2.4 Ionic Bonding and Properties of Ionic Compounds: 30-minute Pack

EDEXCEL 4CH1 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 A technician melts a small ionic crystal and observes that the melt completes a circuit. State the conductivity observation for the molten sample.

(Total for Question 1 is 1 mark)

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2 A student tests the same ionic substance as a solid and as a solution. The solid does not light a lamp, but the solution does. State the conductivity result for each state.

(Total for Question 2 is 2 marks)

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3 State two electrical conductivity observations for a typical ionic compound, for the solid state and when it is molten or dissolved in water, in the context of Edexcel 4CH1.

(Total for Question 3 is 2 marks)

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4 Deduce the formula for the ionic compound formed between calcium ions and carbonate ions (CO_3^{2-}). Show the ionic charges used to deduce the formula.

(Total for Question 4 is 2 marks)

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5 Deduce the formula of the ionic compound formed between magnesium ions and hydroxide ions (OH^-). Show the charges used to deduce the formula.

(Total for Question 5 is 2 marks)

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6 A compound contains aluminium ions, Al^{3+}, and fluoride ions, F^-. Deduce its formula and show how the charges balance.

(Total for Question 6 is 2 marks)

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7 A student compares a solid ionic crystal with its melt using a conductivity probe. The solid gives no reading and the melt gives a reading. Explain both observations in terms of ion arrangement and movement.

(Total for Question 7 is 3 marks)

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8 An engineer selects an ionic material for a component that must remain solid when heated. Explain why a giant ionic lattice can have a high melting point.

(Total for Question 8 is 3 marks)

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9 Deduce the formula of the ionic compound formed between aluminium ions and oxide ions. Include the charges used to deduce the formula.

(Total for Question 9 is 2 marks)

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10 A compound contains magnesium ions, Mg^{2+}, and nitride ions, N^{3-}. Deduce its formula and show how the charges balance.

(Total for Question 10 is 2 marks)

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11 A lab compares a solid ionic compound with the same compound dissolved in water. The solid does not conduct, while the solution conducts. Explain the two observations and identify the charge carriers in the solution.

(Total for Question 11 is 3 marks)

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12 Deduce the formula of the ionic compound formed between ammonium ions (NH_4^+) and sulfate ions (SO_4^{2-}). Show how the charges lead to the formula.

(Total for Question 12 is 3 marks)

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Mark scheme · 2.4 Ionic Bonding and Properties of Ionic Compounds: 30-minute Pack

Question 1

the molten ionic compound conducts electricity **B1**

Answer: The molten ionic compound conducts electricity.

Question 2

the solid does not conduct electricity **B1**

the solution conducts electricity **B1**

Answer: The solid does not conduct; the solution conducts.

Question 3

solid ionic compound does not conduct electricity **B1**

molten or aqueous ionic compound conducts electricity **B1**

Answer: Solids do not conduct; molten or dissolved ionic compounds conduct electricity.

Question 4

states charges: Ca^{2+} and CO_3^{2-} **B1**

deduces formula $CaCO_3$ (charges balance 2+ and 2-) **B1**

Answer: Ca^{2+} and CO_3^{2-} combine to give $CaCO_3$.

Question 5

states charges: Mg^{2+} and OH^- **B1**

deduces formula $Mg(OH)_2$ (one Mg^{2+} balances two OH^-) **B1**

Answer: Mg^{2+} and OH^- combine to give $Mg(OH)_2$.

Question 6

uses one Al^{3+} with three F^- ions **M1**

formula AlF_3, with total charge +3 + 3(-1) = 0 **A1**

Answer: One Al^{3+} and three F^- ions give AlF_3; +3 + 3(-1) = 0.

Question 7

in the solid, ions are held in fixed lattice positions and cannot move through it **B1**

in the melt, ions are free to move **B1**

moving charged ions carry electrical charge through the melt, so it conducts **B1**

Answer: In the solid, ions are fixed in the lattice and cannot move to carry charge. In the melt, ions can move and carry charge, so it conducts.

Question 8

the lattice contains many oppositely charged ions **B1**

strong electrostatic attractions act between oppositely charged ions throughout the lattice **B1**

a large energy input is needed to overcome these attractions, so the melting point is high **B1**

Answer: Many oppositely charged ions form a giant lattice. Strong electrostatic attractions act throughout it, so much energy is needed to overcome them and melt the solid.

Question 9

states charges: Al^{3+} and O^{2-} **B1**

deduces formula Al_2O_3 (cross-over or lowest whole-number ratio) **B1**

Answer: Al^{3+} and O^{2-} combine to give Al_2O_3.

Question 10

uses three Mg^{2+} ions and two N^{3-} ions **M1**

formula Mg_3N_2, with total charge 3(+2) + 2(-3) = 0 **A1**

Answer: Three Mg^{2+} and two N^{3-} ions give Mg_3N_2; 3(+2) + 2(-3) = 0.

Question 11

in the solid, ions are held in fixed lattice positions and cannot move **B1**

in solution, ions are free to move **B1**

the mobile positive and negative ions carry charge through the solution **B1**

Answer: Solid lattice ions cannot move. In solution the positive and negative ions are mobile, and these ions carry charge through the solution.

Question 12

states charges: NH_4^+ and SO_4^{2-} **B1**

uses charges to find ratio: two NH_4^+ needed for one SO_4^{2-} **B1**

gives formula $(NH_4)_2SO_4$ **B1**

Answer: Two NH_4^+ ions balance one SO_4^{2-} to give $(NH_4)_2SO_4$.

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