FOUNDATION

C2F Bonding, Structure and Properties of Matter: Foundation Tier Practice

Total Marks

AQA 8462 · Calculator allowed · about 70 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Atoms are made of smaller particles.

(a) Name the two particles in the nucleus of an atom. **(1)**

(Total for Question 1 is 1 mark)

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2 Ionic bonding forms between metals and non-metals.

(a) Give the charge on a sodium ion, Na+. **(1)**

(b) Give the charge on a chloride ion, Cl-. **(1)**

(Total for Question 2 is 2 marks)

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3 Covalent bonding involves sharing electrons.

(a) State whether a covalent bond is formed by sharing or transferring electrons. **(1)**

(Total for Question 3 is 1 mark)

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4 Metals have a characteristic structure described as a sea of delocalised electrons.

(a) Give two typical physical properties of metals that arise from metallic bonding. **(2)**
Give one property in each box.

(Total for Question 4 is 2 marks)

5 Simple molecular substances have low melting points because of weak forces between molecules.

(a) Explain why iodine (a simple molecular substance) has a low melting point compared with sodium chloride. **(2)**

(Total for Question 5 is 2 marks)

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6 A student draws dot and cross diagrams to show bonding in compounds.

(a) State the ending of the name of ions formed from non-metals (for example chloride from chlorine). **(1)**

(b) Draw a simple dot and cross diagram showing the bonding in hydrogen chloride, HCl. Show the shared pair of electrons only and label the chloride ion's extra electron pair. **(2)**

(Total for Question 6 is 3 marks)

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7 Ionic compounds conduct electricity only when molten or in solution.

(a) Explain why solid sodium chloride does not conduct electricity but molten sodium chloride does. **(3)**

(Total for Question 7 is 3 marks)

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8 A small sample of neon gas is cooled and becomes a liquid at its boiling point of -246 degrees C.

(a) State whether neon atoms are held together by ionic, covalent or weak intermolecular forces in the liquid. **(1)**

(b) Give a reason why noble gases have very low boiling points. **(1)**

9 Giant covalent structures like diamond are very hard and have high melting points.

(a) Explain why diamond has a very high melting point. **(3)**

(Total for Question 9 is 3 marks)

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10 Use the particle model to compare diffusion in gases and liquids.

(a) Compare diffusion in a gas with diffusion in a liquid. Give two differences and a short explanation for each. **(4)**

(Total for Question 10 is 4 marks)

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11 A student is given descriptions and must identify the type of bonding.

(a) Identify the type of bonding in sodium chloride. **(1)**

(b) Identify the type of bonding in chlorine gas, Cl2. **(1)**

(c) Identify the type of bonding in copper metal. **(1)**

(Total for Question 11 is 3 marks)

12 A simple calculation with relative formula mass (Mr). Relative atomic masses: C = 12, H = 1, O = 16.

(a) Calculate the relative formula mass, Mr, of CH4O (one carbon, four hydrogen, one oxygen). **(3)**

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(Total for Question 12 is 3 marks)

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13 A metal sample is a good conductor and can be hammered into a sheet.

(a) Explain why metals conduct electricity. **(1)**

(b) Explain why metals are malleable (can be hammered into a sheet). **(1)**

(Total for Question 13 is 2 marks)

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14 A student compares electrical conductivity of three substances at room temperature: solid copper, solid sodium chloride and aqueous sodium chloride solution.

(a) Rank the three substances from best conductor to worst conductor. **(2)**

(Total for Question 14 is 2 marks)

15 Extended response. Explain how bonding and structure determine the physical properties of the following substances: sodium chloride, diamond and iodine. In your answer compare electrical conductivity, hardness and melting point and link each property to bonding or structure.

Explain how bonding and structure determine the physical properties of sodium chloride, diamond and iodine. Compare conductivity, hardness and melting point and link each property to bonding or structure.

(Total for Question 15 is 6 marks)

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16 A student is given masses to calculate percentage composition by mass. Calculate the percentage of oxygen in copper(II) oxide, CuO. Relative atomic masses: Cu = 64, O = 16.

(a) Calculate the relative formula mass, Mr, of CuO. **(2)**

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(b) Calculate the percentage by mass of oxygen in CuO. Give your answer to 1 decimal place. **(2)**

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(Total for Question 16 is 4 marks)

Mark scheme · C2F Bonding, Structure and Properties of Matter: Foundation Tier Practice

Question 1

- (a) **B1** proton and neutron cao
- **(a) Answer: Proton and neutron.**

Question 2

- (a) **B1** +1 or 1+ cao
- **(a) Answer: +1**
- (b) **B1** -1 or 1- cao
- **(b) Answer: -1**

Question 3

- (a) **B1** sharing electrons cao
- **(a) Answer: Sharing electrons.**

Question 4

- (a) **B1** good conductor of electricity, oe
- (a) **B1** malleable or ductile or high melting point, oe
- **(a) Answer: Good conductor of electricity; malleable (or high melting point).**

Question 5

- (a) **M1** states that iodine has weak intermolecular forces between molecules (Van der Waals) compared with ionic bonds in sodium chloride
- (a) **A1** so less energy is needed to separate particles and iodine melts at a much lower temperature cao
- **(a) Answer: Iodine has weak intermolecular forces between molecules, whereas sodium chloride has strong ionic bonds; therefore less energy is needed to separate iodine molecules so its melting point is much lower.**

Question 6

- (a) **B1** -ide cao
- **(a) Answer: -ide**
- (b) **M1** shows H with one electron and Cl with seven electrons and a shared pair between them (dot and cross or similar), oe
- (b) **A1** shows Cl has three lone pairs remaining (labelled or clearly drawn) cao
- **(b) Answer: H-Cl with a shared pair between H and Cl; Cl also shown with three lone pairs (one pair labelled).**

Question 7

- (a) **M1** states ions are present in solid sodium chloride but are fixed in position (cannot move)
- (a) **M1** states that when molten the ions are free to move
- (a) **A1** conclusion: molten sodium chloride conducts because the mobile ions carry charge, whereas the solid does not cao
- **(a) Answer: In solid sodium chloride the ions are present but fixed in the lattice so they cannot move and cannot carry charge; when molten the lattice breaks down and ions are free to move so they can carry charge and the molten salt conducts.**

Question 8

- (a) **B1** weak intermolecular forces (Van der Waals) cao
- **(a) Answer: Weak intermolecular forces (Van der Waals).**
- (b) **B1** single atoms with very weak intermolecular forces so little energy is needed to separate them, oe
- **(b) Answer: They exist as single atoms with very weak intermolecular forces, so little energy is needed to separate them.**

Question 9

- (a) **M1** states diamond is a giant covalent structure with many strong covalent bonds
- (a) **M1** states a lot of energy is needed to break many covalent bonds
- (a) **A1** conclusion: therefore diamond has a very high melting point cao
- **(a) Answer: Diamond is a giant covalent structure with many strong covalent bonds; a lot of energy is required to break these bonds so diamond has a very high melting point.**

Question 10

- (a) **M1** states particles in a gas move faster or have more kinetic energy than in a liquid, oe
- (a) **M1** states gas particles are further apart so more space to move, oe
- (a) **A1** explains consequence: diffusion in gases is faster because particles move faster and have more space to travel, oe
- (a) **A1** explains consequence: diffusion in liquids is slower because particles move less and are closer together, oe
- **(a) Answer: In gases particles move faster and have more kinetic energy than in liquids; gas particles are also further apart so there is more space to move. Therefore diffusion in gases is faster while diffusion in liquids is slower because particles move less and are closer together.**

Question 11

- (a) **B1** ionic cao
- **(a) Answer: Ionic**
- (b) **B1** covalent cao
- **(b) Answer: Covalent**
- (c) **B1** metallic cao
- **(c) Answer: Metallic**

Question 12

- (a) **M1** substitutes atomic masses: Mr = 1x12 + 4x1 + 1x16
- (a) **M1** adds to get 32
- (a) **A1** 32 cao
- **(a) Answer: 32**

Question 13

- (a) **B1** delocalised electrons are free to move and carry charge, oe
- **(a) Answer: Because delocalised electrons in the metal are free to move and can carry charge.**
- (b) **B1** layers of atoms can slide over each other while the sea of electrons holds the structure together, oe
- **(b) Answer: Because layers of atoms can slide over each other without breaking metallic bonding, with delocalised electrons holding the structure together.**

Question 14

- (a) **M1** order given with reasoning or correct order: copper > aqueous sodium chloride > solid sodium chloride
- (a) **A1** explicit mention that copper has free electrons, aqueous solution has mobile ions, solid ionic lattice has fixed ions cao
- **(a) Answer: Copper > aqueous sodium chloride > solid sodium chloride. Copper conducts via free electrons; aqueous solution conducts via mobile ions; solid ionic lattice does not conduct as ions are fixed.**

Question 15

- **Level 3** (5-6): Detailed explanation. Correctly links each property (electrical conductivity, hardness, melting point) to the correct bonding and structure for all three substances, with comparison between substances.
- **Level 2** (3-4): Partial explanation. Discusses bonding or structure for two properties or two substances with some correct links but missing detail or comparisons.
- **Level 1** (1-2): Simple statements about bonding or a single property with minimal or no linkage to structure. Limited or no comparison.
- **Indicative content:**
  - Sodium chloride: ionic lattice, ions fixed in solid so solid does not conduct; when molten or in solution ions are mobile so conducts; ionic bonding strong so high melting point; ionic lattice can be brittle so can shatter under force.
  - Diamond: giant covalent structure with each carbon bonded to four others; no free electrons so does not conduct; very hard because strong covalent bonds in 3D network; very high melting point due to many bonds requiring large energy to break.
  - Iodine: simple molecular structure with weak intermolecular forces, so low melting point and soft; molecules have no free electrons to carry charge so do not conduct (except when molten if ions formed is not typical); compare: iodine low MP, sodium chloride and diamond high MP; diamond hard, ionic brittle, iodine soft.

Question 16

- (a) **M1** substitutes: Mr = 64 + 16
- (a) **A1** 80 cao
- **(a) Answer: 80**
- (b) **M1** calculates fraction: (16 / 80) x 100
- (b) **A1** 20.0% cao
- **(b) Answer: 20.0%**