3.20 Density and the Particle Model of Matter: 30-minute Pack

AQA 8464 · Calculator allowed · about 30 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Name the change of state described in each case below.

(a) A solid turns into a liquid. **(1)**

(b) A liquid turns into a solid. **(1)**

(c) A liquid turns into a gas. **(1)**

(d) A gas turns into a liquid. **(1)**

(e) A solid turns directly into a gas, without becoming a liquid. **(1)**

(f) A gas turns directly into a solid, without becoming a liquid. **(1)**

(Total for Question 1 is 6 marks)

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2 A concrete paving slab has a mass of 3.6 kg and a volume of 1500 cm^3.
Calculate the density of the slab in kg/m^3. Use the equation: density = mass / volume (1 m^3 = 1000000 cm^3)

(Total for Question 2 is 3 marks)

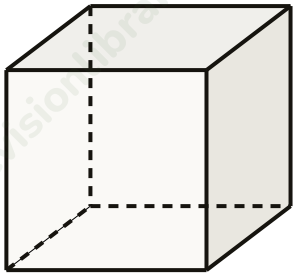
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3 Aisha carries out the required practical to determine the density of a small aluminium cube.

(a) State the piece of equipment Aisha should use to measure the mass of the cube. **(1)**

(b) Aisha measures the length of one side of the cube with a ruler. Suggest one way she could improve the accuracy of this length measurement. **(1)**

(c) The cube has a side length of 2.0 cm. Calculate the volume of the cube. **(2)**



2.0 cm

(d) The mass of the cube is 21.6 g. Calculate the density of the cube. Use the equation: density = mass / volume **(2)**

(e) State two safety precautions Aisha should take when carrying out this experiment. **(2)**

(f) A data sheet gives the accepted density of aluminium as 2.70 g/cm^3. Suggest one reason why Aisha's calculated density might be slightly different from the accepted value, even if all her measurements were taken carefully. **(1)**

(Total for Question 3 is 9 marks)

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4 The table shows the density of three materials.

Material	Density (g/cm^3)
Ice	0.92
Water	1.00
Polystyrene foam	0.05

(a) State whether ice or polystyrene foam would float lower in water (that is, have a greater fraction of its volume below the surface). **(1)**

(b) Explain your answer to part (a), using the densities given in the table. **(2)**

(Total for Question 4 is 3 marks)

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5 Internal energy is the energy stored inside a system by the particles that make it up.

(a) State what is meant by the internal energy of a system. **(1)**

(b) State what is meant by the specific latent heat of a substance. **(2)**

(c) When a solid is heated at its melting point, energy continues to be transferred to it, but its temperature does not increase until it has completely melted. Explain, in terms of the energy of the particles, why the temperature does not increase during melting. **(3)**

(Total for Question 5 is 6 marks)

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Mark scheme · 3.20 Density and the Particle Model of Matter: 30-minute Pack

Question 1

(a) melting **B1**

(a) Answer: Melting

(b) freezing (solidification) oe **B1**

(b) Answer: Freezing

(c) evaporating/boiling oe **B1**

(c) Answer: Evaporating (or boiling)

(d) condensing **B1**

(d) Answer: Condensing

(e) sublimation **B1**

(e) Answer: Sublimation

(f) deposition **B1**

(f) Answer: Deposition

Question 2

1500 / 1000000 = 0.0015 m^3 (volume correctly converted) **M1**

3.6 / 0.0015 substituted **M1**

2400 kg/m^3 cao **A1**

Answer: 2400 kg/m^3

Question 3

(a) a (top-pan/electronic) balance **B1**

(a) Answer: A balance (top-pan balance).

(b) use digital calipers instead of a ruler (more precise) oe; or repeat the measurement at different points on the cube and calculate a mean; or take the reading at eye level to avoid a parallax error **B1**

(b) Answer: Use digital calipers instead of a ruler, or repeat the measurement and take a mean.

(c) 2.0 * 2.0 * 2.0 substituted **M1**

(c) 8.0 cm^3 cao **A1**

(c) Answer: 8.0 cm^3

(d) 21.6 / 8.0 substituted ft from part (c) **M1**

(d) 2.7 g/cm^3 cao **A1**

(d) Answer: 2.7 g/cm^3

(e) handle the metal cube carefully to avoid dropping it on fingers/feet oe **B1**

(e) wash hands after handling the metal sample oe **B1**

(e) Answer: Handle the cube carefully to avoid dropping it; wash hands after handling the metal.

(f) the cube may not be pure aluminium (it could be an alloy) oe; or small errors in measuring the side length have a large effect on the calculated volume and density because the length is cubed **B1**

(f) Answer: The cube might not be pure aluminium (could be an alloy), or a small error in the side length has a large effect once cubed.

Question 4

(a) ice **B1**

(a) Answer: Ice

(b) the closer an object's density is to the density of the liquid it floats in, the greater the fraction of its volume that is submerged **B1**

(b) ice's density (0.92 g/cm^3) is much closer to that of water (1.00 g/cm^3) than polystyrene's density (0.05 g/cm^3), so ice floats with more of its volume underwater than the polystyrene foam does **B1**

(b) Answer: Ice's density is much closer to water's density than polystyrene's is, so ice sits lower (more submerged) than polystyrene when floating.

Question 5

(a) the sum of the kinetic energies and potential energies of all the particles that make up the system oe **B1**

(a) Answer: The sum of the kinetic and potential energies of all the particles that make up the system.

(b) the energy needed to change the state of **B1**

(b) 1 kg of the substance, with no change in temperature **B1**

(b) Answer: The energy needed to change the state of 1 kg of a substance, with no change in temperature.

(c) the energy transferred increases the potential energy of the particles, not their kinetic energy **B1**

(c) this energy is used to (partially) overcome the forces of attraction between particles, allowing them to move away from their fixed positions **B1**

(c) the average kinetic energy of the particles is unchanged, so the temperature stays constant until melting is complete **B1**

(c) Answer: Energy increases the particles' potential energy (overcoming forces of attraction) rather than their kinetic energy, so the temperature stays constant until melting finishes.

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