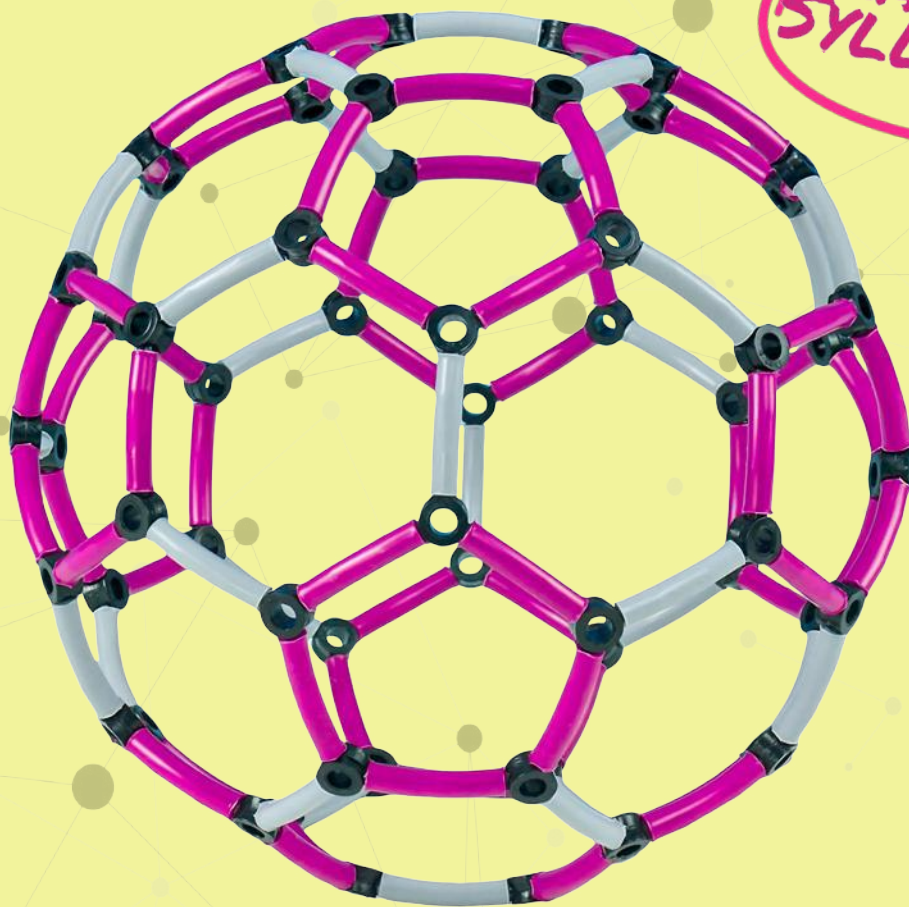


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Unit 1

Classified Past Papers



SCAN ME



IONIC & METALLIC BONDING



- 1 Which of the following equations has the correct state symbols for the reaction of dilute hydrochloric acid with magnesium oxide?

- ☐ **A** $\text{MgO(s)} + 2\text{HCl(aq)} \rightarrow \text{MgCl}_2\text{(s)} + \text{H}_2\text{O(l)}$
- ☐ **B** $\text{MgO(s)} + 2\text{HCl(aq)} \rightarrow \text{MgCl}_2\text{(aq)} + \text{H}_2\text{O(l)}$
- ☐ **C** $\text{MgO(s)} + 2\text{HCl(l)} \rightarrow \text{MgCl}_2\text{(s)} + \text{H}_2\text{O(l)}$
- ☐ **D** $\text{MgO(s)} + 2\text{HCl(l)} \rightarrow \text{MgCl}_2\text{(aq)} + \text{H}_2\text{O(l)}$

(Total for Question = 1 mark)

- 2 Which of the following observations provides the best evidence for the presence of ionic bonding in an unknown substance?

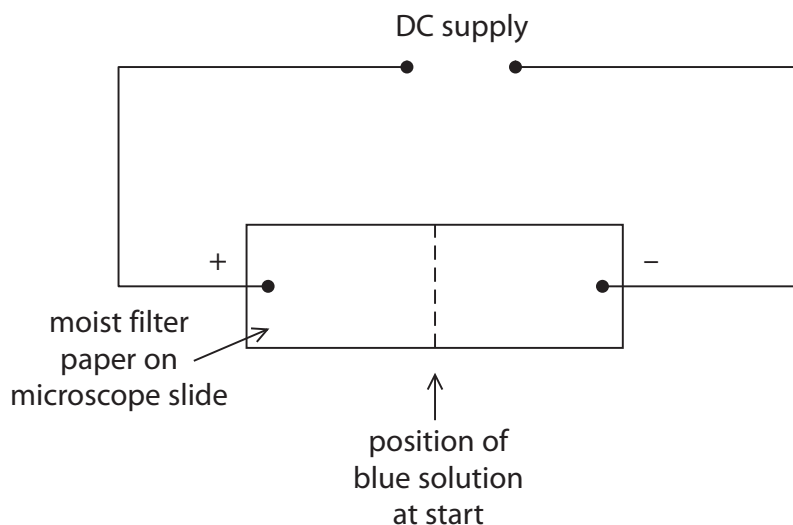
The substance conducts electricity

- ☐ **A** in the solid state.
- ☐ **B** in the solid state and in aqueous solution.
- ☐ **C** in the solid state and when molten.
- ☐ **D** when molten but not in the solid state.

(Total for Question = 1 mark)



- 3 A spot of blue solution was placed in the centre of a piece of moist filter paper supported on a microscope slide and the following experiment was carried out.



After some time, a blue colour moved towards the negative terminal, but no change was visible in the region of the positive terminal. This is because

- ☐ A the negative ions in the solution were colourless and the positive ions were blue.
- ☐ B the positive ions in the solution were colourless and the negative ions were blue.
- ☐ C the negative ions in the solution had not moved but the positive ions had moved.
- ☐ D the positive ions in the solution had not moved but the negative ions had moved.

(Total for Question = 1 mark)

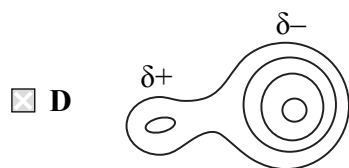
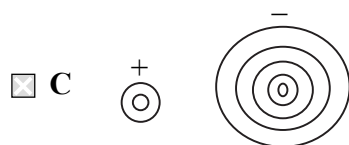
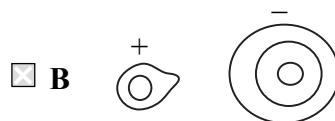
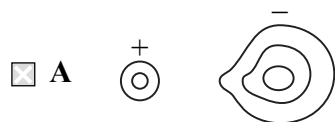
- 4 In which of the following compounds is the **anion** most polarized?

- ☐ A LiF
- ☐ B LiI
- ☐ C KF
- ☐ D KI

(Total for Question = 1 mark)



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



(Total for Question = 1 mark)

- 6 Metals are good conductors of electricity because

- ☐ **A** metal atoms are arranged in a regular lattice.
- ☐ **B** metal ions are very close to each other.
- ☐ **C** metal ions are free to move through the lattice.
- ☐ **D** electrons are free to move through the lattice.

(Total for Question = 1 mark)

IONIC & METALLIC BONDING



7 Which of the following statements is evidence for the existence of ions in ionic compounds?

- ☐ A Ionic compounds, in the solid state, conduct electricity.
- ☐ B When **any** ionic compound in solution is electrolysed, the migration of ions can be seen.
- ☐ C In electron density maps for ionic compounds, there is no single line representing electron density that surrounds both cations and anions.
- ☐ D In electron density maps for ionic compounds, there are some single lines representing electron density that surround both cations and anions.

(Total for Question = 1 mark)

8 Metals usually have high melting temperatures and boiling temperatures because there are

- ☐ A strong attractions between the ions.
- ☐ B strong attractions between the delocalised electrons.
- ☐ C strong attractions between the ions and the delocalised electrons.
- ☐ D strong intermolecular forces.

(Total for Question = 1 mark)

9 The bonding in magnesium oxide, MgO, is

- ☐ A ionic.
- ☐ B metallic and ionic.
- ☐ C ionic and covalent.
- ☐ D metallic and covalent.

(Total for Question = 1 mark)

IONIC & METALLIC BONDING



- 10 Which row in the table shows the lattice energies, in kJ mol^{-1} , of calcium fluoride, potassium fluoride and potassium iodide?

	Calcium fluoride	Potassium fluoride	Potassium iodide
☐ A	–2630	–817	–651
☐ B	–2630	–651	–817
☐ C	–651	–817	–2630
☐ D	–817	–2630	–651

(Total for Question 1 = 1 mark)

- 11 The experimental value for the lattice energy of beryllium iodide is $-2800 \text{ kJ mol}^{-1}$ and the theoretical value is $-2653 \text{ kJ mol}^{-1}$.

The best explanation for the difference is that the

- ☐ A beryllium ion is large and polarizes the iodide ion.
- ☐ B beryllium ion is small and polarizes the iodide ion.
- ☐ C iodide ion is large and polarizes the beryllium ion.
- ☐ D iodide ion is small and polarizes the beryllium ion.

(Total for Question 2 = 1 mark)

- 12 Carbon (diamond) and oxygen both form covalent bonds between their atoms in the element.

What is the **best** reason for the fact that diamond has a much higher melting temperature than oxygen?

- ☐ A Diamond is a solid but oxygen is a gas at room temperature.
- ☐ B Diamond has a giant atomic structure but oxygen has a simple molecular structure.
- ☐ C The covalent bonds between carbon atoms in diamond are stronger than those between oxygen atoms.
- ☐ D There is a single covalent bond between carbon atoms in diamond but a double covalent bond between oxygen atoms.

(Total for Question 3 = 1 mark)

IONIC & METALLIC BONDING



13 Which of the following compounds has the greatest ionic character?

- ☐ **A** Caesium fluoride
- ☐ **B** Caesium iodide
- ☐ **C** Potassium fluoride
- ☐ **D** Potassium iodide

(Total for Question 6 = 1 mark)

14 Potassium combines with iodine to form potassium iodide.

Which of the following describes the bonding in the three substances?

	Potassium	Iodine	Potassium iodide
☐ A	ionic	covalent	ionic
☐ B	metallic	ionic	covalent
☐ C	covalent	covalent	ionic
☐ D	metallic	covalent	ionic

(Total for Question 10 = 1 mark)

15 Metallic bonding is **best** described as the electrostatic attraction between

- ☐ **A** positive ions and delocalized electrons.
- ☐ **B** protons and electrons.
- ☐ **C** positive and negative ions.
- ☐ **D** nuclei and shared pairs of electrons.

(Total for Question 11 = 1 mark)

16 A liquid, which conducts electricity, continues to conduct when it is cooled and solidified. Which of the following could it be?

- ☐ **A** Mercury
- ☐ **B** Bromine
- ☐ **C** Molten sodium chloride
- ☐ **D** Tetrachloromethane

(Total for Question 12 = 1 mark)

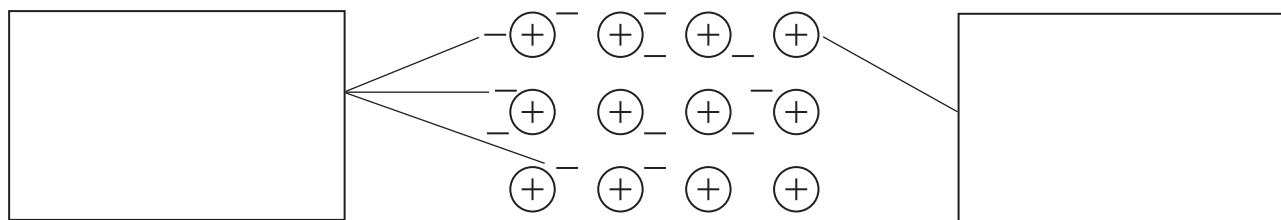
IONIC & METALLIC BONDING



1 The diagram below illustrates a model of the metallic bonding in rubidium.

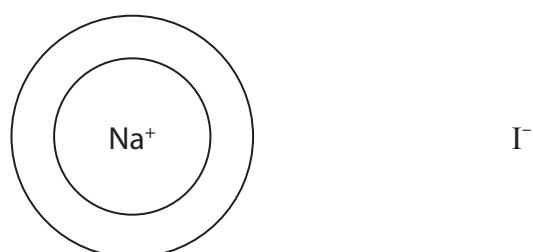
Write appropriate labels in the two empty boxes in order to complete the diagram.

(2)



(ii) Draw an electron density map for the iodide ion in sodium iodide showing any effect the sodium ion has on the iodide ion.

(1)



*(c) The lattice energies of sodium fluoride and magnesium fluoride are shown in the table below.

Compound	Lattice energy / kJ mol^{-1}
Sodium fluoride, NaF	-918
Magnesium fluoride, MgF_2	-2957

Explain, in terms of the sizes and charges of the ions involved, why the lattice energy of MgF_2 is more negative than that of NaF.

(3)

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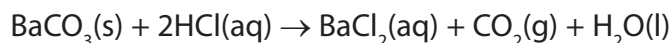
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(Total for Question 1 = 6 marks)

IONIC & METALLIC BONDING



- 2 Barium chloride can be made by reacting solid barium carbonate with dilute hydrochloric acid in the following reaction.



- (a) (i) Write the ionic equation for the reaction of solid barium carbonate with hydrogen ions from the hydrochloric acid. State symbols are not required.

(1)

- (ii) State **two** observations you would make while the reaction is taking place. No change of colour occurs.

(2)

Observation 1

Observation 2

- (b) In an experiment to prepare crystals of hydrated barium chloride, $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$, a volume of 25.0 cm^3 of 2.00 mol dm^{-3} hydrochloric acid, HCl , was transferred to a beaker and solid barium carbonate, BaCO_3 , was added until it was in excess.

- (i) How many moles of acid were used in the reaction?

(1)

- (ii) What mass of barium carbonate, in grams, reacts with this amount of acid?

The molar mass of barium carbonate is 197.3 g mol^{-1} .

(1)

- (iii) Why was an **excess** of barium carbonate used in the experiment?

(1)

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IONIC & METALLIC BONDING



- (iv) How would you separate the barium chloride solution from the reaction mixture in part (iii)?

(1)

- (v) The barium chloride solution was left to crystallize. The crystals were separated and dried carefully. A sample of 5.35 g of hydrated crystals, $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$, which has molar mass 244 g mol^{-1} , was obtained. Calculate the percentage yield of this reaction.

(2)

- (vi) Give **one** reason why the yield of crystals is less than 100%, even when the reactants contain no impurities.

(1)

IONIC & METALLIC BONDING



- *(c) The lattice energies of sodium fluoride, sodium chloride and magnesium fluoride are shown in the table below.

Compound	Lattice energy / kJ mol^{-1}
Sodium fluoride, NaF	–918
Sodium chloride, NaCl	–780
Magnesium fluoride, MgF_2	–2957

Explain, in terms of the sizes and charges of the ions involved, the differences between the lattice energy values of

- (i) NaF and NaCl

(2)

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- (ii) NaF and MgF_2

(2)

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(Total for Question 2 = 12 marks)

IONIC & METALLIC BONDING



- 3 Sodium and chlorine react together to produce sodium chloride. The bonding in the product is different from that in both of the reactants. Evidence for the type of bonding present can be obtained in a number of different ways.

(a) Draw the electron density map for a chlorine molecule to show covalent bonding.

(1)

(b) Sodium chloride is ionically bonded. What is meant by the term **ionic bond**?

(1)

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- (c) Electrolysis is an experiment which you could carry out in a school or college laboratory on an aqueous solution of sodium chloride, to provide evidence for the presence of ionic bonding.

Draw a labelled diagram of the apparatus that you would use for this experiment, indicating how your results would show that the bonding was ionic.

(3)

IONIC & METALLIC BONDING



(d) Chlorine gains an electron when it reacts with sodium to form sodium chloride.

(i) Draw the dot and cross diagram of a chloride ion showing outer electrons only.

(1)

(ii) Give the formula of an ion from **Period 3** that is isoelectronic with the chloride ion.

(1)

(e) Sodium and sodium chloride can both be good conductors of electricity.

Under what conditions do these substances conduct electricity?

Compare the method of conductivity in each case.

(3)

(Total for Question 3 = 10 marks)

IONIC & METALLIC BONDING



4 Metals are good conductors of heat and electricity and usually have high melting temperatures and boiling temperatures.

(a) (i) Describe the **structure** of a metal.

(2)

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(ii) Describe the **bonding** in a metal.

(2)

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(b) Explain why the melting temperature of magnesium (650 °C) is much higher than that of sodium (98 °C).

(3)

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(c) Explain how metals conduct electricity.

(2)

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(Total for Question 4 = 9 marks)

IONIC & METALLIC BONDING

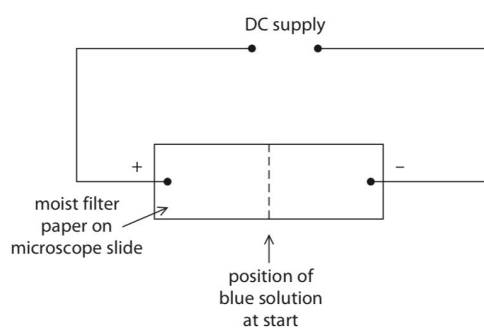


- 5 (a) Briefly describe an experiment, with a diagram of the apparatus you would use, which shows that there are oppositely charged ions in copper(II) chromate(VI), CuCrO_4 . Describe what you would expect to see.

Formula of ion	Colour
$\text{Cu}^{2+}(\text{aq})$	blue
$\text{CrO}_4^{2-}(\text{aq})$	yellow

(4)

Diagram



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- (b) The ions in an ionic lattice are held together by an **overall** force of attraction.

- (i) Describe the forces of attraction in an ionic lattice.

(1)

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- (ii) Suggest **two** forces of repulsion which exist in an ionic lattice.

(2)

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IONIC & METALLIC BONDING



(d) The lattice composed of the ions Mg^{2+} and O^{2-} is stronger than a lattice composed of the ions Mg^+ and O^- .

- (i) Explain, in terms of the charges on the ions and the size of the cations, why this is so.

(2)

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- (ii) Suggest how the lattice energy of $\text{Mg}^{2+}\text{O}^{2-}$ would differ from that of Mg^+O^- .

(1)

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(Total for Question 5 = 15 marks)

IONIC & METALLIC BONDING



6 This question is about the element chlorine (atomic number = 17).

(a) Complete the electronic structure of chlorine.

(1)

$1s^2 2s^2$

(b) Chlorine forms compounds with magnesium and with carbon.

(i) Draw a dot and cross diagram to show the electronic structure of the compound magnesium chloride (only the outer electrons need be shown).
Include the charges present.

(2)

(ii) Draw a dot and cross diagram to show the electronic structure of the compound tetrachloromethane (only the outer electrons need be shown).

(2)

IONIC & METALLIC BONDING



*(iii) Suggest why the melting temperature of magnesium oxide is higher than that of magnesium chloride, even though both are almost 100% ionic.

(3)

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(c) Magnesium chloride may be prepared from magnesium by reaction with chlorine or with hydrochloric acid. Compare these two preparations in terms of the atom economies of the reactions. No calculation is required.

(2)

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(Total for Question 6 = 10 marks)

IONIC & METALLIC BONDING



- 7 Chlorine forms ionic bonds with metals such as sodium and silver. The lattice energies of ionic compounds provide information about their bonds. The table below shows the experimental and calculated values for the lattice energy of sodium chloride and silver chloride.

Compound	Lattice energy / kJ mol ⁻¹	
	Experimental	Calculated
sodium chloride	–780	–770
silver chloride	–905	–833

- (i) Draw a dot-and-cross diagram of sodium chloride, showing outer electrons only. (1)

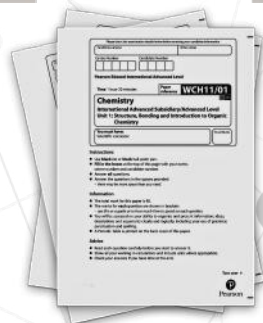
- *(ii) Explain why the experimental and calculated values for the lattice energy of sodium chloride are similar whereas those for silver chloride differ significantly. (3)

(Total for Question 7 = 4 marks)

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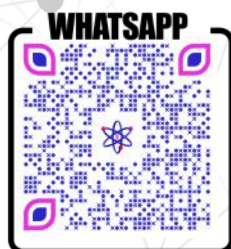
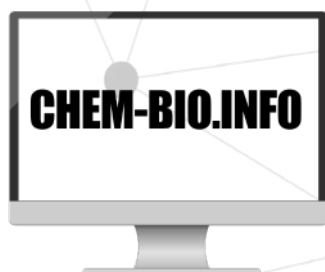
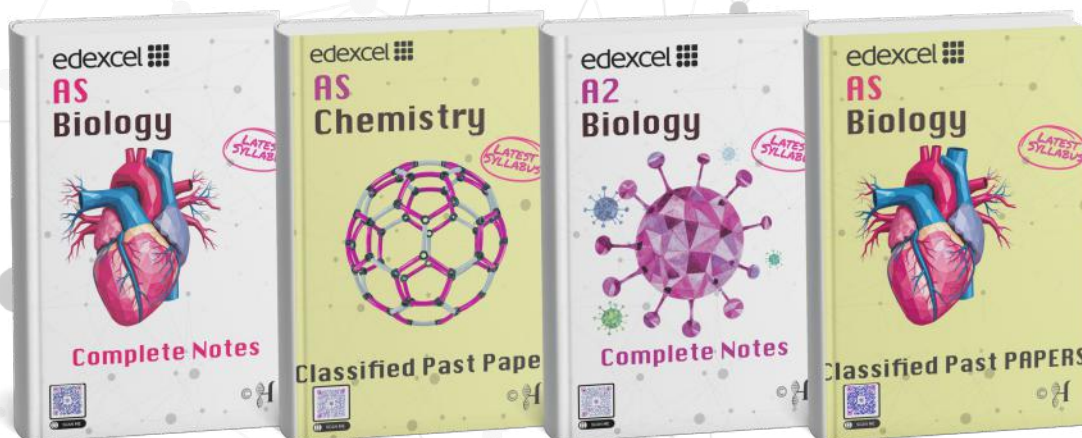
Videos that cover the entire syllabus



Exam-expert solved past papers



Full explanation of Unit 3 practicals



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