



Examiners' Report

June 2024

Int GCSE Chemistry 4CH1 1CR

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Introduction

The earlier questions tended to score well with many questions which were expected.

There were four questions with 4, 5 or 6 marks. All of these were explanations. Many of the candidates struggled with these questions and only the very best scored full marks. They needed to link the statements to gain all the marks which many candidates found difficult.

There were some unusual maths questions and many candidates found these difficult, but those candidates who understood the questions normally scored the marks.

Candidates did not score very well when they were involved with practical questions which implied that many candidates did not do enough practical work which disadvantaged their success in gaining a good score.

Question 1 (a)(i)

A large majority gave the correct answer.

Question 1 (a)(ii)

A large majority gave the correct answer.

Question 1 (a)(iii)

A large majority gave the correct answer.

Question 1 (b)(i)

Many candidates knew the number of protons. Occasionally electrons were referred to which were ignored and a few candidates confused the mass number.

Question 1 (b)(ii)

Again a large majority knew the mass number was the sum of the protons and neutrons. Occasionally candidates just mentioned the neutrons or added the electrons as well.

Question 2 (a)

A large majority knew that oxygen was very well known. Carbon dioxide was mentioned occasionally.

Question 2 (b)

A large majority of candidates scored both marks. A few that didn't score both marks mentioned either hydrogen, methane or carbon monoxide.

Question 2 (c)(i)

Around two thirds of candidates gave the correct answer usually stating that there was not enough oxygen or air, which was allowed. A few candidates mentioned that there was no oxygen which would not have reacted at all, so this was not creditworthy.

Question 2 (c)(ii)

Around two thirds gave the correct answer.

(ii) State why carbon monoxide is poisonous.

It binds to haemoglobin, reducing the blood capacity to carry oxygen. (1)



A clear answer, stating that carbon monoxide reduces the blood capacity to carry oxygen.



You can also mention binding carbon monoxide with haemoglobin, but this is not necessary to gain the mark. It is reducing the capacity to transport oxygen in the blood that is important.

(ii) State why carbon monoxide is poisonous.

(1)

Limits oxygen in the lung



This is not enough to gain the mark, as there is no mention of limiting oxygen when transporting the blood.



Learn the definition in the specification as it is often tested.

Question 2 (d)

Around two thirds gained the mark for substitution. Wrong answers included displacement or addition. Redox was mentioned occasionally and it was allowed.

Question 3 (a)(i)

A very large majority gained the mark.

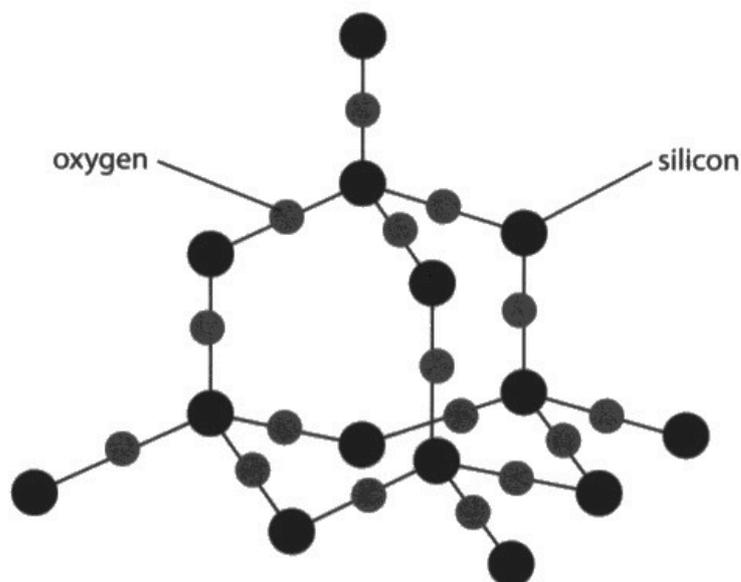
Question 3 (a)(ii)

A large majority also gained the mark. Simple distillation was mentioned occasionally, which was not creditworthy.

Question 3 (b)

The majority of candidates gained two marks, but a significant number lost the first mark for not mentioning different elements, but could be scored if mentioning atoms or elements of silicon and oxygen. A few candidates lost the second mark for not joining or bonding together.

(b) The diagram shows part of the structure of silicon dioxide.



Explain why silicon dioxide is a compound.

(2)

~~it has strong etc~~
made up of oxygen and silicon

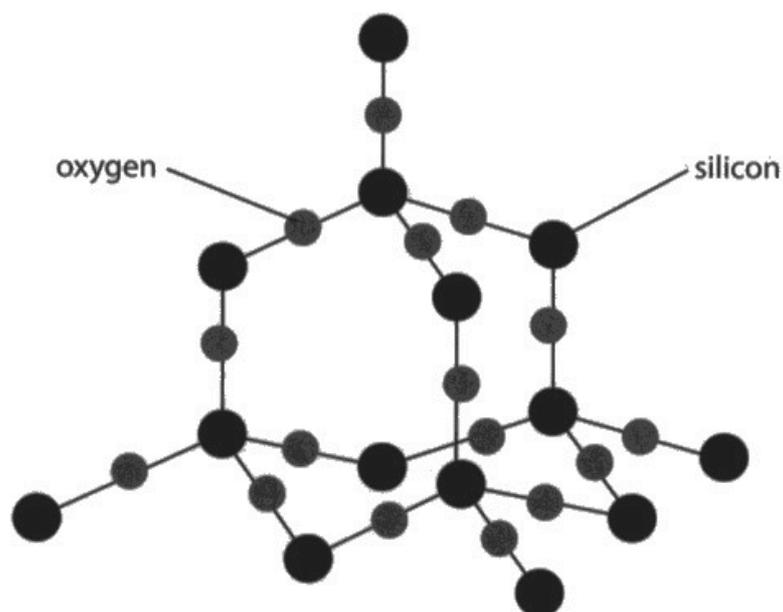


No marks here as just stating made up of oxygen and silicon is not enough. You must also mention elements or atoms to gain the first mark.



For two marks you need two statements. Just showing oxygen and silicon alone is not enough as it is shown on the diagram.

(b) The diagram shows part of the structure of silicon dioxide.



Explain why silicon dioxide is a compound.

(2)

Silicon dioxide is a compound because it contains both silicon and oxygen that are chemically bonded together in a lattice structure.

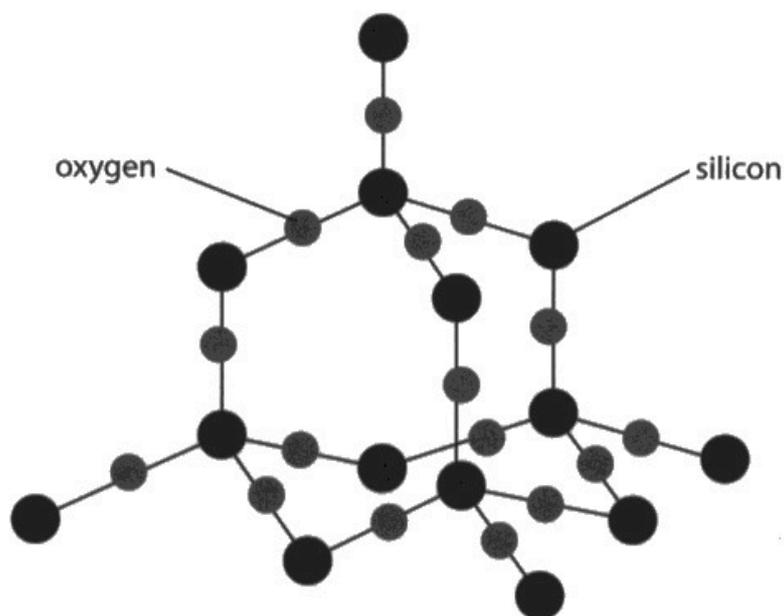


Unfortunately they lost the first marking point as no mention of atoms or elements. Chemically bonded together is enough for the second marking point.



Different elements or atoms are needed to gain the first mark.

(b) The diagram shows part of the structure of silicon dioxide.



Explain why silicon dioxide is a compound.

(2)

Because it contains 2 different elements
chemically bonded together, both silicon and
oxygen



ResultsPlus
Examiner Comments

A clear answer which gains both marks.



ResultsPlus
Examiner Tip

An explanation is needed to gain both marks. It is a compound because two different elements are bonded together.

Question 3 (c)(i)

A very large majority gave the correct answer.

Question 3 (c)(ii)

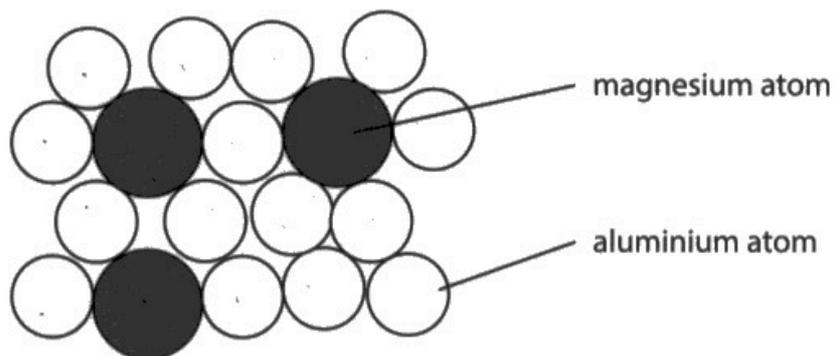
A large majority added the numbers correctly giving an answer of 788.

Question 3 (d)

A well answered question with over two thirds gaining both marks. A common error was to divide 3 by 15 instead of 18, but you can gain the second mark of 20% as error carried forward.

(d) Magnalium is a mixture of magnesium atoms and aluminium atoms.

The diagram shows a sample of magnalium.



Calculate the percentage of magnesium atoms in this sample

(2)

18 atoms

$$\frac{3}{18} \times 100 = 16.666\dots$$

percentage = 16.7 %



ResultsPlus
Examiner Comments

A clear answer gaining both marks.

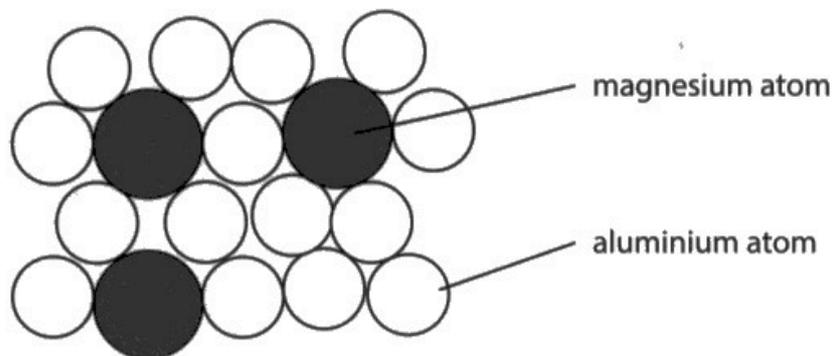


ResultsPlus
Examiner Tip

Always show your working clearly.

(d) Magnalium is a mixture of magnesium atoms and aluminium atoms.

The diagram shows a sample of magnalium.



Calculate the percentage of magnesium atoms in this sample.

(2)

$$3 \div 18 = 0.16$$
$$0.16 \times 100\% = 16\%$$

percentage = 16 %



ResultsPlus
Examiner Comments

3 divided by 18 multiplied by 100 is correct, for the first marking point. Unfortunately 16% is incorrectly rounded so the second marking point cannot be awarded.

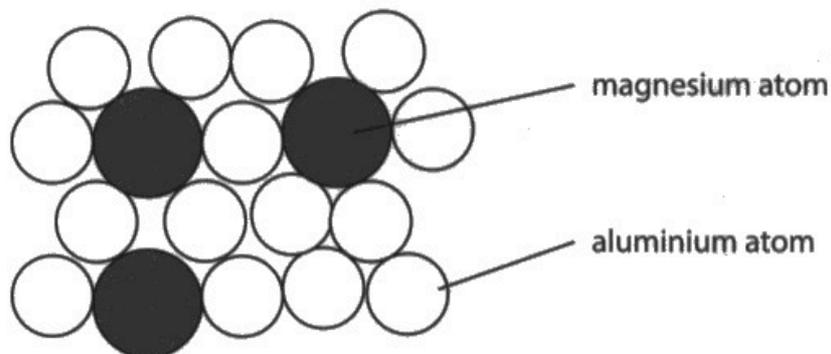


ResultsPlus
Examiner Tip

Do not lose marks by rounding incorrectly. Working is important as just an answer of 16% would have lost both marks.

(d) Magnalium is a mixture of magnesium atoms and aluminium atoms.

The diagram shows a sample of magnalium.



Calculate the percentage of magnesium atoms in this sample.

(2)

15 atoms aluminium

3 atoms magnesium

$$\frac{3}{15} \times 100 = 20$$

~~$\frac{3}{15} \times 100 = 20$~~

$$\frac{3}{18} \times 100 = \frac{50}{3}$$

percentage = 20 %



ResultsPlus
Examiner Comments

This is an unusual answer. 3 divided by 15 multiplied by 100 is incorrect but the second marking point can be an error carried forward to give a mark of 20%. 3 divided by 18 multiplied by 100 is correct, but as the answer on the answer line is incorrect only one mark can be scored.



ResultsPlus
Examiner Tip

This is a list principle, with one right and one wrong. However if the answer on the answer line was correct the other calculation could be ignored and two marks could be gained.

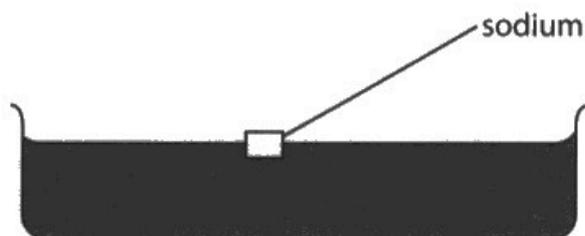
Question 4 (a)

The majority scored both marks. Many candidates lost a mark by stating fizzing. This is not creditworthy as bubbles of hydrogen gas is synonymous with fizzing. Common correct answers were floats, moves and gets smaller or disappears.

4 This question is about the alkali metals.

A teacher demonstrates the reaction between sodium and water.

The teacher fills a trough with water and then adds a piece of sodium.



(a) The sodium reacts with the water, forming bubbles of hydrogen gas and a colourless solution.

State two other observations that would be made.

(2)

1 floats on the water surface with a hissing sound

2 melts into a silvery ball



ResultsPlus
Examiner Comments

Floats on the water surface and melts into a silvery ball is enough for both marks.



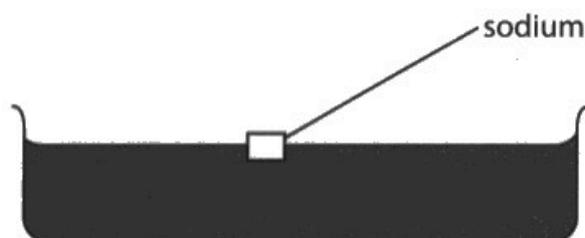
ResultsPlus
Examiner Tip

There are five possible marks here so no need to mention fizzing, bubbles or effervescence.

4 This question is about the alkali metals.

A teacher demonstrates the reaction between sodium and water.

The teacher fills a trough with water and then adds a piece of sodium.



(a) The sodium reacts with the water, forming bubbles of hydrogen gas and a colourless solution.

State two other observations that would be made.

(2)

1 ~~Bubbles~~ The sodium starts to bubble

2 ~~Flame is produced~~ Flaming light is produced



ResultsPlus
Examiner Comments

Starts to bubble is not creditworthy as it is in the stem of the question. A small piece of sodium does not normally catch fire so flaming light is also not creditworthy.



ResultsPlus
Examiner Tip

Read the question and do not repeat the stem as this does not score.

Question 4 (b)

The majority gained both marks for describing the flame test and generally knew it was yellow. A few candidates thought it was red and lost the second mark.

- (b) Give a test to show that, at the end of the reaction, the solution contains sodium ions.

(2)

A flame test should be conducted. If there are sodium ions present, then the colour of the flame should be yellow.



ResultsPlus
Examiner Comments

A clear answer stating that there was a flame test and the flame was yellow, so both marks were awarded.



ResultsPlus
Examiner Tip

A flame test is the only way to identify sodium ions.

(b) Give a test to show that, at the end of the reaction, the solution contains sodium ions.

(2)

We can dip a damp red litmus paper into the solution to observe the color change for sodium ions.



ResultsPlus
Examiner Comments

Using red litmus is not a test for sodium ions so no marks can be awarded.



ResultsPlus
Examiner Tip

This answer is confusing the solution of sodium hydroxide, which shows that it would be alkaline, or OH^- ions would form, but this is not a test for sodium ions.

Question 4 (c)(i)

A large majority answered this correctly. A few candidates just mentioned the same number of electrons without mentioning the outer shell, which was not creditworthy.

Question 4 (c)(ii)

The majority answered this correctly. A few candidates stated that as the radius decreases they become more reactive, which was the wrong way round. This indicated that some did not really understand standard form.

Question 5 (a)(i)

This question differentiated well, giving a full range of marks. Solvent front was the least well known answer.

5 Chromatography is used to separate the components in a mixture.

(a) Diagram 1 shows the apparatus used to separate the different dyes in a food colouring.

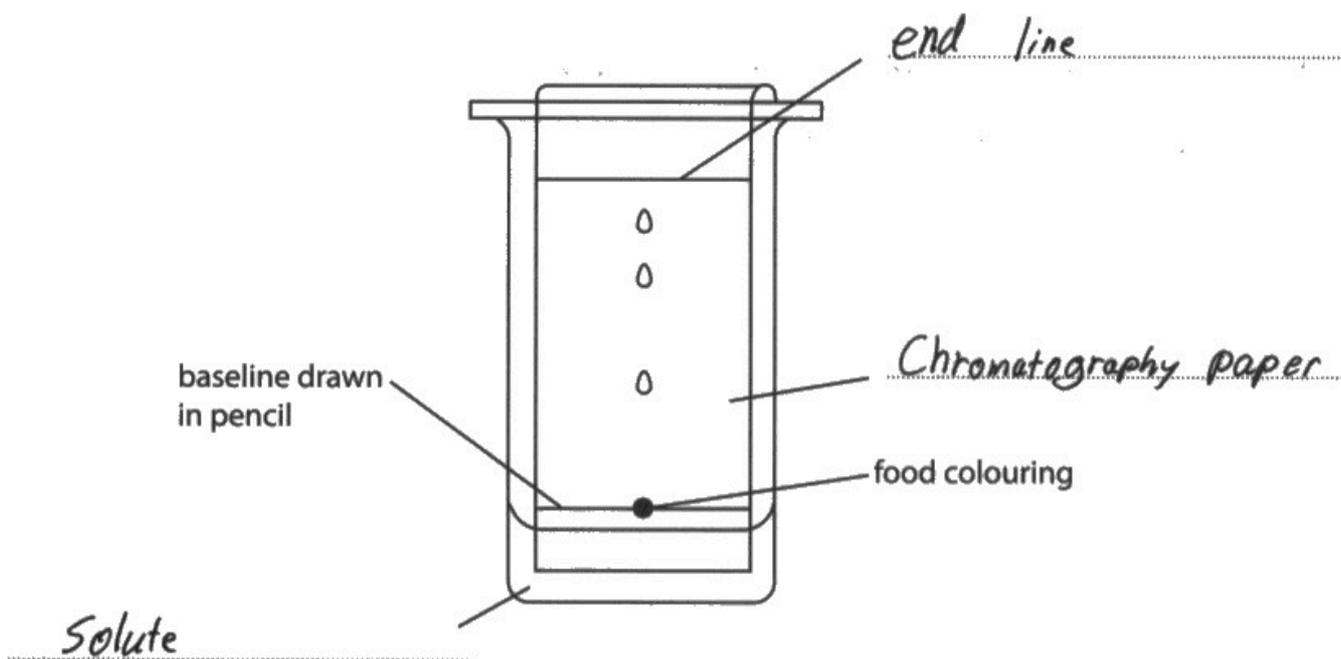


Diagram 1

(i) Complete the diagram by adding the missing labels.

(3)



ResultsPlus
Examiner Comments

One mark for chromatography paper, but no other marks were correct. Solute is not a solvent and end line is not the solvent front.



ResultsPlus
Examiner Tip

Chromatography is a core practical which is often tested, so learn how to set up a chromatography experiment.

This is a good mark scheme answer and all three marks can be awarded.

5 Chromatography is used to separate the components in a mixture.

(a) Diagram 1 shows the apparatus used to separate the different dyes in a food colouring.

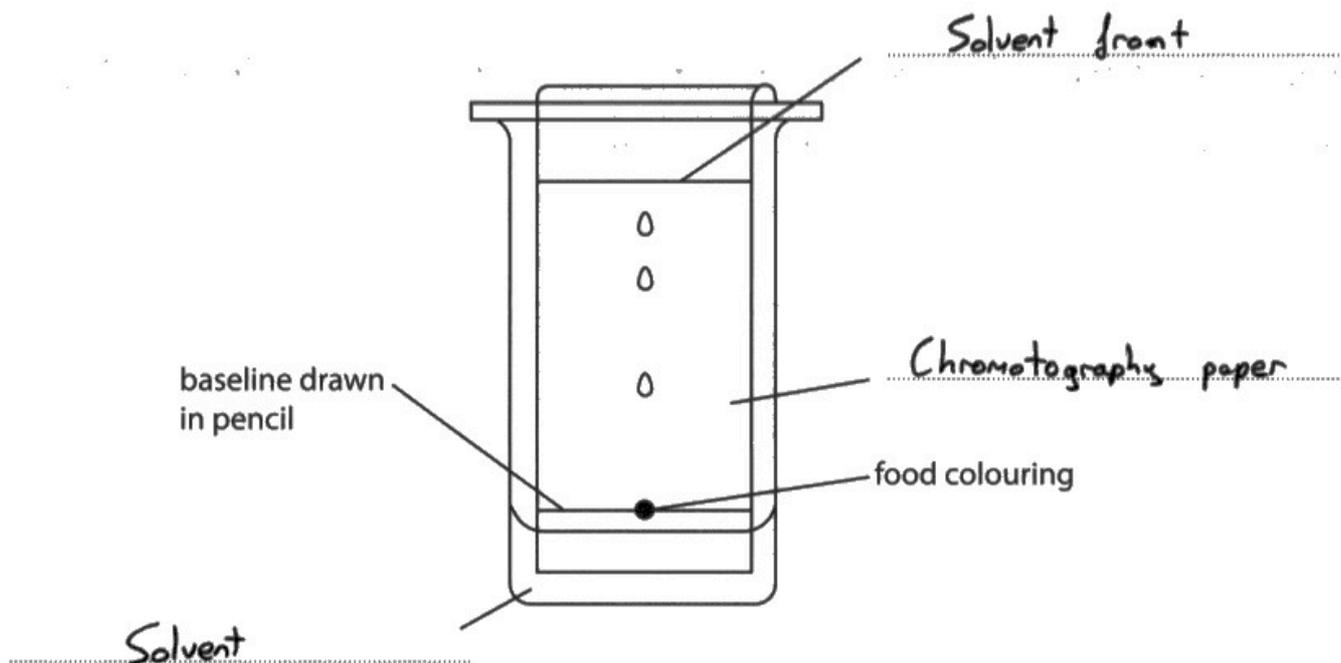


Diagram 1

(i) Complete the diagram by adding the missing labels.

(3)



ResultsPlus
Examiner Comments

As not as good as solvent or chromatography paper, however water, paper and chromatogram can be allowed.

Question 5 (a)(ii)

The majority gained the mark. Most candidates either said the pencil was insoluble or did not travel up the paper, which was enough for the mark. As the question specifically stated why the line was drawn in pencil, no marks were awarded for some candidates stating that ink was soluble or ran up the paper.

Question 5 (b)(ii)

Around two thirds of the candidates gained both marks. Most candidates read the distances correctly. Some lost the second mark for not rounding correctly or the R_f values were upside down.

(ii) Calculate the R_f value of the dye in food colouring W.

(2)

$w = 1.3 \text{ cm}$

$$1.3 \div 6.5 = 0.2$$

1.3 cm

6.5 cm

$$R_f = \underline{0.2}$$



ResultsPlus
Examiner Comments

The values were correct and the R_f value was also correct so both marks were awarded.



ResultsPlus
Examiner Tip

Show all the working and any rounding should be correct.

(ii) Calculate the R_f value of the dye in food colouring W.

(2)

$$\frac{1.5}{6.5} = 0.23$$

$$R_f = 0.23$$



ResultsPlus
Examiner Comments

The first value was out of the range between 1.1 and 1.4 so unfortunately the first mark was not awarded, but error can be carried forward as 0.23 is the correct answer for 1.5 divided by 6.5.



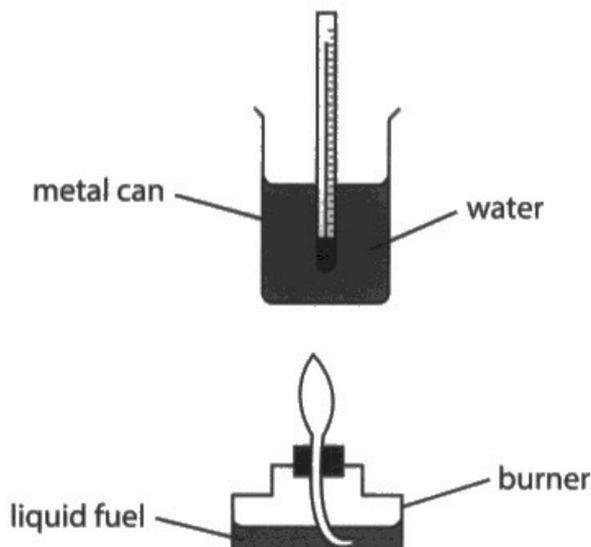
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Examiner Tip

Make sure you measure the values accurately. It is best to measure from the baseline to the middle of the spot.

Question 6 (a)

This discriminated well with only around a quarter of both marks awarded. A common error involved mentioning energy but no reference to heat or thermal energy.

- 6 A student uses this apparatus to find the heat energy released by the combustion of liquid fuels.



- (a) Explain what is meant by the term **fuel**.

(2)

Flammable substance used ~~for~~ as sources of energy. ~~for mechanical items like cars.~~



ResultsPlus
Examiner Comments

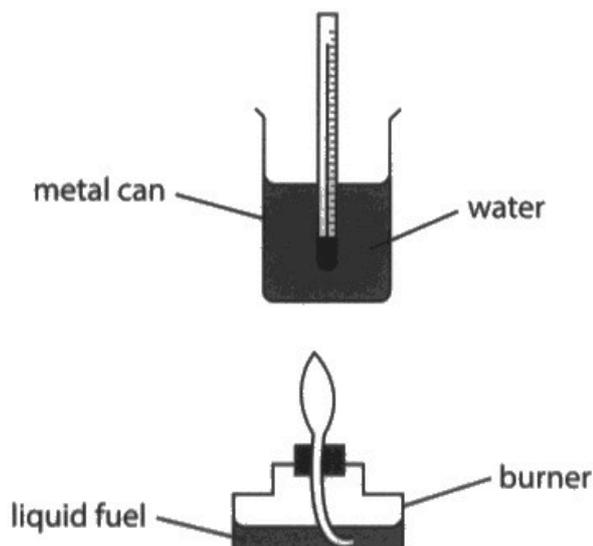
A flammable substance is not necessarily a fuel and sources of energy is not enough as no mention of heat or thermal energy so no marks awarded.



ResultsPlus
Examiner Tip

Learn a definition of a fuel, which is in the specification.

- 6 A student uses this apparatus to find the heat energy released by the combustion of liquid fuels.



- (a) Explain what is meant by the term **fuel**.

(2)

~~Mixture of hydrocarbons~~ what the burner uses to provide heat energy for the experiment, fuel is also a mixture of hydrocarbons



ResultsPlus
Examiner Comments

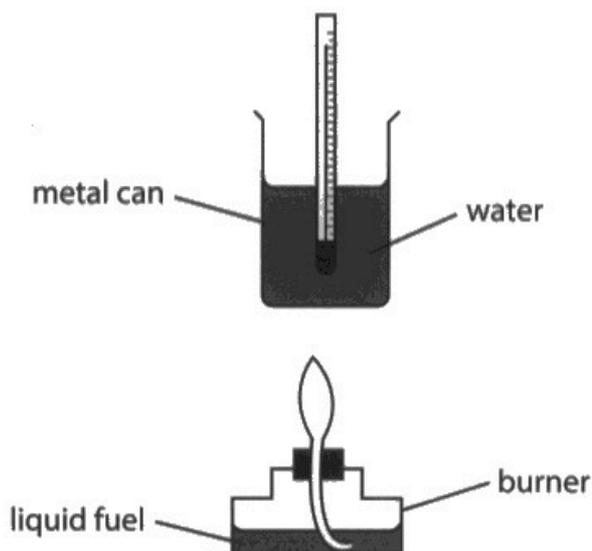
Produce heat energy is enough for the second marking point, but no mention of burning a fuel so the first marking point cannot be awarded.



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Examiner Tip

Mention a fuel burns, combusts or catches fire to gain the first mark.

- 6 A student uses this apparatus to find the heat energy released by the combustion of liquid fuels.



- (a) Explain what is meant by the term **fuel**.

(2)

A substance that releases heat and energy when burned ~~react~~



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Examiner Comments

A substance or fuel that releases heat and is burned is enough for both marks.



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Examiner Tip

A fuel burns and releases heat is enough for two marks.

Question 6 (b)(i)

This was well answered with a large majority gaining both marks. A few candidates subtracted 20.4 from 57.2 instead of adding the two values.

Complete the table by giving the temperatures to the nearest 0.1 °C.

(2)

temperature of the water at the start in °C	20.4
highest temperature reached in °C	77.6
temperature rise in °C	57.2



ResultsPlus
Examiner Comments

A clear answer which gained both marks.



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Examiner Tip

Remember to add the two values to get the highest temperature.

Complete the table by giving the temperatures to the nearest 0.1 °C.

(2)

temperature of the water at the start in °C	24.0°C
highest temperature reached in °C	33.2°C → 81.2°C
temperature rise in °C	57.2



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Examiner Comments

This candidate misread the value of 24.0 rather than 20.4 but the second mark can be awarded for adding the two values correctly, as error carried forward.



ResultsPlus
Examiner Tip

This clearly should be 20.4 not 24.0 as the thermometer only goes up to 23. It is worth checking your answers if you have enough time.

Complete the table by giving the temperatures to the nearest 0.1 °C.

(2)

temperature of the water at the start in °C	20.4
highest temperature reached in °C	36.8
temperature rise in °C	57.2



ResultsPlus
Examiner Comments

This candidate subtracted the values instead of adding them, so just one mark for the correct reading.



ResultsPlus
Examiner Tip

The highest temperature reached must be greater than the temperature rise.

Question 6 (b)(ii)-(iii)

This calculation was well done with most candidates gaining either five or six marks. A large majority gained both marks in Q06(b)(ii). A common error in Q06(b)(iii) was either to omit the negative sign or not give the answer to two significant figures.

(ii) The metal can contains water of mass 150 g.

Show, by calculation, that the heat energy change (Q) for this reaction is approximately 36 000 J.

[for water, $c = 4.2 \text{ J/g/}^\circ\text{C}$]

$$Q = mc \Delta T \quad (2)$$
$$150 \times 4.2 \times 57.2$$
$$= 36036$$

$$Q = \underline{\underline{36036}} \text{ J}$$

(iii) In the experiment, 2.3 g of ethanol ($M_r = 46$) is burned.

Calculate the molar enthalpy change (ΔH), in kJ/mol, for the combustion of ethanol, $\text{C}_2\text{H}_5\text{OH}$

Include a sign in your answer.

Give your answer to two significant figures.

(4)

$$\frac{2.3}{46} = 0.05 \quad \frac{36036}{0.05} = 720720 \text{ J}$$

$$= 720.72 \text{ kJ}$$

$$\approx 720 \text{ kJ}$$

$$\Delta H = \underline{\underline{-720}} \text{ kJ/mol}$$



A very good answer showing all the working clearly and gaining all six marks.



Always show clear working and circling two significant figures helped them to remember the final correct answer.

(ii) The metal can contains water of mass 150 g.

Show, by calculation, that the heat energy change (Q) for this reaction is approximately 36 000 J.

[for water, $c = 4.2 \text{ J/g/}^\circ\text{C}$]

(2)

$$\begin{aligned} Q &= mc \Delta T \\ &= 150 \times 4.2 \times 57.2 \\ &= 36\,036 \text{ J} \end{aligned}$$

$$Q = \underline{36\,036} \text{ J}$$

(iii) In the experiment, 2.3 g of ethanol ($M_r = 46$) is burned.

Calculate the molar enthalpy change (ΔH), in kJ/mol, for the combustion of ethanol, $\text{C}_2\text{H}_5\text{OH}$

Include a sign in your answer.

Give your answer to two significant figures.

(4)

$$\Delta H = \frac{Q}{n}$$

$$n = \frac{\text{mass}}{M_r} = \frac{2.3}{46} = 0.05 \text{ mol}$$

$$\Delta H = \frac{36\,036}{0.05}$$

$$= 720\,720 \text{ J}$$

$$= 720.72 \text{ kJ/mol}$$

$$\Delta H = \underline{720.72} \text{ kJ/mol}$$



This is also a clear answer, showing all the working. Unfortunately they lost the final mark as there was no negative sign and the value was not to two significant figures.



Read the question carefully as the sign and significant figures were needed for the final mark.

(ii) The metal can contains water of mass 150 g.

Show, by calculation, that the heat energy change (Q) for this reaction is approximately 36 000 J.

[for water, $c = 4.2 \text{ J/g/}^\circ\text{C}$]

$$g = 150$$
$$g/^\circ\text{C} = 4.2$$

$$36000$$

$$150 \times 4.2 = 630$$
$$630 \times 57.2 = 36036 \quad (2)$$

$$Q = 36036 \text{ J}$$

(iii) In the experiment, 2.3 g of ethanol ($M_r = 46$) is burned.

Calculate the molar enthalpy change (ΔH), in kJ/mol, for the combustion of ethanol, $\text{C}_2\text{H}_5\text{OH}$

Include a sign in your answer.

Give your answer to two significant figures.

$$\text{grams} = 2.3\text{g}$$
$$M_r = 46$$
$$M_r = (12 \times 2) + (1 \times 5) + 16 + 1 = 46 \text{ (Mr)}$$
$$mol = \frac{2.3}{46} = 0.05$$



(4)

$$\Delta H = 0.05 \text{ kJ/mol}$$



Q06(b)(ii) showed their working and gained the first two marks. In Q06(b)(iii) the candidate gained the second marking point when finding the moles correctly, but nothing else was attempted so no more marks.



When you see a 'show that' question make sure the value in Q06(b)(ii) is approximately 36000J, because if it is not you have made a mistake and should check your working again.

Question 6 (c)

Only around half the candidates gained the mark. The most common answer was heat lost to the surroundings. Energy lost was not creditworthy and did not score. Only a few candidates mentioned incomplete combustion or heat absorbed by the metal can. Others answered vague statements such as read the temperature wrong, did not burn all the ethanol or there was human error. None of these answers were creditworthy.

Question 7 (a)(i)

The majority gained the mark for mentioning the measuring cylinder. A few candidates also mentioned pipette or burette. A few candidates mentioned a beaker but it was not accurate enough so no mark. A gas syringe was not allowed as you do not put liquid in a gas syringe.

Question 7 (a)(ii)

Over half the candidates mentioned that zinc is in excess. A few lost the mark for stating that the acid was in excess or there were vague answers just stating they are zinc pieces so you do not need to measure them.

Question 7 (a)(iii)

The majority gained the mark for stating that so no gas escapes, which was an allowable answer. A few suggested to stop air or other gases entering the syringe, which was not creditworthy.

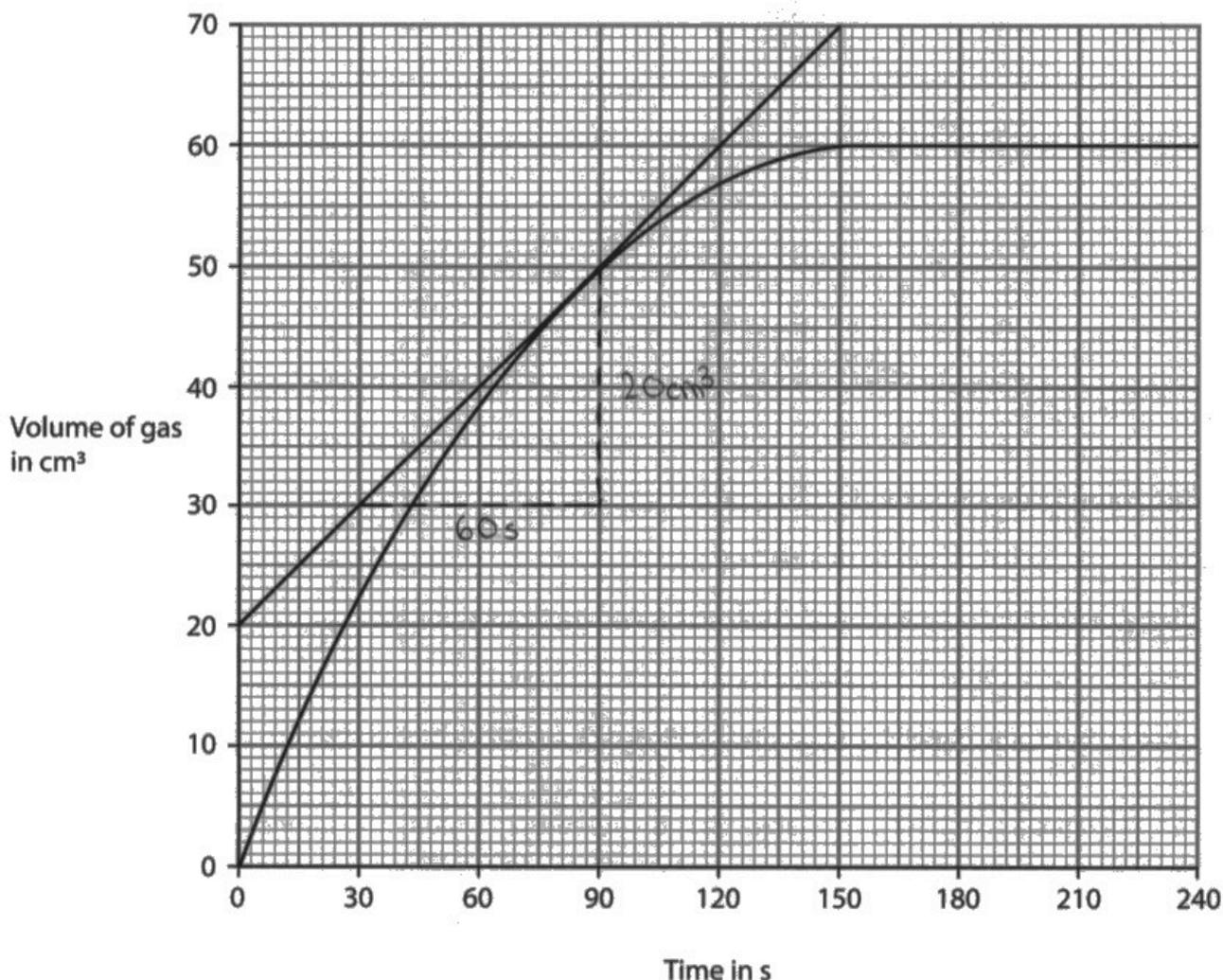
Question 7 (a)(iv)

The majority gained the mark. A common answer was to state that no more gas collects or the volume remained constant or the gas syringe did not move. A few candidates mentioned no fizzing or bubbles, but that was less common. Just stating the reaction was finished or the zinc was used up, which was incorrect, was not creditworthy.

Question 7 (b)(i)

This question discriminated well, with two marks being the most common. Only the best candidates drew the triangle and gained all three marks.

(b) The graph shows the volume of gas collected in the syringe during the experiment.



(i) A tangent to the curve has been drawn at a time of 80 s.

Use the tangent to calculate the rate of reaction at 80 s.

Show your working on the graph.

Give the unit.

$$\frac{20 \text{ cm}^3}{60 \text{ sec}} = 0.33 \text{ cm}^3/\text{s} \quad (3)$$

rate of reaction = 0.33 unit cm³/s

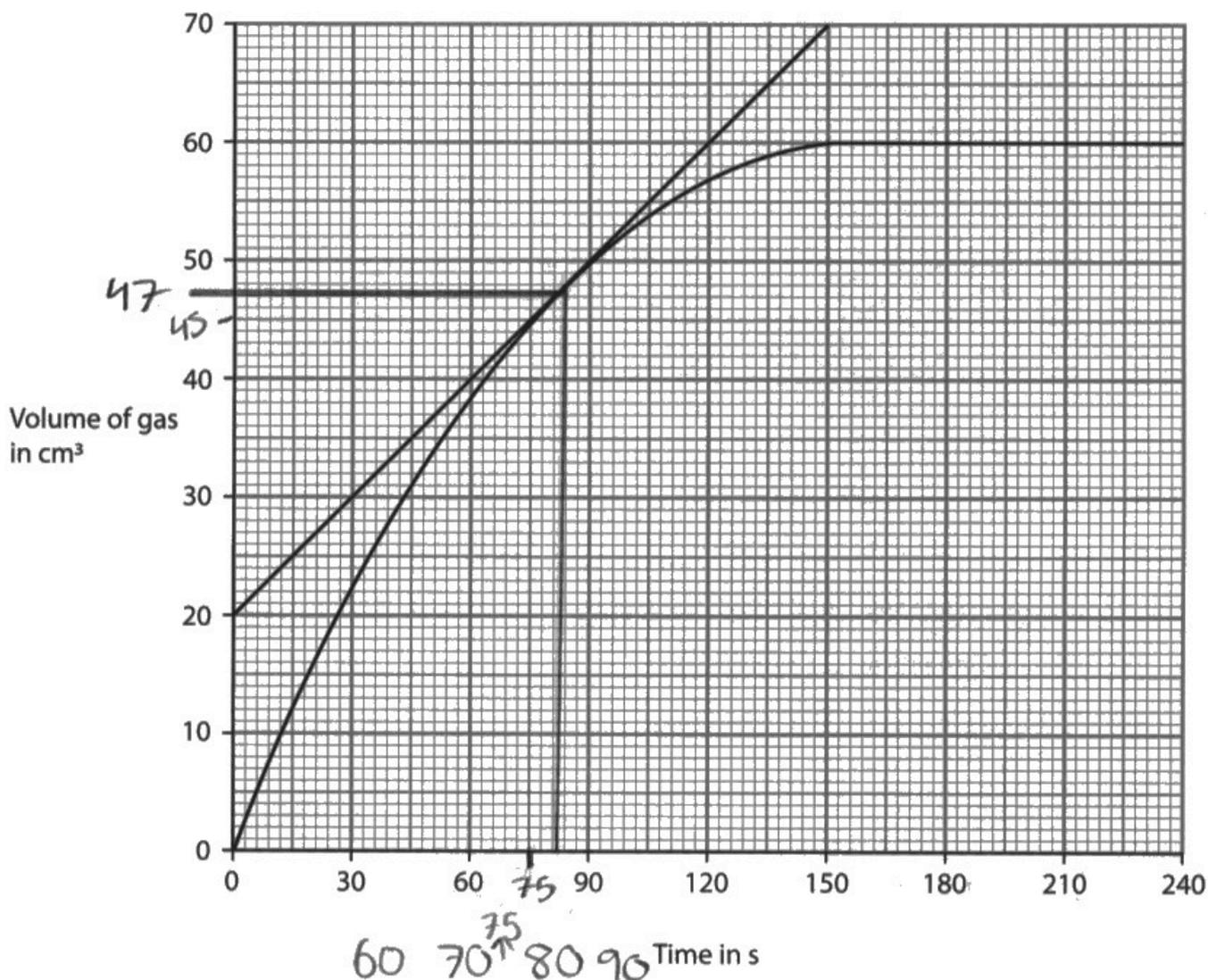


This is a good answer. The triangle is clearly drawn and 20 divided by 60 is the correct answer of 0.33 . Units are also correct so all three marks can be awarded.



Working on the graph must be shown to gain all three marks.

(b) The graph shows the volume of gas collected in the syringe during the experiment.



(i) A tangent to the curve has been drawn at a time of 80 s.

Use the tangent to calculate the rate of reaction at 80 s.

Show your working on the graph.

Give the unit.

$$\begin{aligned} \text{Volume} &= 47 \\ \text{time} &= 80 \end{aligned}$$

(3)

$$\begin{aligned} 47 \div 80 \\ = 0.59 \end{aligned}$$

rate of reaction = 0.59 unit cm³/s

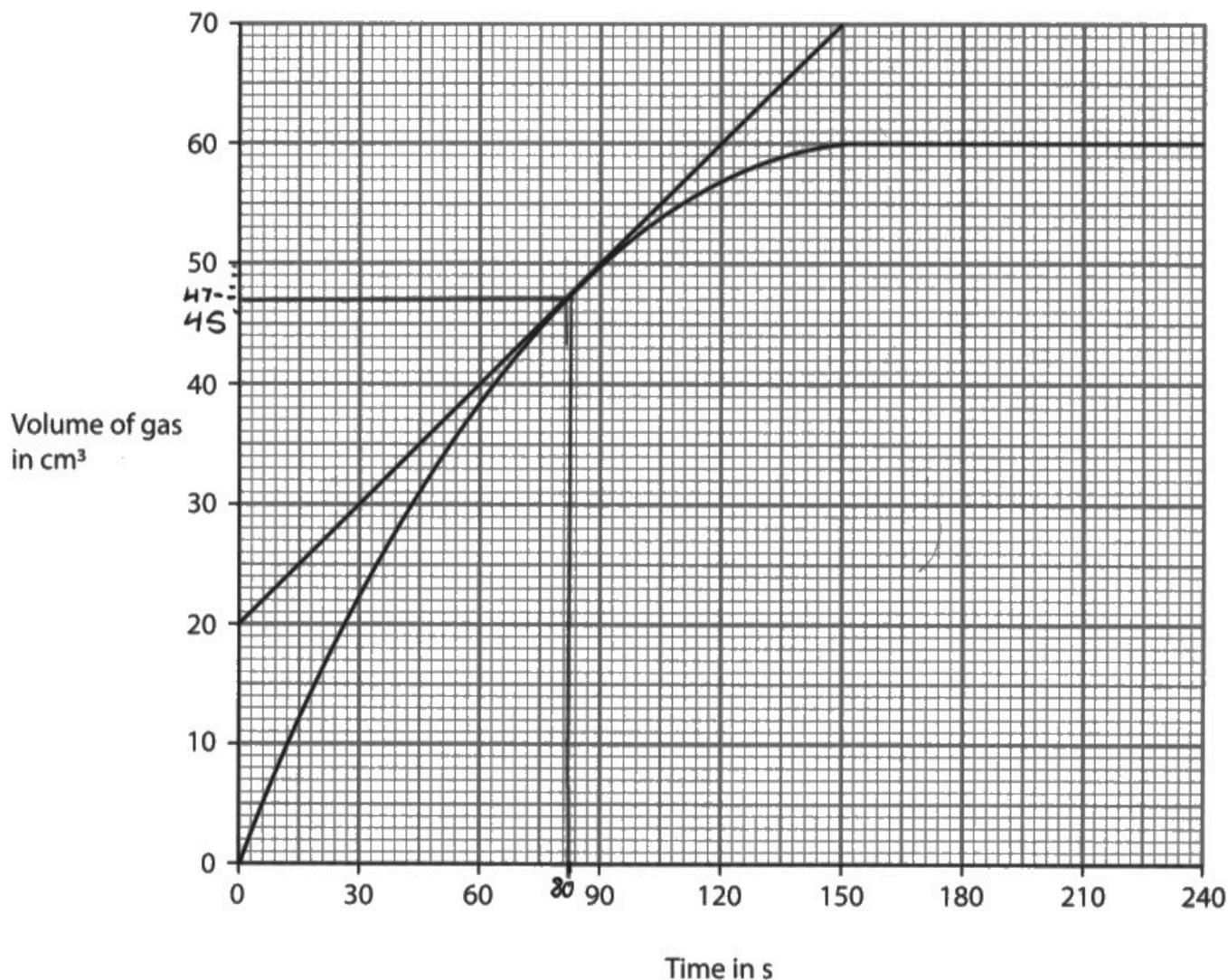


A triangle needs to be drawn to get the correct rate of reaction. However dividing 47 by 80 and finding the correct answer is an error carried forward so one mark can be awarded. The unit is also correct so two marks awarded.



Even if you do not do the triangle you still need to show the working on the graph to gain the second mark.

(b) The graph shows the volume of gas collected in the syringe during the experiment.



(i) A tangent to the curve has been drawn at a time of 80 s.

Use the tangent to calculate the rate of reaction at 80 s.

Show your working on the graph.

Give the unit.

$$\text{rate of reaction} = \frac{\text{vol of gas}}{\text{time}} = \frac{47}{80} = 0.5875^{(3)}$$

rate of reaction = 0.6 unit cm/s



This is also dividing 47 by 80 and 0.6 is enough for one mark.
Unfortunately the unit is incorrect so no more marks.



The volume is in cm^3 and the time is in seconds so the unit has to be cm^3/s .

Question 7 (b)(ii)

This question was discriminated well with the full range of marks. Only the best candidates gained all six marks. Many candidates gained three marks and the weaker candidates one mark.

(ii) Explain the shape of the graph in these regions.

(6)

from 0 s to 60 s

The curve is steep. There ~~is~~ is the ~~most~~ greatest concentration of dilute sulfuric acid.

There are the most collisions per unit time from 0 s to 60 s. So the rate of reaction is the fastest.

from 60 s to 150 s

The curve is less steep. The gradient of the curve is the rate of reaction. The ~~re~~ rate of reaction decreases as the concentration of sulfuric acid decreases.

from 150 s to 240 s

It is a straight line. The reaction is stop because the volume stays constant.

All sulfuric acid is reacted.



This is a very good answer which gains all six marks. The curve is steep, which wouldn't score alone, but the curve then stated that it was less steep so there was a comparison so marking points 1 and 3 were awarded. There is the greatest concentration of sulfuric acid for marking point 2 and could also have been awarded for most collisions per unit time. As the concentration of sulfuric acid decreases was enough for marking point 4 and the reaction stops and all the sulfuric acid reacted is enough for marking points 5 and 6.



This is an explanation, so link the shape of the curves and the reasons why the curve is that shape.

(ii) Explain the shape of the graph in these regions.

(6)

from 0 s to 60 s

The gradient is the steepest as reaction has just started, the sulfuric acid and zinc is mostly unreacted.

from 60 s to 150 s

The rate of reaction starts to slow down as more and more of the acid and zinc starts to be used up.

from 150 s to 240 s

The ~~rate~~ reaction stops as the gradient is flat. Therefore the sulfuric acid is used up and there's no more reactions.



The first marking point is the steepest gains the first mark, but no explanation as why it is the steepest. There is no mention of it becoming less steep and just stating the reaction slows down does not score. The acid and zinc starts to be used up is too vague. The reaction stops and the sulfuric acid is used up is enough for the marks 5 and 6.



Make sure you give an explanation in each section of the three areas.

Question 8 (a)

This question differentiated well. Only a small minority gained all four marks. The majority gained two or three marks. The marking point two was rarely seen, but there were four marks out of five, so some candidates could score four marks. Most candidates scored the first and third marking points.

8 This question is about crude oil.

(a) Describe how crude oil is separated into fractions by fractional distillation.

(4)

First the crude oil is vaporised, this makes all the crude oil turn into gas. The crude oil gas then enters the fractionating column from the bottom. The fractionating column has a temperature gradient and so it is hotter at the bottom and colder at the top. The molecules rise up the fractionating column until they reach their boiling point where they condense. ~~the~~ All the molecules that condense between 2 temperatures are collected and this is known as a fraction. Molecules in the same fraction have the similar ~~same~~ chain length, volatility and melting points.



This was a very good answer and all four marks could be awarded. The candidate stated that crude oil was vapourised and crude oil gas entered at the bottom of the fractionating column. They also mentioned the temperature gradient, hotter at the bottom and cooler at the top. The molecules rise up the column and condense at their boiling points is enough for the fifth marking point.



This is a description so you need to state how crude oil can be separated into fractions by fractional distillation.

8 This question is about crude oil.

(a) Describe how crude oil is separated into fractions by fractional distillation.

(4)

Crude oil is heated and then is split into fractions by fractional distillation and it is non-renewable and can be used as petrol.



ResultsPlus
Examiner Comments

Crude oil is heated and gained the first mark. However it states that it splits into fractions which is just a statement and not creditworthy so just one mark is awarded.



ResultsPlus
Examiner Tip

This needs to be a description of how fractional distillation can be separated into fractions. At least four points need to be mentioned to gain the marks.

Question 8 (b)

This question discriminated well with a whole range of marks. Around a third of the candidates did not understand the question and scored no marks. Around 20% understood the question and gained all four marks. The third marking point was rarely scored but there were still five marks so all four marks could be awarded.

(b) Some of the products of fractional distillation are then cracked.

This equation represents a reaction that occurs during cracking.



Explain why cracking is an important process in the oil industry.

(4)

Cracking ~~helps~~ breaks long-chain alkanes into shorter chain alkanes and alkenes. There is greater demand for short chain alkanes as they are more flammable and can be ~~used~~^{burned} for fuel more easily. Alkenes are useful to make polymers, including plastics. Long-chain alkanes require very high temperatures to combust and are therefore not easy-to-use.



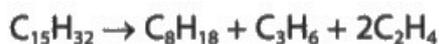
This is a good answer that scored all four marks. Cracking stated that shorter chain alkanes and alkenes were formed. This scored marking points 2 and 4. There is greater demand for short chain alkanes gained the first marking point. They also stated that alkanes are more flammable and alkenes make polymers so marking points 3 and 5 can also be awarded.



This is an explanation why cracking is important. Read the question carefully. The equation can help you to explain why cracking is important.

(b) Some of the products of fractional distillation are then cracked.

This equation represents a reaction that occurs during cracking.



Explain why cracking is an important process in the oil industry.

(4)

It can produce long-chain alkane and short-chain alkene.
The uses of short-chain alkene is much but the resources of them are not enough.
Short-chain alkene can be used as the fuels
fuel is important in the oil industry.



ResultsPlus
Examiner Comments

The candidate mentioned that short chain alkenes were produced, which gained the fourth marking point. Unfortunately there was no mention of greater demand or short chain alkanes. There was a statement which said alkenes were used as fuels, which is not correct so no more marks can be awarded.



ResultsPlus
Examiner Tip

You need to mention short chain alkanes as well. You can see both the alkanes and alkenes in the equation.

Question 8 (c)

Many candidates did not realise sulfur was an impurity in crude oil and consequently often lost all three marks. There were many answers about carbon dioxide and global warming which was not relevant and not creditworthy. A few also mentioned carbon monoxide and nitrogen in crude oil, which lost the first marking point. Those that mentioned sulfur often gained three marks as they also realised that sulfur dioxide was formed which contributed to acid rain.

(c) Fuels obtained from crude oil may contain impurities.

Explain how an impurity found in fuels can cause an environmental problem.

(3)

Fuels sometimes contain sulphur impurities. When fuels are
burnt the sulphur reacts with oxygen to form sulphur dioxide
which emits into the atmosphere and combines with rainwater
(dissolves)
producing acid rain which leaches minerals out of soils, kills
plants and trees, kills aquatic animals and can etc.



ResultsPlus
Examiner Comments

This is a good answer. Fuels contain sulfur and reacts with oxygen to form sulfur dioxide and produces acid rain. This is enough for all three marks.



ResultsPlus
Examiner Tip

Impurities in crude oil needs to be a solid, not a gas and sulfur is the impurity.

(c) Fuels obtained from crude oil may contain impurities.

Explain how an impurity found in fuels can cause an environmental problem.

(3)

Sometime ^{Fuels} ~~papers~~ can that are
Produced from crude oil may
Contain Sulphur which can be evapor-
ated during the process of fractional
distillation and then dissolve into
water and cause acid rain.



ResultsPlus
Examiner Comments

This candidate realises that sulfur is an impurity but there was no mention of sulfur dioxide forming so the second mark cannot be awarded. They still stated that causes acid rain, which can be awarded as long as sulfur has been mentioned.



ResultsPlus
Examiner Tip

Make sure that sulfur burns to produce sulfur dioxide, rather than just stating acid rain forms as sulfur does not dissolve in rain water.

(c) Fuels obtained from crude oil may contain impurities.

Explain how an impurity found in fuels can cause an environmental problem.

(3)

The this causes global warming by combustions.
Causing problems in atmosphere. This creates
holes in the ozone layer



ResultsPlus
Examiner Comments

This question is about global warming, which is not relevant, as global warming has nothing to do with impurities in crude oil. Also holes in the ozone layer has nothing to do with global warming.



ResultsPlus
Examiner Tip

Explanation of impurities have been mentioned twice, so make sure you start by mentioning the impurities.

Question 9 (a)(i)

The majority got all three correct. Ammonium sulfate was the one that was less well done.

- 9 (a) The table shows the formulae of some positive and negative ions, and the formulae of some compounds containing these ions.

	Cl^-	O^{2-}	SO_4^{2-}
Na^+	NaCl	Na_2O	Na_2SO_4
NH_4^+	NH_4Cl		$(\text{NH}_4)_2\text{SO}_4$
Zn^{2+}	ZnCl_2	ZnO	ZnSO_4

- (i) Complete the table by giving the formulae of the missing compounds.

(3)



ResultsPlus
Examiner Comments

All three had the correct formulae.



ResultsPlus
Examiner Tip

Use the charges to balance the ions. The other examples are there to help you.

- 9 (a) The table shows the formulae of some positive and negative ions, and the formulae of some compounds containing these ions.

	Cl^-	O^{2-}	SO_4^{2-}
Na^+	NaCl	Na_2O	Na_2SO_4
NH_4^+	NH_4Cl		NH_4SO_4
Zn^{2+}	ZnCl_2	Zn_2O_2	ZnSO_4

- (i) Complete the table by giving the formulae of the missing compounds.

(3)



ResultsPlus
Examiner Comments

NaCl is correct but Zn_2O_2 is incorrect and so is NH_3SO_4 so just one mark.



ResultsPlus
Examiner Tip

Do not forget to put NH_4 in brackets and multiply it by 2.

Question 9 (a)(ii)

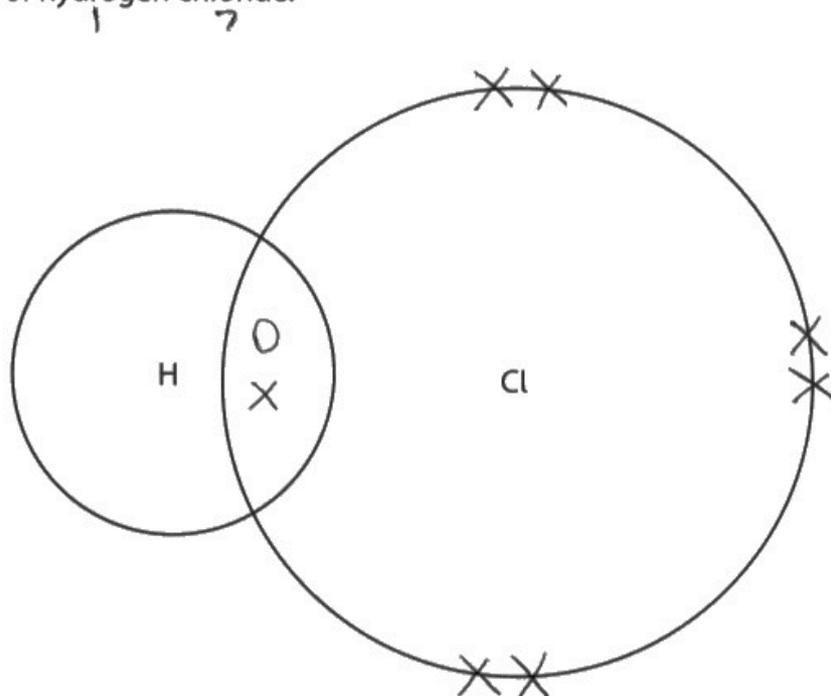
The majority gave the correct answer of zinc sulfate. Wrong answers included zinc sulfide, zinc sulfite, zinc sulfur oxide and zinc sulfuric acid. Sulfate always contains SO_4 .

Question 9 (b)(i)

A large majority gained both marks. Occasionally a few candidates lost the second mark for not having eight around chlorine or an extra electron on hydrogen.

(b) Hydrogen chloride and magnesium chloride have different types of bonding and have different structures.

(i) Complete the dot-and-cross diagram to show the outer shell electrons in a molecule of hydrogen chloride.



ResultsPlus
Examiner Comments

Clear correct answer gains both marks.



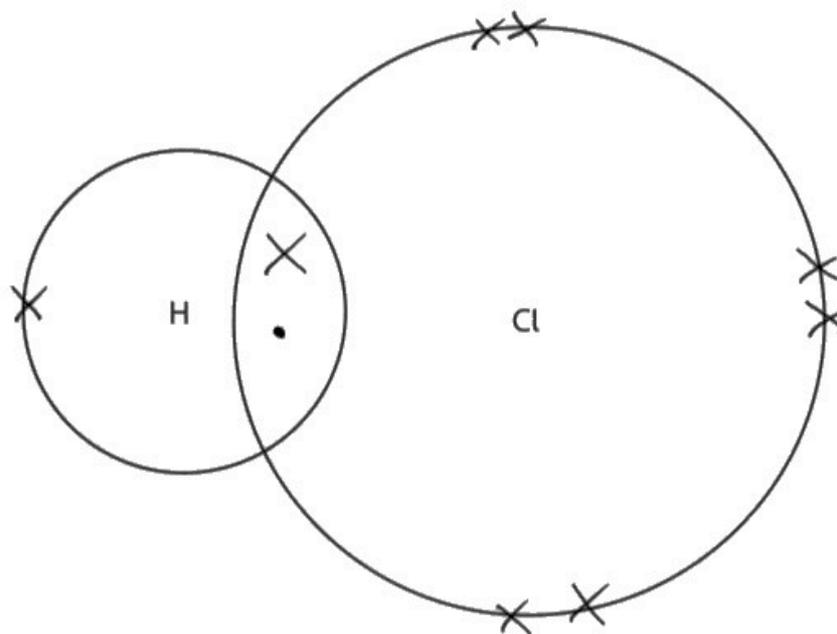
ResultsPlus
Examiner Tip

A good idea to use the dots and crosses and electrons in pairs are easier to check the correct number of electrons.

(b) Hydrogen chloride and magnesium chloride have different types of bonding and have different structures.

(i) Complete the dot-and-cross diagram to show the outer shell electrons in a molecule of hydrogen chloride.

(2)



ResultsPlus
Examiner Comments

Unfortunately an extra electron on hydrogen lost the second marking point.



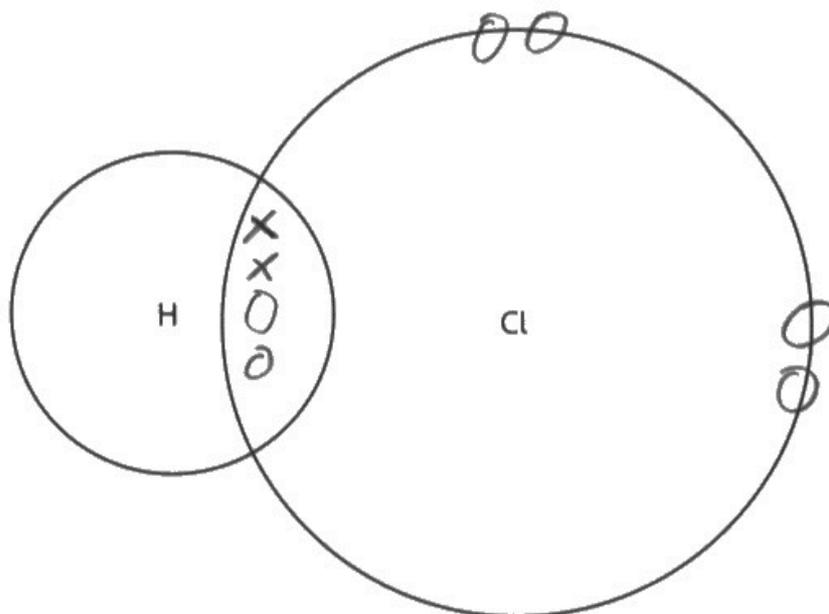
ResultsPlus
Examiner Tip

Only two electrons available in the first shell.

(b) Hydrogen chloride and magnesium chloride have different types of bonding and have different structures.

(i) Complete the dot-and-cross diagram to show the outer shell electrons in a molecule of hydrogen chloride.

(2)



~~Hydrogen~~

~~chloride~~

H₂

Cl

2

7



ResultsPlus
Examiner Comments

No marks here as this is not a double bond so no marks can be awarded as the second marking point is dependent on the first marking point.



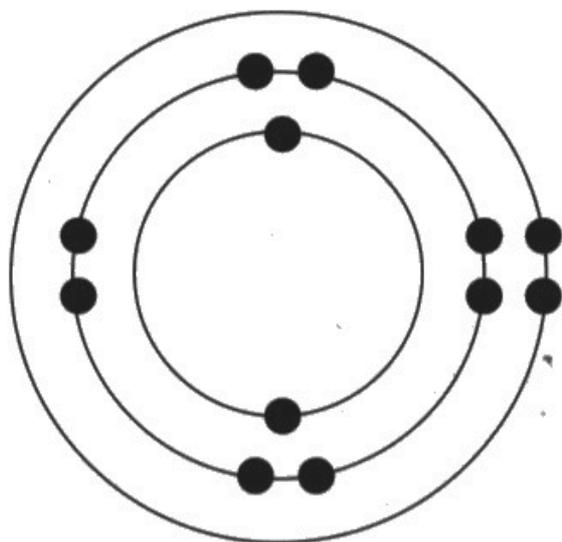
ResultsPlus
Examiner Tip

Should be two electrons on hydrogen and eight electrons on chlorine, including the single bond.

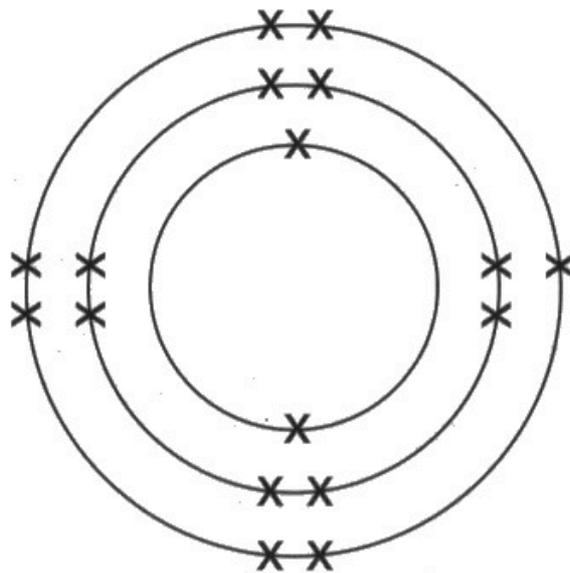
Question 9 (b)(ii)

The majority gained all three marks. Marks 0,1 and 2 were all about the same. Sometimes candidates lost a mark by not showing the inner shells or the charges were missing or incorrect. Some just repeated the same atoms with no transfer of electrons.

(ii) The diagram shows the electronic configuration of a magnesium atom and of a chlorine atom.



magnesium

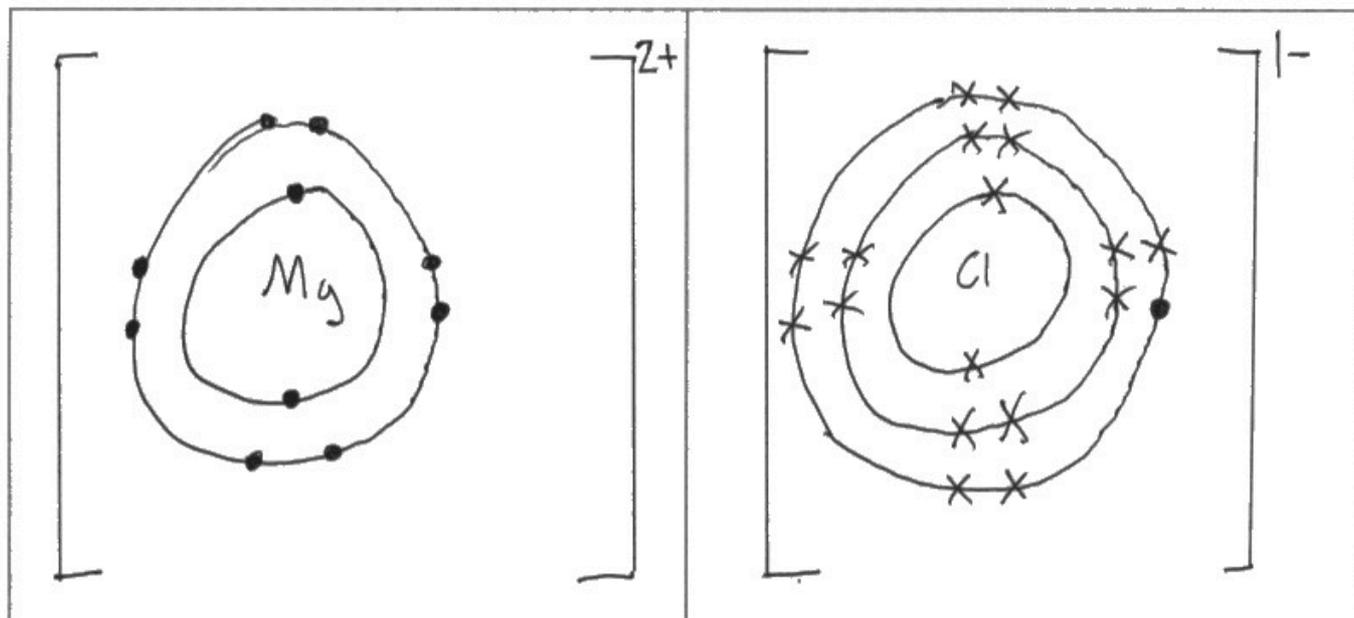


chlorine

Draw the electronic configuration of a magnesium ion and of a chloride ion in the boxes.

Show the charge on each ion.

(3)



magnesium ion

chloride ion

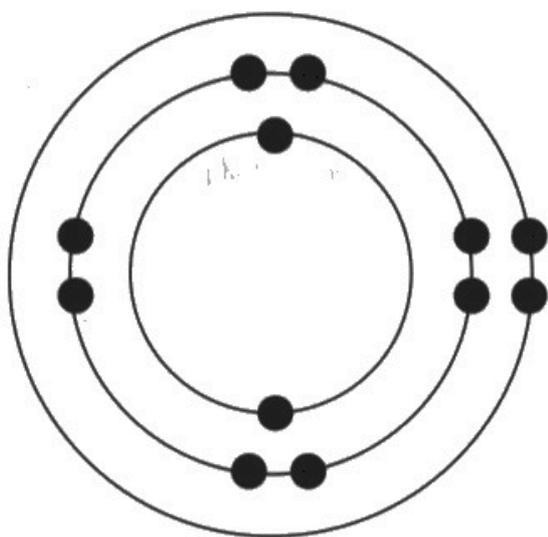


Electrons correct with correct charges on the ions so all three marks can be awarded.

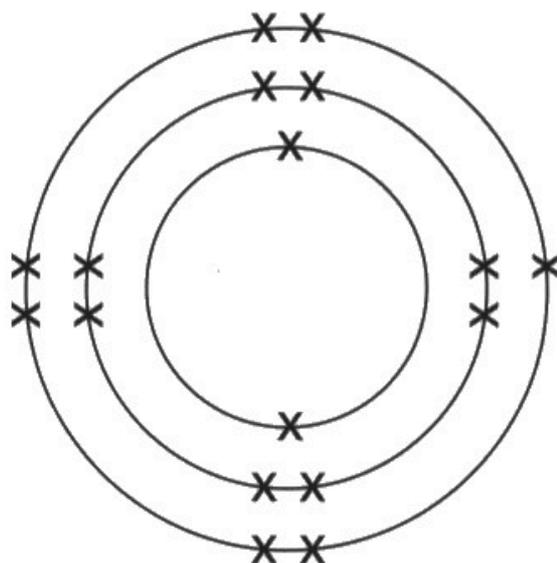


Remember each have 8 electrons on the outer shell to be stable.

(ii) The diagram shows the electronic configuration of a magnesium atom and of a chlorine atom.



magnesium

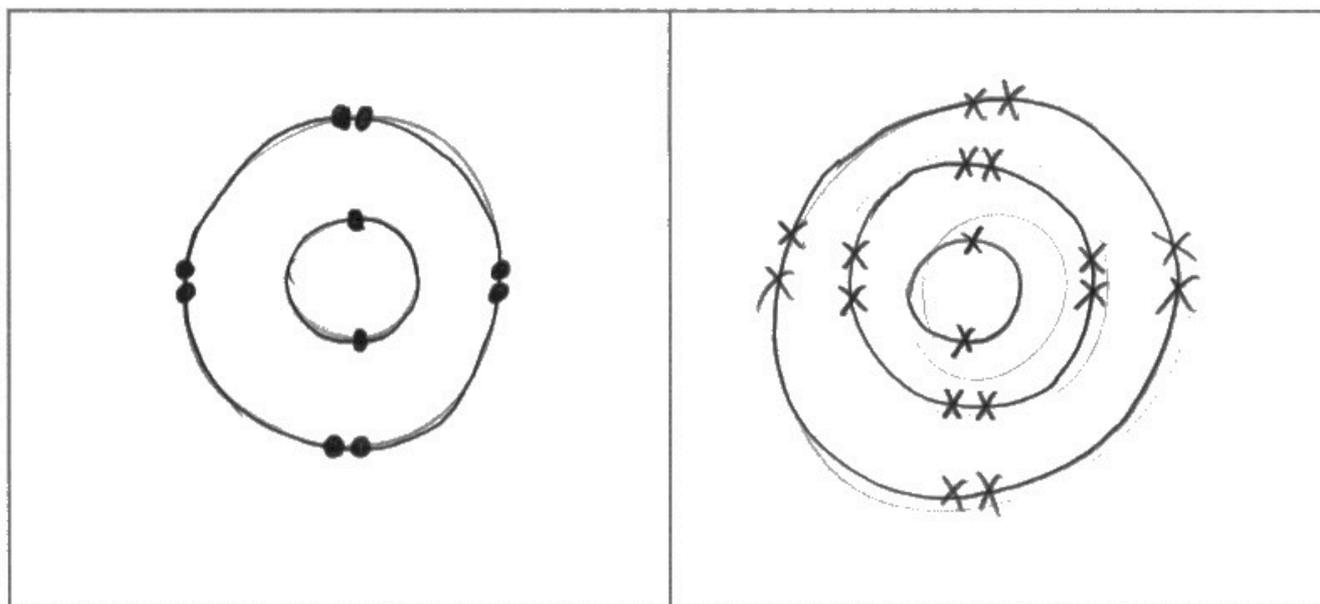


chlorine

Draw the electronic configuration of a magnesium ion and of a chloride ion in the boxes.

Show the charge on each ion.

(3)



magnesium ion

chloride ion

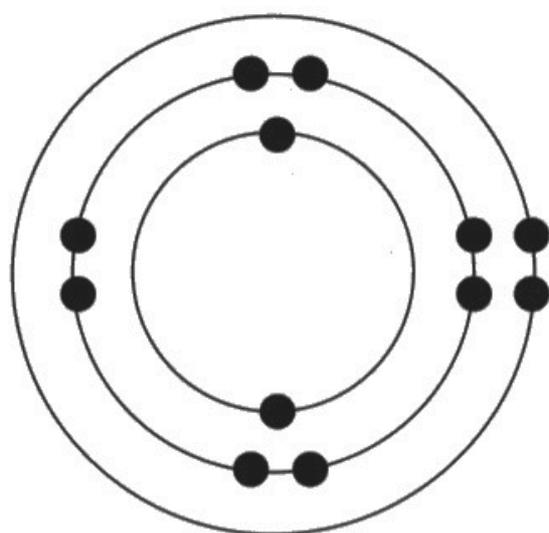


Electrons transferred are correct so two marks, but no charges given so no third mark.

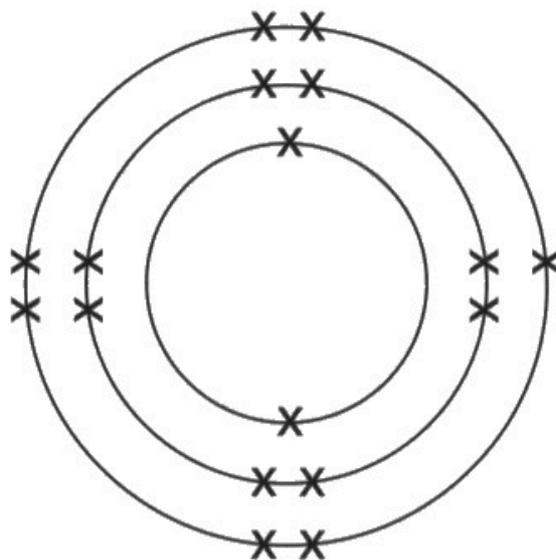


The question asked to show the charges so the third marking point is needed. When two electrons are transferred the charge is $2+$ and only one electron given to chlorine so charge is $1-$.

(ii) The diagram shows the electronic configuration of a magnesium atom and of a chlorine atom.



magnesium

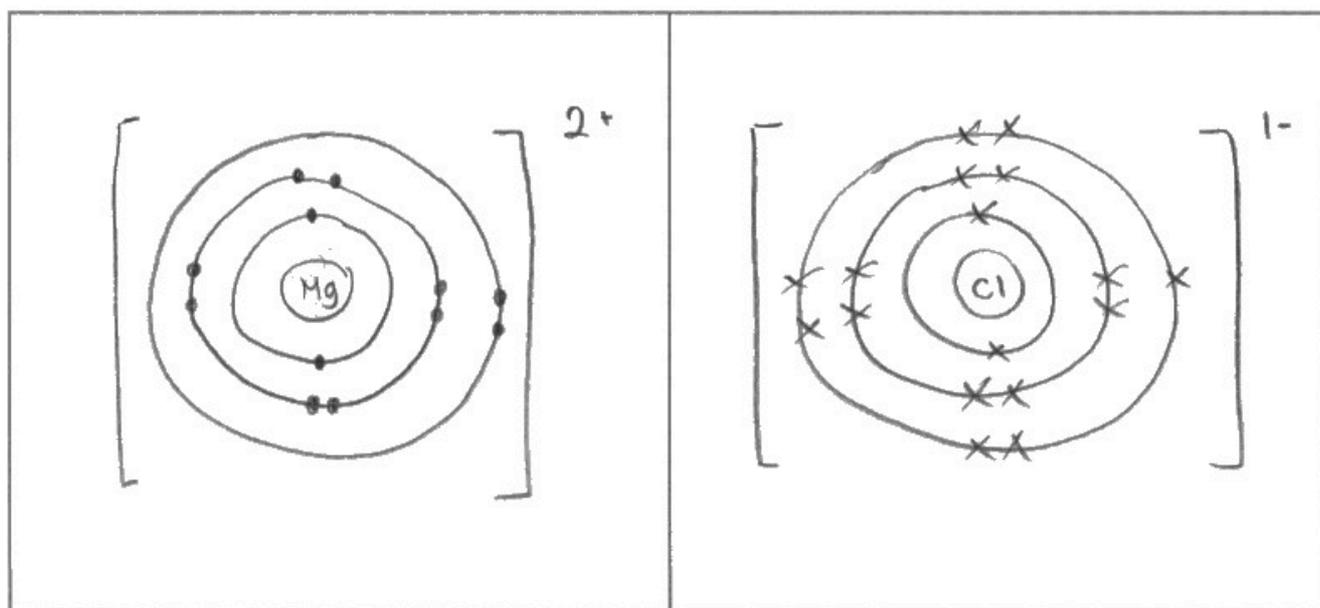


chlorine

Draw the electronic configuration of a magnesium ion and of a chloride ion in the boxes.

Show the charge on each ion.

(3)



magnesium ion

chloride ion



No electrons were transferred so these are just the atoms in the diagrams. Just one mark for the correct charges.



There is no use just copying the two atoms. Electrons must be transferred to gain the marks.

Question 9 (b)(iii)

This question discriminated well with a good range of marks, but only the best candidates had all five marks. Many candidates thought magnesium chloride was covalent or there were intermolecular forces. Many lost the fifth marking point for breaking the bonds in hydrogen chloride rather than the intermolecular forces.

- (iii) Explain why magnesium chloride has a much higher melting point than hydrogen chloride.

Refer to structure and bonding in your answer.

(5)

Magnesium chloride is a giant ionic lattice. There are strong electrostatic forces of attraction between oppositely charged ions. Large amounts of energy is required to overcome these forces.

Hydrogen chloride is a simple molecular structure. There are weak intermolecular forces between molecules. So, less energy is required to overcome these ^{weak} forces.



ResultsPlus
Examiner Comments

This is a very good answer which scored all five marks, as shown in the mark scheme. The structure is well ordered and a very clear answer. There is a comparison between the energy to break the bonds and overcome the forces.



ResultsPlus
Examiner Tip

Read the question carefully and plan your answer in a logical order.

- (iii) Explain why magnesium chloride has a much higher melting point than hydrogen chloride.

Refer to structure and bonding in your answer.

(5)

Magnesium chloride has giant ionic structure and strong ionic bond which take takes more energy to overcome.

Hydrogen chloride has weak intermolecular forces which takes less energy to overcome.



ResultsPlus
Examiner Comments

This is also a clear precise answer and scored four marks. Only one mark was lost as the first marking point did not mention the simple molecular structure of hydrogen chloride.



ResultsPlus
Examiner Tip

You need to refer both bonding and structure and explain why magnesium chloride has a higher melting point than hydrogen chloride to gain all five marks.

- (iii) Explain why magnesium chloride has a much higher melting point than hydrogen chloride.

Refer to structure and bonding in your answer.

(5)

Magnesium ~~is~~ chloride is a giant ionic structure with a large electrostatic force of attraction between oppositely charged ions. Lots of energy is needed to break the bonds. Hydrogen Chloride is a simple covalent bond with weak electrostatic force of attraction so less energy needed to break the bonds.



ResultsPlus
Examiner Comments

This question states that magnesium chloride is a giant ionic structure with large electrostatic forces between oppositely charged ions, which gained two marks, however a simple covalent bond is not acceptable and there was no mention of weak intermolecular forces and less energy to break the bonds was not acceptable so no other marks.



ResultsPlus
Examiner Tip

A simple covalent structure is acceptable but not a simple covalent bond. The covalent bond does not break when it melts, it is the weak intermolecular forces that overcome the forces.

Question 10 (a)

The majority knew the definition and scored both marks. A few candidates lost a mark either not mentioning an alternative pathway or that the activation energy was lowered. Some candidates just wrote about a catalyst speeding up the reaction and is not used up which is not creditworthy.

10 This is the equation for the decomposition of hydrogen peroxide.



The rate of reaction increases when a catalyst of manganese(IV) oxide is added.

(a) Describe how a catalyst increases the rate of a reaction.

(2)

A catalyst provides an alternate pathway with lower activation energy.



ResultsPlus
Examiner Comments

This is the correct definition and scores both marks.



ResultsPlus
Examiner Tip

Learn this definition as it is often tested.

10 This is the equation for the decomposition of hydrogen peroxide.



The rate of reaction increases when a catalyst of manganese(IV) oxide is added.

(a) Describe how a catalyst increases the rate of a reaction.

(2)

It provides an alternative
route for reactions to happen



ResultsPlus
Examiner Comments

It provides an alternative route which is correct but no mention of lower activation energy so only one mark.



ResultsPlus
Examiner Tip

Lower activation energy is needed for the second mark.

10 This is the equation for the decomposition of hydrogen peroxide.



The rate of reaction increases when a catalyst of manganese(IV) oxide is added.

(a) Describe how a catalyst increases the rate of a reaction.

(2)

A catalyst speeds up the rate of a reaction
because it causes more frequent collisions of particles in
a substance



ResultsPlus
Examiner Comments

A catalyst does speed up the rate of reaction and causes more frequent collisions is correct but is not how a catalyst works so this is not creditworthy.



ResultsPlus
Examiner Tip

This needs to describe how a catalyst increases the rate of reaction.

Question 10 (b)(i)

A large majority knew that it was either a conical flask or just a flask. A few candidates mentioned a beaker rather than a flask.

Question 10 (b)(ii)

This question proved difficult with around half the answers scoring no marks. A common error was to say doing it with and without a catalyst and state which took less time, which was not creditworthy. A few candidates mentioned the fact that it weighed the same at the beginning and the end which scored the third marking point, but did not either filter or dry the catalyst so was limited to one mark. Some did filter the mixture but did not dry the catalyst so lost the second marking point.

- (ii) The student waits until the hydrogen peroxide solution completely decomposes.

Describe how the student could then show that the manganese(IV) oxide was a catalyst and not a reactant.

(3)

The student could filter and dry the manganese(IV) oxide and measure the mass, if the mass stays the same before and after, that shows there was no change or reaction in the manganese(IV) oxide.



ResultsPlus
Examiner Comments

This is a good answer and gains all three marks. Filtering and drying the manganese(IV) oxide scored two marks and measured the mass before and after stayed the same was enough for the third marking point.



ResultsPlus
Examiner Tip

To show that this is a catalyst you need to filter and dry the catalyst and show that the mass stays the same.

- (ii) The student waits until the hydrogen peroxide solution completely decomposes.

Describe how the student could then show that the manganese(IV) oxide was a catalyst and not a reactant.

(3)

As the catalyst will not be used up in the reaction, an insoluble solid. Filter the Manganese oxide from the decomposed hydrogen peroxide solution, showing that Manganese oxide is still present.



ResultsPlus
Examiner Comments

The candidate filtered the manganese oxide for one mark, but no mention of drying and no mention of weighing and that the mass stays the same, so no more marks.



ResultsPlus
Examiner Tip

If the catalyst was wet it would not be the same mass, so it must be dried and reweighed.

Question 11 (a)

Not particularly well answered, as less than half the candidates gave a correct answer. Just stating it is made up of carbon is not enough, must state only one type of atom or only made up of carbon atoms.

Question 11 (b)

As this is a standard definition, it was not answered particularly well, as less than half the candidates scored both marks. Marks were lost by not sharing a pair of electrons and a few candidates lost a mark for writing nucleus rather than nuclei. Some vague answers just sharing two non-metals, which was not creditworthy. Occasionally intermolecular forces was mentioned, confusing a covalent bond.

(b) Describe the forces of attraction in a covalent bond.

There's strong attraction force between cations and ⁽²⁾ electrons and also nucleus of ~~both element~~



ResultsPlus
Examiner Comments

This mentioned cations and electrons which implies they are thinking about metallic bonding not covalent bonding. Also they did mention the nucleus but needs to be nuclei, so no marks can be awarded.



ResultsPlus
Examiner Tip

Read the question carefully as there are no cations present in a covalent bond, and there must be attraction between nuclei, not nucleus.

(b) Describe the forces of attraction in a covalent bond.

(2)

et There is an electrostatic force between positive nuclei and shared pair of negative electrons.



ResultsPlus
Examiner Comments

This is a clear answer which gains both marks.



ResultsPlus
Examiner Tip

Learn this definition as it is often tested.

Question 11 (c)(i)

The majority gained both marks knowing that delocalised electrons moved through the structure. Some candidates lost marks for either not mentioning delocalised electrons or just said electrons were free, or carried a current, but did not state that electrons were free to move.

(c) (i) Explain why graphite conducts electricity.

(2)

it has delocalised electrons which are free to
move around and carry a charge



ResultsPlus
Examiner Comments

Both marks were awarded as it has delocalised electrons which are free to move.



ResultsPlus
Examiner Tip

You need to mention delocalised electrons to gain the first marking point.

(c) (i) Explain why graphite conducts electricity.

(2)

There are free electrons around the graphite structure



ResultsPlus
Examiner Comments

There is no mention of delocalised electrons and free electrons is not enough as electrons need to move or flow to gain the second marking point so no marks can be awarded.



ResultsPlus
Examiner Tip

Electrons have to be free to move or flow to get the second mark.

Question 11 (c)(ii)

This question discriminated well with very few candidates gaining all four marks. Many however did score three marks, usually missing the second marking point. A few candidates lost the first two marks by mentioning intermolecular forces in diamond. The third and fourth marking points scored most often.

(ii) Explain why diamond is hard but graphite is soft.

(4)

Graphite is softer than diamond because the graphite has layer structure, different layers of graphite can slide over each other. Diamond's structure is different from graphite, is harder than graphite.



ResultsPlus
Examiner Comments

Just stating diamond is hard and graphite is soft is not creditworthy as the stem is in the question. They did however score the third and fourth marking points for stating that graphite has layers which can slide over each other.



ResultsPlus
Examiner Tip

There is no point mentioning diamond is hard and graphite is soft as this is in the stem of the question.

(ii) Explain why diamond is hard but graphite is soft.

(4)

~~Diamond~~ Diamond is hard as diamond has giant covalent structure. Each carbon atom has covalently bonded with four other ~~carbon~~ carbon atoms. There are numerous strong covalent bonds between the carbon atoms. A larger amount of energy is required to break the ~~numerous~~ numerous strong ~~covalent~~ covalent bonds. Graphite is soft as the structure of graphite is in layers. ~~Each layer~~ The layers can slide over one another. There are only weak forces between the layers. ^{only a} smaller amount of energy is required to overcome the ~~weak~~ weak forces.



ResultsPlus
Examiner Comments

This is a good answer which scored all four points. A giant covalent structure is not creditworthy as this is true for both diamond and graphite, however the first marking point scored as each carbon atom bonded to four other carbon atoms. They also stated that a large amount of energy was required to break the strong covalent bonds, for the second marking point. Graphite is in layers that can slide over one another is enough to gain the third and fourth marking point.



ResultsPlus
Examiner Tip

Make sure there are two points to explain why diamond is hard and two points to explain why graphite is soft. Do not mention intermolecular forces here as marks can be lost.

Question 11 (d)

Those candidates who knew what to do often scored three marks, or sometimes two for not giving a final integer. Many others however just divided the numbers in standard form and were not sure what to do after that, so they often scored zero.

(d) Another form of carbon has molecules with the formula C_x

x represents the number of carbon atoms in each molecule.

Each molecule of C_x has a mass of 1.40×10^{-21} g.

One mole of C_x contains 6.02×10^{23} molecules.

Calculate the M_r of C_x and the value of x

[for carbon, $A_r = 12$]

$$\text{mass of } C_x \text{ (per mole)} \rightarrow \frac{(1.4 \times 10^{-21}) \times (6.02 \times 10^{23})}{1} = 842.8 \text{ g} \quad (3)$$

$$M_r \text{ of } C_x \rightarrow \frac{842.8 \text{ g}}{1 \text{ mol}} = 842.8$$

$$x \rightarrow \frac{842.8}{12}$$

$$\approx 70$$

$$M_r = \underline{842.8}$$
$$x = \underline{70}$$



ResultsPlus
Examiner Comments

This was a good answer, showing all the working and writing the correct answers on the answer lines so all three marks were awarded.



ResultsPlus
Examiner Tip

Always show your working. If you have made a mistake an error could be carried forward.

(d) Another form of carbon has molecules with the formula C_x
 x represents the number of carbon atoms in each molecule.

Each molecule of C_x has a mass of 1.40×10^{-21} g.

One mole of C_x contains 6.02×10^{23} molecules.

Calculate the M_r of C_x and the value of x

[for carbon, $A_r = 12$]

(3)

$$\text{mol} = \frac{\text{mass}}{M_r}$$

$$M_r = \text{mass} \times \text{mol}$$

$$= 1.40 \times 10^{-21} \times 6.02 \times 10^{23}$$

$$M_r = 842.8$$

$$\frac{842.8}{12} = 70.23$$

$$M_r = \underline{842.8}$$
$$x = \underline{70.23}$$



ResultsPlus
Examiner Comments

The first marking point was awarded by multiplying the two answers in standard form. Also dividing 842.8 by 12 scored the second marking point. However 70.23 is not an integer so cannot be awarded.



ResultsPlus
Examiner Tip

x must be an integer to gain the third marking point.

Question 12 (a)

A large majority balanced the equation correctly.

Question 12 (b)(i)

A large majority answered this question correctly. A few candidates lost the mark for not mentioning that the mass does not change. Just stating data stays the same or results stay the same was not creditworthy.

Question 12 (b)(ii)

Just less than half of the candidates scored all three marks and most others scored zero with a few scoring 1 or 2. The mass of chlorine was not always subtracted to give a mass of 1243kg and occasionally 1267kg was used twice. However the ratio was still approximately 1:5 so some marks were sometimes awarded. Often candidates used kilomoles rather than just moles, but were not penalised.

(ii) Use the data to show that the formula of tantalum chloride is TaCl_5

[for tantalum, $A_r = 181$ for chlorine, $A_r = 35.5$]

$$181 + 35.5 \times 5 = 357.5$$

$$2510 - 1267 = 1243$$

(3)



ResultsPlus
Examiner Comments

One mark was awarded for the subtraction but nothing else was creditworthy.



ResultsPlus
Examiner Tip

This was a 'show that' question so the ratio of moles needed to score the third marking point.

(ii) Use the data to show that the formula of tantalum chloride is TaCl_5

[for tantalum, $A_r = 181$ for chlorine, $A_r = 35.5$]

(3)

~~181~~ ~~35.5~~

$$2510 - 1267 = 1243$$
$$\frac{1243}{181} = 6.867 \dots \quad \frac{1243}{35.5} = 35.01$$
$$7 : 35$$
$$1 : 5$$



ResultsPlus
Examiner Comments

The first mark was awarded for the subtraction, but instead of 1267, 1243 was used twice, so the second mark was not awarded. However the ratio was approximately 7:35 or 1:5 so the third mark could be awarded.



ResultsPlus
Examiner Tip

All working must be shown if this is a 'show that' question.

(ii) Use the data to show that the formula of tantalum chloride is TaCl_5

[for tantalum, $A_r = 181$ for chlorine, $A_r = 35.5$]

(3)

$$2510 - 1267 = 1243$$

	$\frac{\text{Ta}}{1267}$	$\frac{\text{Cl}}{1243}$
g:	$\frac{1267}{181}$	$\frac{1243}{35.5}$
Mr:		
n:	$\frac{7}{7}$	$\frac{35.0}{7}$
	= 1	= 5

$$\text{Ta} = 1$$

$$\text{Cl} = 5$$



ResultsPlus
Examiner Comments

This was a clear answer that scored all three marks. The candidate was not penalised for using kilomoles.



ResultsPlus
Examiner Tip

Set out the calculation as shown and show all your working.

Question 12 (c)(i)

Around half the candidates scored zero. The others scored one or two marks. A common error was to state that tantalum loses oxygen rather than tantalum oxide loses oxygen. Some candidates mentioned loss and gain of electrons but this was not creditworthy. Some just stated that reduction and oxidation happened at the same time, which was also not creditworthy.

- (c) Another method of extracting tantalum is by reacting tantalum(V) oxide with carbon.

This is the equation for the reaction.



- (i) Explain why this is a redox reaction.

(2)

Because Ta loses oxygen so reduction
and carbon gains an oxygen so oxidised



ResultsPlus
Examiner Comments

This candidate lost the first mark for stating that Ta loses oxygen and is reduced rather than tantalum oxide loses oxygen and is reduced. However the second mark can be awarded for carbon gaining oxygen and is oxidised.



ResultsPlus
Examiner Tip

This is a common error. Must be tantalum oxide not just tantalum when referring to reduction and losing oxygen.

- (c) Another method of extracting tantalum is by reacting tantalum(V) oxide with carbon.

This is the equation for the reaction.



- (i) Explain why this is a redox reaction.

(2)

Carbon has been oxidised as it has gained oxygen and tantalum oxide has lost oxygen so it has been reduced.



ResultsPlus
Examiner Comments

This is a clear answer and scored both marks.



ResultsPlus
Examiner Tip

Make sure you state the species that have been oxidised and reduced and also that the species have lost and gained oxygen.

Question 12 (c)(ii)

This question discriminated well with all marks represented. Around 50% of candidates scored both marks but a fair number lost the second mark as they found the moles of carbon but stopped there. A few candidates lost marks due to incorrect rounding.

(ii) 2000 mol of tantalum(V) oxide is heated with 500 000 g of carbon.

Show by calculation that the carbon is in excess.

[for carbon, $A_r = 12$]

$$2000 \times 5 = 10000 \text{ mol} \quad (2)$$

$$\text{mass} = \text{moles} \times \text{mr}$$

$$\text{mass} = 10000 \times 12$$

$$= 120,000$$

only 120,000g needed \therefore 500,000g is excess



ResultsPlus
Examiner Comments

This is a clear answer and scores both marks.



ResultsPlus
Examiner Tip

This clearly shows that the mass of carbon is in excess.

(ii) 2000 mol of tantalum(V) oxide is heated with 500 000 g of carbon.

Show by calculation that the carbon is in excess.

[for carbon, $A_r = 12$]

(2)

$$\frac{500000}{12} = 41666.7$$

$$1 : 5 \\ 2000 : 10000$$

only 10000 mol needed

$$41666.7 > 10000 \quad \therefore \text{excess}$$



ResultsPlus
Examiner Comments

This is an alternative method that also scored both marks.



ResultsPlus
Examiner Tip

This answer clearly shows that the moles of carbon is in excess.

(ii) 2000 mol of tantalum(V) oxide is heated with 500 000 g of carbon.

Show by calculation that the carbon is in excess.

[for carbon, $A_r = 12$]

mass	500,000
no. of moles	41666.7
M_r	12

$$\frac{\text{mass}}{\text{no} \mid M_r} \quad (2)$$
$$\frac{500000}{12} = 41666.67$$

therefore Carbon is in excess as it is $> 2000\text{mol}$.



ResultsPlus
Examiner Comments

This was the first marking point, but the answer stopped there, so no marks could be awarded.



ResultsPlus
Examiner Tip

Two stages are required to score both marks.

Question 12 (c)(iii)

This also discriminated well as all marks were represented. Almost 50% of candidates scored both marks, but a significant number scored one mark for failing to multiply the moles by two.

- (iii) Calculate the maximum mass, in grams, of tantalum that can be obtained from 2000 mol of tantalum(V) oxide.

[for tantalum, $A_r = 181$]

(2)

$$2000 \times 2 = 4000$$

$$4000 \times 181 = 724\,000$$

mass = 724 000 g



ResultsPlus
Examiner Comments

A clear answer scoring both marks.



ResultsPlus
Examiner Tip

Use the equation to help answer the calculation.

- (iii) Calculate the maximum mass, in grams, of tantalum that can be obtained from 2000 mol of tantalum(V) oxide.

[for tantalum, $A_r = 181$]

(2)

$$\text{Mass} = M_r \times \text{moles}$$
$$362000 \quad 181 \times 2000$$

$$\text{mass} = \underline{\underline{362000}} \text{ g}$$



ResultsPlus
Examiner Comments

This candidate did not use the equation and forgot to multiply the moles by two. However the second mark can be scored for the error carried forward.



ResultsPlus
Examiner Tip

Do not forget to multiply the moles by two.

Paper Summary

Based on their performance on this paper, candidates should:

- Learn the standard definitions as they are often tested.
- Not waste time repeating the stem in the question as this is not creditworthy.
- Make sure you read the questions carefully as there are clues in some of the questions.
- Make sure you show **all** the working in a 'show that' question or marks will be lost.
- Remember that core practicals are often tested so do not overlook them.
- Make sure when explanations are given that you link each statement with a linked explanation.
- Remember when asked to show working on a graph that marks will be lost if you do not show any working.

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>

