# S1 Science Practice Paper: Laboratory Safety and Scientific Method, Measurement and Units, States of Matter and the Particle Model, Separating Mixtures, Energy and Heat Transfer, Simple Circuits, Forces and Magnets

S1 | Science | Time: 75 minutes | Total: 100 marks | 24 questions

---

## Section A Laboratory Safety and the Scientific Method

**Part A: 4 marks each, 16 marks in total.**

**1. State four safety rules that must be followed in a science laboratory.** [4]

**Answer:** Any four, e.g. wear safety goggles; never eat or drink in the laboratory; point a heated test tube away from people; follow instructions before using apparatus; wash hands after the experiment; report breakages to the teacher at once.

**2. Ming measures the volume of the same beaker of water three times and records 24.5 mL, 24.7 mL and 24.8 mL. Find the mean value. (Give the answer to 1 decimal place.)** [4]

**Answer:** Mean = (24.5 + 24.7 + 24.8) / 3 = 24.7 mL. Repeating a measurement and averaging reduces measurement error.

**3. Complete the unit conversions: (a) 250 m = how many cm? (b) 3200 g = how many kg? (c) 45 mL = how many cm3? (d) 0.75 L = how many mL?** [4]

**Answer:** (a) 250 cm; (b) 3.2 kg; (c) 45 cm3; (d) 750 mL. (1 m = 100 cm, 1 kg = 1000 g, 1 mL = 1 cm3, 1 L = 1000 mL)

**4. Mei studies how the length of light exposure affects the growth of pondweed: one jar is placed by a window, another inside a dark cupboard, all other conditions being the same. State the hypothesis, the independent variable, the dependent variable and one controlled variable of this experiment.** [4]

**Answer:** Hypothesis: the longer the light exposure, the more the pondweed grows. Independent variable: length of light exposure (light or dark). Dependent variable: the growth of the pondweed (e.g. height or number of leaves). Controlled variable: volume of water, water temperature, species or starting size of the pondweed.

## Section B States of Matter and the Particle Model

**Part B: 4 marks each, 16 marks in total.**

**5. Name each change of state: (a) ice to water; (b) water vapour to water; (c) water to water vapour; (d) dry ice changing straight into carbon dioxide gas.** [4]

**Answer:** (a) melting; (b) condensation; (c) evaporation (boiling); (d) sublimation.

**6. A solid is heated and its temperature is recorded every 2 minutes: 20, 35, 50, 80, 80, 80, 95 degrees C. Find (a) the melting point of the substance; (b) how long the melting process lasts.** [4]

**Answer:** (a) Melting point = 80 degrees C, because the temperature stops rising there (a plateau); (b) the plateau covers 3 readings, i.e. 3 x 2 = 6 minutes. During melting the energy absorbed is used to break the regular arrangement of particles, so the temperature stays constant.

**7. Use the particle model to explain why (a) a gas can be easily compressed while (b) a liquid can hardly be compressed.** [4]

**Answer:** (a) The particles in a gas are far apart with very weak forces between them, so pressure pushes them closer and the volume drops noticeably; (b) particles in a liquid are packed closely and almost touching, leaving very little empty space, so it cannot be compressed much.

**8. A piece of metal has a mass of 270 g and a volume of 100 cm3. Find its density and decide whether it floats on water (density of water = 1 g/cm3).** [4]

**Answer:** Density = mass / volume = 270 / 100 = 2.7 g/cm3. Since 2.7 g/cm3 is greater than the density of water (1 g/cm3), the metal sinks and does not float.

## Section C Separating Mixtures

**Part C: 17 marks in total.**

**9. Choose the most suitable separation method for each mixture: (a) sand and water; (b) salt and water (to recover the solid salt); (c) a mixture of ethanol and water; (d) the dyes in ink.** [4]

**Answer:** (a) filtration; (b) evaporation (crystallisation); (c) fractional distillation; (d) chromatography (paper chromatography).

**10. A mixture of ethanol (boiling point 78 degrees C) and water (boiling point 100 degrees C) is separated by fractional distillation. (a) Which liquid distils over first? (b) Where should the thermometer bulb be placed? (c) Why may the distillate still contain a little water?** [5]

**Answer:** (a) Ethanol distils over first because it has the lower boiling point; (b) the bulb should be placed at the top of the fractionating column, where vapour enters the condenser, to measure the temperature of the vapour; (c) some water also vaporises on heating and distils over with the ethanol, so the distillate is not completely pure.

**11. In paper chromatography of a dye, the spot centre moves 3.6 cm while the solvent front moves 9 cm. (a) Find the Rf value of the dye; (b) can an Rf value be greater than 1? Explain.** [5]

**Answer:** (a) Rf = distance moved by the spot / distance moved by the solvent front = 3.6 / 9 = 0.4; (b) no. The solvent carries the dye along, so the dye can never travel further than the solvent front; the Rf value must therefore be less than 1.

**12. At 60 degrees C, 100 g of water dissolves 110 g of potassium nitrate. The saturated solution is cooled to 20 degrees C, where 100 g of water dissolves only 32 g. Find the mass of potassium nitrate that crystallises out.** [3]

**Answer:** Mass crystallised = 110 - 32 = 78 g. Cooling lowers the solubility, so the excess solute crystallises out.

## Section D Energy and Heat Transfer

**Part D: 17 marks in total.**

**13. Identify the main mode of heat transfer in each case: (a) the handle of a metal spoon in hot water also becomes hot; (b) an air conditioner mounted high in a room cools the whole room; (c) you feel warm standing in sunlight.** [4]

**Answer:** (a) conduction (particles pass energy along the metal, and free electrons carry heat quickly); (b) convection (cool air sinks and warm air rises, forming convection currents); (c) radiation (the Sun transfers heat by electromagnetic waves, needing no medium).

**14. 0.5 kg of water is heated from 20 degrees C to 60 degrees C. Given that the specific heat capacity of water is 4200 J/(kg degrees C), find the heat energy required.** [5]

**Answer:** Temperature rise = 60 - 20 = 40 degrees C. Q = mcDT = 0.5 x 4200 x 40 = 84000 J (84 kJ).

**15. A lamp is supplied with 1200 J of electrical energy, of which 900 J is given out as light and heat. Find the energy efficiency of the lamp.** [4]

**Answer:** Efficiency = useful output / input x 100% = 900 / 1200 x 100% = 75%. The remaining 300 J is mostly lost as heat to the surroundings.

**16. A vacuum flask keeps a drink hot for a long time. State two features of its design and explain how each reduces heat loss.** [4]

**Answer:** Any two, e.g. the vacuum between the double glass walls stops conduction and convection; the shiny silvered walls reflect radiation and so reduce radiative heat loss; the stopper reduces convection and evaporation from the top.

## Section E Simple Circuits

**Part E: 17 marks in total.**

**17. Draw (or describe in words) the circuit symbols for: a battery, a lamp, a switch and an ammeter.** [4]

**Answer:** Battery: parallel long and short lines (the long line is the positive terminal); lamp: a circle with a cross inside; switch: a slanted line joining two terminals that can be opened; ammeter: a circle marked A, connected in series in the circuit.

**18. Two lamps L1 and L2 are connected in series to a 4.5 V battery. The voltage across L1 is 1.8 V. (a) Find the voltage across L2; (b) if the current is 0.3 A, state the current through L1 and through L2.** [5]

**Answer:** (a) In a series circuit the voltages add up to the supply voltage: V2 = 4.5 - 1.8 = 2.7 V; (b) the current is the same everywhere in a series circuit, so the current through both L1 and L2 is 0.3 A.

**19. A current of 0.5 A flows through a circuit for 120 seconds. Find the charge that passes.** [4]

**Answer:** Charge Q = I x t = 0.5 x 120 = 60 C (coulombs).

**20. (a) Give one example of a conductor and one of an insulator. (b) Why is a short circuit dangerous? (c) How does a fuse protect a circuit? [4]**

**Answer:** (a) Conductor: copper (or iron, aluminium); insulator: rubber (or plastic, glass). (b) In a short circuit the resistance is very small, so the current becomes very large; the wires overheat and may start a fire, and the battery may be damaged. (c) A fuse melts when the current is too large, breaking the circuit and stopping the excessive current.

## Section F Forces, Simple Machines and Magnets

**Part F: 17 marks in total.**

**21. A school bag has a mass of 12 kg. Given g = 10 N/kg on Earth and g = 1.6 N/kg on the Moon, (a) find the weight of the bag on Earth; (b) find its weight on the Moon. [5]**

**Answer:** (a) W = mg = 12 x 10 = 120 N; (b) W = 12 x 1.6 = 19.2 N. The mass is unchanged, but g is smaller on the Moon, so the weight is smaller.

**22. A crowbar is used as a lever: a load of 60 N is 0.4 m from the pivot and the effort is applied 1.2 m from the pivot. (a) Find the moment of the load; (b) find the minimum effort needed (ignore the weight of the bar). [5]**

**Answer:** (a) Moment = force x distance = 60 x 0.4 = 24 N m; (b) for balance the moments are equal: F x 1.2 = 24, so F = 24 / 1.2 = 20 N. The further the effort is from the pivot, the smaller the effort needed.

**23. (a) What happens when like poles of two bar magnets are brought together? (b) What is the direction of magnetic field lines? (c) Why does a compass needle point north-south? [4]**

**Answer:** (a) Like poles repel each other; (b) outside a magnet the field lines run from the north pole to the south pole, and inside from south back to north; (c) the Earth itself acts as a large magnet, so the small magnet in a compass aligns with the Earth magnetic field and points north-south.

**24. A spring is 8 cm long with no load and 11 cm long when a 2 N weight hangs on it. Assuming the elastic limit is not exceeded, find the total length of the spring when a 5 N weight hangs on it. [3]**

**Answer:** Extension is proportional to force: per newton the spring extends 3 / 2 = 1.5 cm. With 5 N the extension is 1.5 x 5 = 7.5 cm, so the total length = 8 + 7.5 = 15.5 cm.

---