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Examiners' Report
June 2014

GCE Chemistry 6CH01 01

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Introduction

The paper proved accessible to most candidates and provided them with the opportunity to demonstrate their knowledge and understanding of the key concepts in Unit 1. There was very little evidence of candidates having insufficient time to complete the paper.

The mean score for the multiple-choice questions in Section A was 14/20. Questions 1, 4 and 19 were found to be the most straightforward, whilst Questions 2, 9 and 11 were found to be the most demanding of the multiple-choice questions.

Candidates attempted the calculation questions with confidence and the free radical substitution mechanism was correctly recalled by many candidates. The questions requiring good Quality of Written Communication (e.g. Question 21(c) and Question 23(d)(iii)) were found to be the most challenging.

Question 20 (a) (i)

(a) (i) Define the term **hydrocarbon**.

(1)

A molecule containing only carbon and hydrogen atoms.

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Examiner Comments

The candidate has correctly defined the term, remembering to include the word 'only'.

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Examiner Tip

Learn all definitions thoroughly!

Question 20 (a) (ii)

(ii) State what is meant by the term **saturated**, as applied to a hydrocarbon.

(1)

when all of the bonds are single and the hydrocarbon cannot have any more hydrogens.

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Examiner Comments

"All of the bonds are single" equates to 'ONLY single bonds' in the Mark Scheme. The second statement, pertaining to maximum number of hydrogens, is also worthy of the mark in its own right.

(ii) State what is meant by the term **saturated**, as applied to a hydrocarbon.

(1)

A single bond between the two carbons.

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Examiner Comments

No mark was awarded for this response. The word ONLY was needed since in some alkene molecules, such as propene, there is a carbon-carbon double bond and a carbon-carbon single bond.

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Examiner Tip

Make sure your definitions apply in all situations.

Question 20 (b) (i)

(b) Crude oil can be separated into fractions.

(i) What property allows crude oil to be separated by fractional distillation?

(1)

The different boiling points of different chain lengths of hydrocarbons.

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Examiner Comments

Both parts of this sentence are worthy of credit. 'Different boiling points' and 'different chain lengths' are both alternatives in the Mark Scheme.

(b) Crude oil can be separated into fractions.

(i) What property allows crude oil to be separated by fractional distillation?

(1)

Has different melting and boiling points so fractions can be separated at different temperatures

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Examiner Comments

References to 'different melting points' were ignored, as mentioned in the Mark Scheme, so the mark was awarded for this response.

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Examiner Tip

Try to keep answers relevant to the question set and do not include extraneous information in your responses!

Question 20 (b) (ii)

Suggest **one** reason to support this opinion.

(1)

Crude oil is non-renewable

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Examiner Comments

This brief response was worthy of the mark available.

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Examiner Tip

A succinct answer is often all that is required for a one-mark question!

Suggest **one** reason to support this opinion.

(1)

Biodiesel is made from ~~non-renewable~~ sustainable source of fuel such as crops whereas petrol is made from crude oil which will eventually run out & is non renewable.

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Examiner Comments

References to 'sustainability' for biodiesel scored the available mark.

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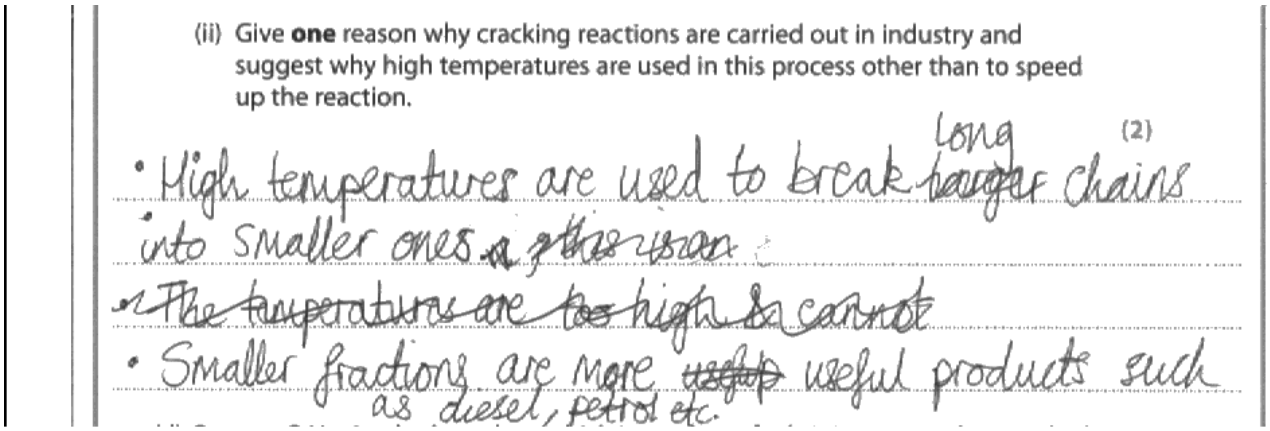
Examiner Tip

You should be aware of which energy sources are renewable and which are non-renewable.

Question 20 (c) (i)

Question 20 (c) (ii)

(ii) Give **one** reason why cracking reactions are carried out in industry and suggest why high temperatures are used in this process other than to speed up the reaction. (2)



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Examiner Comments

This answer scored both the available marks. The second scoring point in the Mark Scheme was addressed before the first scoring point.'Break long chains...' scored the second mark in the Mark Scheme.

Reference to either smaller chains or molecules scored the first mark in the Mark Scheme.

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Examiner Tip

Always check the number of marks available and structure your answer accordingly!

(ii) Give **one** reason why cracking reactions are carried out in industry and suggest why high temperatures are used in this process other than to speed up the reaction.

(2)

Carried out in industry because high pressure and temperature is required for the proces. High temperatures are used to produce a higher and better quality yield of the ~~subs~~ product.

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Examiner Comments

This response scored zero as neither of the marking points were correctly addressed.

Question 20 (d) (i)

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

(1)

A substance that can be involved in a reaction (heated) and releases energy for usage.

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Examiner Comments

"... releases energy..." scored the available mark.

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

(1)

A fuel is a substance which combusts exothermically, and releases energy.

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Examiner Comments

Release of 'energy' or 'heat' had to be stated in order to secure the mark.

Question 20 (d) (ii)

(ii) Write an equation for the **complete** combustion of butane under standard conditions. Include state symbols in your answer.

(2)

$2C_4H_{10(l)} + 13O_{2(g)} \longrightarrow 10H_2O_{(l)} + 8CO_{2(g)}$

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Examiner Comments

This response scored one mark out of the two available. The state symbol for butane should have been (g), rather than (l).

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Examiner Tip

Always read the question carefully. Earlier in the question, it stated that butane "... is a gas under standard conditions." Hence the correct state symbol was (g) for butane.

(ii) Write an equation for the **complete** combustion of butane under standard conditions. Include state symbols in your answer.

(2)

$\rightarrow$

$C_4H_{10(g)} + 6\frac{1}{2}O_{2(g)} \xrightarrow[1\text{atm}]{298\text{K}} 4CO_{2(g)} + 5H_2O_{(l)}$

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Examiner Comments

Both marks were awarded for this answer. All species were correct, as was the balancing of the equation and all four state symbols.

Question 20 (d) (iii)

(iii) Write an equation for the **incomplete** combustion of butane to form carbon monoxide and water only. State symbols are not required.

(1)

$C_4H_{10}(g) + 3\frac{1}{2}O_2 \rightarrow 4CO + 5H_2O$

ResultsPlus
Examiner Comments

This response scored zero as the moles of oxygen were incorrect.

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Examiner Tip

Always check the balancing of your equation!

(iii) Write an equation for the **incomplete** combustion of butane to form carbon monoxide and water only. State symbols are not required.

(1)

$C_4H_{10} + 4\frac{1}{2}O_2 \rightarrow 4CO + 5H_2O$

ResultsPlus
Examiner Comments

This equation scored the mark, as the species and balancing were all correct.

Question 20 (d) (iv)

(iv) Under what conditions would you expect incomplete combustion to occur?

(1)

a lack an insufficient supply of oxygen

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Examiner Comments

This correct answer secured the mark available.

(iv) Under what conditions would you expect incomplete combustion to occur?

(1)

Standard States of 298K in temperature and 100KPa in pressure.

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Examiner Comments

This response did not answer the question set, so no marks were awarded.

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Examiner Tip

Check that the facts you are writing answer the question set!

Question 20 (e) (i)

(e) Butane can react with bromine, in the presence of ultraviolet radiation, according to the following equation.

$$C_4H_{10} + Br_2 \rightarrow C_4H_9Br + HBr$$

(i) Calculate the atom economy by mass for the formation of C_4H_9Br.
Use the expression

$$\text{atom economy} = \frac{\text{molar mass of the desired product}}{\text{sum of the molar masses of all products}} \times 100\ \%$$

Use the Periodic Table as a source of data.

(2)

12 x 4 = 48
1 x 9 = 9
Br = 35

48 + 9 + 35 = 92 ← C_4H_9Br

1 + 35 = 36 ← HBr

92 + 36 = 128 ← HBr and C_4H_9Br

$\frac{92}{128} \times 100 = 71.875$

71.9

Final answer ~~71.888~~ %

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Examiner Comments

Both marks were awarded. The answer was correctly rounded to three significant figures in this case. The number of significant figures required for the final answer was not specified in this question.

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Examiner Tip

Always give your final answers to calculation questions to a suitable number of significant figures.

Question 20 (e) (ii)

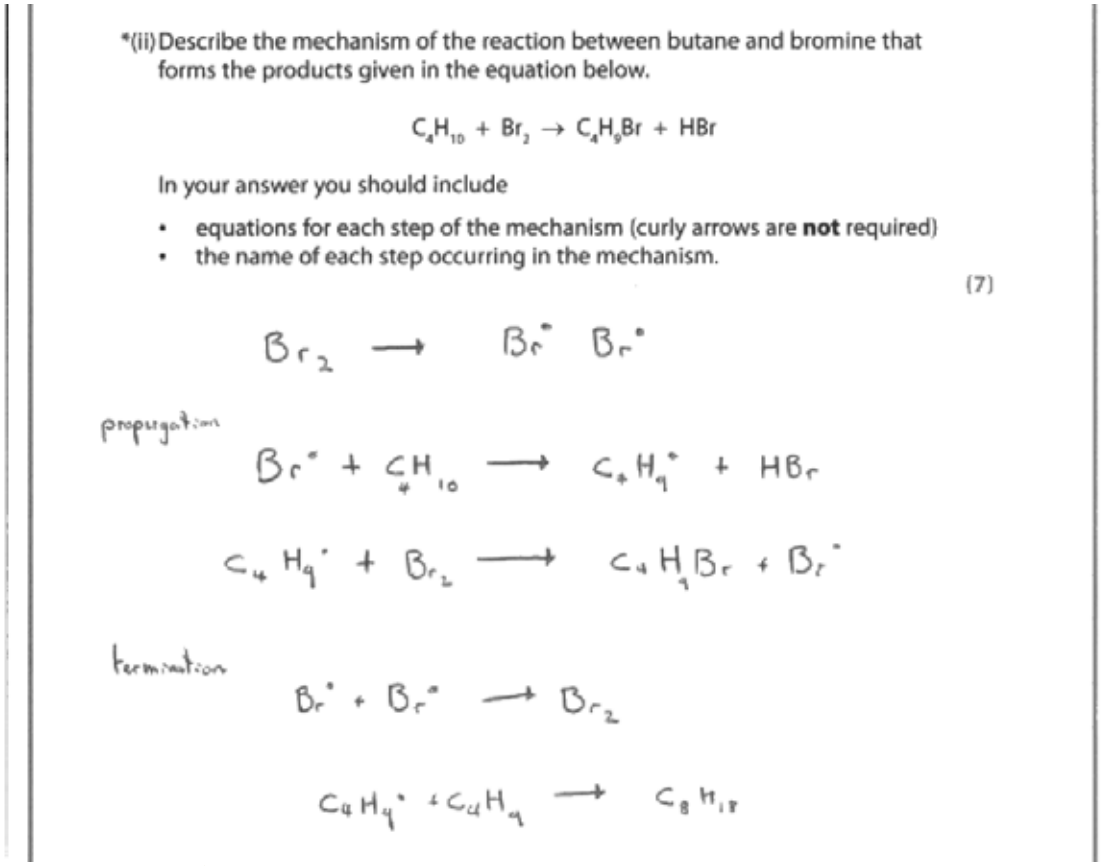
*(ii) Describe the mechanism of the reaction between butane and bromine that forms the products given in the equation below.

$$C_4H_{10} + Br_2 \rightarrow C_4H_9Br + HBr$$

In your answer you should include

- equations for each step of the mechanism (curly arrows are **not** required)
- the name of each step occurring in the mechanism.

(7)



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Examiner Comments

This answer scored six out of the seven available marks. The first mark was not awarded as the word 'initiation' did not appear anywhere in this candidate's answer.

Although there was a dot missing from one of the C_4H_9 radicals, this oversight was ignored as this omission occurred at the termination stage and an incorrect termination step was not penalised.

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Examiner Tip

Identify every step of the mechanism, when asked to do so!

*(ii) Describe the mechanism of the reaction between butane and bromine that forms the products given in the equation below.

$$C_4H_{10} + Br_2 \rightarrow C_4H_9Br + HBr$$

In your answer you should include

- equations for each step of the mechanism (curly arrows are **not** required)
- the name of each step occurring in the mechanism.

(7)

Free radical substitution

Initiation: $Br-Br \rightarrow 2Br\bullet$

Free radicals are formed.

Propagation: $C_4H_{10} + Br\bullet \rightarrow HBr + C_4H_9\bullet$

Products + free radicals are formed: $C_4H_9\bullet + Br_2 \rightarrow C_4H_9Br + Br\bullet$

Br free radical regenerated + cycle continues.

Termination: $2C_4H_9\bullet \rightarrow C_8H_{18}$

Free radicals are used up. $2Br\bullet \rightarrow Br_2$

ResultsPlus
Examiner Comments

This response scored full marks as all seven marking points were correctly addressed.

Question 21 (a)

(a) Define the term **lattice energy**.

(2)

The energy ~~required~~ produced when a cation an an anion join together forming an ionic compound.

ResultsPlus
Examiner Comments

No first mark was awarded, as there was no reference to '1 mol' of an ionic compound.The second scoring point was not awarded, as there was no reference to 'gaseous ions'.

ResultsPlus
Examiner Tip

Learn all definitions thoroughly!

Q

(a) Define the term **lattice energy**.

(2)

The enthalpy change when one mole of ionic substance is formed from its constituent gaseous ~~substituent etc~~ elements under Standard conditions.

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Examiner Comments

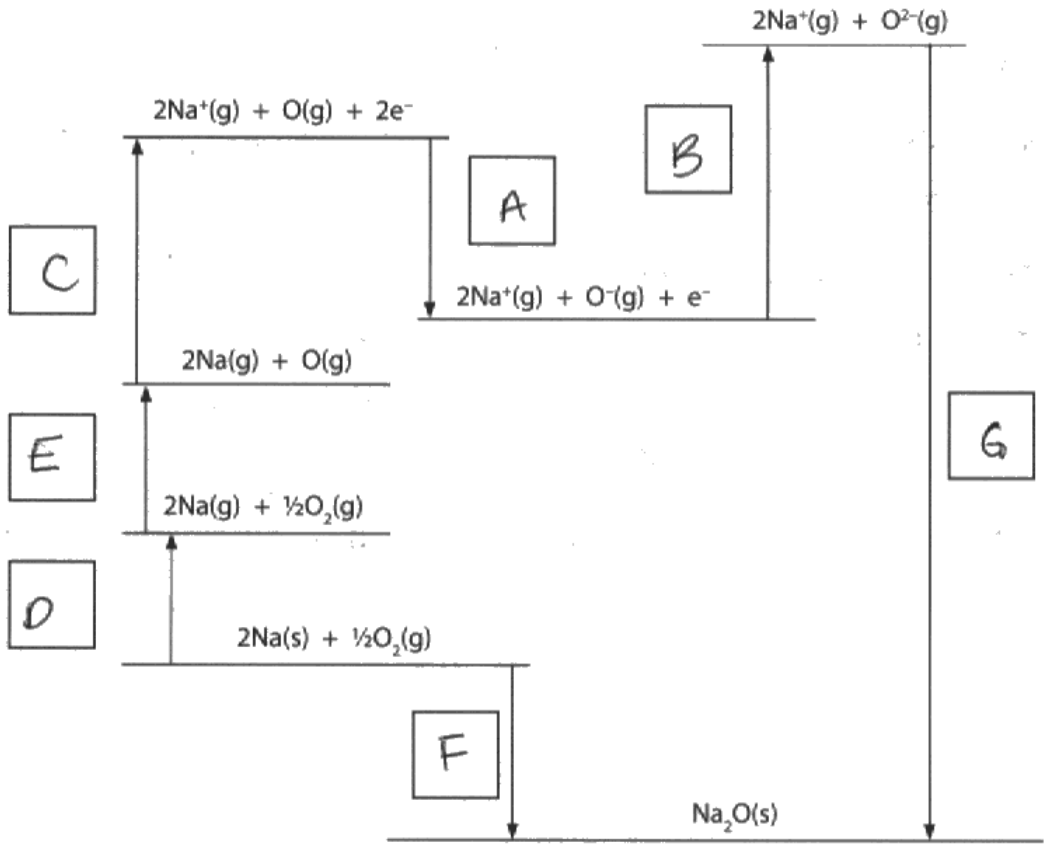
Only the first mark was awarded.The second mark was not awarded as 'gaseous ions' were not mentioned.

Note: 'From gaseous elements' is in the Reject column of the Mark Scheme.

Question 21 (b) (i)

(b) (i) Write the correct letters from the table of data to label the Born-Haber cycle below.

(3)



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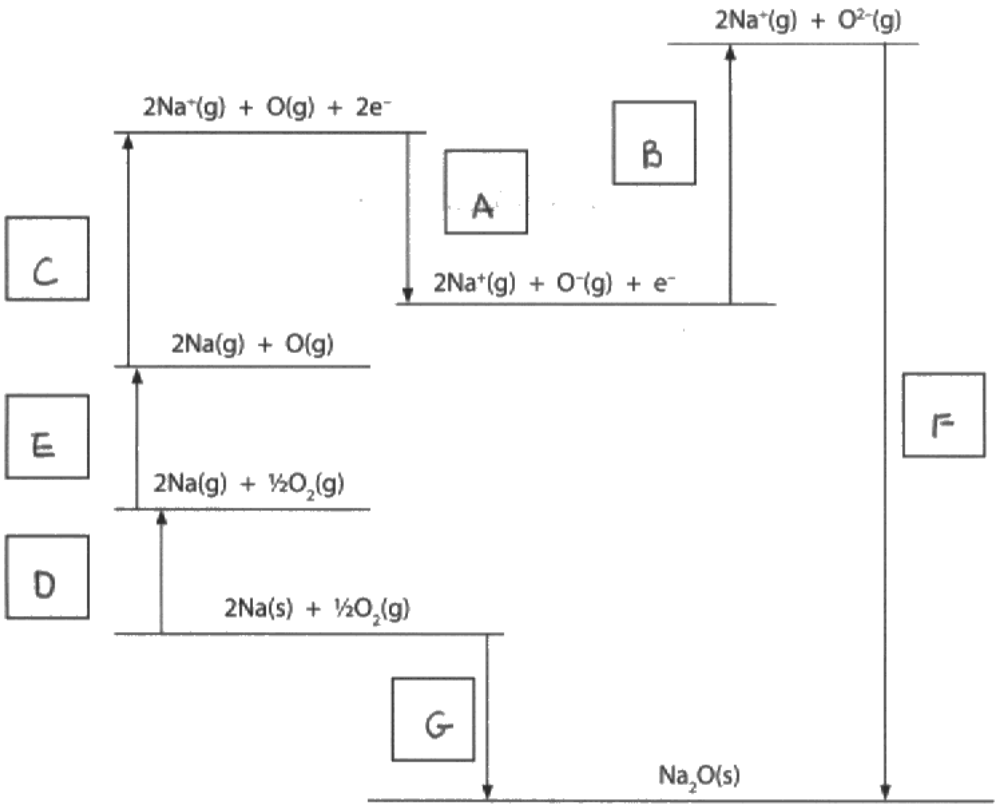
Examiner Comments

All letters are correct, so all three marks were awarded.

(b) (i) Write the correct letters from the table of data to label the Born-Haber cycle below.

(3)



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Examiner Comments

This response scored two out of the three available marks.Letters F and G are the wrong way round. So five letters overall are correct and, as stated in the Mark Scheme, two marks are awarded.

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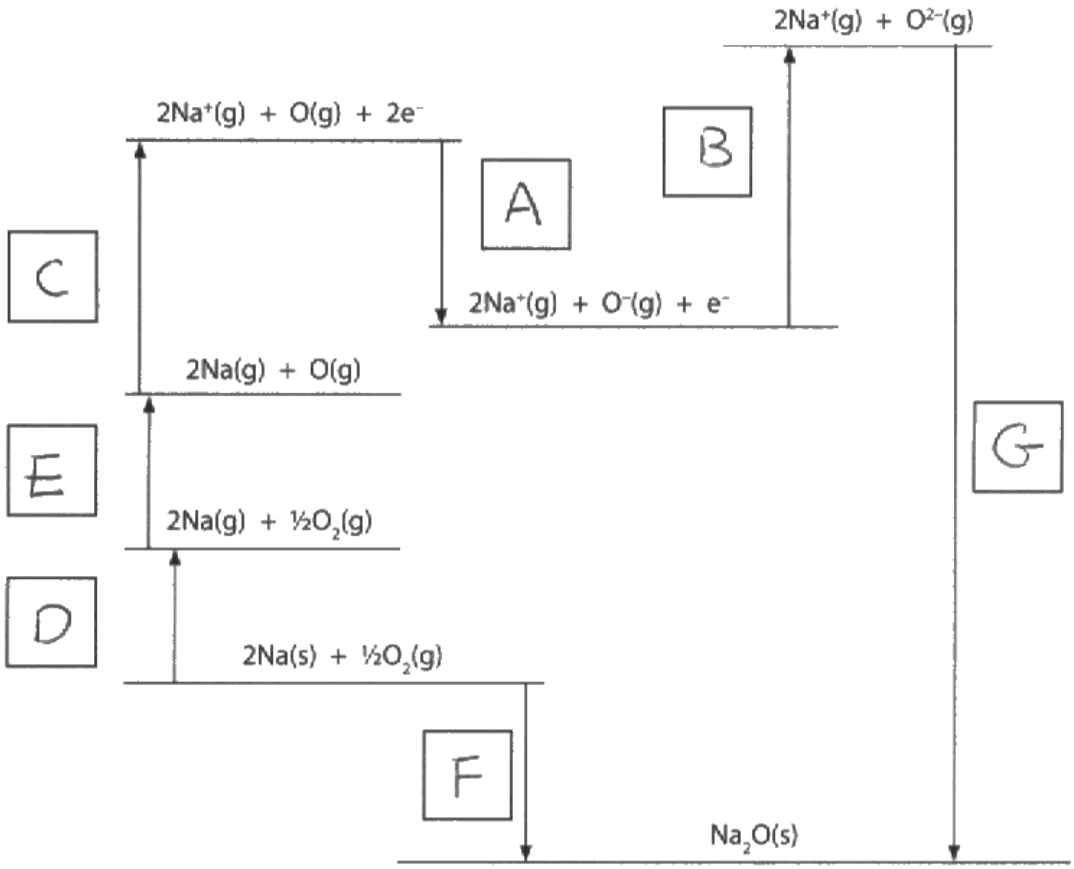
Examiner Tip

Learn all the enthalpy changes required to construct a Born-Haber cycle.

Question 21 (b) (ii)

(b) (i) Write the correct letters from the table of data to label the Born-Haber cycle below.

(3)



(ii) Calculate the lattice energy of sodium oxide, enthalpy change **G**, in kJ mol^{-1}.

(2)

$G = -B - A - C - E - D + F$

$= (-790) - (-141) - (496) - (249) - (108) + (-414)$

$= -1916 \text{ kJ mol}^{-1}$

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Examiner Comments

As per the Mark Scheme, -1916 kJ mol^{-1} scored one out of two marks.The candidate has not doubled 108 (the enthalpy change of atomization of sodium) and has also not doubled 496 (the first ionization energy of sodium) when using the data for sodium oxide, Na_2O.

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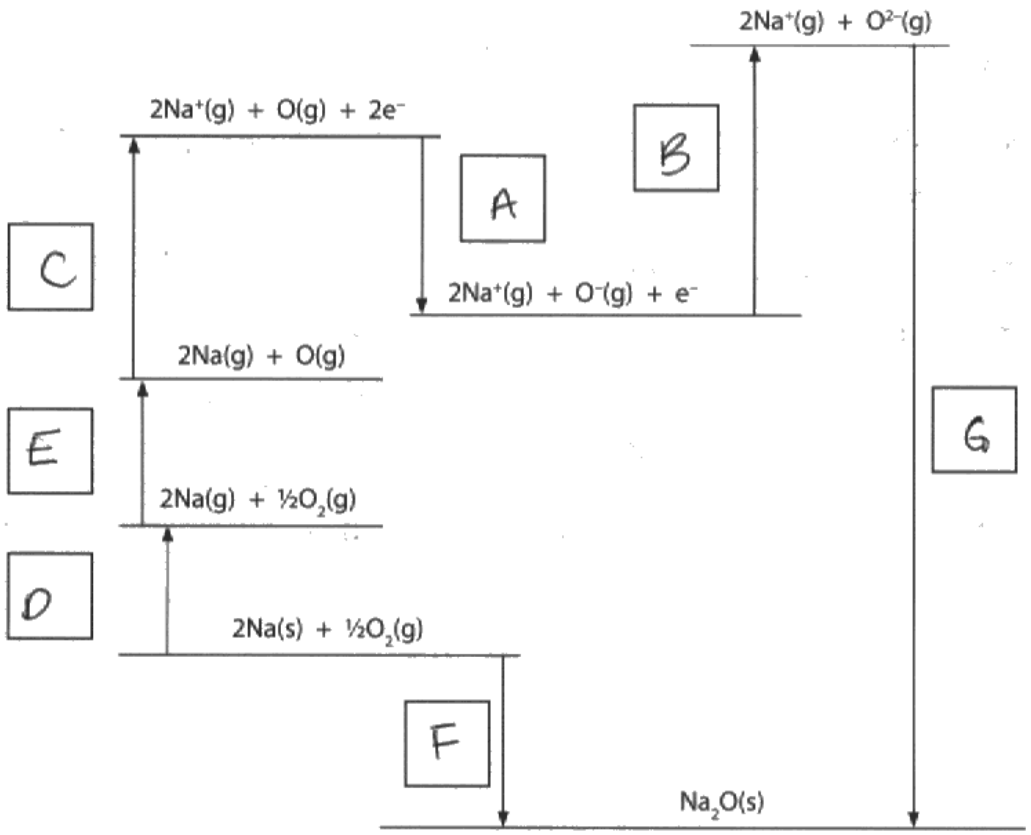
Examiner Tip

Practise constructing Born-Haber cycles for binary ionic compounds with different stoichiometries.

(b) (i) Write the correct letters from the table of data to label the Born-Haber cycle below.

(3)



(ii) Calculate the lattice energy of sodium oxide, enthalpy change **G**, in kJ mol^{-1}.

(2)

$G = -B - A - 2C - E - 2D + F$

$= -790 + 141 - (2 \times 496) - 249 - (2 \times 108) - 414$

$= -2802 - 2661 = 2520$

ResultsPlus
Examiner Comments

This response scored both available marks.

Although the final answer on the answer line was not written very clearly, the value of -2520 kJ mol^{-1} is written above the final answer (along with the working), confirming that this is the candidate's final answer.

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Examiner Tip

If you wish to amend an answer, it is better to cross out your original answer and re-write your new answer rather than try to amend the digits.

Question 21 (c)

*(c) Predict whether the lattice energy of magnesium oxide, MgO, is more or less exothermic than the lattice energy of magnesium sulfide, MgS.

Justify your answer in terms of the sizes and the charges of the ions involved.

(4)

MgO lattice energy is more exothermic as ~~oxide ions have~~ even though both oxide and sulphide ions have the same charge, oxide ions have a smaller radius so there is less shielding and a closer distance to the nucleus. ~~and electrons~~ Subsequently there is a stronger attraction of electrons to the nucleus so ~~they are~~ more energy is required to remove them.

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Examiner Comments

This response scored three out of the four available marks - namely, the first three scoring points in the Mark Scheme.

The fourth mark was not awarded as there was no mention of the relative strength of attraction between the cations and anions (attraction of the nucleus to electrons has been quoted instead, which is not relevant to the required answer).

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Examiner Tip

Make sure that you understand the exact nature of the electrostatic attractions when discussing different types of bonding.

*(c) Predict whether the lattice energy of magnesium oxide, MgO, is more or less exothermic than the lattice energy of magnesium sulfide, MgS.

Justify your answer in terms of the sizes and the charges of the ions involved.

(4)

Magnesium sulfide will ~~not~~ be more exothermic because the sulfide anion is larger so will be more polarised by the Mg^{2+} cation. Therefore more energy will be given out when the lattice is formed. The charges on the Mg^{2+} cations ~~and~~ are equal and so are the sulfide and oxide anions so this will not affect the lattice energy. MgS has a lower charge density than MgO.

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Examiner Comments

This response scored two out of the four marks. The first scoring point was not awarded, as magnesium oxide is more exothermic than magnesium sulfide.The second scoring point was awarded for "...because the sulfide anion is larger..."The third scoring point was awarded as the candidate implied that the charges on the sulfide and oxide anions are the same.The fourth scoring point was not awarded, as no comparison was made between the strength of attraction between Mg^{2+} and O^{2-} ions with that between Mg^{2+} and S^{2-} ions.

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Examiner Tip

Do not confuse discussion of the factors affecting the magnitude of the lattice energies of different compounds with comparisons between theoretical and experimental lattice energy values for the same compound!

Question 22 (a)

Question 22 (b)

Isotope	Percentage abundance
^{58}Ni	69.02
^{60}Ni	27.32
^{62}Ni	3.66

Calculate the relative atomic mass of nickel. Give your answer to **two** decimal places.

(2)

$\left(\frac{69.02}{100} \times 58\right) + \left(\frac{27.32}{100} \times 60\right) + \left(\frac{3.66}{100} \times 62\right)$

$= 58.69$

ResultsPlus
Examiner Comments

Both marks were awarded for this correct response.

ResultsPlus
Examiner Tip

Make sure you know the difference between decimal places and significant figures!

Isotope	Percentage abundance
^{58}Ni	69.02
^{60}Ni	27.32
^{62}Ni	3.66

Calculate the relative atomic mass of nickel. Give your answer to **two** decimal places.

(2)

69.02 + 27.32 + 3.66

= 100

100 ÷ 3 = 33.3

58 + 60 + 62 = 180

180 ÷ 3 = 60

Relative atomic mass of nickle

= 60

ResultsPlus
Examiner Comments

This incorrect response scored no marks.

ResultsPlus
Examiner Tip

Practise calculations involving relative atomic mass determination, given the percentage abundance of each isotope.

Question 22 (c)

(c) Nickel reacts with carbon monoxide, CO, to give the compound nickel carbonyl, $Ni(CO)_4$.

$$Ni(s) + 4CO(g) \rightarrow Ni(CO)_4(g)$$
5.87 ?

(i) Calculate the volume of carbon monoxide, in dm^3, measured at room temperature and pressure, that is required to react completely with 5.87 g of nickel.

[Relative atomic mass: Ni = 58.7
Molar volume of a gas = 24 dm^3 mol^{-1} at room temperature and pressure.]

(3)

mol × mw

Ni 5.87/58.7 = 0.1 1:4

4CO = 0.1 × 4 = 0.4

Volume of CO = 0.4 × 24 = 9.6 dm^3

(ii) Calculate the **number** of carbon monoxide molecules present in the volume of gas you have calculated in (c)(i).

[The Avogadro constant, $L = 6.02 \times 10^{23}$ mol^{-1}]

(1)

moles × AC

$0.4 \times 6.02 \times 10^{23}$

$= 2.408 \times 10^{23}$ /2

$= 1.204 \times 10^{23}$

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Examiner Comments

There is a fully correct answer for (c)(i), so three out of three marks were awarded here.No mark was awarded for (c)(ii), as the correct answer has been halved.

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Examiner Tip

In questions such as those in (c)(ii), make sure you check whether the number of atoms or the number of molecules has to be calculated.

(c) Nickel reacts with carbon monoxide, CO, to give the compound nickel carbonyl, $Ni(CO)_4$.

$$Ni(s) + 4CO(g) \rightarrow Ni(CO)_4(g)$$

(i) Calculate the volume of carbon monoxide, in dm^3, measured at room temperature and pressure, that is required to react completely with 5.87 g of nickel.

[Relative atomic mass: Ni = 58.7
Molar volume of a gas = 24 dm^3 mol^{-1} at room temperature and pressure.]

(3)

(Ni) moles = $\frac{5.87}{58.7}$ = 0.1 moles.

$\frac{0.4}{1} = \frac{x}{24}$ = 9.6 dm^3

Ni : CO
1 : 4
0.1 × 4 = 0.4

(ii) Calculate the **number** of carbon monoxide molecules present in the volume of gas you have calculated in (c)(i).

[The Avogadro constant, $L = 6.02 \times 10^{23}$ mol^{-1}]

(1)

$0.4 \times 6.02 \times 10^{23}$
$= 2.41 \times 10^{23}$

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Examiner Comments

Both (c)(i) and (c)(ii) have been answered correctly.Note how 2.408 x 10^{23} has been correctly rounded to 2.41 x 10^{23} (i.e. three significant figures) in the final answer to (c)(ii).

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Examiner Tip

In calculations, always give your final answer to a sensible number of significant figures!

Question 22 (d) (i)

(d) Nickel(II) nitrate, $Ni(NO_3)_2$, can be made by several different methods.

Method 1

Nickel(II) oxide, NiO, was reacted with dilute nitric acid according to the equation

$$NiO(s) + 2HNO_3(aq) \rightarrow Ni(NO_3)_2(aq) + H_2O(l)$$

(i) Calculate the volume of 2.00 mol dm^{-3} dilute nitric acid, in cm^3, that was required to exactly neutralize 1.494 g of nickel(II) oxide.

Use the relative atomic masses: Ni = 58.7, O = 16.0

(3)

$\frac{1.494}{(58.7+16)} = 0.02$

mol of nitric acid =

$\frac{\text{Vol}}{\text{Mol} \times 1 dm^3}$

$\text{Vol} = 0.04 \times 1000$

$= 40 cm^3$

1 : 2

$NiO : 2HNO_3$

$= 0.04$ Mol

$\text{Vol} = \frac{0.04}{2}$

$= 0.02$

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Examiner Comments

Two marks out of a maximum of three marks were awarded for this answer.The first two scoring points were achieved, but not the third, as the volume of dilute nitric acid required should have been 20 cm^3, not 40 cm^3.

ResultsPlus
Examiner Tip

Check all calculations thoroughly!

(d) Nickel(II) nitrate, $Ni(NO_3)_2$, can be made by several different methods.

Method 1

Nickel(II) oxide, NiO, was reacted with dilute nitric acid according to the equation

$$\underset{0.02}{NiO(s)} + \underset{0.04}{2HNO_3(aq)} \rightarrow Ni(NO_3)_2(aq) + H_2O(l)$$

(i) Calculate the volume of 2.00 mol dm^{-3} dilute nitric acid, in cm^3, that was required to exactly neutralize 1.494 g of nickel(II) oxide.

$\frac{moles}{dm^3} = M$

$dm^3 = \frac{moles}{M}$

Use the relative atomic masses: Ni = 58.7, O = 16.0

(3)

No. of moles of NiO = $\frac{1.494}{58.7+16} = 0.02$

Vol. of $2M HNO_3$ needed = $\frac{0.02 \times 2}{2} = 0.02\ dm^3$.

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Examiner Comments

This answer scored all three marks as a correct answer in units of dm^3 was also acceptable.

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Examiner Tip

Check the units required for your final answer. These are often, but not always, stated in the question.

Question 22 (d) (ii)

Method 2
A volume of 25.0 cm^3 of 2.00 mol dm^{-3} nitric acid, HNO_3, was transferred to a beaker. Solid nickel(II) carbonate, $NiCO_3$, was added until it was in excess.

(ii) Why was **excess** nickel(II) carbonate used?

(1)

to make sure all the acid had reacted

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Examiner Comments

This correct answer scored the mark available.

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Examiner Tip

Knowing which reagent is in excess makes this question straightforward!

Question 22 (d) (iii)

(iii) Why must the beaker be **much** larger than the volume of acid used?

(1)

The acid ~~to~~ could fizz over, so if it is much larger then the acid ~~went~~ won't spill over.

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Examiner Comments

The production of carbon dioxide gas in this reaction, with the resultant fizzing, is the reason that the beaker must be much larger than the volume of acid used.

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Examiner Tip

When carrying out an experiment, always make sure that you understand the method.

(iii) Why must the beaker be **much** larger than the volume of acid used?

(1)

The beaker must be much larger to avoid losing any of the solution

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Examiner Comments

As there was no reference to fizzing (or equivalent), no mark was awarded for this response.

Question 22 (d) (iv)

(iv) Write a balanced equation for the reaction between nickel(II) carbonate and dilute nitric acid, including state symbols.

(2)

$NiCO_{3(s)} + HNO_{3(aq)} \longrightarrow Ni(NO_3)_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$

ResultsPlus
Examiner Comments

This response scored the first mark, as all the species are correct.The second mark was not awarded as, although all five state symbols were correct, the equation has not been balanced ($2HNO_3$ required).

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Examiner Tip

Check balancing when writing equations!

(iv) Write a balanced equation for the reaction between nickel(II) carbonate and dilute nitric acid, including state symbols.

(2)

$NiCO_{3(s)} + 2HNO_{3(aq)} \longrightarrow Ni(NO_3)_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$

ResultsPlus
Examiner Comments

Both marks were awarded for this fully correct response.

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Examiner Tip

Don't forget to give state symbols in equations when they are required.

Question 22 (d) (v)

*(v) For **Method 2**, describe the practical steps that you would take to obtain pure dry crystals of hydrated nickel(II) nitrate, $Ni(NO_3)_2.6H_2O$, from a mixture of nickel(II) nitrate solution and unreacted solid nickel(II) carbonate.

(4)

filter to remove the excess nickel (II) carbonate. then heat to remove excess water (until crystals have began to form around edge). then leave to cool in a drying cupboard. then clean crystals with a small volume of cold distilled water and then filter again.

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Examiner Comments

This answer scored three out of the four possible marks.The first three marks were awarded. The fourth scoring point was not awarded as there is no mention of drying the crystals.

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Examiner Tip

Be familiar with all the stages carried out during the preparation of salt crystals.

*(v) For **Method 2**, describe the practical steps that you would take to obtain pure dry crystals of hydrated nickel(II) nitrate, $Ni(NO_3)_2.6H_2O$, from a mixture of nickel(II) nitrate solution and unreacted solid nickel(II) carbonate.

(4)

1. Following the reaction, filter the solution through a funnel and filter paper to remove unreacted solids.
2. Heat the solution to remove excess water, stopping when crystals begin to form.
3. Leave to solution to fully crystalise.
4. Remove the crystals and dry them off with absorbant tissue paper.

ResultsPlus
Examiner Comments

This is an excellent answer, addressing all four scoring points. So maximum credit was earned.

ResultsPlus
Examiner Tip

Set out your answers clearly, in a logical way!

Question 23 (a)

Question 23 (b)

(b) An atom of potassium has mass number 39. Explain why argon is placed before potassium in the modern Periodic Table.

(1)

Potassium has a larger atomic number than Argon

ResultsPlus
Examiner Comments

A concise, correct response, so the mark available was awarded.

ResultsPlus
Examiner Tip

Be aware that elements are arranged in the Periodic Table in order of increasing atomic number.

(b) An atom of potassium has mass number 39. Explain why argon is placed before potassium in the modern Periodic Table.

(1)

Argon is a noble gas therefore it's under group 0. Also the atomic number for potassium is 19 so and argon is 18 so potassium comes after argon as ~~that's how the~~ the periodic table is according to atomic numbers

ResultsPlus
Examiner Comments

Quoting the correct atomic numbers for argon and potassium earned the mark.

Question 23 (c)

(c) In the context of the Periodic Table, explain what is meant by the term **periodicity**.

(2)

The arrangement of elements ~~[illegible]~~ in order of ~~[illegible]~~ increasing atomic number across periods.

ResultsPlus
Examiner Comments

Neither scoring point was addressed, so no marks were awarded here.

ResultsPlus
Examiner Tip

Make sure that you answer the question set!

(c) In the context of the Periodic Table, explain what is meant by the term **periodicity**.

(2)

a ~~[illegible]~~ pattern that slowly increases and repeats itself. ~~for example in the periodic table~~

ResultsPlus
Examiner Comments

Both the available marks were awarded here.For the first mark, there is a mention of a "pattern" and, for the second mark, the idea that the pattern "...repeats (itself)".

Question 23 (d) (i)

(i) Name **one** of the elements above that is composed of **simple molecules** at room temperature and pressure.

(1)

Chlorine

ResultsPlus
Examiner Comments

Chlorine exists as diatomic molecules, Cl_2.

ResultsPlus
Examiner Tip

Be aware, too, that phosphorus exists as molecules, P_4, as does sulfur, S_8.

Question 23 (d) (ii)

(ii) Silicon has a giant atomic structure. Explain how this structure results in the high melting temperature shown on the graph.

(2)

There are many strong covalent bonds between the Si atoms v as silicon exists as a giant covalent lattice. These bonds ~~requ~~ are hard to break so require a lot of energy to break so the melting point is very high.

ResultsPlus
Examiner Comments

This response scores two marks, as both scoring points have been addressed.

ResultsPlus
Examiner Tip

Always relate melting temperature to the amount of heat energy needed to overcome the interactions (e.g. bonds) between the particles.

(ii) Silicon has a giant atomic structure. Explain how this structure results in the high melting temperature shown on the graph.

(2)

since silicon has a giant structure, lots of energy is needed to break the bonds in ade to melt it thats why the melting temperature is higher at 1400°C

ResultsPlus
Examiner Comments

This response scored one out of two marks.The first mark was not awarded as there is no mention of 'strong' bonds.The second mark was awarded as the requirement that "lots of energy is needed to break the bonds ..." has been included in the answer.

Question 23 (d) (iii)

(iii) Explain why the melting temperature of magnesium is higher than that of sodium.

(3)

The melting temperature of magnesium is higher than that of sodium because sodium can only form 1 bond but magnesium can form 2 bonds. The more covalent bonds there are, the stronger these bonds are. Therefore it takes more energy to break the bonds because the attraction felt between the 2 positive electrostatic nuclei and the shared electrons is higher, so the melting point is higher.

ResultsPlus
Examiner Comments

This answer scores no marks. The third scoring point mark was not awarded as the nature of the electrostatic attractions in a metal have been described incorrectly.

ResultsPlus
Examiner Tip

Make sure that you fully understand the nature of the electrostatic attractions present in metallic bonding.

(iii) Explain why the melting temperature of magnesium is higher than that of sodium.

(3)

Na has a +1 charge whereas Mg has a +2 charge, therefore in magnesium the attraction between the positive ion and the delocalised electrons are stronger, as magnesium has more delocalised electrons.

ResultsPlus
Examiner Comments

This answer scored two out of the three available marks. The 'charge' mark was not awarded, as there is no reference to magnesium ions (or Mg^{2+}) having a higher charge than sodium ions (or Na^{+}).A mark was awarded for the statement that "magnesium has more delocalised electrons".The final scoring point was addressed, as the stronger attraction between magnesium ions and the delocalised electrons has been acknowledged.

Paper Summary

On the basis of their performance on this paper, candidates are offered the following advice.

- Make sure that your writing is legible
- Use the amount of space provided for each answer, along with the mark allocation, as a guide to how much detail is required in your response
- Make sure you understand what you are being asked to do before you start to answer the question
- Make sure you understand clearly the difference between an ATOM, a MOLECULE and an ION
- As well as learning practical techniques, think about the reason for each step of the procedure and why it works.

Grade Boundaries

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