5 Which property shows a **general decrease** across the Periodic Table from sodium to chlorine?

⊠ **A** atomic radius

⊠ **B** electronegativity

⊠ **C** first ionisation energy

⊠ **D** melting temperature

(Total for Question 5 = 1 mark)

6 The electronic configurations of the atoms of four elements are shown.

What is the electronic configuration of the atom of element which has the **lowest** first ionisation energy?

⊠ **A** $1s^2 2s^2 2p^6 3s^2$

⊠ **B** $1s^2 2s^2 2p^6 3s^2 3p^1$

⊠ **C** $1s^2 2s^2 2p^6 3s^2 3p^2$

⊠ **D** $1s^2 2s^2 2p^6 3s^2 3p^3$

(Total for Question 6 = 1 mark)

10 Which equation represents the **second** ionisation energy of magnesium?

⊠ **A** $Mg(g) \rightarrow Mg^{2+}(g) + 2e^-$

⊠ **B** $Mg^+(g) \rightarrow Mg^{2+}(g) + e^-$

⊠ **C** $Mg^+(s) \rightarrow Mg^{2+}(s) + e^-$

⊠ **D** $Mg(g) \rightarrow Mg^+(g) + e^-$

(Total for Question 10 = 1 mark)

6 The first ionisation energy of sulfur is lower than that of phosphorus.

Which is the best explanation for this?

⊠ **A** the atomic radius of sulfur is greater than that of phosphorus

⊠ **B** the electronegativity of sulfur is greater than that of phosphorus

⊠ **C** the repulsion between the outer electrons of sulfur is greater than that of phosphorus

⊠ **D** the shielding by the inner shell electrons of sulfur is greater than that of phosphorus

(Total for Question 6 = 1 mark)

3 The first seven ionisation energies, in kJ mol^{-1}, of an element are shown.

$$1010, \ 1900, \ 2910, \ 4960, \ 6270, \ 21\,300, \ 25\,400$$

In which group of the Periodic Table is this element located?

⊠   **A**   Group 3

⊠   **B**   Group 4

⊠   **C**   Group 5

⊠   **D**   Group 6

(Total for Question 3 = 1 mark)

14 Which is the simplest ionic equation for an alkali reacting with an acid?

⊠   **A** $2H^+(aq) \ + \ 2OH^-(aq) \ \rightarrow \ 2H_2O(l)$

⊠   **B** $H^+(aq) \ + \ OH^-(aq) \ \rightarrow \ H_2O(aq)$

⊠   **C** $H^+(aq) \ + \ OH^-(aq) \ \rightarrow \ H_2O(l)$

⊠   **D** $2H^+(aq) \ + \ O^{2-}(aq) \ \rightarrow \ H_2O(l)$

(Total for Question 14 = 1 mark)

1 The first ionisation energies of four successive elements in the Periodic Table are shown.

Element	P	Q	R	S
First ionisation energy / kJ mol^{-1}	1251	1521	419	590

(a) Which element has atoms with a full outer shell of electrons?

   ☒   **A**   element P

   ☒   **B**   element Q

   ☒   **C**   element R

   ☒   **D**   element S

(b) Which element could be X in a gaseous covalent compound with the formula HX?

   ☒   **A**   element P

   ☒   **B**   element Q

   ☒   **C**   element R

   ☒   **D**   element S

(c) Which element could be Y in an ionic compound with the formula YF_2?

   ☒   **A**   element P

   ☒   **B**   element Q

   ☒   **C**   element R

   ☒   **D**   element S

(d) Which element has atoms with the largest atomic radius?

   ☒   **A**   element P

   ☒   **B**   element Q

   ☒   **C**   element R

   ☒   **D**   element S

(Total for Question 1 = 4 marks)

8 Which is the strongest **oxidising** agent in these displacement reactions?

$$Cl_2 + 2Br^- \rightarrow Br_2 + 2Cl^-$$

$$Br_2 + 2I^- \rightarrow 2Br^- + I_2$$
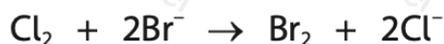
- ☒ **A** chlorine
- ☒ **B** bromide ions
- ☒ **C** bromine
- ☒ **D** iodide ions

(Total for Question 8 = 1 mark)

9 The first four ionisation energies of the elements gallium (Ga), indium (In), germanium (Ge) and tin (Sn) are shown.

Which values are the first four ionisation energies of gallium?

- ☒ **A** 557 1821 2705 5200
- ☒ **B** 579 1979 2963 6200
- ☒ **C** 709 1412 2943 3930
- ☒ **D** 762 1537 3302 4411

(Total for Question 9 = 1 mark)

10 Which solution contains the **smallest** number of ions?

- ☒ **A** $500\,cm^3$ of $0.06\,mol\,dm^{-3}$ $Ca(NO_3)_2(aq)$
- ☒ **B** $500\,cm^3$ of $0.09\,mol\,dm^{-3}$ $KI(aq)$
- ☒ **C** $250\,cm^3$ of $0.12\,mol\,dm^{-3}$ $BaCl_2(aq)$
- ☒ **D** $250\,cm^3$ of $0.09\,mol\,dm^{-3}$ $(NH_4)_2SO_4(aq)$

(Total for Question 10 = 1 mark)

8 Which is the equation for the **second** ionisation of element J?

- ☒ **A** $J(g) \rightarrow J^{2+}(g) + 2e^-$
- ☒ **B** $J^+(g) \rightarrow J^{2+}(g) + e^-$
- ☒ **C** $J^+(g) \rightarrow J^{3+}(g) + 2e^-$
- ☒ **D** $J^{2+}(g) \rightarrow J^{3+}(g) + e^-$

(Total for Question 8 = 1 mark)

9 Which is a reason why fluorine has a higher first ionisation energy than oxygen?

☒ **A** a fluorine atom has fewer unpaired electrons

☒ **B** a fluorine atom has fewer shells of electrons

☒ **C** a fluorine atom has more electrons

☒ **D** a fluorine atom has more protons

(Total for Question 9 = 1 mark)

18 This question is about the elements in Period 2 of the Periodic Table.

(a) The first ionisation energies of some elements in Period 2 are shown.

Element	Li	Be	B	C	N	O	F	Ne
First ionisation energy / $kJ\,mol^{-1}$	520	900	801	1086	1402		1681	2081

(i) Explain the **general** trend in first ionisation energy across Period 2.

(2)

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(ii) Predict a value for the first ionisation energy of oxygen.
Justify your answer.

(3)

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(c) Beryllium reacts with chlorine to form beryllium chloride.

In the gas phase, beryllium chloride exists both as a simple molecule, $BeCl_2$, and as a dimer, Be_2Cl_4.

(i) Draw a dot-and-cross diagram of the molecule, $BeCl_2$.

(1)

(ii) Explain the shape and bond angle in the molecule $BeCl_2$.

(4)

Shape

Bond angle

Explanation

16 This question is about silicon.

(a) (i) Define relative atomic mass.

(2)

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(ii) Calculate the relative atomic mass of a sample of silicon, using the isotopic abundance data provided.
Give your answer to 3 significant figures.

Isotope	Abundance (%)
^{28}Si	91.07
^{29}Si	4.62
^{30}Si	3.00
^{32}Si	1.31

(2)

(iii) In the mass spectrum of silicon, there is also a small peak at $m/z = 14$.
Deduce the formula of this particle.

(1)

(b) Consider the elements Al, Si, P and S.

(i) Explain the trend in the first ionisation energies of Al, Si and P.

(3)

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(ii) Explain why sulfur does **not** follow this trend.

(2)

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(Total for Question 16 = 10 marks)

21: This question is about ionisation energy.

(a) Write the equation for the third ionisation energy of calcium.

Include state symbols.

(3)

(b) (i) The following data show the first seven ionisation energies for an element in Period 3. Deduce, with a reason, the identity of the element.

(2)

Ionisation number	1	2	3	4	5	6	7
Energy / kJ mol^{-1}	1000	2251	3361	4564	7012	8496	27107

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(ii) State the general trend in first ionisation energies across Period 3.

(1)

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(c) (i) Plot the following first ionisation energies of the elements in Period 2 on the grid below.

(3)

Element	Li	Be	B	C	N	O	F	Ne
1st ionisation energy / kJ mol^{-1}	520	900	801	1086	1402	1314	1681	2081
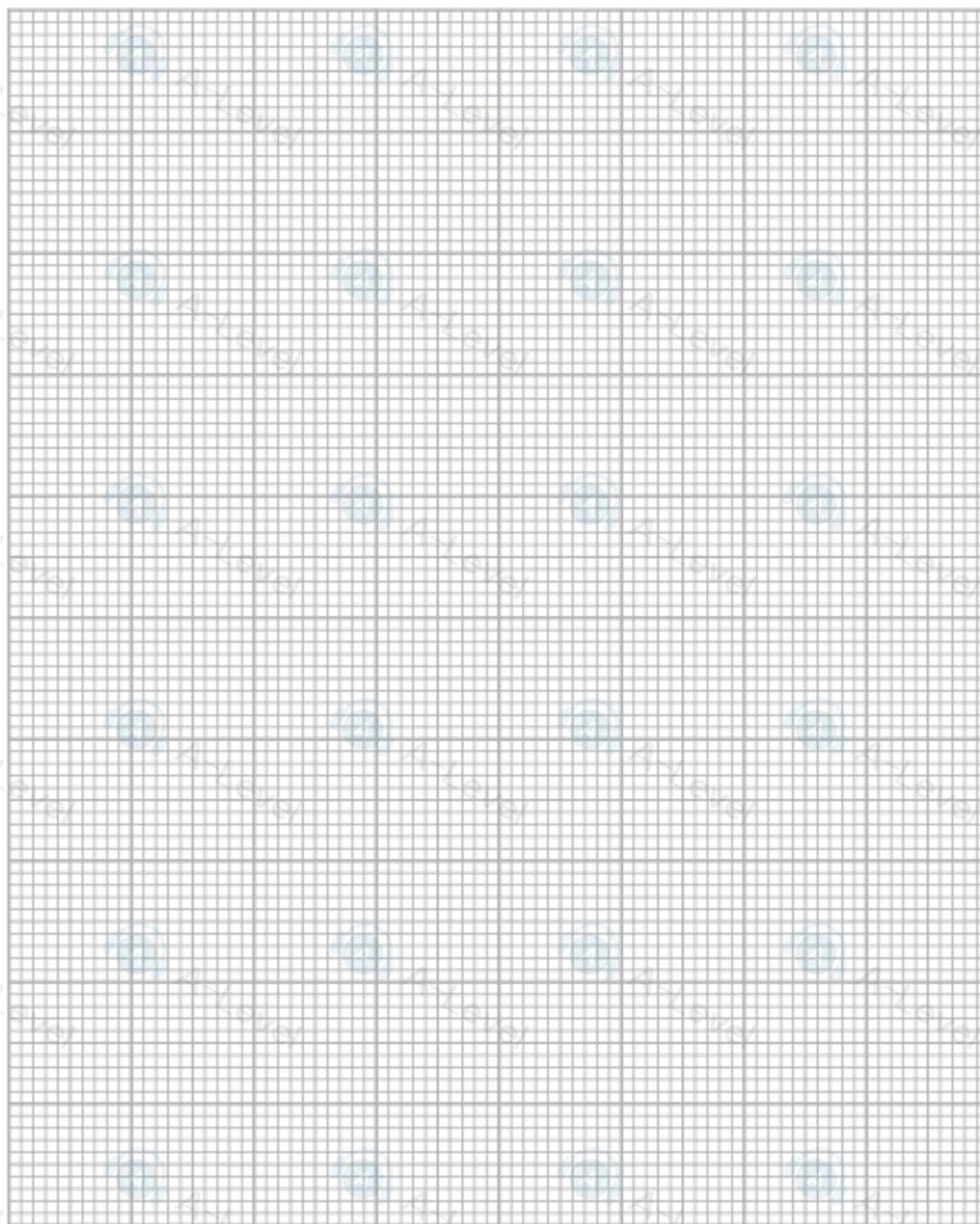
202505

20 The periods in the Periodic Table show trends in physical properties.

(a) (i) Explain the general trend in first ionisation energies for the Period 2 elements.

(2)

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(ii) Explain which **one** of the elements from **lithium** to **nitrogen** deviates from this general trend.

(3)

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20 The periods in the Periodic Table show trends in physical properties.

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(3)

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