

OCR A-LEVEL CHEMISTRY A • H432

CHEMISTRY



EXAM QUESTION PACK

3.1.1 PERIODICITY

SCORE

/67

PERCENTAGE

%

STEMUP

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- 1 Antimony, Sb, has atomic number 51.

Complete the table below to show where antimony is found in the Periodic Table.

Period	Block

[1]

- 2(a) Silicon dioxide, SiO_2 , has the same structure and bonding as diamond.

State the structure and bonding in SiO_2 .

----- [1]

- (b) Describe and explain the electrical conductivity of sodium oxide, Na_2O , and sodium in their solid and molten states.



In your answer you should use appropriate technical terms, spelled correctly.

----- [5]

3 The Periodic Table is arranged in periods and groups.

Elements in the Periodic Table show a periodic trend in atomic radius.

State and explain the trend in atomic radius from Li to F.



In your answer you should use appropriate technical terms, spelled correctly.

trend

explanation

.....

.....

.....

.....

.....

[3]

4 Aluminium has 13 successive ionisation energies.

(i) Write the equation for the **third** ionisation energy of aluminium.

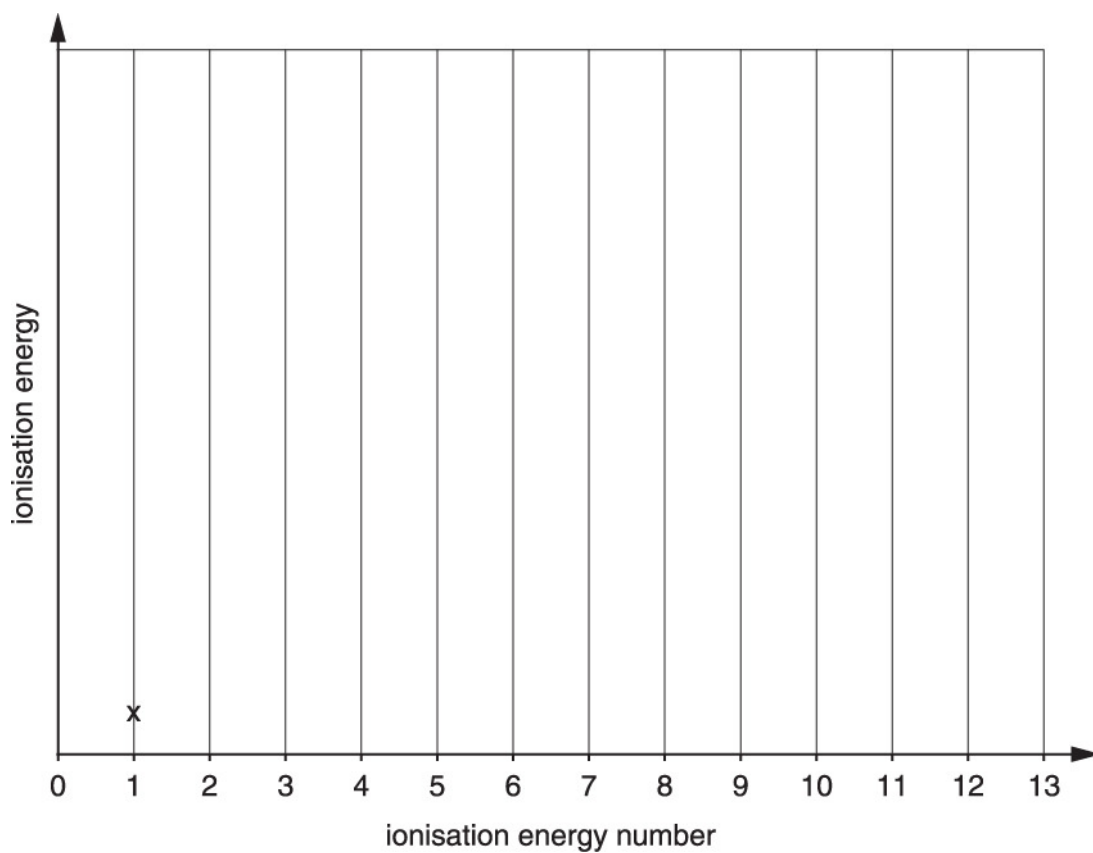
Include state symbols.

-----[1]

(ii) On the axes below, add crosses to show the 13 successive ionisation energies of aluminium.

The value for the first ionisation energy has been completed for you.

You do not have to join the crosses.



[2]

5 This question is about the attraction between particles.

State how and explain why the attraction between nuclei and outermost electrons in gaseous atoms varies across Period 3.

[2]

6 This question is about trends in the periodic table.

Which trend is correct?

- A melting point decreases from lithium to carbon
- B boiling point decreases from fluorine to iodine
- C first ionisation energy decreases from lithium to caesium
- D first ionisation energy increases from nitrogen to oxygen

Your answer

[1]

- 7 Bromine and mercury are the only two naturally occurring elements that are liquids at room temperature and pressure. Some physical properties of these two elements are given below.

	Appearance at room temperature	Melting point / °C	Boiling point / °C	Electrical conductivity of the liquid
Bromine	dark orange liquid	−7.2	58.8	very low
Mercury	shiny silver liquid	−38.8	356.7	good

Mercury and bromine react together to form mercury(II) bromide, HgBr_2 .

Describe and explain how electrical conductivity occurs in mercury(II) bromide and mercury, in both solid and molten states.

[5]

- 8 Which particles are attracted in metallic bonding?

- A anions and delocalised electrons
- B cations and delocalised electrons
- C oppositely charged ions
- D protons and electrons

Your answer

[1]

- 9 Which statement is **not** correct for Group 2 metals?
- A An unpaired electron is present in an s-orbital.
 - B Chemical reactivity increases with increasing atomic number.
 - C The first ionisation energy decreases with increasing atomic number.
 - D Atomic radius increases with increasing atomic number.

Your answer

[1]

- 10 A chemist determines some properties of two substances, **C** and **D**.

The results are shown in the table.

	C	D
Melting point / °C	660	801
Electrical conductivity when solid	Yes	No
Electrical conductivity when molten	Yes	Yes
Solubility in water	No	Yes

Which row correctly identifies the bonding and structure in **C** and **D**?

	C	D
A	giant ionic	giant metallic
B	giant ionic	giant ionic
C	giant metallic	giant metallic
D	giant metallic	giant ionic

Your answer

[1]

11(a) Ionisation energies can provide evidence for electron structure.

Write an equation for the first ionisation energy of chlorine.

Include state symbols.

-----[1]

(b) The following data shows the first eight successive ionisation energies of an element.

Ionisation energy	1st	2nd	3rd	4th	5th	6th	7th	8th
Energy / kJ mol^{-1}	590	1145	4912	6474	8144	10 496	12 320	14 207

In which group of the periodic table would this element be found?

Use the data to justify your choice.

group:

justification:

-----[2]

- 12 The trend in the first and second ionisation energies of Group 2 elements can be linked to the increase in chemical reactivity down the group.

The first and second ionisation energies of calcium and strontium are given in the table.

Element	First ionisation energy / kJmol^{-1}	Second ionisation energy / kJmol^{-1}
Ca	590	1145
Sr	550	1064

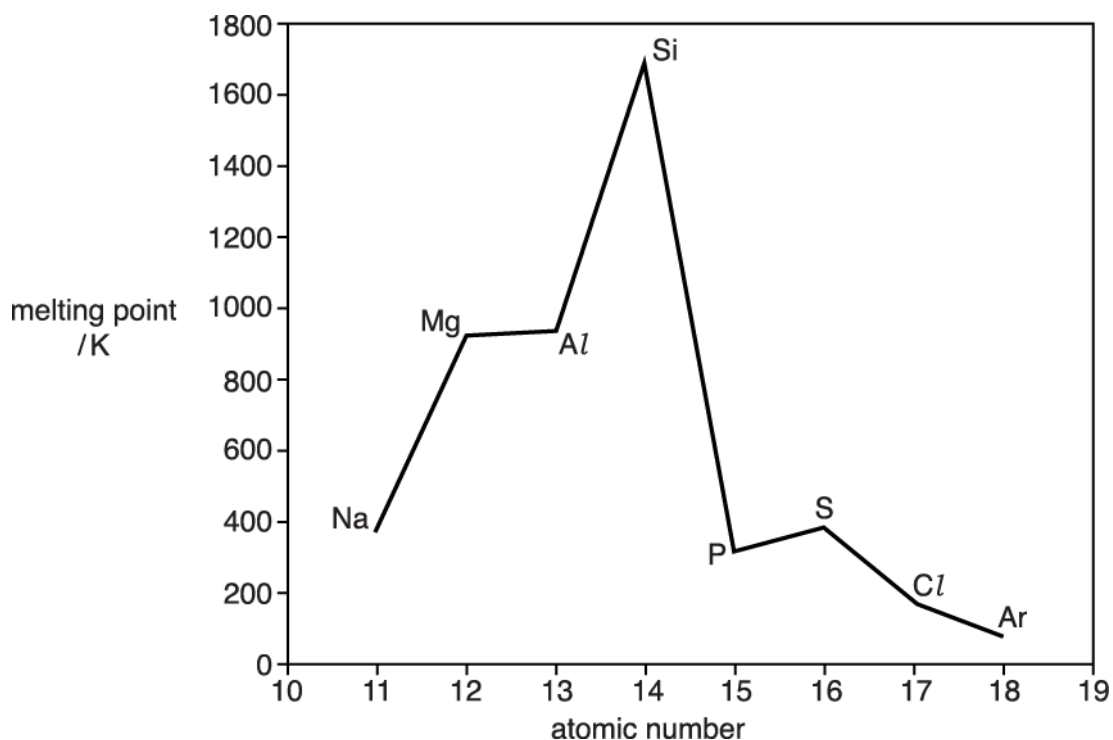
- (i) Write an equation, including state symbols, to represent the **second** ionisation energy of strontium.

-----[1]

- (ii) Explain why the first ionisation energy of strontium is less than the first ionisation energy of calcium.

-----[3]

13(a) The graph shows the melting points of the elements in Period 3 of the periodic table.



Phosphorus and chlorine have simple molecular structures.

More information about phosphorus and chlorine is given in the table below.

Element	Molecular formula
phosphorus	P ₄
chlorine	Cl ₂

Explain the differences in the melting points of phosphorus and chlorine.

[3]

Include the names of the particles and describe the forces between the particles in the structures.

[4]

14(a) The elements of Period 2 and Period 3 of the Periodic Table are shown in **Table 3.1**.

Group	1	2	3	4	5	6	7	0
Period 2	Li	Be	B	C	N	O	F	Ne
Period 3	Na	Mg	Al	Si	P	S	Cl	Ar

Table 3.1

The elements in these two periods show a repeating pattern in chemical and physical properties.

What is the name given to this repeating pattern of properties?

-----[1]

(b) State the element in **Table 3.1** with:

- the lowest first ionisation energy -----
- the lowest fourth ionisation energy -----
- the lowest boiling point -----

[3]

16 Electron configurations for atoms of different elements are shown below.

Which electron configuration represents the element with the largest first ionisation energy?

- A $1s^2 2s^2$
- B $1s^2 2s^2 2p^4$
- C $1s^2 2s^2 2p^6$
- D $1s^2 2s^2 2p^6 3s^2$

Your answer

[1]

17 Successive ionisation energies of four elements in Period 3 are shown below.

Which letter could represent magnesium?

	Ionisation energy / kJ mol^{-1}				
	1st	2nd	3rd	4th	5th
A	1251	2298	3822	5159	6542
B	738	1451	7733	10543	13630
C	496	4563	6913	9544	13352
D	578	1817	2745	11577	14842

Your answer

[1]

18 Which element has the highest melting point?

- A silicon
- B phosphorus
- C sulfur
- D chlorine

Your answer

[1]

- A student dissolves **B** and **C** in water in separate test tubes and analyses the solutions.

Test	Observation	
	B(aq)	C(aq)
Addition of $\text{HNO}_3(\text{aq})$ followed by $\text{BaCl}_2(\text{aq})$	bubbles no change	no change white precipitate

Explain your reasoning.

[5]

20 The table below compares the properties of sodium sulfide, sodium and sulfur.

Complete the table.

		Sodium sulfide	Sodium	Sulfur
Melting point / °C		1180	98	113
Type of structure (giant or simple)				
Electrical conductivity (good or poor)	solid			
	liquid			

[3]

21 What determines the order of elements in the Periodic Table?

- A first ionisation energy
- B number of electrons in the outer shell
- C number of protons in the nucleus
- D relative atomic mass

Your answer

[1]

22 The first five successive ionisation energies of an element Y are shown below.

1st	2nd	3rd	4th	5th
496	4563	6913	9544	13352

What is the formula of a chloride of Y?

A YCl

B YCl_2

C YCl_3

D YCl_4

Your answer

[1]

23 Which element has induced dipole–dipole interactions (London forces) in its solid lattice?

A boron

B magnesium

C silicon

D sulfur

Your answer

[1]

24 Why are silicon, carbon, oxygen and chlorine all classified as p-block elements?

[1]

25 Which statement about the periodic table is **not** correct?

- A The elements are arranged in groups with similar chemical properties.
- B The elements are arranged in periods with repeating trends in properties
- C The elements are arranged in order of increasing atomic number.
- D The elements in the halogen group increase in reactivity down the group.

Your answer

[1]

26 The table below shows two physical properties of the element strontium.

Melting point	high
Electrical conductivity	very good

Explain these physical properties of strontium, in terms of bonding and structure.
Include a labelled diagram in your answer.

Diagram

Explanation

[5]

END OF QUESTION PAPER

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
1			period = 5 AND block = p ✓	1	Examiner's Comments Although virtually every candidate got off to a steady start with this opening question, it was perhaps not quite as secure an opening question as in previous years. Of the two parts, it was the identification of the Block that caused problems with some candidates giving the Group number.
			Total	1	
2	a		Giant covalent (lattice) ✓	1	ALLOW 'Giant lattice with covalent bonds' ALLOW 'Giant covalent bonds' IGNORE 'Giant molecular' or 'macromolecular' DO NOT ALLOW 'Covalent bonds between molecules' Examiner's Comments This question allowed many candidates to achieve the mark but only the more succinct wrote the expected response of 'giant covalent'. Candidates unfamiliar with the concept of structure and bonding thought that the requirement to give the structure meant that they had to describe the geometry of the Si atom in SiO₂.
	b		<i>Conductivity of Na mark</i> M1: Sodium conducts in the solid and molten states ✓ <i>Reason for conductivity of Na mark</i> M2: Sodium has delocalised electrons (in both solid and liquid state) ✓ <i>Conductivity of Na₂O mark</i> M3: Na₂O conducts when molten and not when solid ✓	5	Quality of written communication 'delocalis(z)ed' spelled correctly once and used in context for second marking point ALLOW 'carries charge' for conducts for M1 and M3 IGNORE 'charge carriers' for electrons OR ions for M2, M4 and M5 DO NOT ALLOW M2 if incorrect bonding is seen for Na DO NOT ALLOW ions move for solid Na for M2 IGNORE ions move for molten Na for M2 ALLOW solid Na₂O is a poor conductor for M3 IGNORE references to aqueous Na₂O for M3

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			<i>Reason for conductivity of Na₂O marks</i> M4: Molten Na₂O has ions which are mobile ✓ M5: Solid Na₂O has ions which are fixed (in position) OR ions are held (in position) OR ions are not mobile AND in an (ionic) lattice OR structure ✓		IGNORE references to aqueous Na₂O for M4 IGNORE 'delocalised ions' OR 'free ions' for 'mobile ions' for M4 DO NOT ALLOW M4 AND M5 if incorrect bonding is seen in Na₂O DO NOT ALLOW any mention of electrons moving for M4 DO NOT ALLOW suggestion that it is only positive or only negative ions move for M4 IGNORE 'there are no delocalised electrons' for M5 ALLOW first and second statements of M5 to be unlinked in separate sentences ALLOW 'ions fixed in position by ionic bonds' for M5 Examiner's Comments This extended writing question gave weaker candidates problems, often resulting from a weakness in the ability to arrange their answer in a cogent, non-repeating manner. The more able candidates were able to rattle off excellent answers but weaker candidates dropped marks by leaving out key points; in the worst cases failing to discuss the conductivity of sodium at all. Of the possible errors that candidates made, the most common remained the suggestion that conductivity in molten Na₂O relies on mobile electrons. Within the better answers it was common for candidates to say that the ions were unable to move in solid Na₂O, but not to give the required explanation of why they lacked mobility. Centres are recommended to advise candidates, particularly weaker ones, that the use of bullet points often helps as a form of response that allows candidates to check that all aspects of the answer have been addressed.
			Total	6	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
3	M1 <i>Trend AND nuclear charge mark</i> (from Li to F) atomic radius decreases AND nuclear charge increases or number of protons increases ✓ M2 <i>same shell / shielding mark</i> (outer) electrons are in same shell OR (outer) electrons experience similar or same shielding ✓ OR same number of shells M3 <i>nuclear attraction mark</i> Greater nuclear attraction on (outer) electrons or shells OR (Outer) electrons or shells are attracted more strongly to the nucleus ✓	3	ALLOW ORA throughout if it is clear that the Period is being crossed right to left ALLOW 'proton number increases' IGNORE 'atomic number increases' IGNORE 'nucleus gets bigger' IGNORE 'effective nuclear charge increases' DO NOT ALLOW 'charge increases' without reference to nuclear' IGNORE there is shielding DO NOT ALLOW sub-shells OR orbitals DO NOT ALLOW 'electrons are at a similar distance' This will also contradict M1 ALLOW 'there is no change in shielding' IGNORE 'shielding has no effect' DO NOT ALLOW 'there is no shielding' Quality of written communication 'nucleus' OR 'nuclear' spelled correctly once and used in context for third marking point ALLOW pull for attraction IGNORE for M3, 'electrons are pulled closer to nucleus' as this is a re-statement of the trend mark. DO NOT ALLOW 'greater nuclear charge' for 'greater nuclear attraction' for M3 Examiner's Comments Of the three marks on offer, the mark most commonly awarded was the one for the correct statement of the trend linked to an increase in each atom's nuclear charge. The next most popular mark was given for identifying that this increase in proton number would increase the attractive forces operating on the outer shell electrons, although a number of candidates did not get this as they rushed the answer and so just referred vaguely to increased attraction, without describing it in the required level of detail. The mark related to shielding, or the fact that each subsequent electron is being accommodated in the same shell was awarded the least of the

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					three, with a significant number of candidates omitting to mention this at all. Candidates should be aware that using incorrect statements such as 'there is no shielding' could lead to correct statements being contradicted.
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
4		i	$\text{Al}^{2+}(\text{g}) \rightarrow \text{Al}^{3+}(\text{g}) + \text{e}^{-}$ ✓	1	State symbols required (ignore states on electrons) ALLOW $\text{Al}^{2+}(\text{g}) - \text{e}^{-} \rightarrow \text{Al}^{3+}(\text{g})$ ALLOW e for e^{-} Examiner's Comments This was well answered. The most common error was to omit the state symbols. Only occasionally did candidates attempt to ionise Al directly to Al^{3+}.
		ii	All (thirteen) ionisation energies show an increase ✓ The two largest increases are between the third and fourth AND the eleventh and twelfth ionisation energies ✓	2	IGNORE line if drawn IGNORE 0 if included ALLOW one mark for three lines (no crosses) showing an increase between: first and third; fourth and eleventh; twelfth and thirteenth AND Largest increases between each line ALLOW crosses outside grid Examiner's Comments Candidates made a good attempt at this question. For the first mark, successive ionisation energies had to increase. The most common error was to confuse the plot with that for the first ionisation energy against atomic number and so show step drops after the 3rd and 11th values. For the second mark the candidates had to show major increases after the 3rd and 11th values. Here the most common error was to reverse the plot and so show these after the 2nd and 10th values as clearly the candidates were thinking about removing the electrons in the pattern of the configuration (2:8:3).
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
5			The attraction (between nuclei and outermost electrons) increases (across the period) AND The nuclear charge increases OR The number of protons increase ✓ (Outer) electrons are in the same shell OR (Outer) electrons experience similar shielding OR Same number of shells OR Atomic radius decreases ✓	2	ALLOW There is no change in shielding But DO NOT ALLOW 'there is no shielding' DO NOT ALLOW electrons are at the same distance Examiner's Comments This question was well answered.
			Total	2	
6			C	1	
			Total	1	
7			HgBr₂ conducts when molten but not when solid (1) ... because ions are mobile in molten HgBr₂ (1) ... but are fixed in a lattice in solid HgBr₂ (1) Mercury conducts in both the solid and molten states ... (1) ... because delocalised electrons move (in both solid and liquid state) (1)	5	Explanations must be included for 2nd and 3rd marks. ignore references to aqueous HgBr₂ ignore 'delocalised ions' OR 'free ions' for 'mobile ions' do not allow any mention of electrons moving do not allow any mention of + ions moving
			Total	5	
8			B	1	
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
9			A	1	
			Total	1	
10			D	1	
			Total	1	
11	a		$\text{C}(g) \rightarrow \text{C}^+(g) + e^-$ Correct species, balanced AND correct state symbols	1	allow $\text{C}(g) - e^- \rightarrow \text{C}^+(g)$ ignore state symbols after electron
	b		Group: 2 (1) Justification: Large increase between 2nd and 3rd ionisation energy values. (1)	2	allow alkaline earth No ecf for justification (dependent on correct group)
			Total	3	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
12		i	$\text{Sr}^+(\text{g}) \rightarrow \text{Sr}^{2+}(\text{g}) + \text{e}^- \checkmark$	1	ALLOW $\text{Sr}^+(\text{g}) - \text{e}^- \rightarrow \text{Sr}^{2+}(\text{g})$ ALLOW e for electron (i.e. charge omitted) IGNORE states on the electron Examiner's Comments The equation for the second ionisation energy of strontium proved no difficulty for the most able candidates who provided both the correct state symbols and charges. It was surprising however that 40% of candidates failed to score what was meant to be a straightforward mark.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
		ii	<i>Atomic radius</i> larger atomic radius OR more shells ✓ <i>Effect of nuclear charge / shielding</i> Increased nuclear charge outweighed by increased distance / shielding OR more / increased shielding ✓ <i>Nuclear attraction</i> less nuclear attraction OR less attraction on electrons ✓	3	FULL ANNOTATIONS MUST BE USED ----- ALLOW ORA: comparison needed for each mark. ALLOW 'more / higher energy levels' ALLOW 'electrons further from nucleus' ALLOW 'extra / new shell' IGNORE more orbitals OR more sub-shells OR different shell ALLOW more electron repulsion from inner shells IGNORE responses with no comparison IGNORE nuclear charge / effective nuclear charge ALLOW 'less nuclear pull' OR 'electrons held less tightly' Examiner's Comments This descriptive question was well answered with the vast majority of candidates picking up two of the three available marks. Where a candidate scored two marks it was often due to the omission of any comment about the reduction in attraction between the nucleus and the electron as the group was descended. A common error was to discuss the reduction in nuclear charge rather than nuclear attraction.
			Total	4	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
13	a		Phosphorus has more electrons ✓	1	ALLOW ORA but comparison should be used for the all marks DO NOT ALLOW Phosphorus has more electrons in the outer shell or larger electron cloud. IGNORE Phosphorus molecules are bigger or have greater M_r. Examiner's Comments It as pleasing to see that the vast majority of candidates were able to use the terms London forces or induced dipole–dipole interactions rather than van der Waals as used in the legacy specification. Unfortunately, many candidates also chose to discuss how the strength of the covalent bonds increased melting points rather than just considering the intermolecular forces. Answers were either very good or very poor. Where a candidate only scored two marks it was mainly due to not discussing the influence the number of electrons has on the strength of the force.
			Stronger London forces OR Stronger induced dipole(-dipole) interactions ✓	1	ALLOW 'more' for 'stronger' ALLOW stronger van der Waals' / vdW forces
			More energy required to break the intermolecular forces / bonds OR London forces ✓	1	DO NOT ALLOW attraction between atoms- or that covalent bonds are broken
	b		Magnesium metallic (bonds) ✓	1	ALLOW the (electrostatic) attraction between cations / positive ions and delocalised electrons for both Mg marks ✓✓
			cations/positive ions/ Mg^{2+} AND delocalised electrons ✓	1	DO NOT ALLOW molecules for second mark IGNORE 'sea of electrons'
			Silicon covalent ✓	1	ALLOW the attraction between a shared pair of electrons and the nuclei of the (bonded) atoms for both marks ✓✓

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
			between atoms ✓	1	DO NOT ALLOW any intermolecular forces in marking points 2 and 4 or silicon molecules Examiner's Comments The best answers linked the type of bonding with the correct particles in just a few statements to score all four marks. Those candidates who attempted to fill the answer space often contradicted correct answers by discussing the intermolecular forces between the particles. Some very able candidates did not include that the particles in silicon are atoms whereas others gave answers which suggested that silicon was made up of molecules.
			Total	7	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
14	a		Periodicity ✓	1	Examiner's Comments The term 'periodicity' was known to all but a very small minority of candidates.
	b		Sodium OR Na ✓ Silicon OR Si ✓ Neon OR Ne ✓	3	Examiner's Comments The periodic properties of elements were not fully known. Most realised that sodium had the lowest first ionisation energy, less were aware that silicon had the lowest fourth ionisation energy and fewer still were unable to deduce that neon had the lowest boiling point.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c		<i>M1 Number of bonding electrons mark</i> Magnesium has more outer OR bonding electrons ✓ <i>M2 Ionic charge mark</i> Magnesium ions have a greater (positive) charge (density) ✓ <i>M3 Attraction mark</i> Magnesium has a greater attraction between ions and delocalised electrons ✓	3	ALLOW reverse argument throughout ALLOW 'more delocalised electrons' for 'more outer electrons' DO NOT ALLOW 'Magnesium molecules' for M1 ALLOW Mg^{2+} ion OR Mg ion for 'magnesium ion' ALLOW Mg^{2+} and Na^+ for M2 (may be seen in a diagram) IGNORE magnesium has a greater charge but ALLOW magnesium has a greater ionic charge IGNORE nuclear charge DO NOT ALLOW 'atoms' or 'molecules' having a greater charge for M2 ALLOW 'stronger metallic bonds' only when a clear description of metallic bonding is given. Eg 'The attraction of positive (metal) ions to delocalised electrons' QWC 'delocalised/delocalized' spelled correctly at least once in context of M3 (may be seen in M1 but used in M3) 'delocalised' need not be directly next to electrons eg Mg has more delocalised electrons and the ions have a greater attraction to these electrons would secure M3 Examiner's Comments This question proved to be a good question in terms of distinguishing candidates. Good candidates were able to secure three marks with succinct, but well-explained answers. Weaker candidates were confused as to why the strength of metallic bonding increased from Na to Mg.
			Total	7	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
15			D	1	<u>Examiner's Comments</u> B and C were common incorrect answers
			Total	1	
16			C	1	<u>Examiner's Comments</u> Many candidates did not take into account the trend across periods, with A being a common incorrect answer.
			Total	1	
17			B	1	<u>Examiner's Comments</u> Generally scored well.
			Total	1	
18			A	1	<u>Examiner's Comments</u> Most candidates correctly identified Si as giant covalent. A common error was answer option D.
			Total	1	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
19			Observations linked to anion identifications Bubbles/effervescence/fizzing/gas AND carbonate ✓ (white OR precipitate) AND sulfate ✓ Use of molar mass in reasoning Molar mass used ONCE with carbonate OR sulfate ✓ Identification B: K_2CO_3 ✓ C: Na_2SO_4 ✓	5	FULL ANNOTATIONS WITH TICKS, CROSSES, CON, etc MUST BE USED For bubbles, ALLOW carbon dioxide/CO_2 BUT DO NOT ALLOW hydrogen/H_2 For carbonate, ALLOW CO_3 For sulfate, ALLOW SO_4 e.g. Carbonate: $140 - (12 + 48)$; $140 - 60$ Sulfate: $140 - (32.1 + 64)$; $140 - 96.1$ $K_2CO_3 = 138.1$ $Na_2SO_4 = 142.1$ ALLOW ONE of the two identification marks for: • Correct names: B potassium carbonate AND C sodium sulfate • Incorrect formulae i.e. B KCO_3 AND C $NaSO_4$ <i>Communicates the same as names</i> Examiner's Comments This was a challenging question that discriminated extremely well. The more able candidates derived the anions from the two chemical tests and identified the cations using the molar masses of the salt and the anions. Weak candidates seemed to have little idea on how to approach such a question and they often achieved no credit. It was disappointing that many candidates were unable to identify a carbonate and sulfate from their chemical tests. Common errors included incorrectly identifying the gas with dilute acid as hydrogen, and identifying the white precipitate with barium ions as characteristic of a chloride. Candidates who used the provided molar mass of 140 usually went on to show that the cations contributed masses of approximately 80 for the carbonate and 44 for the sulfate. Candidates then needed to divide each value by 2 to obtain formulae

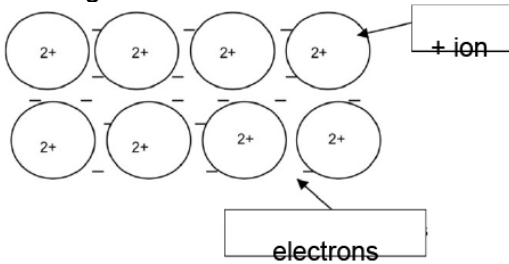
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance																				
					of K ₂ CO ₃ and Na ₂ SO ₄ . Many did not divide by 2 and instead concluded that the compounds were RbCO ₃ , KSO ₄ or CaSO ₄ . Strangely, some candidates thought they were identifying Group 1 metals and not salts.																				
			Total	5																					
20			<table><tr><td></td><td>Na₂S</td><td>Na</td><td>S</td></tr><tr><td>Melting point / °C</td><td>1180</td><td>98</td><td>113</td></tr><tr><td>Type of structure</td><td>giant</td><td>giant</td><td>simple</td></tr><tr><td>Conductivity of solid</td><td>poor</td><td>good</td><td>poor</td></tr><tr><td>Conductivity of liquid</td><td>good</td><td>good</td><td>poor</td></tr></table> ✓ ✓ ✓ One mark for each correct column		Na ₂ S	Na	S	Melting point / °C	1180	98	113	Type of structure	giant	giant	simple	Conductivity of solid	poor	good	poor	Conductivity of liquid	good	good	poor	3	Mark by COLUMN <u>Examiner's Comments</u> The majority of candidates obtained 2 or 3 marks on this question. Many candidates seemed unaware that sodium was a metal.
	Na ₂ S	Na	S																						
Melting point / °C	1180	98	113																						
Type of structure	giant	giant	simple																						
Conductivity of solid	poor	good	poor																						
Conductivity of liquid	good	good	poor																						
			Total	3																					
21			C	1	<u>Examiner's Comments</u> Most candidates correctly selected C (number of protons) but a sizeable number selected D (relative atomic mass) or B (number of electrons) instead.																				
			Total	1																					

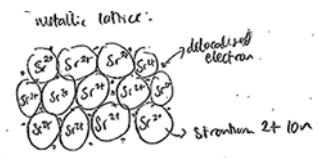
Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
22			A	1	<u>Examiner's Comments</u> Success depended on identifying the group of Y and working out the formula of the chloride. Most candidates recognised the large increase between 1st and 2nd ionisation energies, leading to the conclusion that Y is in Group 1 and the correct formula is YCl (A).
			Total	1	
23			D	1	<u>Examiner's Comments</u> As is often the case, candidates find structure and bonding difficult. Many candidates selected silicon (C) instead of the correct response of sulfur (D).
			Total	1	
24			Highest energy electron(s) in a p orbital/p sub-shell ✓	1	ALLOW outer electron(s) in a p orbital/sub-shell BUT IGNORE p shell ALLOW electron configuration ends in p OR the last electron is in a p orbital ALLOW valence electron(s) in p orbital/sub-shell <u>Examiner's Comments</u> Candidates were expected to identify that a p-block element has its highest energy electron(s), or outer electrons, in a p orbital or sub-shell. Lower ability candidates often omitted 'electrons' in their responses and just repeated the information in the question.
			Total	1	
25			D	1 (AO1.1)	
			Total	1	

Mark Scheme

Question	Answer/Indicative content	Marks	Guidance
26	Bonding and structure  Metallic bonding diagram Regular arrangement of labelled + ions ✓ scattering of labelled electrons between other species ✓ Properties linked to explanation metallic bond or attraction between the electrons and the positive ions/cations ✓ bonds are strong/require a lot of energy to break AND high melting point ✓ Delocalised electrons move AND good conductivity ✓	5 (AO1.1×3) (AO2.1×2)	Diagram must have at least two rows and a minimum of two ions per row (allow Sr^+ or Sr^{2+}) ALLOW for labels: + ions, positive ions, cations ALLOW e^- OR e as label for electron DO NOT ALLOW intermolecular forces ALLOW mobile electrons Examiner's Comments In general, the diagrams were poorly drawn or inadequately labelled. Many candidates lost marks as they did not specify the movement of electrons as the reason why metals conduct electricity. Too many candidates wrote "delocalised electrons carry the charge" or negated the metallic bonding description with "intermolecular forces" in their responses. Exemplar 1 Diagram  Explanation ...metallic bonding is strong forces of attraction between positive ions and delocalised electrons... as there are free moving electrons, which can carry a current, the material has a very good electrical conductivity. Therefore has a good structure, which makes it has a high melting point as the... it requires high amounts of energy to overcome the strong forces of attraction, as metallic bonds are strong. This candidate scored 3 marks for the description but lost 2 marks as the

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
					electrons were not throughout the structure, merely drawn around the ions, and the positive ions were not labelled. Exemplar 2 Diagram  Explanation: Strontium is a group 2 metal. This means it forms metallic bonds in which strontium ions (2+ charge) are attracted to negatively charged delocalised electrons. These delocalised electrons are able to move around the lattice and so therefore are able to carry a current of electricity even as a solid. This makes it a good electrical conductor. It has a high melting point due to the strong electrostatic forces of attraction and this needs to be overcome in order for it to change state. This candidate scored 5 marks for the excellent description with a well drawn and labelled diagram, clearly showing the electrons throughout the structure in-between the ions.
			Total	5	