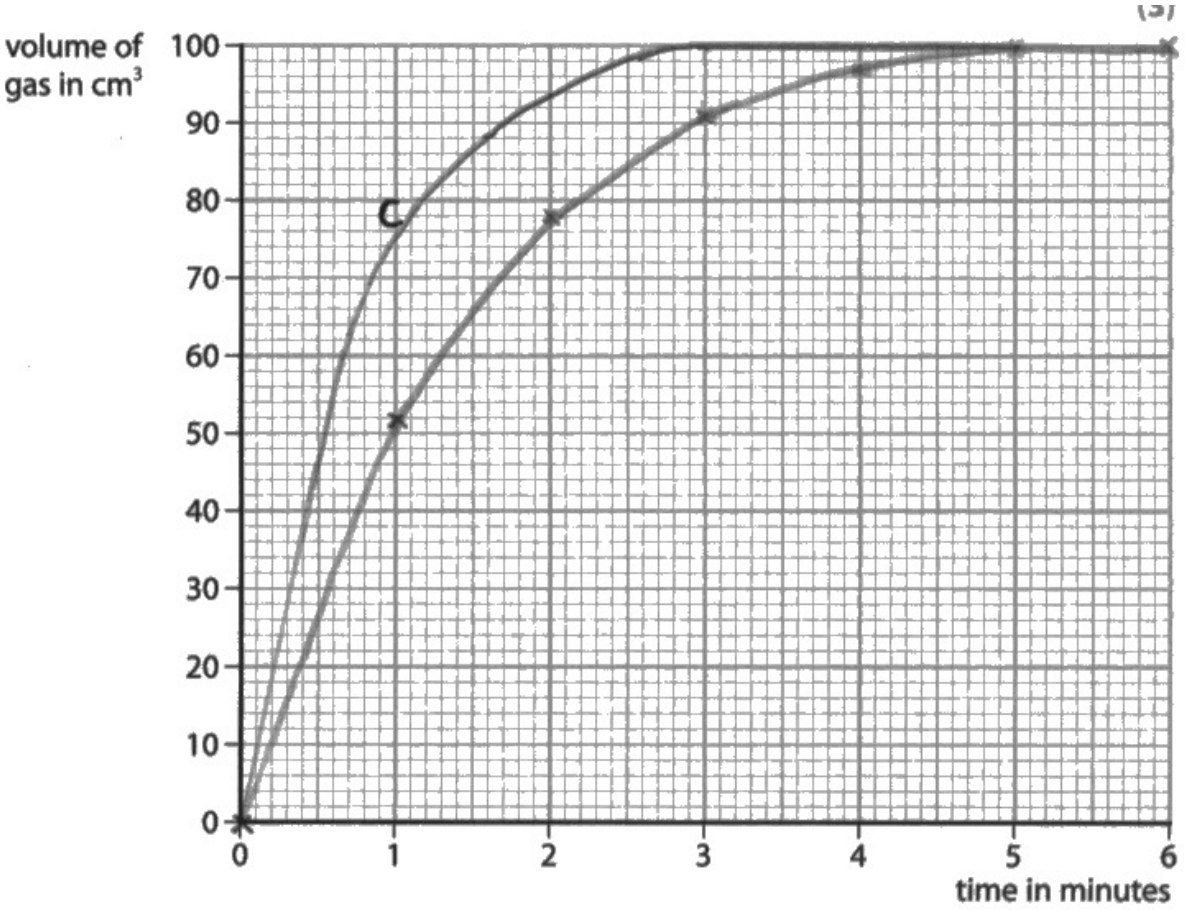
The first of the lines showing a faster rate of reaction scored the mark, but the line went too far over 100 cm^3 for the 2nd mark to be given.



ResultsPlus
Examiner Comments

1 mark.

Although not labelled, it was clear which line answered part (c). This scored 1 mark for the steep first section, but the line then dropped back down significantly after reaching 100 cm^3 and so missed the 2nd mark.



(c) The student repeated the experiment using the same volume of acid and the same mass of marble chips but used smaller marble chips.

All other conditions remained the same.

The student found that the reaction with the smaller marble chips was faster to start with but produced the same volume of gas.

Using this information, draw a line on the grid to show the results for the reaction with the smaller marble chips.

Label this line 'C'.

ResultsPlus
Examiner Comments

2 marks.

A well-executed addition to the graph in Q8(a) which showed a steeper part to start with where the reaction was faster using the smaller marble chips and then flattened at the top to show that the same volume of gas was produced.

Question 8 (e)

Most candidates chose an appropriate means of measuring time for this investigation. Of those that scored zero, most did not attempt the question.

Question 9 (a)

It was very pleasing to see that just under half the candidates could explain, on the basis of their electronic configurations, why the listed metals were placed in group 1 of the periodic table. A small number of candidates were given 1 mark for stating that they all had the same number of electrons in their outer shell or, for some, where they gave the electronic configurations of Li, Na and K and stated that 1 was the last number on each of them.

Common errors included:

- Stating the outer electron shell was full.
- Stating that all group 1 metals needed to gain 1 electron to fill the outer shell.

9 Figure 18 shows some information about some group 1 metals.

group 1 metal	atomic number	relative atomic mass
lithium	3	7
sodium	11	23
potassium	19	39
rubidium	37	85
caesium	55	133

Figure 18

(a) Explain, in terms of their electronic configurations, why these metals are placed in group 1 of the periodic table.

(2)

They all have only 1 electron in their outer shell.

ResultsPlus
Examiner Comments

2 marks.

This was the ideal answer and was seen quite often.

ResultsPlus
Examiner Tip

Remember: the number of electrons in the outer shell = the group number of the element in the periodic table

(a) Explain, in terms of their electronic configurations, why these metals are placed in group 1 of the periodic table.

(2)

They are placed in order of their electronic configuration with the Lithium having the smallest and Caesium having the highest

ResultsPlus
Examiner Comments

0 marks.

The answer looks like a description of one of the sets of numbers in Figure 18 showing the atomic number and relative atomic mass of the elements in group 1.

(a) Explain, in terms of their electronic configurations, why these metals are placed in group 1 of the periodic table.

(2)

Same amount of electrons in their outer shell.

ResultsPlus
Examiner Comments

1 mark.

This was a partially correct answer and it is true that all the elements do have the same number of electrons in their outer, but that number was missing from the answer.

Question 9 (c)

This was quite a straightforward equation to balance and to give the correct state of potassium, so it was somewhat disappointing to see that about a third of the candidates scored no marks here; mostly through not attempting the question. For those that did, the balancing was generally correct, but the state symbol was quite variable.

The most common errors seen included:

- Balancing: 2 and a 3 or 2 and a 4.
- State symbol: (aq) and (l).

(c) The word equation for the reaction of potassium with bromine is

potassium + bromine → potassium bromide

Add the missing state symbol and balance the equation for this reaction.

(2)

2 K(aq) + $Br_2(g)$ → 2 KBr(s)

ResultsPlus
Examiner Comments

1 mark.

Correct balancing of the potassium and potassium bromide – 1 mark.

Incorrect state symbol – 0 marks.

(c) The word equation for the reaction of potassium with bromine is

potassium + bromine → potassium bromide

Add the missing state symbol and balance the equation for this reaction.

(2)

2 K(s) + $Br_2(g)$ → 2 KBr(s)

ResultsPlus
Examiner Comments

1 mark.

Incorrect balancing of the potassium bromide with the potassium on the left-hand side – 0 marks.

The state symbol was correct, though – 1 mark.

Question 9 (d)

Explaining the meaning of the term 'isotopes' remains problematic for many candidates. They get confused between what remains the same and what is different between the isotopes of a particular element. Ideally the explanation should be 'atoms of the same element with different mass numbers'. However, same number of protons, but a different number of neutrons is also acceptable. Apart from getting protons and neutrons mixed up at this level, some candidates then throw in electrons into the explanation. So, often, examiners will see the same number of protons and electrons, but different numbers of neutrons and then there can be variations of the three sub atomic particles within the explanation. This is where candidates tend to lose marks. On this paper, the minority of candidates scored marks, and fewer scored both marks with a correct explanation.

(d) A sample of potassium contains three isotopes, potassium-39, potassium-40 and potassium-41.

Explain the meaning of the term **isotopes**.

(2)

~~atoms with~~ isotopes are atoms with the same number of protons but a different number of neutrons

ResultsPlus
Examiner Comments

2 marks.

This scored for the same number of protons and for a different number of neutrons.

A description like this was not that common.

(d) A sample of potassium contains three isotopes, potassium-39, potassium-40 and potassium-41.

Explain the meaning of the term **isotopes**.

(2)

The same element but with a different number of protons and the same number of neutrons.

ResultsPlus
Examiner Comments

0 marks.

Unfortunately, this candidate has the protons and neutrons the wrong way round. So, no marks overall.

Question 9 (e)

This proved to be quite an accessible 6-mark question with about 65% of candidates able to score on at least a Level 1 answer. Of these, the majority could give reasonable description of the reactions of the group 1 metals with water showing a correct trend of reactivity and making some form of prediction about the behaviour of rubidium and caesium when dropped into water. Examiners reported that 4 marks were frequently given for an appropriate answer. For a Level 3 answer, candidates needed to name at least one product of the reaction, which was rare, along with more detailed descriptions of the reactions such as sodium melting to form a ball or potassium exploding/spitting at the end of its reaction with water. It was clearly evident that most candidates had actually seen the reactions demonstrated by their teachers as well as watching the various available video clips on the reactions of rubidium and caesium with water. Unfortunately, there were some candidates who misinterpreted the question and attempted to explain the behaviour of the group 1 metals centring around the ease of loss of the outermost electron with some using the concept of inner electron shell shielding to explain the increasing ease of electron loss down the group, which was quite impressive at this level but did not answer the question.

*(e) The reactivity of the group 1 metals increases from lithium to caesium.

Often, teachers demonstrate the reactions of lithium, sodium and potassium with water.

These reactions can be used to predict the behaviour and reactions of rubidium and caesium with water.

Describe the reactions of each of the group 1 metals with water including the predicted behaviour and reactions of rubidium and caesium.

You may use word equations in your answer.

(6)

rubidium and caesium are lower down on the periodic table meaning they will have high reactivity and low melting point. as ~~their~~ they are more reactive because their outer shell ection is lost easily due to it being further away from the nucleus.

ResultsPlus
Examiner Comments

0 marks.

This response did not answer the question. There was nothing in the response about the reactivity of the group 1 metals in water or the prediction about the reaction of rubidium and caesium with water.

*(e) The reactivity of the group 1 metals increases from lithium to caesium.

Often, teachers demonstrate the reactions of lithium, sodium and potassium with water.

These reactions can be used to predict the behaviour and reactions of rubidium and caesium with water.

Describe the reactions of each of the group 1 metals with water including the predicted behaviour and reactions of rubidium and caesium.

You may use word equations in your answer.

(6)

As each metal from group 1 only has 1 electron on the outer shell, this electron can be lost easily to form a reaction. Elements with less shells mean the outer electron has a stronger force for the nucleus rather than electrons on much further shells to the nucleus as these can be lost easily due to weaker attraction to the nucleus. The more easily an electron can be lost meaning the more reactive it it (ie it has more shells).

So Rubidium and Caesium have a higher amount of electrons than Lithium, Sodium and Potassium meaning they have more shells (but only 1 electron on that outer shell) so that electron has a weaker force to the nucleus so it can be lost more easily so it is more reactive. Lithium only dissolves in water, this is a less reactive element. however further down group 1 we go, the more reactive each element gets, so we can predict Rubidium and Caesium are extremely reactive. They might cause loud pops and cause a lot of fizzing / bubbling and will occur extremely fast.

ResultsPlus
Examiner Comments

2 marks.

The candidate had written at length about why the group 1 metals were reactive and why both rubidium and caesium would be more reactive, but all this did not answer the question. The only creditable part of the answer came in the very last line with some relevant observations along with the overall trend given throughout the answer.

*(e) The reactivity of the group 1 metals increases from lithium to caesium.

Often, teachers demonstrate the reactions of lithium, sodium and potassium with water.

These reactions can be used to predict the behaviour and reactions of rubidium and caesium with water.

Describe the reactions of each of the group 1 metals with water including the predicted behaviour and reactions of rubidium and caesium.

You may use word equations in your answer.

(6)

Lithium- slight fizzing, little movement.
Sodium- fizzing, movement on water, fire sparks, melting
potassium- lots of fizzing, quick movement on water, potassium is on fire, melting
Rubidium - On fire, bubbling and fizzing, melting quickly, extremely fast movement.
Caesium- blows up

ResultsPlus
Examiner Comments

4 marks.

A somewhat minimalist answer. There were relevant observations given for lithium, sodium and potassium and this continued through to suitable predictions for rubidium and caesium. It was unfortunate the candidate had not identified the products of the reaction of one of the metals with water as 6 marks could have been given.

Question 10 (a)

This question tested the candidates' understanding and knowledge of particle size by being asked to place the 4 particles into their correct size order. Only a small number of candidates produced a correct answer. For the majority, many thought that nanoparticles were smaller than atoms or even protons, with molecules usually being given as the largest of the four.

Question 10 (b)(ii)

It was somewhat disappointing to see how many candidates did not know how to calculate the volume or surface area of a cube, since it is a mathematical skill requirement of the specification. A good number managed to complete the calculation correctly and give the answer as 1:15.

Errors mostly occurred in calculating the surface area of the cube by only calculating the area of just one face of the cube. This then led to the answer of 1:90 which scored 2 marks.

Some candidates did make an error calculating the surface area to volume ratio by inverting the fraction and this led to an answer of 0.066 which scored 2 marks.

(ii) Calculate the simplest surface area to volume ratio for the nanoparticle in Figure 19.

Show your working.

(3)

90x90 = 8100 x 6 = 48600 - Surface area

90x90 x90 = 729000 - volume

729000 ÷ 48600 = 15

surface area to volume ratio = 1 : 15

ResultsPlus
Examiner Comments

3 marks.

This was a nicely laid out answer.

The calculations clearly showed the surface area and volume of the cube correctly calculated (1 mark each).

Division of the volume by the surface gave the correct answer of 1:15 (3rd mark).

(ii) Calculate the simplest surface area to volume ratio for the nanoparticle in Figure 19.

Show your working.

(3)

90x90x90 = 729000

90x90x6 = 48600

surface area to volume ratio = 1 : 5

ResultsPlus
Examiner Comments

2 marks.

The first line shows the calculation of the volume – 729000 (nm^2) – 1 mark.

The second line shows the calculation of the surface area of the cube – 48600 (nm^2) – 1 mark.

It wasn't clear how the final answer was obtained, which was incorrect.

(ii) Calculate the simplest surface area to volume ratio for the nanoparticle in Figure 19.

Show your working.

(3)

90 + 90 + 90 = 270 nm (surface area)

90 × 90 × 90 = 729000 nm^3 (volume)

90 + 90 + 90 + 90 = 360 × 6 = 2160 nm

÷ 2160 = 337.5

surface area to volume ratio = 1 : 337.5

ResultsPlus
Examiner Comments

2 marks.

The volume was calculated correctly – 729000 nm^3 – 1 mark.

The surface area was incorrectly calculated on the next line – 0 marks.

The ratio (with the transferred error) 2160 : 729000 comes out as 1:337.5 which is the answer that's given – 1 mark.

(ii) Calculate the simplest surface area to volume ratio for the nanoparticle in Figure 19.

Show your working.

(3)

90x90 = 8100 : 729000
÷8100 ÷8100

90x90x90 = 729000 1:90

surface area to volume ratio = 1 : 90

ResultsPlus
Examiner Comments

2 marks.

The volume of the cube was calculated correctly – 729000 (nm^3) – 1 mark.

The surface area was incorrect – 8100 (nm^2) – 0 marks.

This was just the surface area of one face of the cube.

Ratio surface : volume = 8100 : 729000 = 1:90 – 1 mark.

This was quite a common error.

Question 10 (c)(i)

There was range of answers seen here showing the creativity of candidates of producing a variety of patterns involving the tetrafluoroethene molecule diagram given on the paper. However, none of these were correct. A correct repeating unit was only known and drawn by the minority of candidates for 2 marks. 1 mark was given for answers where an error had been made in drawing the repeat; these included missing off the continuation bonds or repeat units still with the double bond in place. It's not necessary for a repeat unit to show brackets (with 'n' outside) around the structure; these brackets are useful to help show the repeating chain structure of a polymer molecule.

(c) Figure 20 shows the structure of a molecule of tetrafluoroethene.

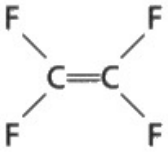
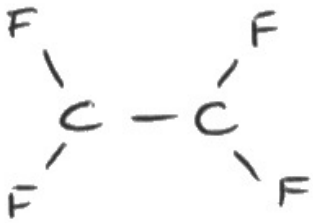


Figure 20

(i) Tetrafluoroethene can form the polymer poly(tetrafluoroethene).

Draw a diagram to show the structure of the repeating unit of this polymer.

(2)



ResultsPlus
Examiner Comments

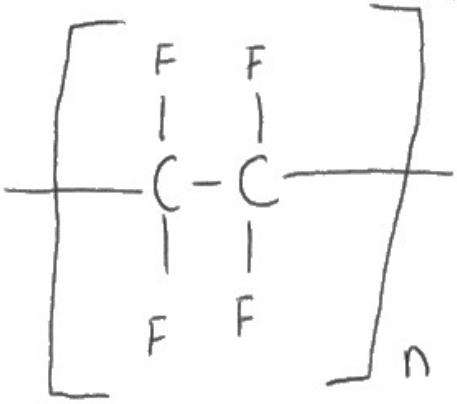
1 mark.

The double bond had been broken, but the joining bonds were missing.

(i) Tetrafluoroethene can form the polymer poly(tetrafluoroethene).

Draw a diagram to show the structure of the repeating unit of this polymer.

(2)



ResultsPlus
Examiner Comments

2 marks.

This score for both the double bond opening up and joining bonds at both ends being present.

The square brackets and 'n' were ignored.

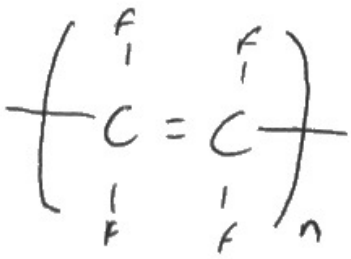
ResultsPlus
Examiner Tip

When drawing the repeat unit of a polymer, make sure the double bond has been broken and there are joining bonds on either side.

(i) Tetrafluoroethene can form the polymer poly(tetrafluoroethene).

Draw a diagram to show the structure of the repeating unit of this polymer.

(2)



ResultsPlus
Examiner Comments

1 mark.

The double bond hasn't been opened up, but there are joining bonds present.

The brackets and 'n' were ignored.

Question 10 (c)(ii)

The greater majority of the answers scoring full marks on this question identified non-stick pans as a use for PTFE, which is undoubtedly the most well-known use of this material at this level. Nevertheless, other uses such as plumbers' tape for helping to seal copper water pipe joints and to coat clothing and carpets to make them stain resistant were also seen. Most candidates who mentioned frying pans were able to link it to a property and reason, but this was less so for uses such as clothing. However, the overwhelming majority of candidates either did not attempt this question or suggested an incorrect use, such as 'insulation', 'to make chairs' where generic properties of polymers were used.

Other incorrect answers included toothpaste (probably due to the fluorine connection), plastic bags, road surfaces, cleaning, sunscreen and other polymers such as polyester and PVC.

(ii) Poly(tetrafluoroethene) is also known as Teflon™.

State one use of poly(tetrafluoroethene) and explain how one of its properties makes it suitable for that use.

(3)

use

frying pans

explanation

~~it makes~~ they're non stick, so food does not stick on the pan.

ResultsPlus
Examiner Comments

3 marks.

This was the most popular correct answer.

Frying pans (1); non-stick (1); food does not stick on the pan (1).

(ii) Poly(tetrafluoroethene) is also known as Teflon™.

State one use of poly(tetrafluoroethene) and explain how one of its properties makes it suitable for that use.

(3)

use

as a polymer (cover wires)

explanation

does not conduct electricity, and has a high m.p and b.p so can be used safely to cover up wires.

ResultsPlus
Examiner Comments

3 marks.

This was judged to be worth full marks here for:

Use – coating wires.

Reasons – does not conduct electricity and has a high melting point.

(ii) Poly(tetrafluoroethene) is also known as Teflon™.

State one use of poly(tetrafluoroethene) and explain how one of its properties makes it suitable for that use.

(3)

use

tent

explanation

its propertys are useful for a tent as it is flexable and is also waterproof so your tent wont leak

ResultsPlus
Examiner Comments

3 marks.

Another valid use/explanation that was judged to be worth full marks:

tent – waterproof, so the tent won't leak.

(ii) Poly(tetrafluoroethene) is also known as Teflon™.

State one use of poly(tetrafluoroethene) and explain how one of its properties makes it suitable for that use.

(3)

use

Being used on frying pans

explanation

Teflon is used on frying pan and cooking pots because it will protect the metal from being damaged teflon is also a very good conductor of heat which means it can be used on frying pans.

ResultsPlus
Examiner Comments

1 mark.

Only the use here scored the mark.

The explanation given didn't justify why PTFE was used to coat frying pans.

Paper Summary

Based on the performance of this year's cohort, candidates are offered the following advice:

- Read all of the question and understand what the command words such as 'describe' and 'explain' mean.
- Be familiar with the practical techniques included in the specification such as the identification of ions, exothermic changes, fermentation of sugars and how to produce a concentrated solution of ethanol, rates of reactions and the reactions of the alkali metals.
- Ensure that you revise the core practicals thoroughly and can explain what has happened each experiment.
- Know how to write word equations and simple balanced equations given a description of a reaction.
- Know the meaning of hazard symbols and other safety measures used in a laboratory.
- Learn and understand the meaning of key terms such as molecule, isotope, empirical formula.
- Practise calculations of the type seen in this examination paper and know how to round to a set number of decimal places or significant figures.
- Learn how to test for cations and anions as described in the specification.

To help with the above, centres are encouraged to make use of the past GCSE questions using Exam Wizard to target particular topics and assessment objectives.

Grade boundaries

Grade boundaries for this, and all other papers, can be found on the website on this link:

https://qualifications.pearson.com/en/support/support-topics/results-certification/grade-boundaries.html

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