2.19 Structures, Properties and Nanoparticles: Test Pack

AQA 8464 · Calculator allowed · about 40 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Give two properties of ionic compounds that distinguish them from simple covalent molecules.

(a) Property 1 **(1)**

(b) Property 2 **(1)**

(Total for Question 1 is 2 marks)

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2 State what is meant by the term 'allotrope' and give one example of allotropy in carbon.

(a) Definition of allotrope. **(1)**

(b) Example in carbon. **(1)**

(Total for Question 2 is 2 marks)

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3 A metal sample has a density of 8.96 g cm^{-3} and a volume of 12.5 cm^3. Calculate the mass of the sample in grams. Show substitution and give the answer to three significant figures.

(a) Show the substitution into mass = density x volume. **(2)**

(b) Give the final answer to three significant figures with units. **(2)**

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(Total for Question 3 is 4 marks)

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4 Describe the electrical conductivity of a solid ionic lattice and explain what happens to the ions when the compound is melted.

(a) Describe the conductivity of the solid ionic lattice. **(1)**

(b) Explain what happens when the ionic solid is melted and why it then conducts. **(2)**

(Total for Question 4 is 3 marks)

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5 Give the structure name for each of the following substances and state whether they are solids that conduct electricity when solid.
Substances: A sodium chloride, B diamond, C graphite.

(a) Sodium chloride: structure and conductivity as a solid? **(1)**

(b) Diamond: structure and conductivity as a solid? **(1)**

(c) Graphite: structure and conductivity as a solid? **(1)**

(Total for Question 5 is 3 marks)

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6 Explain why metals generally have high melting points and are malleable, making reference to structure and bonding.

(a) Explain high melting points. **(1)**

(b) Explain malleability. **(2)**

(Total for Question 6 is 3 marks)

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7 A piece of copper metal and a sample of silicon (a giant covalent solid) are compared.

(a) State which of the two is a better electrical conductor and give one reason. **(2)**

(b) State one physical property of silicon that is a result of its giant covalent structure. **(1)**

(Total for Question 7 is 3 marks)

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8 A student is investigating how particle size affects the rate of a reaction using powdered zinc and zinc lumps reacting with excess hydrochloric acid. The student records the time taken for hydrogen gas to stop being produced. The results are: powdered zinc average time 45 s; lump zinc average time 320 s.

(a) State why the powdered zinc reacts faster than the lumps. **(2)**

(b) Suggest two improvements to the method to make the comparison fairer between powder and lumps. **(2)**

(Total for Question 8 is 4 marks)

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9 A chemist measures the melting points of three compounds and obtains: compound X 1710°C, compound Y 801°C, compound Z -10°C. Use these data to identify the likely type of bonding for each compound and give a brief reason in each case.

(a) Compound X: type of bonding and reason. **(1)**

(b) Compound Y: type of bonding and reason. **(1)**

(c) Compound Z: type of bonding and reason. **(2)**

(Total for Question 9 is 4 marks)

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10 Fullerenes are forms of carbon with cage-like structures. State one potential use of fullerenes and explain briefly why their structure makes this use possible.

(a) Give one potential use. **(1)**

(b) Explain briefly how the cage-like structure helps in this use. **(2)**

(Total for Question 10 is 3 marks)

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Mark scheme · 2.19 Structures, Properties and Nanoparticles: Test Pack

Question 1

(a) high melting or boiling point (strong ionic lattice with strong electrostatic attraction) cao **B1**

(a) Answer: High melting or boiling point

(b) conducts electricity when molten or dissolved (ions are mobile) cao **B1**

(b) Answer: Conducts electricity when molten or dissolved

Question 2

(a) different forms of the same element with different structures and properties cao **B1**

(a) Answer: Different forms of the same element with different structures and properties.

(b) diamond, graphite, graphene or fullerenes (any one) **B1**

(b) Answer: Diamond

Question 3

(a) substitutes: mass = 8.96 x 12.5 **M1**

(a) evaluates the product to get a numerical value **M1**

(b) correct rounding or presentation to three significant figures **M1**

(b) 112 g cao **A1**

(b) Answer: 112 g

Question 4

(a) solid ionic lattice does not conduct electricity (ions fixed in place) cao **B1**

(a) Answer: A solid ionic lattice does not conduct electricity because the ions are fixed in place.

(b) on melting, ions are free to move (ions become mobile) or ions dissociate in molten state **B1**

(b) mobile ions carry charge so the molten ionic liquid conducts electricity cao **B1**

(b) Answer: On melting the ions become mobile and can move; these mobile ions carry charge so the molten compound conducts electricity.

Question 5

(a) giant ionic lattice; does not conduct as a solid (ions fixed) **B1**

(a) Answer: Giant ionic lattice; does not conduct as a solid

(b) giant covalent lattice; does not conduct as a solid (all electrons are used in bonds) **B1**

(b) Answer: Giant covalent lattice; does not conduct as a solid

(c) layered covalent structure; conducts as a solid (delocalised electrons between layers) cao **B1**

(c) Answer: Layered covalent structure; conducts as a solid

Question 6

(a) strong metallic bonds between positive ions and delocalised electrons require a lot of energy to overcome **B1**

(a) Answer: Strong metallic bonds between positive ions and delocalised electrons require a lot of energy to break, giving high melting points.

(b) metal ions are in layers that can slide over each other **B1**

(b) delocalised electrons maintain bonding when layers slide so the metal does not shatter, oe **B1**

(b) Answer: Metal ions are arranged in layers that can slide over each other while delocalised electrons continue to hold the lattice together, so the metal is malleable.

Question 7

(a) copper is the better conductor **B1**

(a) because copper has delocalised electrons that can move and carry charge (silicon does not have free electrons in the same way) oe **B1**

(a) Answer: Copper, because it has delocalised electrons that move and carry charge.

(b) very high melting point (strong covalent bonds throughout the giant lattice) cao **B1**

(b) Answer: Very high melting point

Question 8

(a) powder has larger total surface area exposed to acid per unit mass **B1**

(a) more frequent collisions between acid particles and zinc surface increases reaction rate, oe **B1**

(a) Answer: Powdered zinc has a much larger total surface area for the same mass so there are more frequent collisions with acid, increasing the reaction rate.

(b) use the same mass of zinc in both tests, or same concentration and volume of acid, or control temperature **B1**

(b) ensure the same stirring or mixing so results are comparable, oe **B1**

(b) Answer: Use the same mass of zinc and the same concentration and volume of acid, and keep temperature and stirring the same.

Question 9

(a) giant covalent (e.g. network) because very high melting point **B1**

(a) Answer: Giant covalent; very high melting point indicates strong covalent bonds throughout lattice.

(b) ionic or metallic possible; high melting point suggests strong ionic or metallic bonding **B1**

(b) Answer: Ionic or metallic; high melting point suggests strong electrostatic or metallic bonding between particles.

(c) simple molecular **B1**

(c) low melting point indicates weak intermolecular forces between molecules cao **B1**

(c) Answer: Simple molecular; low melting point because only weak intermolecular forces need to be overcome.

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Question 10

(a) drug delivery, lubricants, catalysts or in electronics (any one) **B1**

(a) Answer: Drug delivery

(b) cage can trap or carry small molecules or atoms inside, allowing encapsulation or controlled release **B1**

(b) large surface area and stability allow interactions useful in catalysis or electronics, oe **B1**

(b) Answer: The cage can trap or carry small molecules inside, enabling encapsulation and controlled release; fullerenes also have large surface areas useful for catalysis or electronic interactions.

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