5.1 Density pressure and change of state

Name: _____ Class: _____ Date: _____ **Total: 27 marks**

Objective

Build the skills to answer exam questions on **density, pressure and change of state** 、 : $\rho = m/V$, $p = F/A$, pressure in liquids, particles in solids, liquids and gases, specific heat capacity, and melting and boiling.

You must be able to:

- calculate density and pressure
- calculate the pressure difference in a liquid with $p = h\rho g$
- use specific heat capacity, $\Delta Q = mc\Delta T$
- measure the density of a regular and an irregular object

1 Key knowledge and worked examples

Density, pressure and heating

idea	equation or rule
density	$\rho = m \div V$ (kg/m^3 or g/cm^3)
pressure	$p = F \div A$ (Pa = N/m^2)
pressure difference in a liquid	$p = h \times \rho \times g$, with $g = 10$ N/kg
specific heat capacity	$\Delta Q = m \times c \times \Delta T$
change of state	while a substance melts or boils its temperature stays the same; the energy breaks bonds between particles
particles	solid: fixed, close, vibrate; liquid: close, move past each other; gas: far apart, fast, random

Worked example 1: density. A block has mass 540 g and volume 200 cm^3. Find its density.

1. Known: $m = 540$ g; $V = 200$ cm^3.
2. Rule: $\rho = m \div V$.
3. Numbers: $540 \div 200$.
4. Result: 2.7 **g/cm^3**.

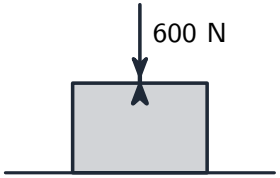
Worked example 2: heating. Find the energy to warm 2.0 kg of oil by 5.0 °C. For oil, $c = 2000$ J/(kg °C).

1. Known: $m = 2.0$ kg; $c = 2000$; $\Delta T = 5.0$.
2. Rule: $\Delta Q = mc\Delta T$.
3. Numbers: $2.0 \times 2000 \times 5.0$.
4. Result: 20 000 **J**.

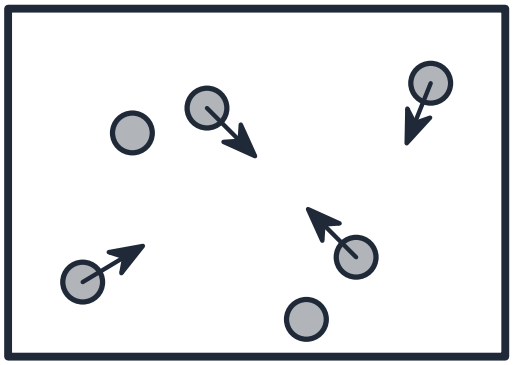
Answer shapes: pressure needs the area in m^2; 1 cm^2 = 0.0001 m^2.

2 Practice

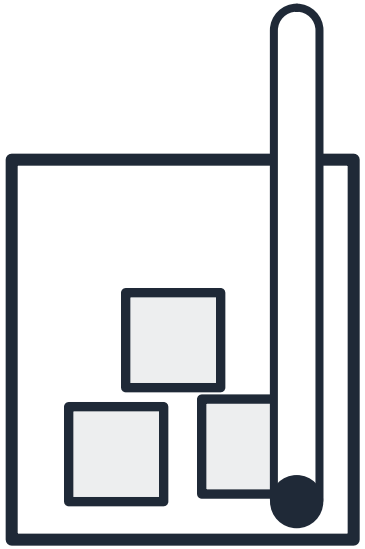
2.1 A box weighs 600 N and rests on an area of 0.20 m^2. Calculate the pressure on the floor. [2]



2.2 Describe the arrangement and movement of particles in a gas. [2]

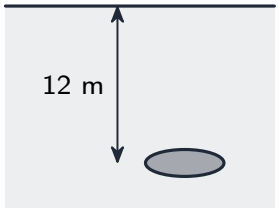


2.3 Explain why the temperature of ice stays at 0 °C while it melts, even though it is being heated. [2]

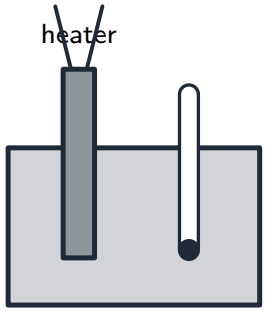


3 Exam-style questions

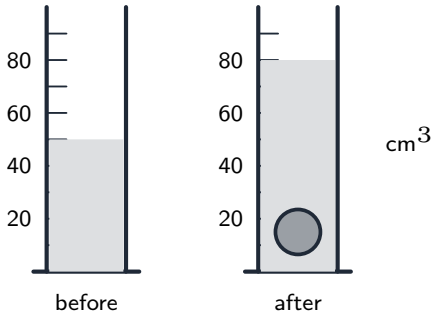
3.1 A diver is 12 m below the surface of the sea. Sea water has density 1030 kg/m^3. Calculate the pressure due to the water on the diver. [3]



3.2 A 1.5 kg aluminium block is heated by a 50 W heater for 300 s. Its temperature rises by 11 °C. Calculate the specific heat capacity of aluminium. [3]



3.3 A student wants to find the density of a small stone. She uses a balance and a measuring cylinder.



(a) The stone has a mass of 78 g. Use the readings to find its volume. [3]

(b) Calculate the density of the stone. [3]

(c) Explain why a cork floats on water but the stone sinks. Water has density 1.0 g/cm^3 and cork about 0.24 g/cm^3. [3]

(d) Describe how the student can measure the density of a regular block and of the stone as accurately as possible. [6]

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