# S1 Science Practice Paper 1 | Lab safety, units, states of matter, density, heat transfer, microscope

**Junior Secondary Science**

S1 Science practice paper 1 with solutions: lab safety, units, states of matter and the particle model, density, energy and heat transfer, microscopes and cells.

## 1. Laboratory safety and apparatus (16 marks)

*A group of S1 students heat a liquid in the laboratory. The Bunsen safety flame is about 800 C and the luminous flame about 500 C; the test tube holds 24 cm3 and must be at most one third full when heated; two balance readings are 12.35 g and 7.80 g with a container of 5.20 g; a measuring cylinder with 1 cm3 graduations reads 42 cm3.*

| # | Question |
|---|---|
| **1** | (a) What is the temperature difference between the safety flame and the luminous flame? |
| **2** | (b) What is the largest volume of liquid the tube may hold while being heated? |
| **3** | (c) What is the total of the two readings, and the net mass of the sample after subtracting the container? |
| **4** | (d) The uncertainty is half of the smallest graduation. What is it in cm3, and what is the percentage error of the reading? |

## 2. Measurement and unit conversion (16 marks)

*Science records use consistent units. A set of measurements: length 2.5 m, mass 0.45 kg, volume 750 mL, time 45 minutes, temperature 25 C.*

| # | Question |
|---|---|
| **5** | (a) Convert 2.5 m into centimetres. |
| **6** | (b) Convert 0.45 kg into grams. |
| **7** | (c) Convert 750 mL into litres and into cm3. |
| **8** | (d) Convert 45 minutes into seconds, and 25 C into kelvin (K = C + 273). |

## 3. States of matter and the particle model (18 marks)

*200 g of ice is heated from -10 C until it becomes water at 100 C. Specific heat capacity of ice is 2.1 J/(g C), latent heat of fusion of ice is 334 J/g, specific heat capacity of water is 4.2 J/(g C). In the particle model, particles in a solid vibrate about fixed positions, in a liquid they slide past each other, and in a gas they move freely.*

| # | Question |
|---|---|
| **9** | (a) How much energy is needed to warm the ice from -10 C to 0 C? |
| **10** | (b) How much energy is needed to melt all the ice at 0 C, and does the temperature change during melting? |
| **11** | (c) How much energy is needed to heat the water from 0 C to 100 C? |
| **12** | (d) What is the total energy needed for the whole process, in kJ? |

## 4. Density and floating (18 marks)

*The density of a stone is found by displacement: the cylinder reads 50 cm3 before and 74 cm3 after the stone is added, and the stone has a mass of 60 g. A wooden block has a volume of 20 cm3 and a mass of 12 g; a liquid has a volume of 250 cm3 and a mass of 200 g; the density of water is 1.0 g/cm3.*

| # | Question |
|---|---|
| **13** | (a) What is the volume of the stone and its density? |
| **14** | (b) Calculate the density of the wooden block and state whether it floats or sinks in water. |
| **15** | (c) What is the density of the liquid? |
| **16** | (d) If 250 cm3 of the liquid is mixed with 500 cm3 of water (volumes add up), what is the density of the mixture? |

## 5. Energy and heat transfer (16 marks)

*A 2000 W kettle heats 1.5 kg of water from 20 C to 100 C; specific heat capacity of water is 4200 J/(kg C). Another 500 g of water cools by 6 C in 10 minutes. A metal rod has ends at 100 C and 20 C and conducts 20 J each second. Solar radiation is 500 W/m2; a black surface absorbs about 90 per cent and a silver surface about 20 per cent.*

| # | Question |
|---|---|
| **17** | (a) How much energy is needed, and at 2000 W what is the minimum time in seconds and in minutes? |
| **18** | (b) How much energy does that cup of water lose in the 10 minutes? |
| **19** | (c) What is the temperature difference along the rod, and how much energy is conducted in one minute? |
| **20** | (d) By how many percentage points do the two surfaces differ, and how much energy does the black surface absorb per square metre each second? |

## 6. Microscopes and cell observation (16 marks)

*A compound microscope has a 10x eyepiece and 10x and 40x objectives. With the 10x objective the field of view is 1.8 mm across and about 36 cells are visible. A cell is 0.5 mm long in reality.*

| # | Question |
|---|---|
| **21** | (a) What is the total magnification with the 10x and with the 40x objective? |
| **22** | (b) Under the 40x objective, what is the image length of the cell in mm? |
| **23** | (c) With the 40x objective, what is the field diameter? (Magnification rises four times, so the diameter shrinks to one quarter.) |
| **24** | (d) Field area is inversely proportional to the square of magnification. About how many cells are visible with the 40x objective? |