

Structured Questions

The Ionic Model

Forming Ions / Binary Ionic Compounds / Ionic Lattices

Easy (3 questions)	/19
Medium (3 questions)	/25
Hard (3 questions)	/35
Total Marks	/79

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Easy Questions

1 (a) Define ionic bonding.

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(1 mark)

(b) State the type of bonding in potassium chloride which melts at 1043 K.

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(1 mark)

(c) Describe the structure and bonding in solid magnesium oxide.

.....
.....
(2 marks)

(d) Outline why solid magnesium chloride does not conduct electricity.

.....
(1 mark)

2 (a) Predict whether phosphorus(V) oxide and sodium oxide conduct electricity in their solid and molten states. Complete the boxes with "yes" or "no".

	Phosphorus(V) oxide	Sodium oxide
Solid state		
Molten state		

.....
.....
(2 marks)

(b) State the formula of the compounds formed between the elements below.

i) Sodium and sulfur.

[1]

ii) Magnesium and phosphorus.

[1]

.....
.....
(2 marks)

(c) Describe the covalent bond present in a chlorine molecule and how it is formed.

.....
.....
(2 marks)

(d) Draw the Lewis (electron dot) structure of chloromethane.

.....
(1 mark)

3 (a) This question is about ionic lattices.

i) State the definition of lattice enthalpy, ΔH^θ_{latt} [1]

ii) Explain why lattice enthalpy is always endothermic [1]

(2 marks)

(b) Magnesium forms a stable ion of Mg^{2+}

i) Which noble gas has the same electronic structure as Mg^{2+} ? [1]

ii) Write the electronic structure of the magnesium ion, Mg^{2+} , in full [1]

(2 marks)

(c) Predict the electrical conductivity of magnesium fluoride in each of the following states:

State	Electrical conductivity (Y / N)
Solid	
Liquid	
Aqueous	

(3 marks)

Medium Questions

1 (a) Calcium sulfide is an ionic solid that is phosphorescent and glows in the dark after a light source is removed.

i) Describe the nature of the bonding in calcium sulfide. [1]

ii) State one physical property of calcium sulfide. [1]

(2 marks)

(b) Suggest why the melting point of calcium sulfide is much higher than that of elemental calcium or sulfur.

(3 marks)

(c) Calcium sulfide has a lattice structure similar to sodium chloride.

Describe the lattice structure of calcium sulfide and draw a representative 3D diagram.

Label each ion and use different size spheres to distinguish between the different types of ions present.

(4 marks)

(d) State the formula of calcium phosphate and calcium hydroxide.

(2 marks)

2 (a) The table shows the properties of four substances.

substance	boiling point	electrical conductivity of solid	electrical conductivity when molten
copper	high	conducts	conducts
lithium bromide	high	does not conduct	conducts
sulfur	low	does not conduct	does not conduct

State the meaning of the term ionic bonding.

.....

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(2 marks)

(b) Identify the information in the table that shows that lithium bromide is an ionic compound.

.....

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(2 marks)

(c) Lithium bromide dissolves in organic solvents, whereas potassium fluoride is insoluble in organic solvents.

Suggest a reason for the difference in solubility in organic solvents.

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(4 marks)

3 (a) Strontium nitride reacts with water to form strontium hydroxide and ammonia.

Write the balanced symbol equation for this reaction.

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.....
(2 marks)

(b) Strontium nitride has a melting point of 1200 °C.

- i) Explain why its melting point is high. [1]
- ii) State and explain the conditions under which strontium nitride will act as an electrical conductor. [3]

.....
.....
(2 marks)

(c) The melting point of magnesium nitride is 1500 °C. Explain the difference between the melting point for strontium nitride and magnesium nitride.

.....
.....
(2 marks)

Hard Questions

1 (a) Magnesium fluoride is a white crystalline salt that has a giant ionic lattice structure.

State whether the following substances conduct electricity when solid or molten, and explain your answers in terms of the particles involved:

- magnesium
- magnesium fluoride
- boron tribromide

(5 marks)

(b) Sodium chloride and iodine are both solids. Sodium chloride does not melt until it reaches a temperature of 1074 K yet iodine sublimates when heated gently, giving off purple vapours. Sodium chloride will conduct electricity when molten and iodine is a very poor conductor of electricity.

State the type of crystal structure for each of iodine and sodium chloride.

(2 marks)

(c) Explain why iodine vaporises easily.

(2 marks)

(d) Explain the differences in the electrical conductivity of sodium chloride and iodine.

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(3 marks)

2 (a) The nitrate (V) ion, NO_3^- , is a polyatomic ion, bonded by covalent bonds.

The three oxygen atoms are bonded by one single covalent bond, one double covalent bond and one dative covalent bond.

Draw the Lewis structure for NO_3^- .

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(2 marks)

(b) An ionic compound has the empirical formula $\text{H}_4\text{N}_2\text{O}_3$.

Suggest the formulae of the ions present in this compound.

.....
.....

(2 marks)

(c) The compounds SO_2 and MgO are both oxides but with different melting points as shown below.

Compound	Melting point / °C
SO_2	-72
MgO	2852

Describe the bonding in, and the structure of, SO_2 and MgO and explain the difference in their melting points.

.....
.....
.....

(4 marks)

- (d)** Ammonia, NH_3 , has the same crystalline structure as SO_2 and yet its melting point is 2°C . Explain the difference in melting point between SO_2 and NH_3 .

(2 marks)

3 (a) This question is about ionic compounds.

The table shows the formulae of some positive and negative ions, and the formulae of some compounds containing these ions.

	Mg^{2+}	Al^{3+}	NH_4^+
S^{2-}	MgS	Al_2S_3	
NO_3^-		$\text{Al}(\text{NO}_3)_3$	NH_4NO_3
CO_3^{2-}	MgCO_3		$(\text{NH}_4)_2\text{CO}_3$

i) Complete the table by giving the three missing formulae.

[3]

ii) Give the name of the compound with the formula NH_4NO_3

[1]

.....

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.....

(4 marks)

(b) Magnesium nitrate is an ionic compound. Explain the following physical properties in terms of its structure:

i) Volatility

[2]

ii) Electrical conductivity

[2]

iii) Solubility

[3]

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(7 marks)

(c) Write an equation to show the lattice enthalpy for magnesium sulfide

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(2 marks)