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Examiners' Report
June 2023

Int GCSE Single Science

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June 2023

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Introduction

Many candidates found this paper difficult and there were a lot of unanswered questions. Some candidates lacked basic knowledge, so could not access a lot of the more demanding marks. Nevertheless, the paper discriminated well and there was a good range of marks overall.

Candidates clearly understood atomic structure in Question 1, although there was some confusion with groups, periods and isotopes.

Question 2 showed a good understanding of experiments to determine the percentage of oxygen in a mixture of gases; in this case, a mixture of oxygen and an inert gas rather than air.

Many candidates found Question 3 more challenging and many struggled with the method for chromatography and describing how to calculate an R_f value.

Candidates did better than expected with the observations in Question 4, but many struggled to explain the final colour of the indicator.

The topic of Rates of Reaction was fairly well understood in Question 5, but many candidates struggled to explain how decreasing the rate of a reaction would alter a graph.

Candidates coped very well with the calculation in Question 6, but few could describe how the combustion of octane causes acid rain.

Many candidates could give the meaning of **covalent bond** in Question 7, but the differences between giant covalent and simple molecular structures was very poorly understood.

Question 1 (a)(i)

Most candidates correctly identified the nucleus.

Question 1 (a)(ii)

Most candidates got two marks here, but there was some confusion between periods and groups. The most common mistake was to have the numbers the wrong way around.

Question 1 (a)(iii)

A lot of candidates answered Q01(a)(iii) incorrectly. Many know that an ion has a full outer shell of electrons, but few knew that B^{3+} had 3 fewer electrons than atoms of boron. Common incorrect answers included 11.

Question 1 (b)

(b) There are two common isotopes of boron.

$^{10}_{5}B$ $^{11}_{5}B$

In terms of sub-atomic particles, give one similarity and one difference between these isotopes.

(2)

similarity

they have the same atomic number

difference

and different atomic mass

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Examiner Comments

Read the question twice, then highlight what's important.

If the question asks for sub-atomic particles, make sure you refer to them in the answer.

Question 2 (a)

Many candidates scored a mark in this question as they were familiar with other similar experiments.

(a) State how the results show that all the oxygen has reacted.

(1)

Because each minute the gas in the tube was constantly decreasing

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Examiner Comments

Focus on the results in the table. The volume decreases as the oxygen is reacting. The last three results are the same because all the oxygen as reacted.

Question 2 (b)

A number of candidates scored 3 marks here. A number thought air was in the tube rather than a mixture of oxygen and an inert gas, so there were quite a lot of answers around 20%. A number lost marks for incorrectly rounded answers or answers not given to 1 decimal place.

(b) Use the results to calculate the percentage of oxygen by volume in the mixture of oxygen and helium.

Give your answer to 1 decimal place.

(3)

$51.7 - 43.8 =$

$\frac{7.9}{51.7} \times 100 =$

percentage = 15.28 %

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Examiner Comments

Read the question. Either highlight '1 decimal place' in the question or write 1dp next to the answer line.

(b) Use the results to calculate the percentage of oxygen by volume in the mixture of oxygen and helium.

Give your answer to 1 decimal place.

(3)

$$\frac{51.7-43.8}{51.7}$$

percentage = 15.2 %

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Examiner Comments

Take care not to lose marks for incorrectly rounded answers. The working is correct here, but the answer rounds to 15.3% not 15.2%

Question 2 (c)

Most candidates correctly calculated the M_r of P_4O_6.

Question 3 (a)

Most candidates scored 2 marks here. There was some confusion between fractional distillation and simple distillation. Some candidates ticked multiple boxes and did not score a mark for that row.

Question 3 (b)

Many candidates clearly understood how to separate rock salt, but lost marks for poorly expressed answers.

(b) Rock salt is a mixture of sand and salt.

Salt is soluble in water.

Describe a method to separate the sand and the salt from a sample of rock salt.

(3)

fiter the Sand by using some sort of siv and then ~~to boile~~ ~~boil~~ boil the water to get really hot

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Examiner Comments

Use the information in the question. Line space is important here.

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Examiner Tip

Use bullet points in answers.

- Add water to the rock salt and stir.
- Filter the sand from the salty water.
- Heat the salty water until crystals of salt form.

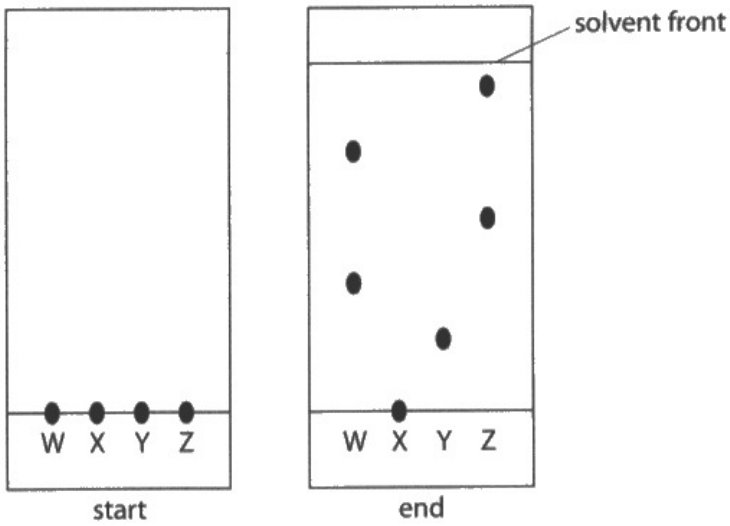
Question 3 (c)(i)

Candidates were clearly familiar with chromatography and knew the method. Reading the question was a problem here and a lot of answers included unnecessary detail. A number of candidates described how to calculate an R_f value.

(c) A student uses paper chromatography to separate the dyes contained in food colourings.

The student places spots of four known food colourings, W, X, Y and Z, on the chromatography paper.

The diagram shows the chromatography paper at the start and at the end of the experiment.



(i) Describe how the student should complete the experiment after placing the four spots on the paper.

(3)

He should measure from the first line then to the last one and then how far the ~~dot~~ spot moved then devide the length from line to line by how far the ~~d~~spot moved and then they can see which one is the most solvent

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Examiner Comments

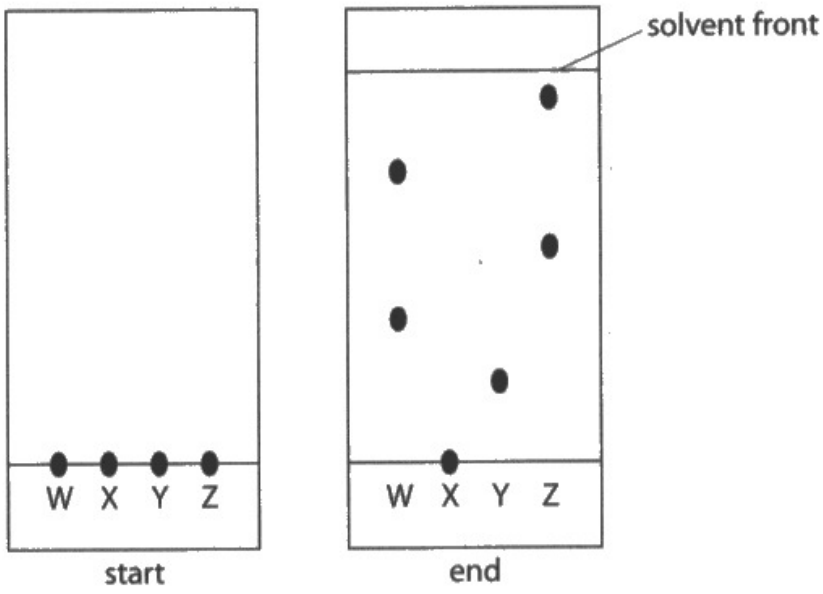
Make sure you answer the question!

This was asking how to complete the method, not how to calculate an R_f value.

(c) A student uses paper chromatography to separate the dyes contained in food colourings.

The student places spots of four known food colourings, W, X, Y and Z, on the chromatography paper.

The diagram shows the chromatography paper at the start and at the end of the experiment.



(i) Describe how the student should complete the experiment after placing the four spots on the paper.

(3)

They should draw a baseline in pencil and ~~fill~~ put the paper in a beaker ~~contain~~ containing water, they should then wait for the dyes (four spots) to come up and then they should bring out the paper and let it dry. The amount of water in the beaker should not be to be above the baseline.

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Examiner Comments

Focus on the question. There was no credit here for any description of a method before placing the dots on the paper.

Use bullet points in the answer.

- Add solvent to a beaker.
- Suspend the paper in the beaker, so the solvent is below the level of the spots.
- Wait until the solvent gets close to the top of the paper.
- Let the paper dry.

Question 3 (c)(ii)

Most candidates knew how to calculate an R_f value. Most had read the question, so gave a description rather than a calculation. The most common error was to have the division upside down.

(ii) Describe how the student could determine the R_f value for food dye Y.

Do not include any calculations.

(2)

The student should measure how far the solvent travelled and how far the dye travelled using a ruler. Then the student should divide the distance of the solute by the distance of the solvent

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Examiner Comments

Aim for a concise answer – distance moved by dye divided by distance moved by solvent would have scored both marks here.

Question 3 (c)(iii)

Most candidates got 1 mark in this question.

Question 4 (a)(i)

Most candidates only scored 1 mark here. The most common reason was confusion with the state symbols for liquids such as water (l) and solutions (aq).

Question 4 (a)(ii)

Candidates were clearly familiar with this demonstration and described the observations really well.

(ii) Give two observations that would be made when a small piece of sodium is added to a large trough containing water.

(2)

1 fizzing

2 melting of sodium into a metal ball

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Examiner Comments

A great, concise answer.

Question 4 (a)(iii)

There were a lot of misconceptions in this question. In this question, 'explain' means 'state and explain'.

One mark was given for blue (not purple) as the final colour and the one mark for an alkaline solution (or sodium hydroxide) being produced.

(iii) At the end of the reaction, a few drops of red litmus indicator are added to the trough.

Explain the final colour of the indicator.

(2)

The red litmus paper turns blue as the liquid in the trough is alkaline.

ResultsPlus
Examiner Comments

A great answer scoring both marks.

(iii) At the end of the reaction, a few drops of red litmus indicator are added to the trough.

Explain the final colour of the indicator.

(2)

Blue.

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Examiner Comments

Stating the final colour was enough for 1 mark.

Question 4 (b)

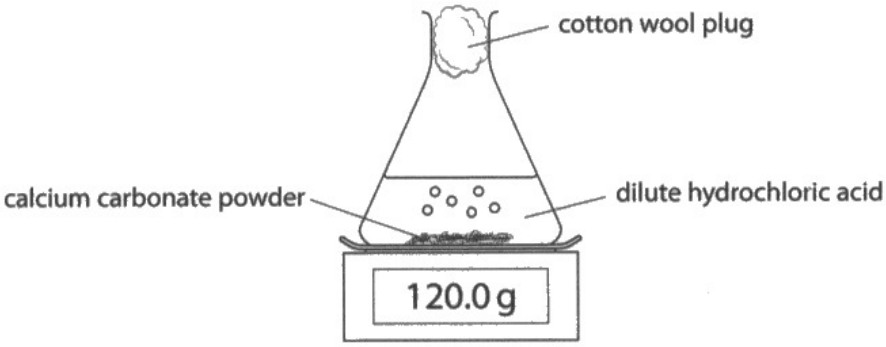
Most candidates correctly identified the unknown metal as potassium.

Question 5 (a)(i)

There were few correct answers to this question. The question was looking for cotton wool stopping acid spraying out.

There were many incorrect comments about the plug stopping gas leaving the flask.

5 A student uses this apparatus to investigate the rate of reaction between calcium carbonate powder and an excess of dilute hydrochloric acid.

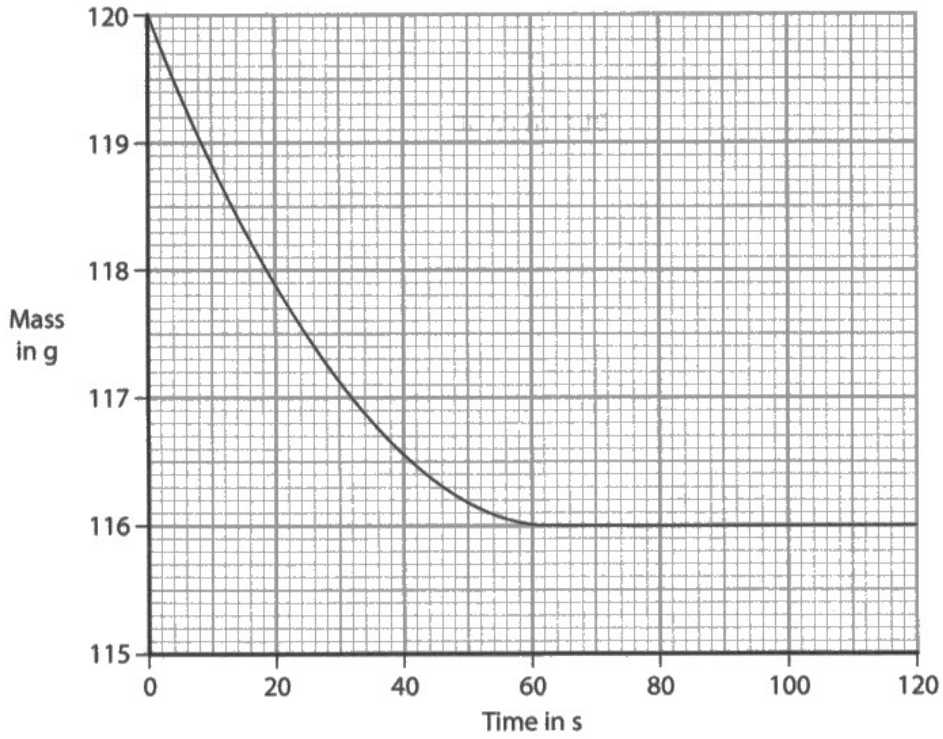


This is the equation for the reaction.

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

The student records the mass of the flask and its contents every 20 seconds for two minutes.

The graph shows the student's results.



(a) (i) Give a reason why using a cotton wool plug makes the results more accurate. (1)

so that the acid doesn't escape.

References to acid rather than gas not escaping scored here.

Question 5 (a)(ii)

There were few correct answers to this question. Candidates should make better use of the information in the question which referred to an excess of hydrochloric acid; the reaction therefore stopped because the calcium carbonate had run out.

Question 5 (b)(i)

Many candidates scored 1 of the available marks here. Candidates had clearly read the question and gave a description of how the curve would change.

(b) The student repeats the experiment using the same mass of calcium carbonate, but uses lumps instead of powder.

The rate of reaction decreases.

(i) Describe how the curve on the graph would change when lumps of calcium carbonate are used.

(2)

The slope would be shallower. It would plateau at the same y axis ~~number~~ cordinate but the plateau would be at a layer x axis cordinate

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Examiner Comments

A great answer.

One mark for the curve becoming less steep and the second mark for the reaction taking a longer time (to produce the same mass of gas).

Question 5 (b)(ii)

Most candidates scored a mark for identifying that the lumps of calcium carbonate have a smaller surface area than powder.

Question 5 (c)

Most candidates scored some credit in this question. Marks were scored for reading the mass lost from the graph, dividing the mass lost by 10 then giving the units as g/s

(c) The mean rate of reaction can be determined using this formula.

$$\text{mean rate of reaction} = \frac{\text{mass lost}}{\text{time taken to lose this mass}}$$

Determine the mean rate of reaction during the first 10 seconds.

Give the unit.

$\frac{118.8}{10} = 11.88$ g/s (3)

mean rate of reaction = 11.88 unit g/s

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Examiner Comments

This answer scored 2 marks.

118.8g is the mass at 10 seconds rather than the mass lost. Marks were scored for dividing the mass by 10 and giving the correct units.

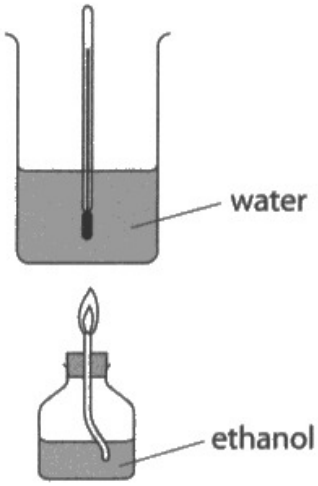
Question 6 (a)(i)

This calculation was well answered by most. Candidates did have to know the formula $Q=mc\Delta T$.

Some candidates only scored 1 mark for correctly calculating ΔT.

6 This question is about fuels.

(a) A scientist uses this apparatus to find the heat energy change when ethanol (C_2H_5OH) is burned.



(i) These are the scientist's results.

mass of water	150 g
temperature of water at the start	21.5 °C
maximum temperature of water	62.7 °C

Calculate the heat energy change, in joules.

[for water, c = 4.2 J/g/°C]

4·2 x 41·2 =
173·04

(3)

heat energy change = 173·04 J

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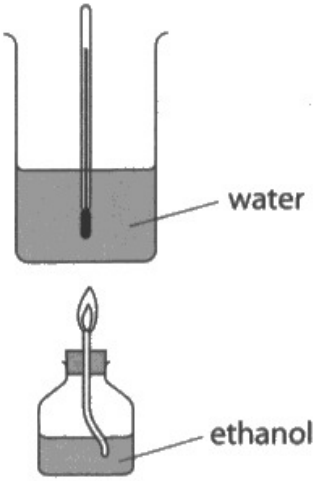
Examiner Comments

Only 1 mark here for ΔT.

6 This question is about fuels.

(a) A scientist uses this apparatus to find the heat energy change when ethanol (C_2H_5OH) is burned.



(i) These are the scientist's results.

mass of water	150 g
temperature of water at the start	21.5 °C
maximum temperature of water	62.7 °C

Calculate the heat energy change, in joules.

[for water, c = 4.2 J/g/°C]

(3)

$150 \times 4.2 \times (62.7 - 21.5)$

$= 150 \times 4.2 \times 41.2$

$= 25956$

heat energy change = 25956 J

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Examiner Comments

An excellent answer with very clear working.

Question 6 (b)(i)

Most candidates correctly identified the toxic gas as carbon monoxide.

Question 6 (b)(ii)

A disappointing number of candidates scored here. Answers such as carbon or soot were given credit.

Question 6 (c)

Very few candidates scored here.

This question was open-ended and there were two ways of scoring marks. Candidates could either write about nitrogen and oxygen reacting in the high temperatures of the car engine and the oxides of nitrogen then reacting with water forming an acid. The other way was to write about sulfur impurities in petrol which produce sulfur dioxide when the petrol burns which reacts with water forming an acidic solution.

(c) Petrol contains octane.

Describe one way that the combustion of petrol causes acid rain.

Do not refer to carbon dioxide in your answer.

(3)

Combusion of petrol can cause Sulphure dioxide into atmosphere. It can then react with water in clouds and acid rain forms.

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Examiner Comments

This scored the final two marking points.

(c) Petrol contains octane.

Describe one way that the combustion of petrol causes acid rain.

Do not refer to carbon dioxide in your answer.

(3)

This is because impurities such as Sulfur are often found in gas petrol, sulfure reacts with oxygen during combustion to produce Sulfur dioxide, this reacts with water particles resulting in acid rain.

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Examiner Comments

An excellent answer that could only have been made clearer by using bullet points.

Question 6 (d)(i)

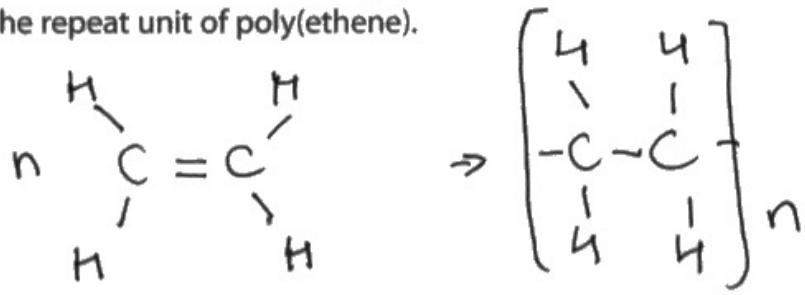
Some candidates scored here. Some candidates gave $2C_3H_7$ which balanced perfectly, but could not have been given credit as no alkane or alkene has this formula.

Question 6 (d)(ii)

As usual, candidates found repeating units difficult.

(ii) Poly(ethene) is produced from ethene. = 2

Give the repeat unit of poly(ethene).



(1)

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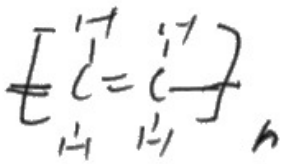
This scored even though the question didn't ask for the equation.

(ii) Poly(ethene) is produced from ethene.

Give the repeat unit of poly(ethene).



(1)

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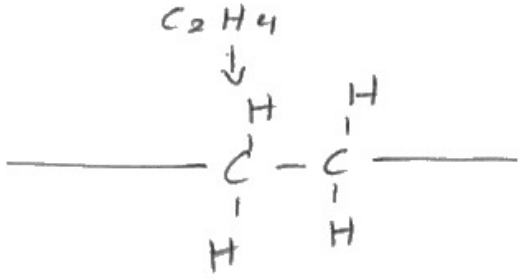
This did not score as repeating units do not have double bonds.

(ii) Poly(ethene) is produced from ethene.

Give the repeat unit of poly(ethene).

(1)



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A perfect answer. Repeating units do not need brackets or 'n'.

Question 7 (a)(i)

Many candidates knew what is meant by the term 'covalent bond'. Some scored marks for correctly describing the forces of attraction in a covalent bond showing an excellent understanding.

7 Silicon chloride and silicon dioxide have different structures, but both contain covalent bonds.

(a) (i) State what is meant by the term **covalent bond**.

(2)

a shared pair of electrons

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Examiner Comments

Don't feel the need to fill the whole space!

This response scored 2 marks.

7 Silicon chloride and silicon dioxide have different structures, but both contain covalent bonds.

(a) (i) State what is meant by the term **covalent bond**.

(2)

It is the sharing of electrons between ~~non-metals~~ ~~two~~ atoms which are non-metals.

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Only 1 mark here. Pairs of electrons are shared.

Question 7 (a)(ii)

Different properties of structures were poorly understood. To score full marks, candidates had to identify the structure, the bond or force being broken or overcome then compare the energy required.

Explain why silicon dioxide has a higher melting point than silicon chloride.

Refer to structure and bonding in your answer.

(5)

- Silicon dioxide is a giant covalent structure, with very strong covalent bonds between shared pairs of electrons between atoms, which means a lot of energy would be required to break these bonds.
- However, Silicon chloride is a ~~covalent~~ simple molecular covalent structure, which means it has got weak intermolecular forces of attraction, and little energy would be required to overcome these forces.

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Excellent exam technique here.

The use of one paragraph for silicon dioxide and another for silicon chloride is a good idea.

The structure of the answer makes it very easy for the examiner to award full marks.

Explain why silicon dioxide has a higher melting point than silicon chloride.

Refer to structure and bonding in your answer.

(5)

Because silicon dioxide has a giant structure and strong bonds and it's required a lot of energy. Higher molecular forces

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Examiner Comments

This answer could not score full marks as no comparison was made to silicon chloride.

Question 7 (b)(i)

Many candidates could correctly balance this equation.

Question 7 (b)(ii)

This question was poorly answered by most. One mark was awarded for identifying a suitable reagent such as a metal carbonate or hydrogencarbonate or a metal that would react with acid and not water, and the second mark for the observation.

(ii) Hydrogen chloride gas dissolves in water to produce an acidic solution.

Describe a test, other than using an indicator, to show that the solution is acidic.

(2)

Phenopthalein. Add the solution on phenopthalein, if it turns colourless the reaction is acidic.

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Read the question!

Phenolphthalein is an indicator, so cannot be given credit here.

(ii) Hydrogen chloride gas dissolves in water to produce an acidic solution. acid formed

Describe a test, other than using an indicator, to show that the solution is acidic. Reaction produces hydrogen gas also which when a lighted splint is put in mouth of hydrogen gas test tube, hydrogen gas (2) burns with a 'squeaky' pop.

If you react the acidic solution formed with a metal carbonate for instance sodium carbonate, then the products of reaction should be ~~CO_2~~ carbon dioxide, water and (the metal's salt) from reaction a salt. Collect gas produced and bubble through limewater, if limewater turns cloudy (carbon dioxide is present) then solution is acidic.

(Total for Question 7 = 10 marks)

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Examiner Comments

Good use of underlining here to emphasise that we are **not** looking for an indicator. It's also really good practice to write some notes as you process the information in the question.

Paper Summary

Based on their performance on this paper, candidates should:

- Read the question at least twice before starting the answer.
- Ensure the answer addresses the points in the question.
- Highlight or underline what's important in the question.
- Use bullet points in answers.
- Plan answers to demanding or longer answer questions.

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