2.2 Bonding, Structure and Properties of Matter: Test Pack

AQA 8462 · Calculator allowed · about 55 minutes

Total Marks

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

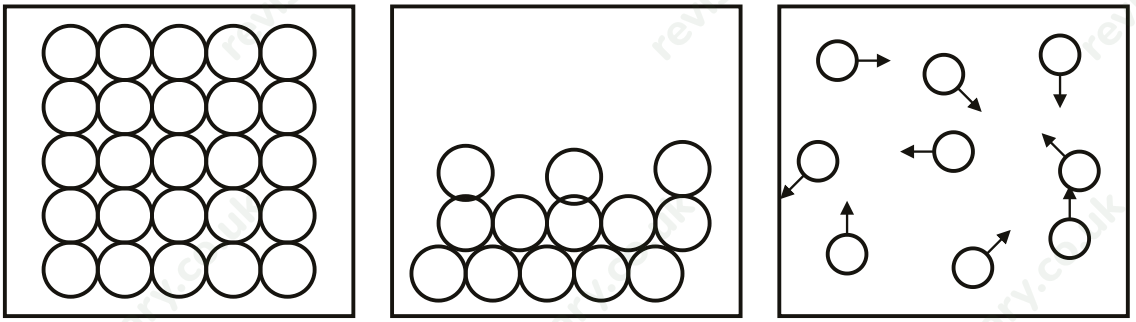
(a) Compare diffusion in a gas with diffusion in a liquid. Give two differences and a short explanation for each. **(4)**

(Total for Question 2 is 4 marks)

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3 Figure 1 shows the arrangement of particles in three samples of the same substance: Sample X, Sample Y and Sample Z.

Figure 1



(a) Identify the state of matter shown in Sample Z. **(1)**

(b) Describe two differences between the particles in Sample X and the particles in Sample Y, one about how they are arranged and one about how they move. **(2)**

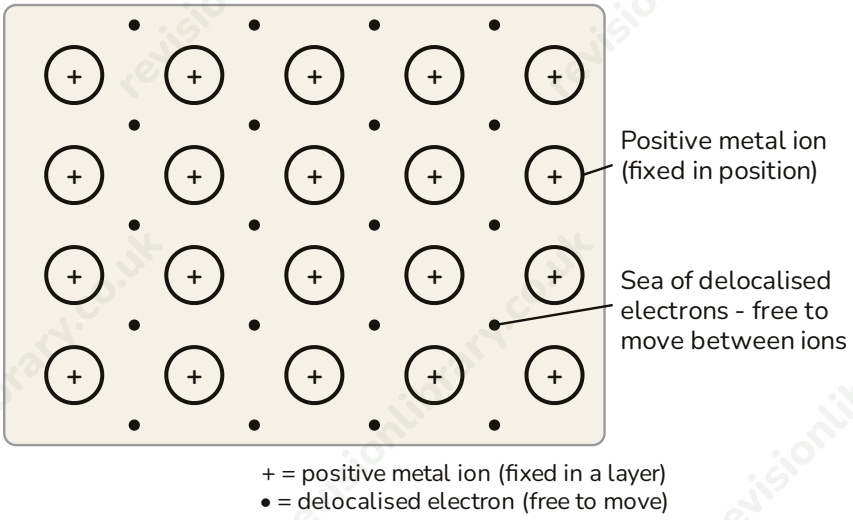
(c) Explain, in terms of the particle model, why a gas can be compressed (squashed into a smaller volume) much more easily than a liquid. **(2)**

(Total for Question 3 is 5 marks)

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4 Copper is a typical metal.

Structure of a typical metal (e.g. copper)



(a) Describe the structure of a typical metal such as copper. **(2)**

(b) Explain why metals such as copper are malleable (can be hammered or bent into shape). **(2)**

(c) Explain why metals such as copper are good conductors of electricity. **(2)**

(Total for Question 4 is 6 marks)

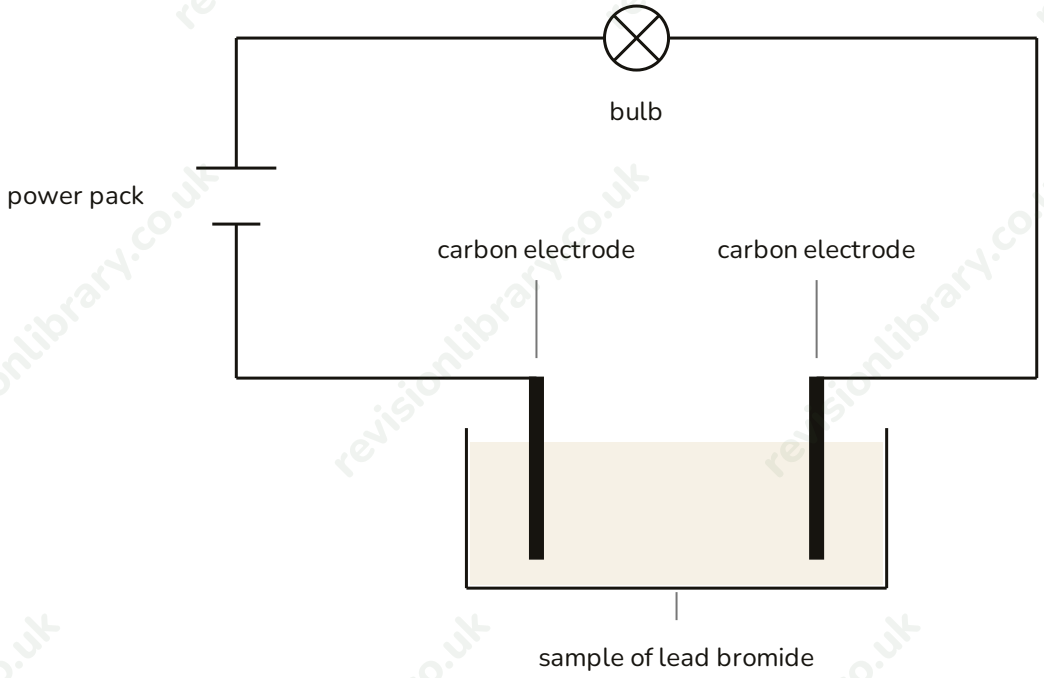
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5 The simple particle model represents all particles as small, solid, inelastic spheres with no forces acting between them. Evaluate the limitations of this model.

(Total for Question 5 is 3 marks)

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6 A student investigates the electrical conductivity of the ionic compound lead bromide ($PbBr_2$) in three different states: solid at room temperature, molten (melted), and dissolved in water to form a solution. Figure 2 shows the circuit used, with two carbon electrodes dipped into the sample and connected to a power pack via a bulb.



(a) Identify the independent variable in this investigation. **(1)**

(b) Identify the dependent variable in this investigation. **(1)**

(c) State one variable that should be controlled for a fair test, and explain why it should be controlled. **(2)**

(d) Give one hazard associated with this practical and a precaution that should be taken to reduce the risk. **(2)**

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(e) The table shows the student's results. **(3)**

State of lead bromide	Does the bulb light?
Solid	No
Molten	Yes, brightly
Dissolved in water	Yes, brightly

Use the results and your knowledge of ionic bonding to explain why solid lead bromide does not conduct electricity, but molten and dissolved lead bromide do.

(f) Suggest two improvements to this investigation that would increase confidence in the conclusion. **(2)**

(Total for Question 6 is 11 marks)

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7 Explain why solid sodium chloride does not conduct electricity but molten sodium chloride does.

(a) Explain why solid NaCl does not conduct. **(1)**

(b) Explain why molten NaCl conducts. **(1)**

(Total for Question 7 is 2 marks)

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8 Chlorine, Cl_2, exists as small (simple) covalent molecules.

(a) Explain why substances made of small covalent molecules, such as chlorine, have low melting and boiling points. **(3)**

(b) Explain why substances made of small covalent molecules do not conduct electricity. **(2)**

(Total for Question 8 is 5 marks)

9 Silicon can form the giant covalent structure found in sand and also form discrete molecules in other compounds. Consider diamond (a form of carbon) and a molecule of silicon tetrachloride, $SiCl_4$.

(a) State whether diamond is a giant covalent structure or a simple molecular substance. **(1)**

(b) State whether $SiCl_4$ is a giant covalent structure or a simple molecular substance. **(1)**

(c) Give one reason why diamond is hard while $SiCl_4$ is a liquid at room temperature. **(1)**

(Total for Question 9 is 3 marks)

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Mark scheme · 2.2 Bonding, Structure and Properties of Matter: Test Pack

Question 1

(a) proton and neutron cao **B1**

(a) Answer: Proton and neutron.

Question 2

(a) states particles in a gas move faster or have more kinetic energy than in a liquid, oe **M1**

(a) states gas particles are further apart so more space to move, oe **M1**

(a) explains consequence: diffusion in gases is faster because particles move faster and have more space to travel, oe **A1**

(a) explains consequence: diffusion in liquids is slower because particles move less and are closer together, oe **A1**

(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 3

(a) gas **B1**

(a) Answer: Gas

(b) in Sample X the particles are arranged in a fixed, regular pattern; in Sample Y the particles are arranged randomly oe **B1**

(b) in Sample X the particles can only vibrate about fixed positions; in Sample Y the particles are free to move around/slide past each other oe **B1**

(b) Answer: X is regularly arranged and particles only vibrate in place (solid); Y is randomly arranged but particles can still move past each other (liquid).

(c) in a gas there are large spaces (gaps) between the widely spaced particles **B1**

(c) so the particles can be pushed closer together (into those spaces); in a liquid the particles are already close together/touching so there is very little space to reduce oe **B1**

(c) Answer: Gas particles are far apart with large gaps between them, so they can be pushed closer together; liquid particles are already touching, so there is almost no space left to compress.

Question 4

(a) a giant structure of positively charged metal ions arranged in (regular) layers oe **B1**

(a) surrounded by/held together by a sea of delocalised (outer-shell) electrons oe **B1**

(a) Answer: A giant lattice of positive metal ions arranged in layers, surrounded by a sea of delocalised electrons.

(b) the layers of metal ions can slide over each other oe **B1**

(b) because the delocalised electrons hold the ions together from all directions, so the structure does not break/shatter when the layers move oe **B1**

(b) Answer: The layers of ions can slide over each other while the sea of delocalised electrons continues to hold them together, so the metal bends rather than shattering.

(c) metals contain delocalised electrons that are free to move throughout the structure **B1**

(c) these moving (delocalised) electrons can carry electrical charge/current oe **B1**

(c) Answer: The delocalised electrons are free to move through the whole structure and carry electrical charge.

Question 5

the model does not show that real particles have different sizes and shapes (atoms and molecules are not all identical spheres) oe **B1**

the model does not show the forces of attraction that act between particles oe **B1**

the model treats particles as solid with nothing inside, but atoms are mostly empty space and contain smaller particles (e.g. electrons, nucleus) oe (any three suitable limitations credited) **B1**

Answer: Limitations include: particles are not really identical solid spheres; the model ignores forces of attraction between particles; and atoms are not solid, they contain smaller particles and are mostly empty space.

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Question 6

(a) the physical state of the lead bromide (solid, molten, or dissolved in solution) oe **B1**

(a) Answer: The state of the lead bromide (solid, molten or in solution).

(b) whether the bulb lights (or the size of the current/reading on an ammeter) oe **B1**

(b) Answer: Whether the bulb lights (or the current recorded).

(c) e.g. the voltage/power supply used; the mass/amount of lead bromide used; the electrodes used (any suitable controlled variable) **B1**

(c) so that any difference in the bulb lighting is caused only by the change in state of the lead bromide, not by another factor oe **B1**

(c) Answer: Control the voltage of the power supply (or amount of lead bromide/electrodes used) so that the state of the compound is the only variable affecting the result.

(d) hazard: molten lead bromide is very hot and can cause burns **B1**

(d) precaution: use tongs, a heatproof mat and eye protection, and keep the source of heat away from skin (matching precaution to stated hazard) **B1**

(d) Answer: Hazard: molten lead bromide can cause burns. Precaution: use tongs to handle the hot container and place it on a heatproof mat.

(e) in the solid, the ions are held in fixed positions in the giant lattice and cannot move **B1**

(e) when molten or dissolved, the ions are free to move throughout the liquid/solution **B1**

(e) the moving/mobile ions can carry electrical charge, completing the circuit, so the bulb lights oe **B1**

(e) Answer: Solid ions are fixed in the lattice and cannot move to carry charge; when molten or dissolved the ions are free to move and carry charge, so the bulb lights.

(f) repeat the experiment (for each state) and check the results are the same/reproducible oe **B1**

(f) use an ammeter to record the actual current for each state (quantitative data) instead of only observing whether the bulb lights oe **B1**

(f) Answer: Repeat each test and use an ammeter to measure the actual current, giving quantitative rather than just observational data.

Question 7

(a) no mobile charged particles in the solid state (ions fixed in the lattice) **B1**

(a) Answer: In solid NaCl the ions are fixed in the lattice so there are no mobile charged particles to carry current.

(b) ions are free to move when molten so mobile charged particles conduct electricity **B1**

(b) Answer: When molten the ions are free to move and so mobile charged particles can conduct electricity.

Question 8

(a) simple molecular substances consist of individual molecules held together by weak intermolecular forces (forces of attraction between molecules) **B1**

(a) only a small amount of energy is needed to overcome/break these weak intermolecular forces **B1**

(a) the strong covalent bonds within each molecule are not broken when the substance melts or boils oe **B1**

(a) Answer: Only the weak intermolecular forces between molecules need to be overcome (not the strong covalent bonds within them), so little energy is needed and melting/boiling points are low.

(b) the molecules have no overall electrical charge **B1**

(b) there are no free ions or delocalised electrons able to carry charge oe **B1**

(b) Answer: Molecules are electrically neutral and there are no free ions or delocalised electrons to carry a charge.

Question 9

(a) giant covalent structure cao **B1**

(a) Answer: Giant covalent structure

(b) simple molecular substance (discrete $SiCl_4$ molecules) cao **B1**

(b) Answer: Simple molecular substance (discrete $SiCl_4$ molecules)

(c) diamond has strong covalent bonds in a giant network requiring much energy to break; $SiCl_4$ has weak intermolecular forces between discrete molecules so it is liquid at room temperature **B1**

(c) Answer: Diamond is hard because of the strong covalent bonds in its giant network; $SiCl_4$ is liquid because only weak intermolecular forces act between its discrete molecules.

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