

Solutions

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

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.

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.

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 5 and 6 minutes: the temperature falls fastest there (13 °C per minute, the steepest drop in the table), and temperature measures the particles' average kinetic energy.