Exercise walk-through

3.2
Changes of state and internal energy (4.3.1.2–4.3.2.1)

AQA · GCSE · Physics

Changes of state and internal energy

- Mass is conserved: when a substance changes state, the number of particles stays the same.
- Changes of state are **physical changes** : if you reverse the change, the material gets back its original properties. No new substance is made.

Exercise 2.1

2.1 Name the change of state: (a) dew forming on grass at dawn; (b) wet clothes drying on a line; (c) a puddle becoming ice overnight. [3]

dew forming | clothes drying | puddle freezing

Exercise 2.1

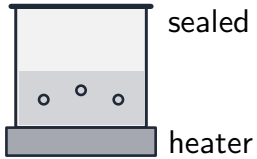
2.1 Name the change of state: (a) dew forming on grass at dawn; (b) wet clothes drying on a line; (c) a puddle becoming ice overnight. [3]

dew forming | clothes drying | puddle freezing

2.1 (a) condensing. (b) evaporating. (c) freezing.

Exercise 2.2

2.2 Water boils in a closed container from which no material escapes. State what happens to the total mass and to the arrangement of particles. [2]

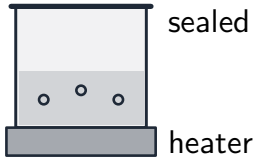


2.3 Define internal energy. [2]

internal energy

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internal energy

2.2 The mass stays the same – no particles are lost, boiling only changes their arrangement from close together to far apart; the particles spread out to fill the container as a gas.

2.3 Internal energy is the total kinetic energy and potential energy of all the particles (atoms and molecules) that make up the system.

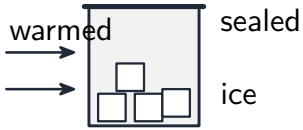
Exercise 3.1

3.1 A sealed can of ice is warmed until it becomes water, then steam. Nothing enters or leaves the can.

(a) State what happens to the total mass of the contents, with a reason. [2]

(b) Explain what happens to the internal energy of the contents while the ice melts. [2]

(c) A student says "melting is a chemical change because the ice changes." Correct the student. [2]



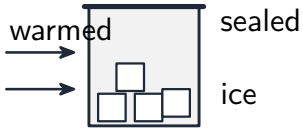
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3.1 (a) The total mass is unchanged: the sealed can keeps all particles in – a change of state conserves mass. (b) The internal energy increases: the supplied energy raises the particles' potential energy as the solid structure breaks down, while their average kinetic energy – and so the temperature – stays constant. (c) Melting is a physical change: if the water is refrozen it recovers the original properties of ice; no new substance is formed.

Setup for exercise 3.2

3.2 Ethanol evaporates from an open dish. After a week the dish is empty.

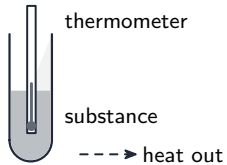
(a) Explain, using the particle model, where the ethanol went. [3]

(b) State whether the ethanol's mass has been destroyed, and justify your answer. [2]



Exercise 3.2

3.3 The table shows a substance's temperature as it cools.



Time in minutes	**0**	**1**	**2**	**3**	**4**	**5**	**6**
Temperature in °C	88	76	60	60	60	48	35

(a) State what is happening between 2 and 4 minutes. [2]

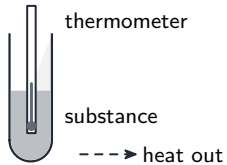
(b) Explain why the temperature is constant there even though energy is leaving. [2]

(c) State the substance's freezing point. [1]

(d) At which stage is the particles' average kinetic energy falling fastest? Justify your choice. [2]

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3.2 (a) The surface particles with the greatest energy escape the liquid's attraction; they become gas particles moving randomly with large gaps between them; the gas spreads through the air in the room, so the dish empties. (b) It has not been destroyed: the

Full solution on next slide

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Full solution 3.2

3.2 (a) The surface particles with the greatest energy escape the liquid's attraction; they become gas particles moving randomly with large gaps between them; the gas spreads through the air in the room, so the dish empties. (b) It has not been destroyed: the particles still exist as a gas mixed with the air – mass is conserved, only the state changed.

3.3 (a) The substance is freezing / changing from liquid to solid at constant temperature. (b) Energy is being transferred away, but it comes from the particles' potential energy as bonds form; the average kinetic energy – and hence the temperature – is unchanged until all the liquid has solidified. (c) 60 °C. (d) Between 1 and 2 minutes: the temperature falls fastest there (16 °C per minute, the steepest drop in the table), and temperature is related to the particles' average kinetic energy.