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Examiners' Report
June 2024

GCSE Combined Science 1SC0 2CF

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Introduction

The examination paper was based on the 9-1 Combined Science specification that was first assessed in 2018. The paper consisted of six questions which were common with the 1CH0_2F Chemistry paper and much of questions 5 and 6 common with the 1SC0_2CH Combined Science (Chemistry) Higher tier paper. As with the other examination papers that have assessed the current specification, a wide variety of question types were used that were suitable for this level, which included multiple choice, short open response, completing sentences, interpreting graphs, drawing diagrams of apparatus, and calculations appropriate for the Foundation tier. This examination paper also assessed writing word equations and writing open-ended answers in the 6-mark question. To make the calculations more accessible, appropriate equations were given where possible to help the students complete the calculations.

This examination paper targeted grades 1 – 5 with about half the marks targeting grades 4 and 5. It was also noted that there were many blank responses on the open-ended questions as well as where practical knowledge was being tested.

Question 1 (a)(i)

About two-thirds of the candidates identified sulfur as the element in period 3 missing from the table. Of the those that did not score the mark, there were many who just gave the symbol for sulfur, but as the **name** was asked for, the symbol did not score. There were also many candidates who mixed up the terms ‘period’ and ‘group’ and gave the name of a group 3 element as the answer here.

Question 1 (a)(ii)

About two-thirds of the candidates gave the correct relative atomic mass of silicon. The most popular incorrect answer given was the atomic number of silicon rather than its relative atomic mass. Another common seen response was the relative atomic mass of sulfur, as follow on from Q01(a)(i).

Question 1 (a)(iii)

This should have been a straightforward question at this level, but only about a third of the candidates identified either the correct metal or the correct non-metal, and about a quarter of the candidates identified both correct elements. Many had the two elements the wrong way round or identified argon as the metal with the lowest melting point or sodium as the non-metal with the lowest melting point.

(iii) State which metal and which non-metal in Figure 1 have the lowest melting points.

(2)

metal with lowest melting point ....Na........

non-metal with lowest melting point ....Ar........

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Examiner Comments

2 marks

Both answers were correct. On this question we accepted names or the atomic symbols for the elements.

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Examiner Tip

If a question asks for the NAME of an element, make sure you use the name and not the atomic symbol.

Likewise, if a question asks for the ATOMIC SYMBOL of an element, make sure you use the atomic symbol and not the name.

(iii) State which metal and which non-metal in Figure 1 have the lowest melting points.

(2)

metal with lowest melting point .... aragon ....

non-metal with lowest melting point .... sodium ....

ResultsPlus
Examiner Comments

1 mark

The candidate has used the correct elements but the wrong way round. For this we gave 1 mark.

(iii) State which metal and which non-metal in Figure 1 have the lowest melting points.

(2)

metal with lowest melting point .... Aluminium ....

non-metal with lowest melting point .... Argon ....

ResultsPlus
Examiner Comments

1 mark

Aluminium was a common error here for the metal with lowest melting point.

Argon scored for the non-metal with the lowest melting point.

Question 1 (b)(i)

Most candidates identified the piece of apparatus correctly, but many identified it as a 'measuring cylinder'. Worryingly, there a sizeable number who thought it was a test tube.

(b) Alkali metals react with water to produce an alkaline solution and hydrogen gas.

A test tube of gas can be tested to see if the gas is hydrogen by putting a lighted splint at the top of the test tube.

A student suggests the following method to show that an alkaline solution and hydrogen gas are produced in this reaction.

step 1 pour 150 cm^3 water into the container shown in Figure 2

step 2 add a small piece of lithium to the water in the container shown in Figure 2

step 3 hold a lighted splint above the container

step 4 hold some damp red litmus paper above the mixture in the container

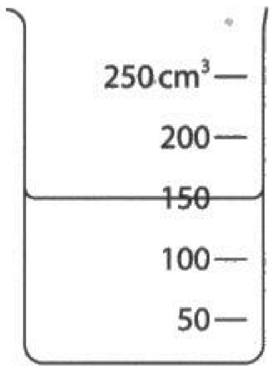

Figure 2

(i) Give the name of the container shown in Figure 2.

(1)

measuring tube

ResultsPlus
Examiner Comments

0 marks

There were many incorrect answers seen for this question. The candidate could see that there measurements on the side of the piece of apparatus.

ResultsPlus
Examiner Tip

Make sure you are familiar with the names of common pieces of equipment used in a school lab.

(b) Alkali metals react with water to produce an alkaline solution and hydrogen gas.

A test tube of gas can be tested to see if the gas is hydrogen by putting a lighted splint at the top of the test tube.

A student suggests the following method to show that an alkaline solution and hydrogen gas are produced in this reaction.

step 1 pour 150 cm^3 water into the container shown in Figure 2

step 2 add a small piece of lithium to the water in the container shown in Figure 2

step 3 hold a lighted splint above the container

step 4 hold some damp red litmus paper above the mixture in the container

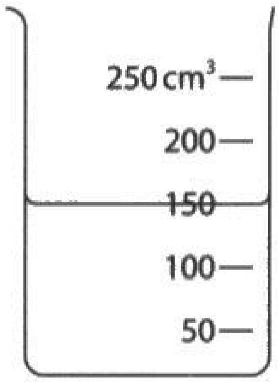

Figure 2

(i) Give the name of the container shown in Figure 2.

(1)

meaursing cylinder

ResultsPlus
Examiner Comments

0 marks

This was another common error seen by examiners.

Question 1 (b)(ii)

This question proved tricky for the candidates. It appeared that many did not know what was asked of them and these candidates merely rewrote the two steps as their answer. There were also many candidates who thought it was just asking them to describe the test for hydrogen seen as hold the lighted splint in the container for step 3 and then they described the result of that test in step 4.

Step 3: Those who dropped the lighted splint into the container did not score as the splint would have fallen into the reaction mixture. This answer appeared quite often. Of those who had some idea by holding the lighted splint in the container or near the reaction mixture did not back that procedural change with a reason.

Step 4: Dropping the litmus paper into the reaction was given by many candidates, but again, few gave a reason for this change. Most candidates opted to either hold dry red litmus paper above the reaction mixture or change to blue litmus paper or even universal indicator paper.

Only a small number of candidates gave an answer that scored 3 marks.

Question 2 (b)(i)

It was good to see that the majority gave the answer ‘thermometer’ as what was used to measure the temperature as shown in the diagram of the apparatus. However the spelling of ‘thermometer’ was quite ranging: eg termomoter, fermometer, phermometer and thermonitor were just some of the misspellings seen. The common error seen, however, was ‘thermostat’ which was not credited.

Question 2 (b)(ii)

Only a small proportion of the candidates could give the reason for using a beaker to support the insulating container. Also credited was the idea of extra insulation or prevention of heat loss. Many thought the glass beaker was there in case the insulating container broke or if it was too hot to hold.

(ii) State **one** reason for using the piece of equipment **A** in Figure 3.

(1)

~~IA~~ To keep the cup from falling over.

> **ResultsPlus**
> **Examiner Comments**
>
> 1 mark
>
> This was the ideal answer – we were looking for an answer that understood the need to keep the insulated cup upright and not to fall over.

(ii) State **one** reason for using the piece of equipment **A** in Figure 3.

(1)

To make sure the tub is secure and nothing falls out

> **ResultsPlus**
> **Examiner Comments**
>
> 1 mark
>
> The mark was given for 'to make sure the tub *(sic)* **is secure** ...'.
>
> An answer of 'nothing falls out', ie spillages, alone did not score.

(ii) State **one** reason for using the piece of equipment **A** in Figure 3.

(1)

To make sure you don't burn yourself

ResultsPlus
Examiner Comments

0 marks

Several candidates thought it was to prevent burns, which was not awarded, but if the candidate had said to prevent loss of heat, that would have scored as the glass beaker does give a little extra insulation.

Question 2 (b)(iii)

Just under half the candidates understood the use of a lid to prevent heat loss. There were many candidates who thought that the lid was there to 'keep the temperature in' or to prevent the loss of a gas from the reaction.

(iii) A student suggests putting a lid on piece of equipment **B**.

State why this would help to give a more accurate value for the temperature change.

(1)

Traps heat

ResultsPlus
Examiner Comments

1 mark

A correct answer, couldn't be more succinct.

(iii) A student suggests putting a lid on piece of equipment **B**.

State why this would help to give a more accurate value for the temperature change.

(1)

it keeps all the heat locked inside instead of it all leaving and the room temp changing it

ResultsPlus
Examiner Comments

1 mark

Although a little wordy, this was a correct answer.

(iii) A student suggests putting a lid on piece of equipment **B**.

State why this would help to give a more accurate value for the temperature change.

(1)

It would stop heat from dissipating into the atmosphere.

ResultsPlus
Examiner Comments

1 mark

This was a good answer.

Question 2 (b)(iv)

The most popular answer seen here was (+)3.0 for salt B and – 1.5 for salt C. This scored 3 marks. Only a few recognised that the most negative change of temperature showed the salt that absorbed most energy when it dissolved by ticking the appropriate answer. Most candidates, however, ticked the box that had the largest number which was (+)3. We weren't insisting on the + sign to show the increase in temperature, but the – sign was needed for the correct direction of change for salt S.

(iv) Four different salts, **P**, **Q**, **R** and **S**, are dissolved in water.

Figure 4 shows the starting temperature of the water and the final temperature of the solution after the salt dissolves.

	salt P	salt Q	salt R	salt S
starting temperature in °C	20.0	20.0	20.0	20.0
final temperature in °C	22.4	19.5	23.0	18.5
temperature change in °C	+2.4	–0.5	+3	-1.5
salt that absorbed most heat energy when it dissolved			✓	

Figure 4

Complete the table

- to show the temperature changes when salt **R** and salt **S** dissolve
- by placing a tick (✓) in the box, on the bottom row, for the salt that **absorbs** the most heat energy when it dissolves.

(4)

ResultsPlus Examiner Comments

3 marks

This scored 1 mark for +3 on salt R and 2 marks for – 1.5 for salt S. The salt that would absorb the most here would be salt S rather than salt R.

Question 2 (b)(v)

Only a few candidates could use the information about the formula of barium chloride and the chloride to give the formula of the barium ion. Many just restated the formula of barium chloride, but the most common two answers were 'Ba' and 'Ba^{+}'.

(v) One of the salts dissolved is barium chloride, $BaCl_2$.

Barium chloride contains the chloride ion, Cl^-.

Give the **formula** of the barium ion in barium chloride.

(1)

$BaCl_2$

(Total for Question 2 = 9 marks)

ResultsPlus
Examiner Comments

0 marks

Many candidates just repeated the formula of barium chloride as their answer.

(v) One of the salts dissolved is barium chloride, $BaCl_2$.

Barium chloride contains the chloride ion, Cl^-.

Give the **formula** of the barium ion in barium chloride.

(1)

Ba^2

(Total for Question 2 = 9 marks)

ResultsPlus
Examiner Comments

0 marks

Almost, but not quite there.

(v) One of the salts dissolved is barium chloride, $BaCl_2$.

Barium chloride contains the chloride ion, Cl^-.

Give the **formula** of the barium ion in barium chloride.

(1)

Ba^{+2}

(Total for Question 2 = 9 marks)

ResultsPlus Examiner Comments

1 mark

A correct answer – most candidates found it difficult to work out the formula for the barium ion.

Question 3 (a)(i)

Over three-quarters of the candidates could identify the number of carbon atoms in a molecule of compound X. However, several candidates just wrote the molecular formula which seemed to be the most common error.

Question 3 (a)(ii)

Most candidates identified as the other element present in molecules of compound X. Errors, here, included the answers of ‘hydrocarbon’ and ‘hydron’.

Question 3 (b)

This question involved the candidate completing three sentences. The standard of answers was quite variable. Only a relatively small number of candidates gave three correct answers. Many candidates gave the correct answer to the first incomplete sentence, but a large number gave bitumen as the fraction with the smallest molecules – presumably they saw that bitumen was fraction collected from the bottom of the fractionating column. The second question yielded a wide variety of answers; some the correct answer, but others gave the incorrect answer 'lower' and a substantial number of candidates wrote the name of one of the other fractions, usually diesel oil. The third question was often completed with answers such as 'formed', 'produced', 'combusted' etc, but some did identify a product of combustion as answer. This question required the candidates to think a little more as normally sentence completion question have been accompanied by a box containing a range of words that could be used as their answers.

(b) Figure 6 shows where fractions are produced in the fractional distillation of crude oil.

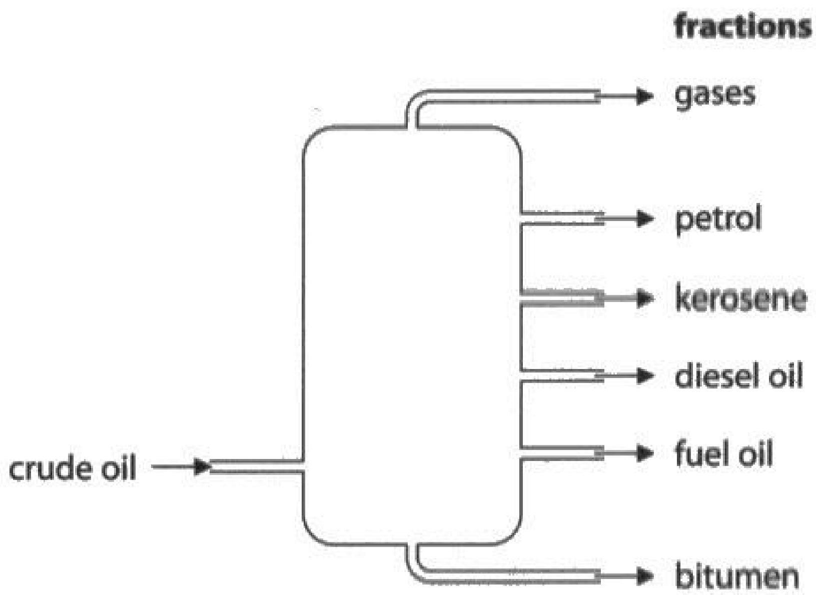

Figure 6

Complete the sentences about fractions obtained from crude oil.

(3)

The fraction with the smallest molecules is called ......gases...... .

Compared to petrol, the boiling point of kerosene is ......300°C...... .

When petrol burns, one product is ......Fuel...... .

ResultsPlus
Examiner Comments

1 mark

This answer just scores for the 1st line – gases.

(b) Figure 6 shows where fractions are produced in the fractional distillation of crude oil.

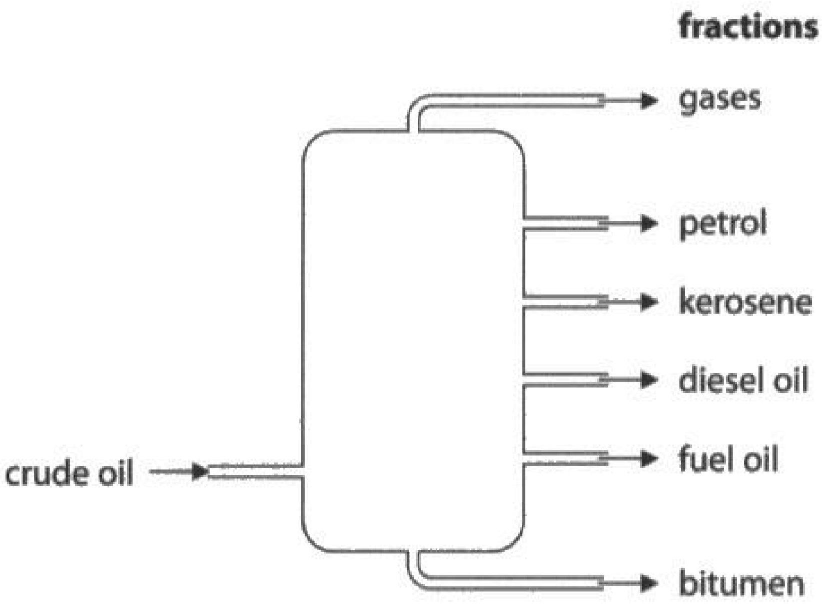

Figure 6

Complete the sentences about fractions obtained from crude oil.

(3)

The fraction with the smallest molecules is called ......gases...... .

Compared to petrol, the boiling point of kerosene is ......higher...... .

When petrol burns, one product is ......carbon dioxide...... .

ResultsPlus
Examiner Comments

3 marks

This answer scores for completing all three lines.

(b) Figure 6 shows where fractions are produced in the fractional distillation of crude oil.

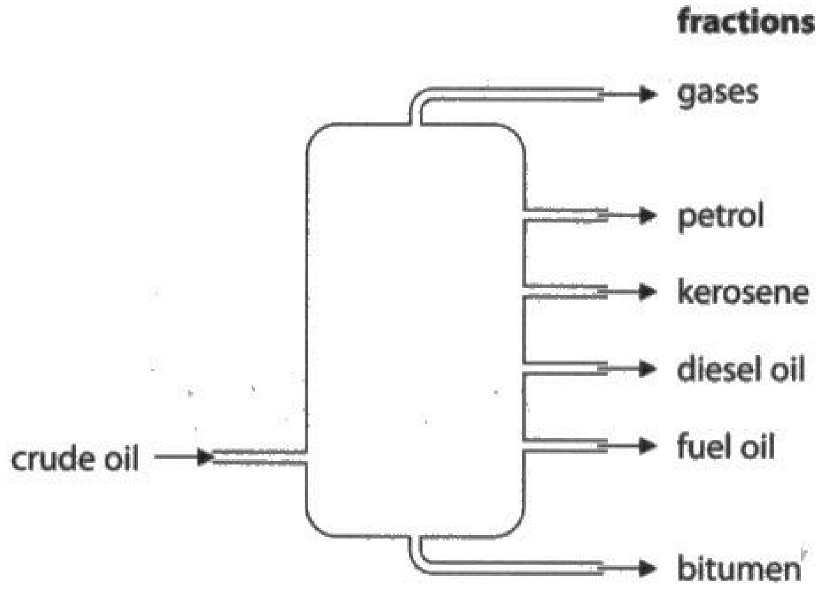

Figure 6

Complete the sentences about fractions obtained from crude oil.

(3)

The fraction with the smallest molecules is called ..... bitumen ..... .

Compared to petrol, the boiling point of kerosene is ..... Higher ..... .

When petrol burns, one product is ..... produced ..... .

ResultsPlus
Examiner Comments

1 mark

This answer scored just for the second line. Many candidates thought that the fraction collected at the bottom of the fractionating tower had the smallest molecules.

Question 3 (c)

This proved to be a quite a tricky question. There were a significant number who, from the answers they gave, didn't understand what was going on. Also here, it was clear that several candidates did not read the whole of the information given before the command line. Some candidates merely copied out the two bullet points. It was also surprising to see that many candidates thought that pH12 was acidic. When answering questions such 'Explain how the pH changes …', candidates do need to say in their whether the pH increases of the pH decreases and not repeat 'The pH changes because …'. Judging from the answers, many candidates focussed on the burning of the fossil fuels or the dissolution of the sulfur dioxide in water rather than what happened with the sulfur dioxide solution was added to sodium hydroxide solution, so when the candidate wrote that 'the temperature rose because of the reaction', it wasn't clear which reaction they were writing about. This was not well answered question with about three-quarters of the candidates scoring 0 marks and just a few candidates scoring all three marks.

(c) When some impure hydrocarbon fuels are burned, sulfur dioxide is one of the products.

Some sulfur dioxide gas is dissolved in water to form solution W.

When solution W is added to sodium hydroxide solution of pH 12

- **the pH changes**
- **the temperature increases.**

Explain how the pH changes and why the temperature increases.

(3)

The temperature increases due to a chemical reaction between sulfur dioxide and wate. Ph changes as it is no longer 12.

(Total for Question 3 = 10 marks)

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0 marks

Many candidates seemed to think that the points about the change of pH and temperature increase referred to the sulphur dioxide dissolving in water and had completely misread the question.

(c) When some impure hydrocarbon fuels are burned, sulfur dioxide is one of the products.

Some sulfur dioxide gas is dissolved in water to form solution **W**.

When solution **W** is added to sodium hydroxide solution of pH 12

- the pH changes
- the temperature increases.

Explain how the pH changes and why the temperature increases.

(3)

The pH will decrease and become less of an alkali. The temperature will increase due to the particles in the solution colliding together more ~~[illegible]~~ frequently

(Total for Question 3 = 10 marks)

ResultsPlus
Examiner Comments

1 mark

Just 1 mark scored here for the pH will decrease.

(c) When some impure hydrocarbon fuels are burned, sulfur dioxide is one of the products.

Some sulfur dioxide gas is dissolved in water to form solution **W**.

When solution **W** is added to sodium hydroxide solution of pH 12

- the pH changes
- the temperature increases.

Explain how the pH changes and why the temperature increases.

(3)

Because the sodiam hydroxide solution neutrilises solution W. It decreases the PH because they even each other out. The temparature increases because of the reaction. - It produces heat.

(Total for Question 3 = 10 marks)

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3 marks

A rare example of an answer that scored 3 marks:

- sodium hydroxide neutralising solution W
- decreases pH
- the reaction producs heat

Question 4 (a)

The actual colour of bromine (reddish-brown) was known by a small number of candidates. Unfortunately, many gave ‘brown’ as their answer which is not correct. Bromine water is brown or yellow-brown depending on its concentration, the element bromine is reddish-brown in colour. Generally, the physical state of bromine seemed to be known by most of the candidates.

4 This question is about bromine.

(a) Give the colour and physical state of bromine at room temperature.

(2)

colour ....brown....

physical state ....liquid....

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Examiner Comments

1 mark

Thi scored just for 'liquid'. Brown is not the accepted colour of bromine.

4 This question is about bromine.

(a) Give the colour and physical state of bromine at room temperature.

(2)

colour ....red-brown....

physical state ....liquid....

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Examiner Comments

2 marks

Red-brown is an accepted description of the colour of bromine.

4 This question is about bromine.

(a) Give the colour and physical state of bromine at room temperature.

(2)

colour ...... redish brown. ......

physical state ...... liquid. ......

ResultsPlus
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2 marks

Reddish-brown is an accepted colour of bromine.

Question 4 (b)(i)

This question was answered well with most candidates able to construct a word equation given the relevant information. As expected, the main errors seen were 'bromide' in place of 'bromine' and 'hydrogen bromine' in place of 'hydrogen bromide'.

(b) Bromine reacts with hydrogen to form hydrogen bromide.

(i) Write the word equation for this reaction.

(2)

Br + H → HBr^2

ResultsPlus Examiner Comments

0 marks

The question asked for a word equation. Attempting to write a balanced equation is more difficult and it would have to be fully correct and balanced for the 2 marks.

(b) Bromine reacts with hydrogen to form hydrogen bromide.

(i) Write the word equation for this reaction.

(2)

Bromine + Hydrogen → Hydrogen bromine

ResultsPlus Examiner Comments

1 mark

This scored for the correct names of the reactants, but not for the product.

(b) Bromine reacts with hydrogen to form hydrogen bromide.

(i) Write the word equation for this reaction.

(2)

Bromine + hydrogen → hydrogen bromide

ResultsPlus
Examiner Comments

2 marks

A correct word equation.

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Examiner Tip

Practise writing word equations for reactions – your teacher should be able to provide you with many examples.

Question 4 (b)(ii)

Only a minority of the candidates could correctly identify the type of reaction taking place between the solution of hydrogen bromide and an alkali. The common errors here included 'chemical reaction', 'displacement', 'reduction' and a variety of separation techniques such as distillation.

(ii) Hydrogen bromide dissolves in water to form a solution.

This solution of hydrogen bromide reacts with alkalis.

State the type of reaction that occurs when a solution of hydrogen bromide reacts with an alkali.

(1)

displacement reaction

ResultsPlus
Examiner Comments

0 marks

Displacement reaction was one of the common errors seen as an answer.

(ii) Hydrogen bromide dissolves in water to form a solution.

This solution of hydrogen bromide reacts with alkalis.

State the type of reaction that occurs when a solution of hydrogen bromide reacts with an alkali.

(1)

Neutralisation

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1 mark

A correct answer

Question 4 (c)

Candidates were given information about the relative speed of reaction between three halogen elements and hot iron wool, with the halogens being list as shown in group 7 of the periodic table. About half of the candidates were able to give and acceptable answer about the relative speed of the reaction between fluorine and hot iron wool. Surprisingly, the most common error seen was just to repeat the relative speed of reaction of chlorine with the hot iron wool, ie 'reacts very quickly' which did not follow the trend. The other common error seen was, surprisingly, that fluorine would react very slowly.

(c) Bromine and the other halogens react with hot iron wool.

Figure 7 shows the relative speed of some of these reactions.

halogen	relative speed of reaction
fluorine	
chlorine	reacts very quickly
bromine	reacts quickly
iodine	reacts slowly

Figure 7

Fluorine also reacts with hot iron wool.

Use Figure 7 to predict the relative speed of this reaction.

(1)

Fluorine will have an even quicker reaction then chlorine.

ResultsPlus
Examiner Comments

1 mark

The candidate had understood the trend in reactivity.

(c) Bromine and the other halogens react with hot iron wool.

Figure 7 shows the relative speed of some of these reactions.

halogen	relative speed of reaction
fluorine	
chlorine	reacts very quickly
bromine	reacts quickly
iodine	reacts slowly

Figure 7

Fluorine also reacts with hot iron wool.

Use Figure 7 to predict the relative speed of this reaction.

(1)

reacts very slowly.

ResultsPlus Examiner Comments

0 marks,

Despite the other descriptions showing a trend, a significant number of candidates came up with this answer.

(c) Bromine and the other halogens react with hot iron wool.

Figure 7 shows the relative speed of some of these reactions.

halogen	relative speed of reaction
fluorine	
chlorine	reacts very quickly
bromine	reacts quickly
iodine	reacts slowly

Figure 7

Fluorine also reacts with hot iron wool.

Use Figure 7 to predict the relative speed of this reaction.

(1)

Reacts instantly

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1 mark

An acceptable answer.

Question 4 (d)

It was pleasing to see that a good number of candidates carried out a correct calculation to determine the masses of potassium and bromide present in potassium bromide. It was disappointing to see so many candidates not use a calculator and use a method of 'chunking' to do the calculation; sometimes errors crept in here and they ended up with an incorrect mass of potassium. Other errors included where candidates tried using the relative atomic masses of the elements in their calculations. Candidates do need to be aware that if relative atomic masses need to be used in a calculation, they WILL be given in that part of the question. A small number of candidates had carried out the calculation correctly but had put the masses of the two elements on the wrong answer lines; in these situations, 2 marks were awarded.

(d) Potassium bromide contains 32.8% potassium by mass.

Calculate the mass of potassium and the mass of bromine in 500 g potassium bromide.

5 = 1%
0.5 = 0.1%

(3)

~~32.8 / 500 × 100~~

Pot = 32.8%   164 = 32.8 of 500g

bro = 67.2%   336 = 67.2% of 500g

mass of potassium = 164 g

mass of bromine = 336 g

(Total for Question 4 = 9 marks)

ResultsPlus Examiner Comments

3 marks

Both answers were correct. Here the candidates had worked out the percentage of bomine in the compound before calculating its mass.

(d) Potassium bromide contains 32.8% potassium by mass.

Calculate the mass of potassium and the mass of bromine in 500 g potassium bromide.

(3)

Potassium:

500 - 32.8 = 467.2

$\frac{467.2}{500} \times 100 = 93.44$ g

Bromine:

500 - 93.44 = 406.56

mass of potassium = 93.44 g

mass of bromine = 406.56 g

(Total for Question 4 = 9 marks)

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1 mark

The calculation to determine the mass of potassium was incorrect. However, 1 mark was given for finding the mass of bromine based on that error: 500 – 93.44 = 406.56 (g).

(d) Potassium bromide contains 32.8% potassium by mass.

Calculate the mass of potassium and the mass of bromine in 500 g potassium bromide.

(3)

potassium	~~Hydrogen~~ Bromide
32.8 / 39	16.4 / 80
= 32.8 ÷ 39 → 0.84	= 16.4 ÷ 80 → 0.205
= 4.097 ↩ 0.84 / 0.205	

500 → 32.8
= 156 × 10 + 0.4
= 160.4 / 100 = 16.4

mass of potassium = 4.097 g

mass of bromine = 0.205 g

(Total for Question 4 = 9 marks)

ResultsPlus
Examiner Comments

0 marks

This answer was seen frequently where the candidate had erroneously divided the percentage of potassium by its relative atomic mass; for bromine had then halved the potassium's percentage and then divided that by the relative atomic mass of bromine. There was nothing to credit here.

ResultsPlus
Examiner Tip

In a calculation, if you need to use relative masses of any element, they will be given in the question.

(d) Potassium bromide contains 32.8% potassium by mass.

Calculate the mass of potassium and the mass of bromine in 500 g potassium bromide.

(3)

potassium bromide = 32.8% potassium

32.8% = 16400g (32.8 x 500)

67.2% = 33600g (67.2 x 500)

mass of potassium = 16,400 g

mass of bromine = 33,600 g

(Total for Question 4 = 9 marks)

ResultsPlus Examiner Comments

0 marks

Unfortunately, the candidate had not divided by 100 when using the percentage figures. This was a common mistake.

Question 5 (a)

On the whole, there were relatively few good drawings of suitable apparatus to collect and measure the gas given off in the reaction between marble chips and dilute hydrochloric acid. This reaction is a core practical, so it would be expected that all candidates had met the apparatus. Of those that produced a valid diagram, most opted to collect and measure the gas in a gas syringe; fewer went for the more demanding diagram of collecting the gas in a water-filled up-ended measuring cylinder in a container of water. However, most candidates did not attempt this question.

5 A student investigates the reaction between marble chips and dilute hydrochloric acid.

The student measures the total volume of carbon dioxide gas produced each minute, for 10 minutes.

(a) Figure 8 shows part of the apparatus used in the experiment.

Complete Figure 8 by drawing and labelling apparatus that could be used to collect and measure the volume of the carbon dioxide gas.

(2)

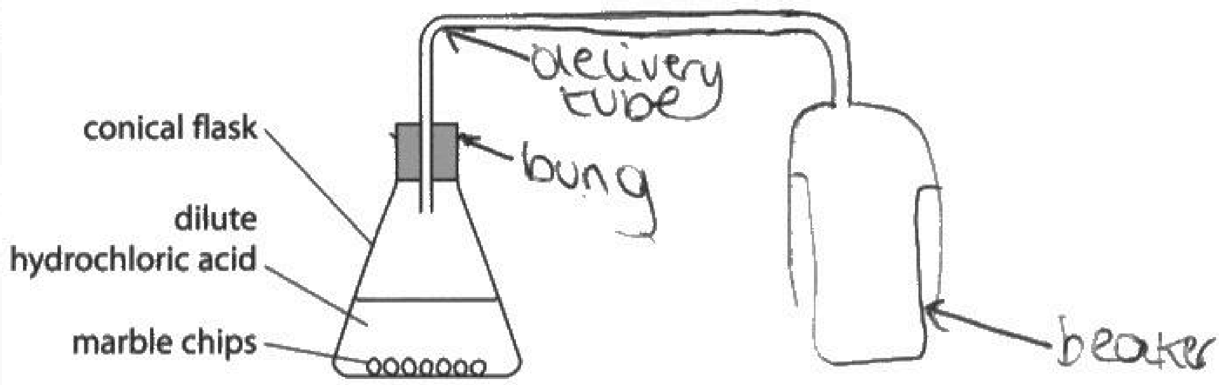

Figure 8

ResultsPlus Examiner Comments

0 marks

A sealed system like this would not collect the gas and could not be used to meaure its volume.

ResultsPlus
Examiner Tip

Practise drawing and labelling equipment that is used in the core practicals.

Remember not to include stands and clamps.

5 A student investigates the reaction between marble chips and dilute hydrochloric acid.

The student measures the total volume of carbon dioxide gas produced each minute, for 10 minutes.

(a) Figure 8 shows part of the apparatus used in the experiment.

Complete Figure 8 by drawing and labelling apparatus that could be used to collect and measure the volume of the carbon dioxide gas.

(2)

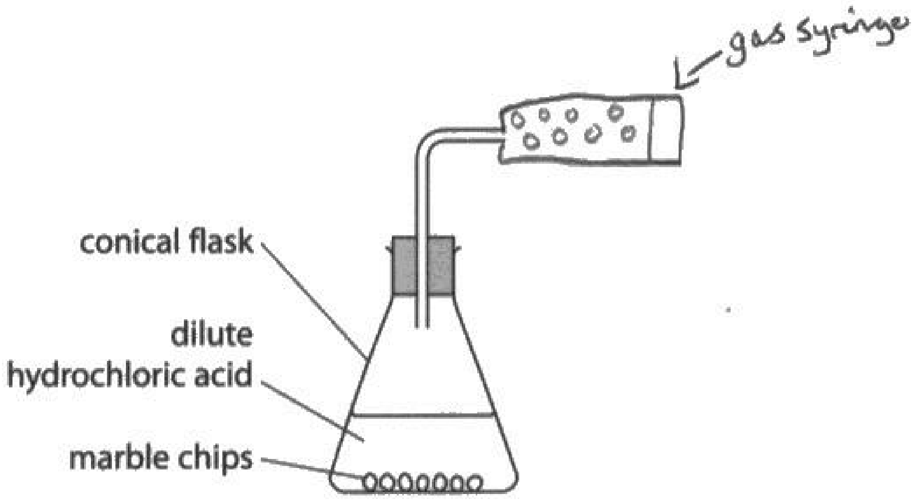

Figure 8

ResultsPlus
Examiner Comments

1 mark

The drawing wasn't recognisable as a gas gas syringe, but this scored for the label.

5 A student investigates the reaction between marble chips and dilute hydrochloric acid.

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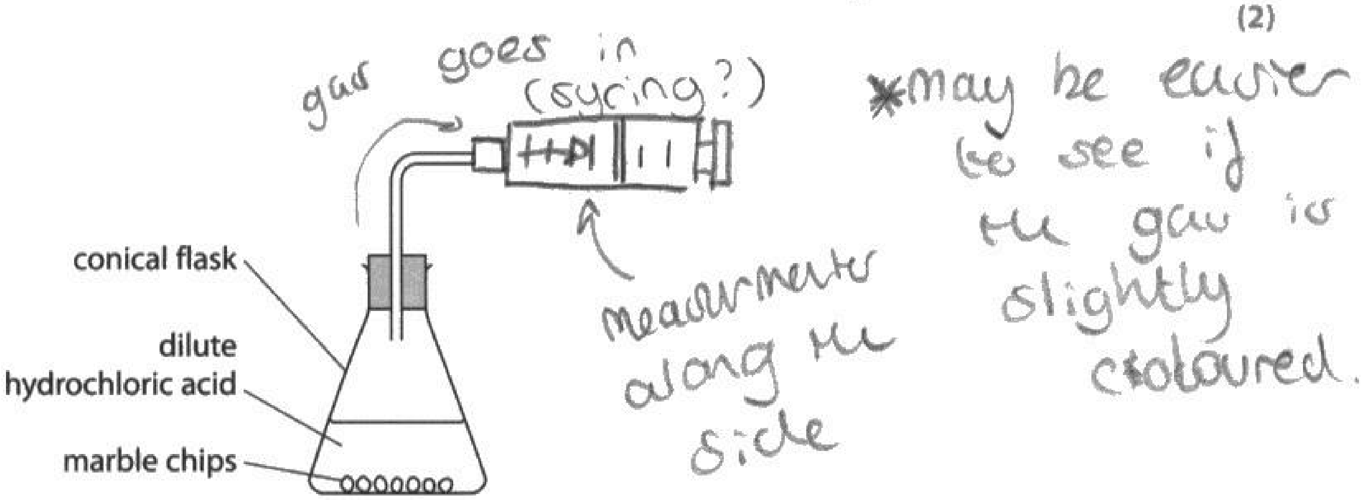

Figure 8

ResultsPlus
Examiner Comments

1 mark

This was clear enough to be recognised as a gas syringe, but unfortunately that was not labelled.

5 A student investigates the reaction between marble chips and dilute hydrochloric acid.

The student measures the total volume of carbon dioxide gas produced each minute, for 10 minutes.

(a) Figure 8 shows part of the apparatus used in the experiment.

Complete Figure 8 by drawing and labelling apparatus that could be used to collect and measure the volume of the carbon dioxide gas.

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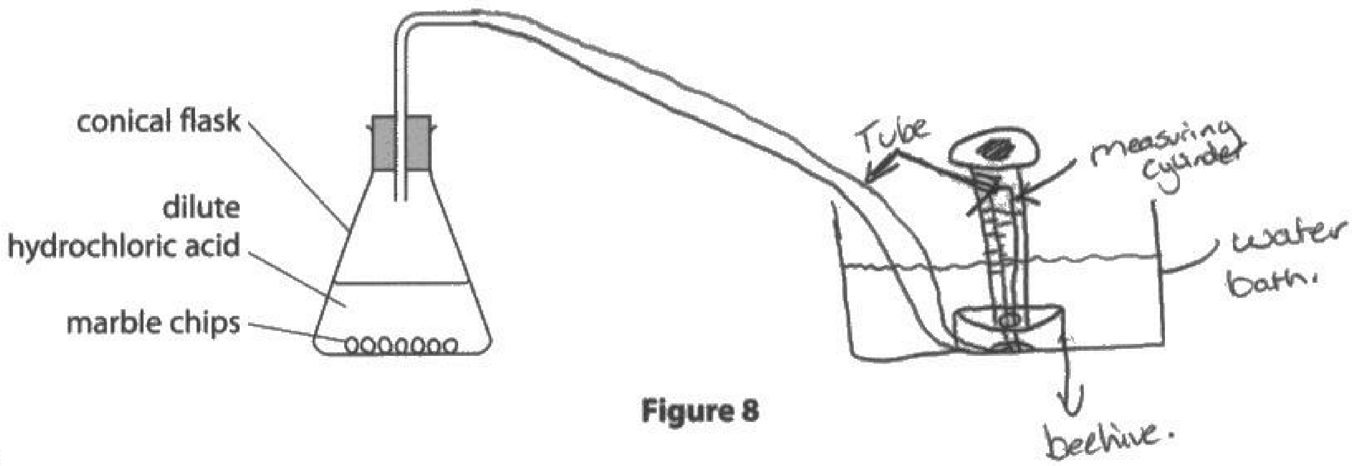

Figure 8

ResultsPlus Examiner Comments

2 marks

Collection by displacement of water from a labelled measuring cylinder scored both marks.

Question 5 (b)(i)

About half the candidates could read the volume of gas collected after 3.5 minutes from the graph. Although there was tolerance of +/ – 1 cm^3 for the answer, there were many candidates whose reading was outside the range of 46 – 48 cm^3.

Question 5 (b)(ii)

Despite having the equation to calculate the rate of reaction using the tangent to the graph at 3.5 minutes, many candidates either did not understand the question or did not know how to answer the question judging by the significant number of blank responses. Rather than working out from the graph, a change in volume divided by the corresponding change in time, many candidates divided that change in volume by 3.5 (minutes) and together taking into the tolerance of reading from the graph, this resulted in a range of possible answers that were worth 1, 2 or 3 marks.

(ii) Using the tangent, calculate the rate of reaction at 3.5 minutes in cm^3 per minute.

$$\text{rate of reaction} = \frac{\text{change in gas volume}}{\text{change in time}}$$

(3)

$$\frac{46}{3.5} = 13.14$$

rate = 13.14 cm^3 per minute

ResultsPlus
Examiner Comments

2 marks

This candidate has divided by the time at which the rate is being calculated, not the change in time.

(ii) Using the tangent, calculate the rate of reaction at 3.5 minutes in cm^3 per minute.

$$\text{rate of reaction} = \frac{\text{change in gas volume}}{\text{change in time}}$$

(3)

~~8~~ 70 − 25 = $\frac{45}{7.2}$ = 6.25

rate = 6.25 cm^3 per minute

ResultsPlus
Examiner Comments

3 marks

The working is shown clearly here along with the final answer.

Question 5 (c)

There were several good answers seen to explain the effect on the rate of reaction of using smaller marble chips with a larger surface area, compared to the same mass of larger marble chips. However, a significant number related smaller marble chips to a smaller surface area and this led to an incorrect explanation. Answers that did not score included where candidates wrote about size of reaction as opposed to rate of reaction.

(c) The student repeats the experiment using the same mass of smaller marble chips.

All other conditions remain the same.

Explain the effect on the rate of reaction of using smaller marble chips.

(2)

The rate of reaction will be quicker because the smaller chips of marble can dissolve easier.

ResultsPlus
Examiner Comments

1 mark

Rate of reaction is quicker and the marble chips dissolving faster is the same marking point.

(c) The student repeats the experiment using the same mass of smaller marble chips.

All other conditions remain the same.

Explain the effect on the rate of reaction of using smaller marble chips.

(2)

larger surface area, making the reaction occur faster

ResultsPlus
Examiner Comments

2 marks

Both marking points are contained in this answer.

Question 5 (e)

The question opened by stating that the volume of carbon dioxide was measured and the question asked for a different way that the amount of carbon dioxide produced could be measured. Unfortunately, the greater majority of the candidates misunderstood or did not read the first sentence and gave an answer about measuring the volume of the gas. Only relatively few candidates opted for measuring the mass of the flask or simply just stating 'use a balance' or 'use scale**s**' – 'scale' alone did not score.

(e) In this experiment the volume of carbon dioxide gas produced is measured.

Give a different way that the amount of carbon dioxide produced can be measured.

(1)

gas syringe

ResultsPlus
Examiner Comments

0 marks

This was a common error made by the majority of the candidates. Using a gas syringe is measuring the volume of the gas and is not a different method that was asked for.

(e) In this experiment the volume of carbon dioxide gas produced is measured.

Give a different way that the amount of carbon dioxide produced can be measured.

(1)

carbon dioxide can be measured by a thermometer

ResultsPlus
Examiner Comments

0 marks

One of the more bizarre answers, where the candidate has focussed on using a piece of apparatus to measure something.

(e) In this experiment the volume of carbon dioxide gas produced is measured.

Give a different way that the amount of carbon dioxide produced can be measured.

(1)

the mass of the substance

ResultsPlus
Examiner Comments

1 mark

Measuring the mass of the gas described in a suitable way was only given by a small number of candidates.

Question 5 (f)

For most candidates, this was an unusual question as at the end of the experiment, the reaction would have stopped, the bubbling would have stopped and since the acid was in excess, all the marble chips would have reacted and there would be none left, so all that would be seen is a colourless solution. Other acceptable answers included some indication such as 'no bubbling' to show that the reaction had stopped. Most candidates who answered the question gave answers such as 'bubbles could be seen', 'small pieces of marble chips' or even 'a blue solution was formed'. Those who recognised that all that would be left was the excess hydrochloric acid said that they would see the hydrochloric acid, which unfortunately was the correct substance left in the flask but is not what they SEE.

(f) In this experiment there is an excess of dilute hydrochloric acid.

State what you would **see** in the conical flask at the end of the experiment.

(1)

we would see a high amount of left over hydro chloric acid left in the beaker.

(Total for Question 5 = 11 marks)

ResultsPlus
Examiner Comments

0 marks

The correct substance, but not the correct observation.

ResultsPlus
Examiner Tip

When asked 'state what you would **see** ...', the question is asking for an observation – here it would be 'a colourless liquid'.

(f) In this experiment there is an excess of dilute hydrochloric acid.

State what you would **see** in the conical flask at the end of the experiment.

(1)

Colourless liquid

(Total for Question 5 = 11 marks)

ResultsPlus
Examiner Comments

1 mark

This was one of the few correct anwers to this question.

(f) In this experiment there is an excess of dilute hydrochloric acid.

State what you would **see** in the conical flask at the end of the experiment.

(1)

small remains of water and no marble chips as it would all react

(Total for Question 5 = 11 marks)

ResultsPlus
Examiner Comments

1 mark

This was an acceptable way of describing what would be seen at the end of the reaction.

(f) In this experiment there is an excess of dilute hydrochloric acid.

State what you would **see** in the conical flask at the end of the experiment.

(1)

Clear Lestover chunks of the marbles.

(Total for Question 5 = 11 marks)

ResultsPlus
Examiner Comments

0 marks

The candidate must have missed the point of the sentence where it said there was an excess of dilute hydrochloric acid.

ResultsPlus
Examiner Tip

The purpose of using an excess of a reactant is to ensure that ALL of the other reactant is used up.

Question 6 (a)

It was quite disappointing to see only a small of candidates describing the correct test to show that a gas is oxygen. The answer needed to specify that a 'glowing splint' was being used to score the first marking point and then give the correct result: 'it relights'. There were many answers seen where the candidate described lighting a splint then blowing it out – unfortunately if it had been extinguished, then it would not relight even in the presence of oxygen. Surprisingly, several students gave the correct test, but spoilt their answer by saying that a 'squeaky pop' was heard to show that the gas was oxygen. Others did describe the test for hydrogen, some hoped that splint would relight, others other incorrect gas tests and several thought it would be a good idea to just breathe it in.

6 This question is about the atmosphere.

(a) Describe the test to show that a gas is oxygen.

(2)

A lit splint makes a squeky pop

ResultsPlus
Examiner Comments

0 marks

The wrong gas test. A large number of candidates described the test for hydrogen in answer to this question.

6 This question is about the atmosphere.

(a) Describe the test to show that a gas is oxygen.

(2)

Lit splint relights.

ResultsPlus
Examiner Comments

0 marks

The correct test has to described before a mark is given for the result.

6 This question is about the atmosphere.

(a) Describe the test to show that a gas is oxygen.

(2)

Glowing splint , Squeaky pop sound.

ResultsPlus
Examiner Comments

1 mark

Correct test, incorrect result.

6 This question is about the atmosphere.

(a) Describe the test to show that a gas is oxygen.

(2)

glowing splint relights

ResultsPlus
Examiner Comments

2 marks

Correct test and result.

Question 6 (b)

At this end of the paper, several candidates find the questions harder as they do overlap with the Higher Tier and are targeted at grades 4 and 5. This calculation was fairly straightforward for about a quarter of the candidates and was easier for those with calculators (as specified on the front cover of the examination paper). Some candidates confused 50.000 g with fifty thousand grams which meant some of the answers were rather large. Most who carried out a successful calculation tended to produce the final answer of 48.942 g, but some subtracted the mass of oxygen given in the question from 50.000 g without scaling it up for the other mass of copper and so just scored the second marking point.

(b) Copper reacts with oxygen to form copper oxide.

2.100 g of copper will react completely with 0.529 g of oxygen.

In an experiment, 4.200 g of copper is heated with 50.000 g of oxygen until the reaction is complete.

Calculate the mass of oxygen remaining at the end of the experiment.

(2)

50.000 −
0.529 −
494 1 1

mass of oxygen = 49.471 g

ResultsPlus
Examiner Comments

1 mark

The mark was scored for the calculation 50.000 – 0.529 = 49.741 (g).

(b) Copper reacts with oxygen to form copper oxide.

2.100 g of copper will react completely with 0.529 g of oxygen.

In an experiment, 4.200 g of copper is heated with 50.000 g of oxygen until the reaction is complete.

Calculate the mass of oxygen remaining at the end of the experiment.

(2)

....

....

mass of oxygen = 48.942 g

ResultsPlus
Examiner Comments

2 marks

A risky strategy for an F tier candidate. A slight error in writing down the answer would then have caused the mark to be 0.

ResultsPlus
Examiner Tip

Always show your working for calculations.

(b) Copper reacts with oxygen to form copper oxide.

2.100 g of copper will react completely with 0.529 g of oxygen.

×2

In an experiment, 4.200 g of copper is heated with 50.000 g of oxygen until the reaction is complete.

Calculate the mass of oxygen remaining at the end of the experiment.

(2)

50.000g − 0.529 × 2 = 48.942

(1.058)

mass of oxygen = 48.942 g

ResultsPlus
Examiner Comments

2 marks

A well laid out calculation together with the correct answer.

Question 6 (c)(i)

About a quarter of the candidates recognised that the noble gases were inert because they had a full outer shell, but fewer went on to back that up the consequence that electrons then would not be gained, lost or shared. Many candidates ignored part of the question where it asked for the explanation to be 'in terms of electrons' and just described what inert meant for which there was no credit. The most common misconception seen by markers was that many candidates thought that the noble gases has no electrons in the outer shell, presumably they linking the group number (0) to the number of electrons in the outer shell.

(c) Helium, neon and argon are all inert.

(i) Explain, in terms of electrons, why these gases are inert.

(2)

Because they have a full electron shell, making them unreactive

ResultsPlus
Examiner Comments

0 marks

The candidate missed out which shell they were writing about. It needed to have been 'full **outer (**electron) shell' to score the first marking point.

(c) Helium, neon and argon are all inert.

(i) Explain, in terms of electrons, why these gases are inert.

(2)

as they all have full outer shells of electrons therefore they do not need to give or take any electrons meaning they are in group 8.

ResultsPlus
Examiner Comments

2 marks

Both marking points were scored.

(c) Helium, neon and argon are all inert.

(i) Explain, in terms of electrons, why these gases are inert.

(2)

They all have 8 electrons on the outer shell

ResultsPlus
Examiner Comments

0 marks

The candidate had written 'They all have 8 electrons ...'. Unfortunately, this doesn't apply to helium which only has two electrons in its outer shell.

(c) Helium, neon and argon are all inert.

(i) Explain, in terms of electrons, why these gases are inert.

(2)

Because these are in Group 0 and Group 0 has 0 electrons in the outer shell.

ResultsPlus
Examiner Comments

0 marks

Unfortunately many candidates related the group number (0) to the number of electrons in the outer shell when answering this question. That doesn't apply to the elements of group 0.

Question 6 (d)

Candidates were asked to **explain** the effect that plant life had on the Earth's atmosphere and the temperature of the Earth. There were many candidates who took the opportunity just to transfer the information given in the table into sentences without any interpretation or explanation, so effectively they did not answer the question. Here, a simple description of what happened to the levels of carbon dioxide and of oxygen since before plant life started to evolve was a level 1 answer. A level 2 answer involved some explanation involving the increasing amount of plant life; the majority of candidates gave such an answer, but few gave a more detailed answer including what happened to the temperature of the Earth time, which accounted the very small proportion candidates achieving a Level 3 mark of 5 or 6.

*(d) Figure 10 shows how plant life and the atmosphere of Earth have changed over time.

period of time	plant life	amount of carbon dioxide in atmosphere	amount of oxygen in atmosphere
the earliest Earth	no plant life	very high	none
about 3,500 million years ago	plant life evolved	high	very low
about 10,000 years ago	about 60% of land covered by trees	0.03%	about 21%
today	less than 40% of land covered by trees	0.04%	about 21%

Figure 10

Explain the effect that plant life has had on the Earth's atmosphere and the temperature of the Earth.

You should refer to the information in Figure 10 including

- the plant life
- the amounts of carbon dioxide
- the amounts of oxygen

(6)

Plant life has increased Earths living capabilities massively. This is mostly due to photosynthesis. Photosynthesis has helped because it decreased the amount of carbon dioxide in the atmosphere and gave out oxygen. This also decreases the earths temperature and formed 'the ozone layer.' The amount of oxygen has also massively increased, going from none in the atmosphere to almost 21%.

ResultsPlus
Examiner Comments

4 marks – a level 2 answer

The candidate had explained how photosynthesis in the evolving plants had changed the amounts of carbon dioxide and oxygen in the atmosphere. The third sentence was incorrect and can be ignored when deciding a suitable level for the mark awarded.

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Figure 10

Explain the effect that plant life has had on the Earth's atmosphere and the temperature of the Earth.

You should refer to the information in Figure 10 including

- the plant life
- the amounts of carbon dioxide
- the amounts of oxygen

(6)

- amount of carbon dioxide decrease
- amount of oxygen increase by roughly 21%
- more plant life around 10,000 years ago compared to now but less plant life during the earliest earth compared to now.

ResultsPlus Examiner Comments

2 marks – a level 1 answer

The answer just contained a description of what happened to the amounts of carbon dioxide and oxygen in the atmosphere over the years. The link with evolving plant life was not made.

*(d) Figure 10 shows how plant life and the atmosphere of Earth have changed over time.

period of time	plant life	amount of carbon dioxide in atmosphere	amount of oxygen in atmosphere
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Figure 10

Explain the effect that plant life has had on the Earth's atmosphere and the temperature of the Earth.

You should refer to the information in Figure 10 including

- the plant life
- the amounts of carbon dioxide
- the amounts of oxygen

(6)

there was an increase in plant life and as plants use carbon dioxide for photosynthesis there was a decrease in carbon dioxide in the atmosphere. As plants produce oxygen as a waste product in photosynthesis there was an increase in oxygen in the atmosphere. However there was then a decrease in plant

Life with less than 40 % of land being covered by trees. This decrease in plant life has led to an increase in ~~4~~ carbon dioxide in the atmosphere therefor it is ~~a~~ collecting in the top layers of earth and trapping heat in earth. this means the temp of earth has increased. Therefor plant life is directly linked to the heat of earth the more ~~Plants~~ Plants the less heat trapped in earth Less Plants means more heat trapped in earth.

ResultsPlus
Examiner Comments

5 marks – a level 3 answer

The candidate had related the changes in amounts of carbon dioxide and oxygen to how plant life had evolved to cover 60% of the land, explaining the role of photosynthesis together with how temperature had changed as a result.

Paper Summary

The candidates who performed well on this paper were those who had read and understood the questions, answered the questions succinctly without repeating the question. They also answered the extended writing questions in a logical manner and set out their calculations in full so it was easy to see how the final answer was obtained.

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

- Make use of the past GCSE papers that their teachers can provide
- Read the whole question to ensure that they know what is needed for the answer.
- Revise the core practicals as these form the basis of many of the questions covering practical work.
- Practise writing word equations and using formulae of ionic compounds to write the formula of ions present.
- Practise answering the types of calculations seen in this examination paper
- Learn and understand the trends of properties of the fractions obtained by the fractional distillation of crude oil
- Learn and understand the different types of reaction eg neutralisation
- Learn the gas tests

Teachers can help their candidates with their revision by accessing past paper questions targeting particular topics using Exam Wizard or downloading whole papers from the Pearson website.

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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