5.1 Density pressure and change of state

Name: _____ Class: _____ Date: _____ **Total: 21 marks**

Objective

Cover density, pressure and (P) change of state (5.3–5.14P): $\rho = m/V$, $p = F/A$, pressure difference $p = h\rho g$, heating curves, particle models and specific heat capacity. Original IGCSE-level practice.

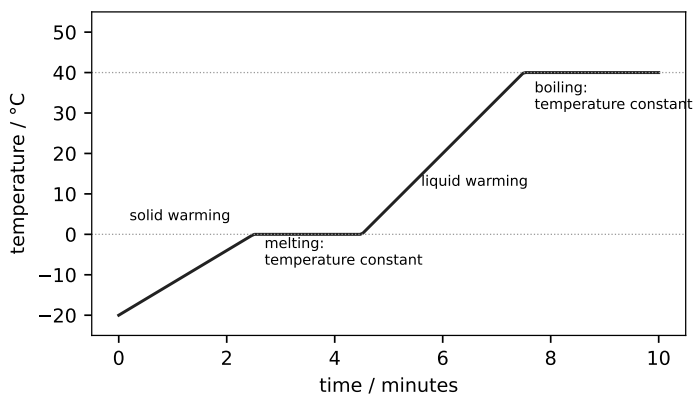
1 Key knowledge and worked examples

- **Three equations**

$$\rho = m/V \qquad p = F/A \qquad p = h\rho g$$

Worked check. A 96 g cube of side 2 cm: $V = 8 \times 10^{-6}$ m^3, $\rho = 0.096/8 \times 10^{-6} = 12\,000$ kg/m^3.

- **The heating curve's flat parts**



(P) $\Delta Q = mc\Delta T$ – and at a phase change, $\Delta T = 0$: the energy breaks bonds instead.

2 Practice

2.1 A stone of mass 150 g displaces 50 cm^3 of water. Calculate its density in g/cm^3 and kg/m^3. [3]

2.2 Calculate the pressure of a 60 N force on 0.2 m^2. [2]

2.3 Calculate the pressure difference 5 m deep in water ($\rho = 1000$ kg/m^3, g = 10 N/kg). [2]

2.4 (P) State what happens to the temperature while a pure substance boils. [1]

2.5 (P) Calculate the energy needed to heat 4 kg of water (c = 4200 J/(kg °C)) by 15 °C. [3]

3 Exam-style questions

3.1 Describe how to find the density of an irregular stone, naming the measuring instruments. [4]

3.2 Explain, using the particle model, why the temperature stops rising while ice melts. [3]

3.3 (P) A 2 kg metal block (c = 500 J/(kg °C)) is heated from 20 °C with 60 000 J of energy. Calculate its final temperature. [3]

Solutions

2.1 $\rho = 150/50 = 3$ g/cm^3; $= 3000$ kg/m^3.

2.2 $p = 60/0.2 = 300$ Pa.

2.3 $p = 5 \times 1000 \times 10 = 50\,000$ Pa.

2.4 (P) It stays constant – energy goes to breaking intermolecular bonds.

2.5 $\Delta Q = 4 \times 4200 \times 15 = 252\,000$ J.

3.1 Measure the mass on a balance; half-fill a measuring cylinder with water and read its volume; lower the stone in and read the new volume – the rise is the stone's volume; density = mass ÷ volume.

3.2 Energy supplied breaks the bonds holding particles in the solid lattice; potential/chemical energy of the arrangement increases while kinetic energy stays the same; temperature measures average kinetic energy, so it stays constant until all the ice has melted.

3.3 $\Delta T = Q/(mc) = 60\,000/(2 \times 500) = 60$ °C; final temperature $= 20 + 60 = 80$ °C.