MR SULLY UNFOLDS PHYSICS ANSWERS

# States of matter and internal energy

AQA 4.3.1.2–4.3.2.1
Particle model · Paper 1
Foundation & Higher

Name _____ Class _____ Date _____

Heating a substance either raises its temperature or changes its state. The particle model explains both.

**KEY IDEAS**

- Solid: close, regular arrangement, vibrating. Liquid: close, random, moving past each other. Gas: far apart, fast, random.
- Changes of state are physical changes: **mass is conserved** and they can be reversed.
- **Internal energy** = total kinetic + potential energy of all the particles in a system.

## Section A · Recall

Grade 4–5

**1** Name the change of state for each. [4]

**a** Solid → liquid

Melting

**b** Gas → liquid

Condensing

**c** Liquid → solid

Freezing

**d** Solid → gas

Sublimating

**2** Define internal energy. [2]

The total kinetic energy and potential energy

of all the particles that make up a system.

**3** Explain why the mass of a substance stays the same when it melts. [1]

No particles are added or removed, so mass is conserved.

## Section B · Explain

Grade 5–6

**4** Describe the arrangement and movement of particles in a solid, a liquid and a gas. [3]

Solid: close together, regular pattern, vibrate about fixed positions.

Liquid: close together, random arrangement, can move past each other.

Gas: far apart, random, move quickly in all directions.

**5** Explain what happens to the particles when a substance is heated, and how this can change the substance. [3]

Heating increases the energy of the particles (internal energy increases).

This either raises the temperature (particles move faster),

or changes the state (bonds between particles are broken).

## Section C · Stretch

Grade 7+

**6** A bath of warm water at 40 °C has more internal energy than a cup of boiling water at 100 °C. Explain how this is possible. [3]

**Internal energy is the total energy of ALL the particles.**

**The bath has far more particles (much greater mass).**

**So even though each particle has less kinetic energy on average, the total is larger.**

## Exam-style question

AQA style

**7** Some ice cubes are taken from a freezer and left in a warm room.

**a** Describe what happens to the internal energy of the ice as it melts. [1]

**It increases.**

**b** The temperature of the ice stays at 0 °C while it melts. Explain why. [3]

**Energy is transferred to the ice,**

**but it increases the potential energy of the particles (breaking bonds),**

**not their kinetic energy, so the temperature doesn't change.**

**c** Explain why this is a physical change, not a chemical change. [1]

**No new substance is formed; the water can be frozen back into ice.**

**Total: _____ / 21**

| **How confident am I?** | Not yet | Nearly | Got it |
|---|---|---|---|
| I can describe particles in solids, liquids and gases | ☐ | ☐ | ☐ |
| I can define internal energy | ☐ | ☐ | ☐ |
| I can explain what happens during a change of state | ☐ | ☐ | ☐ |