M.1 Particle Theory & States of Matter

Practice Worksheet — name: _____ date: _____

FORMULAS FOR THIS TOPIC

DENSITY $\rho = \frac{m}{V}$

SECTION A — MULTIPLE CHOICE

A1. During boiling, the temperature of a liquid stays constant because the energy supplied is used to:

- (A) Increase the speed of the particles
- (B) Overcome the forces between particles
- (C) Break the particles into atoms
- (D) Heat the container

A2. A gas is compressed into half its volume at constant temperature. The particles now:

- (A) Move faster
- (B) Hit the container walls more often
- (C) Become smaller
- (D) Stick together

A3. A drop of food colouring spreads through cold water in 40 minutes but through hot water in 5 minutes. This is because in hot water:

- (A) The dye particles dissolve better
- (B) The water particles move faster, so diffusion is quicker
- (C) Convection replaces diffusion
- (D) The dye particles become lighter

SECTION B — SHORT ANSWER

B1. Use particle theory to explain why gases can be compressed easily but solids cannot. [3 marks]

B2. Sketch a heating curve for ice heated from −20 °C to 120 °C and label the key regions. [4 marks]

B3. A block has mass 540 g and dimensions 10 cm × 5 cm × 4 cm. Will it float in water? Show your working. [3 marks]

ANSWER KEY

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Section A

A1: Overcome the forces between particles — At the boiling point, added energy separates particles against their attractive forces (increasing potential energy) rather than speeding them up (kinetic energy) — so the temperature, which measures average kinetic energy, holds steady until the change of state completes.

A2: Hit the container walls more often — Constant temperature means constant particle speed. Squeezing the same number of particles into half the space doubles the frequency of wall collisions — which is why pressure rises.

A3: The water particles move faster, so diffusion is quicker — Diffusion happens by random particle motion. Higher temperature means faster-moving particles, more frequent collisions and quicker mixing — no stirring required.

Section B

B1: Gas particles are far apart with mostly empty space between them, so they can be pushed closer together. Solid particles are already touching in fixed, closely packed positions, so there is almost no space to remove — strong forces resist any further compression.

B2: The curve rises (ice warming), flattens at 0 °C (melting — energy breaks the rigid structure), rises again (water warming), flattens at 100 °C (boiling — energy separates particles into gas), then rises again (steam warming). The two plateaus occur because energy goes into changing state, not raising temperature.

B3: Volume = 10 × 5 × 4 = 200 cm^3. Density = 540/200 = 2.7 g/cm^3 (aluminium). Since 2.7 g/cm^3 > 1.0 g/cm^3 (water), the block sinks.