11 Which compound shows the greatest degree of polarisation?

- ☒ **A** sodium chloride
- ☒ **B** sodium iodide
- ☒ **C** magnesium chloride
- ☒ **D** magnesium iodide

(Total for Question 11 = 1 mark)

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12 Which ion is isoelectronic with a noble gas atom (Group 0/8)?

- ☒ **A** H^+
- ☒ **B** O^-
- ☒ **C** Sc^{3+}
- ☒ **D** Zn^{2+}

(Total for Question 12 = 1 mark)

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9 A sample of the element chlorine, Cl_2, was analysed in a mass spectrometer. Chlorine has **two** isotopes.

What is the **total** number of peaks, due to ions with a single positive charge, which could be seen in the mass spectrum?

- ☒ **A** two
- ☒ **B** four
- ☒ **C** five
- ☒ **D** six

(Total for Question 9 = 1 mark)

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5 Which is the equation for the reaction of magnesium chloride solution with sodium hydroxide solution?

- ☒ **A** $Mg^+(aq) + OH^-(aq) \rightarrow MgOH(s)$
- ☒ **B** $Mg^{2+}(aq) + 2OH^-(aq) \rightarrow Mg(OH)_2(s)$
- ☒ **C** $MgCl(aq) + NaOH(aq) \rightarrow MgOH(aq) + NaCl(aq)$
- ☒ **D** $MgCl_2(aq) + 2NaOH(aq) \rightarrow Mg(OH)_2(aq) + 2NaCl(aq)$

(Total for Question 5 = 1 mark)

5 Diphosphane, P_2H_4, reacts spontaneously with oxygen.

$$xP_2H_4 + yO_2 \rightarrow P_4O_{10} + zH_2O$$

The equation for this reaction is balanced when

- ☒ **A** $x = 1$ $y = 6$ $z = 2$
- ☒ **B** $x = 2$ $y = 6$ $z = 2$
- ☒ **C** $x = 2$ $y = 7$ $z = 4$
- ☒ **D** $x = 4$ $y = 9$ $z = 8$

(Total for Question 5 = 1 mark)

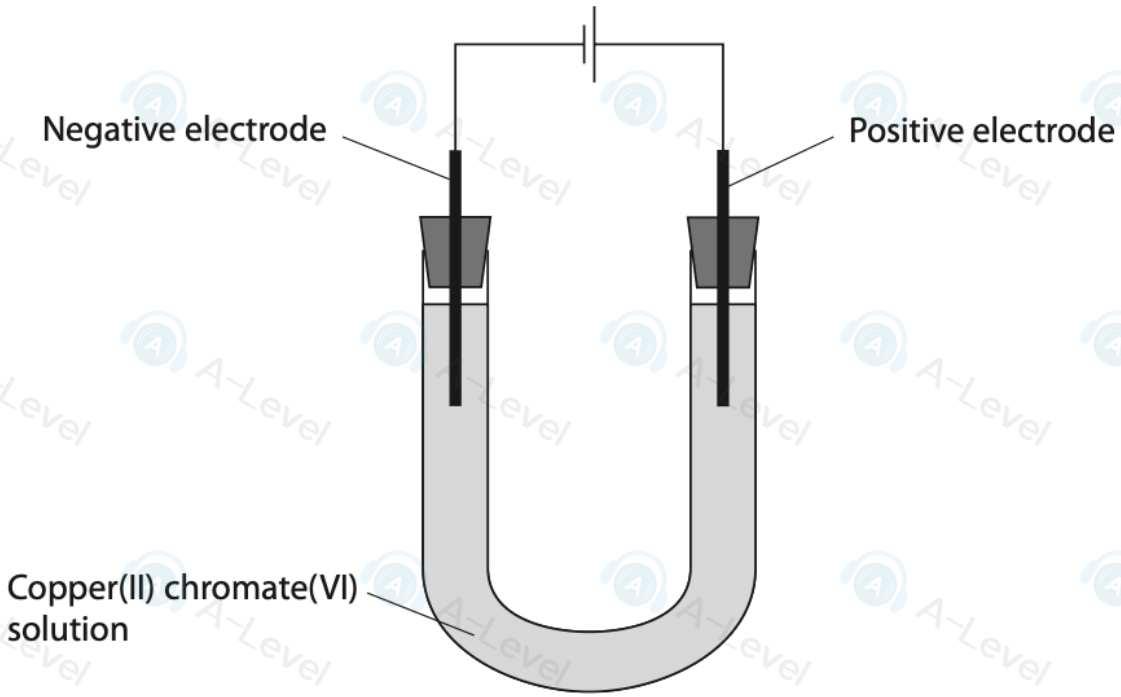
13 Which solution contains chloride ions with a concentration of $0.0500\,mol\,dm^{-3}$?

[A_r values: Ca = 40.1 Cl = 35.5 Na = 23.0]

	Solute	Mass of solute / g	Volume of solution / cm^3
☒ **A**	calcium chloride	1.39	250
☒ **B**	calcium chloride	1.39	500
☒ **C**	sodium chloride	1.46	250
☒ **D**	sodium chloride	1.46	1000

(Total for Question 13 = 1 mark)

7 A direct electrical current was passed through a green solution of copper(II) chromate(VI) in the apparatus shown.



Which colours would be seen at each electrode after several minutes?

		Negative electrode	Positive electrode
☒	**A**	blue	green
☒	**B**	green	blue
☒	**C**	blue	yellow
☒	**D**	yellow	blue

(Total for Question 7 = 1 mark)

3: Which amount does **not** have a mass of approximately 6 g?

☒ **A** 0.33 mol water (H_2O; $M_r = 18$)

☒ **B** 0.25 mol magnesium (Mg; $A_r = 24.3$)

☒ **C** 0.033 mol glucose ($C_6H_{12}O_6$; $M_r = 180$)

☒ **D** 0.025 mol copper(II) sulfate ($CuSO_4$; $M_r = 159.6$)

(Total for Question 3 = 1 mark)

8: Which substance does **not** exist as a giant lattice?

- ☒ **A** silver (Ag)
- ☒ **B** sodium chloride (NaCl)
- ☒ **C** graphite (C)
- ☒ **D** buckminsterfullerene (C_{60})

(Total for Question 8 = 1 mark)

11 A piece of filter paper is soaked in water and attached to a microscope slide.

A few crystals of green copper(II) chromate(VI) are placed in the centre of the filter paper.

The filter paper is connected to a DC supply of 20 V.

What colours are observed on the paper after a few minutes?

☒	**A**	blue	yellow
☒	**B**	green	blue
☒	**C**	yellow	green
☒	**D**	yellow	blue

(Total for Question 11 = 1 mark)

6 Copper metal can displace silver from silver nitrate solution according to the equation shown.

$$Cu + 2AgNO_3 \rightarrow 2Ag + Cu(NO_3)_2$$

10 g of copper metal was added to an excess of silver nitrate solution.

The silver metal was collected, washed with deionised water and left to dry.

What is the mass of silver metal collected, assuming a 100 % yield?

- ☒ **A** between 10 g and 20 g
- ☒ **B** 20 g
- ☒ **C** between 20 g and 40 g
- ☒ **D** more than 40 g

(Total for Question 6 = 1 mark)

10 Which is the electronic configuration of chromium?

(Total for Question 10 = 1 mark)

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8 A block of lead measuring 10 cm × 10 cm × 10 cm contains 3.295×10^{25} atoms.

Calculate the density of lead.

[A_r value: Pb = 207.2 Avogadro constant, $L = 6.02 \times 10^{23}$ mol^{-1}]

- ☒ **A** 3.79 g cm^{-3}
- ☒ **B** 4.49 g cm^{-3}
- ☒ **C** 11.34 g cm^{-3}
- ☒ **D** 54.73 g cm^{-3}

(Total for Question 8 = 1 mark)

16: How many hydrogen atoms are in 14 g of methane?

[$L = 6.02 \times 10^{23}$]

- ☒ **A** 5.268×10^{23}
- ☒ **B** 6.880×10^{23}
- ☒ **C** 2.107×10^{24}
- ☒ **D** 2.752×10^{24}

(Total for Question 16 = 1 mark)

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10 This question is about the Period 3 elements Na, Mg, Al, Si, P, S and Cl.

(a) Which statement is **not** correct for these Period 3 elements?

(1)

- ☒ **A** atoms of Cl(g) have the highest first ionisation energy
- ☒ **B** ions of $Cl^-(g)$ and $S^{2-}(g)$ have the same ionic radius
- ☒ **C** atoms of Na(g) have the largest atomic radius
- ☒ **D** atoms of P(g) have the most unpaired electrons

(b) The melting temperatures of these elements are shown in the table.

Element	Na	Mg	Al	Si	P	S	Cl
Melting temperature / K	371	922	933	1683	317	392	172

Which of the elements has the strongest **intermolecular** forces?

(1)

- ☒ **A** Al
- ☒ **B** Si
- ☒ **C** P
- ☒ **D** S

(Total for Question 10 = 2 marks)

21 Boric acid is a white solid often used as an antiseptic.

(a) Boric acid contains 17.48% by mass of boron, 77.67% of oxygen and the remainder is hydrogen. The molar mass of boric acid is 61.8 g mol^{-1}.
[A_r values: H = 1 B = 10.8 O = 16]

Show that the molecular formula of boric acid is H_3BO_3.

You must show all your working.

(4)

(b) The formula of boric acid can also be written as $B(OH)_3$.

(i) Draw a dot-and-cross diagram for this molecule.
Show outer electrons only.

(3)

(ii) Suggest a value for the O—B—O bond angle. Justify your answer.

(2)

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(Total for Question 21 = 9 marks)

23: This question is about structure and bonding.

(a) Ionic bonding occurs between metals and non-metals.

(i) Describe ionic bonding.

(1)

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(ii) Explain why the ionic bonding in magnesium fluoride might be expected to be stronger than the ionic bonding in sodium fluoride.

(2)

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(iii) Sodium and oxygen react to form sodium oxide, which is also ionic.
Draw the dot-and-cross diagram showing the ions present in sodium oxide.

(2)

(iv) Draw the ionic lattice for sodium chloride.

You should show at least nine ions.

(2)

(b) Non-metal atoms join together using covalent bonds.

(i) Describe covalent bonding.

(1)

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(iii) The three molecules (methane, ammonia and water) each have a different shape. Complete the table below.

(3)

molecule	shape	bond angle
methane		
ammonia		
water		

(iv) Explain the differences between the molecular shapes and bond angles for ammonia and water.

(2)

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(v) Ethene and poly(ethene) have different melting temperatures.

Molecule	Melting temperature (K)
ethene	104.1
poly(ethene)	400

Explain why their melting temperatures are different.

(2)

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(c) Metals are held together by metallic bonding.

(i) Describe metallic bonding.

(1)

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(ii) Metals conduct electricity when solid.

Explain, with the aid of a diagram, why copper conducts electricity.

(2)

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(Total for Question 23 = 21 marks)

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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