1 Which of these statements is **incorrect**?

☒ **A**   The atomic radius of metals increases down a Group.

☒ **B**   The trend in the melting temperature of successive elements across Period 2 is similar to that in Period 3.

☒ **C**   A metallic structure is held together by attractions between metal atoms and delocalized electrons.

☒ **D** Na^+ and O^{2-} ions are isoelectronic.

(Total for Question = 1 mark)

2 The electronegativities of four pairs of elements are given below. Which pair would form the compound with the greatest ionic character?

☒ **A**   0.7

☒ **B**   0.7

☒ **C**   1.0

☒ **D**   0.8

(Total for Question = 1 mark)

3 The nucleus of a $^{23}_{11}$ Na atom contains

☒ **A**   11 protons and 12 neutrons.

☒ **B**   11 protons and 12 electrons.

☒ **C**   23 protons and 11 neutrons.

☒ **D**   23 protons and 11 electrons.

(Total for Question = 1 mark)

4 The first five successive ionization energies of an element, **X**, are shown in the table below.

Ionization energy	first	second	third	fourth	fifth
Value / kJ mol⁻¹	590	1100	4900	6500	8100

Which ion is **X** most likely to form when it reacts with chlorine?

☒ **A** X^+

☒ **B** X^{2+}

☒ **C** X^{3+}

☒ **D** X^{4+}

(Total for Question = 1 mark)

5 Which pair of atomic numbers represents elements which are both in the p-block of the Periodic Table?

☒ **A**   4,

☒ **B**   6,

☒ **C**   8,

☒ **D**   10,

(Total for Question = 1 mark)

6 The electronic structure of an atom of an element in Group 6 of the Periodic Table could be

☒ **A** $1s^2\ 2s^2\ 2p^2$

☒ **B** $1s^2\ 2s^2\ 2p^4$

☒ **C** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^6\ 4s^2$

☒ **D** $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^{10}\ 4s^2\ 4p^6$

(Total for Question = 1 mark)

7 Which of the following formulae for compounds of germanium, Ge, is unlikely to be correct, given the position of germanium in the Periodic Table?

☒ **A** GeF_3

☒ **B** GeS_2

☒ **C** GeO_2

☒ **D** GeH_4

(Total for Question = 1 mark)

8 The electronic configurations of the atoms of four different elements are given below. For which element would you expect the value of the first ionization energy to be the largest?

☒ **A** $1s^1$

☒ **B** $1s^2$

☒ **C** $1s^2\ 2s^1$

☒ **D** $1s^2\ 2s^2$

(Total for Question = 1 mark)

9 Which of the following has the smallest ionic radius?

☒ **A** F^-

☒ **B** Na^+

☒ **C** Mg^{2+}

☒ **D** O^{2-}

(Total for Question = 1 mark)

10 Which of the following does **not** have exactly 10 electrons?

☒ **A** An ion of fluorine, F^-

☒ **B** A molecule of methane, CH_4

☒ **C** A molecule of nitrogen, N_2

☒ **D** An ion of sodium, Na^+

(Total for Question = 1 mark)

11 Which of the following statements is **true**?

☒ **A**   Calcium hydroxide is more soluble in water than magnesium hydroxide.

☒ **B**   Chlorine is more electronegative than fluorine.

☒ **C**   Iodine is a stronger oxidizing agent than bromine.

☒ **D**   The first ionization energy of barium is greater than that of strontium.

(Total for Question = 1 mark)

12 An isotope of an element, atomic number z, has mass number $2z + 4$. How many neutrons are in the nucleus of the element?

☒ **A** $z + 4$

☒ **B** $z + 2$

☒ **C** z

☒ **D** 4

(Total for Question = 1 mark)

13 When an Al^{4+} ion is formed from an Al atom, the fourth electron is lost from the

☒ **A** 1s sub-shell.

☒ **B** 2s sub-shell.

☒ **C** 2p sub-shell.

☒ **D** 3s sub-shell.

(Total for Question = 1 mark)

14 A molecule is

☒ **A** a group of atoms bonded by ionic bonds.

☒ **B** a group of atoms bonded by covalent bonds.

☒ **C** a group of ions bonded by covalent bonds.

☒ **D** a group of atoms bonded by metallic bonds.

(Total for Question   1 mark)

15 The relative atomic mass is defined as

☒ **A** the mass of an atom of an element relative to 1/12 the mass of a carbon-12 atom.

☒ **B** the mass of an atom of an element relative to the mass of a hydrogen atom.

☒ **C** the average mass of an element relative to 1/12 the mass of a carbon atom.

☒ **D** the average mass of an atom of an element relative to 1/12 the mass of a carbon-12 atom.

(Total for Question   1 mark)

16 The definition of the mole is

☒ **A** the amount of any substance which occupies a volume of 24 dm^3 at room temperature and pressure.

☒ **B** the amount of any substance containing the same number of identical entities as there are in exactly 12 g of the carbon-12 isotope.

☒ **C** the number of atoms in exactly 12 g of the carbon-12 isotope.

☒ **D** the number of molecules in exactly 2 g of hydrogen at room temperature and pressure.

(Total for Question   1 mark)

17 The first eight ionization energies of an element are (in kJ mol^{-1}):
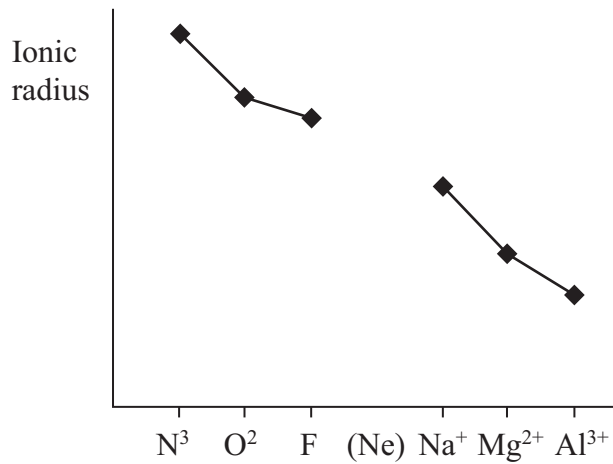
789, 1577, 3232, 4356, 16091, 19785, 23787, 29253.

The element is in

☒ **A** Group 1

☒ **B** Group 2

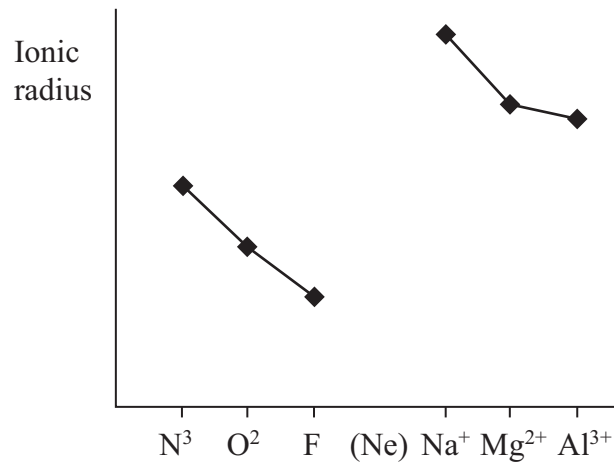☒ **C** Group 3

☒ **D** Group 4

(Total for Question   1 mark)

18 Which of the graphs shows (from left to right) the trend in the ionic radius of the isoelectronic ions N^{3-}, O^{2-}, F^-, Na^+, Mg^{2+}, Al^{3+}?
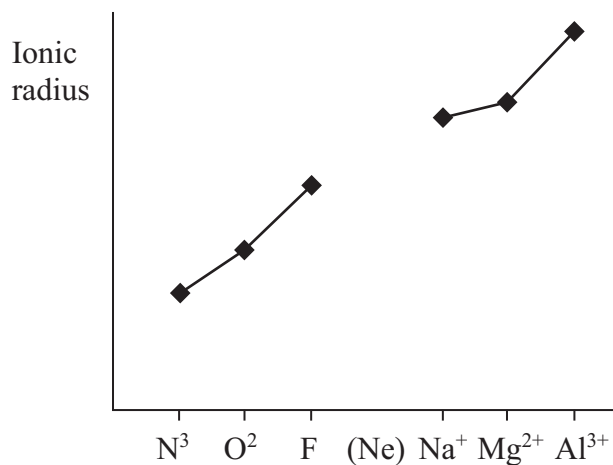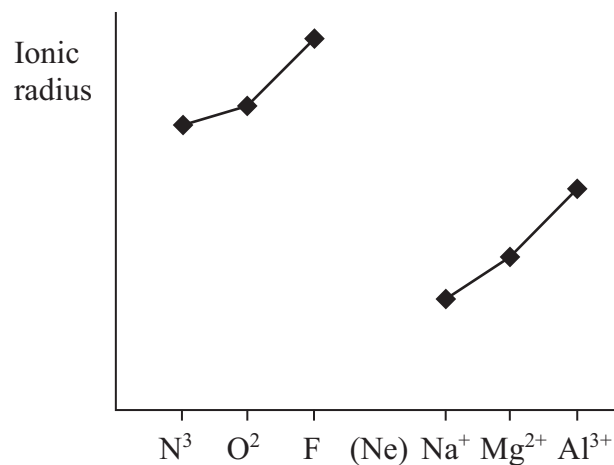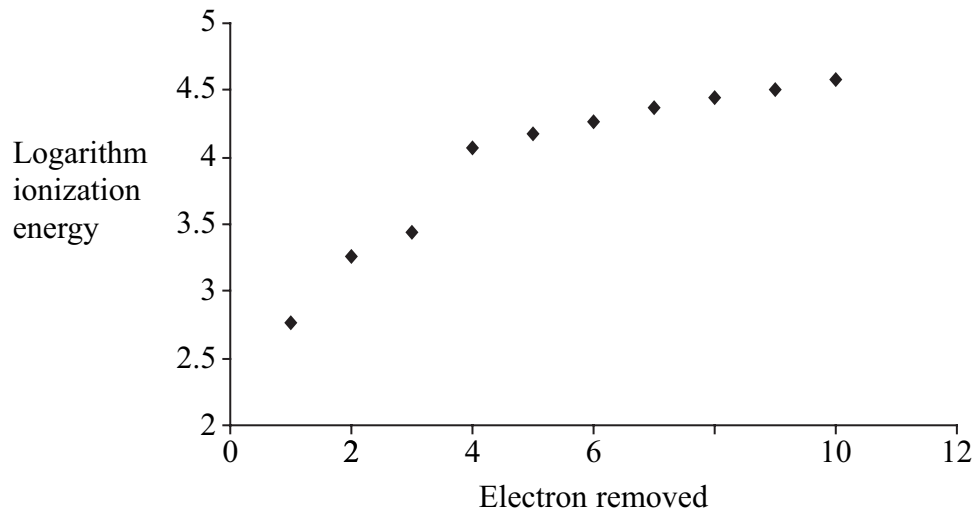
☒ **A**

Ionic radius

N^{3-} O^{2-} F (Ne) Na^+ Mg^{2+} Al^{3+}

☒ **B**

Ionic radius

N^{3-} O^{2-} F (Ne) Na^+ Mg^{2+} Al^{3+}

☒ **C**

Ionic radius

N^{3-} O^{2-} F (Ne) Na^+ Mg^{2+} Al^{3+}

☒ **D**

Ionic radius

N^{3-} O^{2-} F (Ne) Na^+ Mg^{2+} Al^{3+}

(Total for Question   1 mark)

19 The graph below represents the successive ionization energies of an element **X** plotted

against the number of the electron removed. **X** is not the symbol for the element.

(a) From this graph it is possible to deduce the group in the Periodic Table to which **X** belongs. **X** is in

(1)

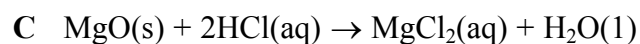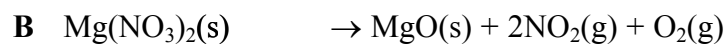☒ **A**   Group 1

☒ **B**   Group 3

☒ **C**   Group 5

☒ **D**   Group 7

(b) From the graph it is possible to deduce that the most stable ion of **X** will be

(1)

☒ **A** X^{3+}

☒ **B** X^+

☒ **C**   X

☒ **D** X^3

(Total for Question   2 marks)

20 The equations below show some reactions of magnesium and its compounds.

A $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$

B $Mg(NO_3)_2(s) \rightarrow MgO(s) + 2NO_2(g) + O_2(g)$

C $MgO(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(1)$

D $Mg(s) + CuSO_4(aq) \rightarrow MgSO_4(aq) + Cu(s)$
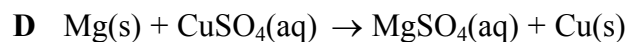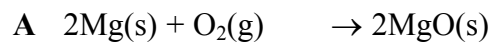
(a) Which equation is **not** balanced?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

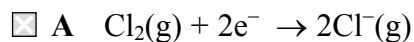(b) Which equation can be classified as a displacement reaction?
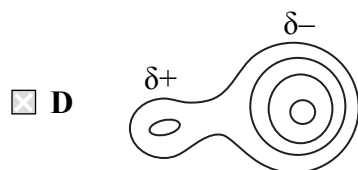
(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(Total for Question = 2 marks)

21 Which of these equations represents the electron affinity of chlorine?

☒ **A** $Cl_2(g) + 2e^- \rightarrow 2Cl^-(g)$

☒ **B** $Cl_2(g) - 2e^- \rightarrow 2Cl^-(g)$

☒ **C** $\frac{1}{2}Cl_2(g) + e^- \rightarrow Cl^-(g)$

☒ **D** $Cl(g) + e^- \rightarrow Cl^-(g)$
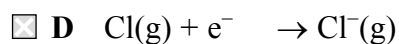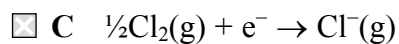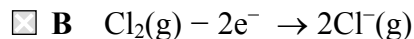
(Total for Question = 1 mark)

22 Which of these electron density maps best represents the bonding in the compound lithium iodide, LiI?

☒ **A**

☒ **B**

☒ **C**

☒ **D**
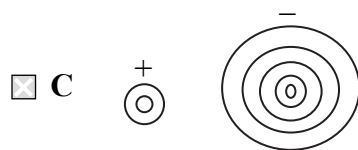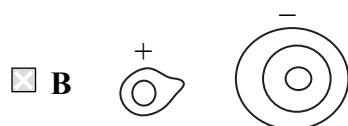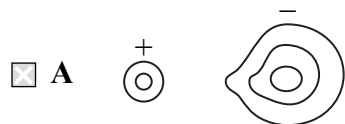
(Total for Question = 1 mark)

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(Total for Question = 1 mark)

24 A sample of gas was prepared for use in helium-neon lasers. It contained 4 g of helium and 4 g of neon. What is the ratio of helium atoms to neon atoms in the sample?

☒ **A** 1 : 1

☒ **B** 2.5 :

☒ **C** 1 : 5

☒ **D** 5 : 1

(Total for Question = 1 mark)

25 The overall equation for the reaction between sulfur and oxygen to form sulfur trioxide is shown below.

$$2S(s) + 3O_2(g) \rightarrow 2SO_3(g)$$
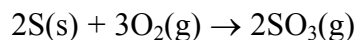
0.9 mol of $O_2(g)$ reacted completely with excess sulfur. What volume, in dm^3, of sulfur trioxide would form?

[Assume the molar gas volume = 24 dm^3 mol^{-1}]

☒ **A** $(0.9 \times 3/2) \times 24$

☒ **B** $(0.9 \times 3/2) \div 24$

☒ **C** $(0.9 \times 2/3) \times 24$

☒ **D** $(0.9 \times 2/3) \div 24$

(Total for Question = 1 mark)