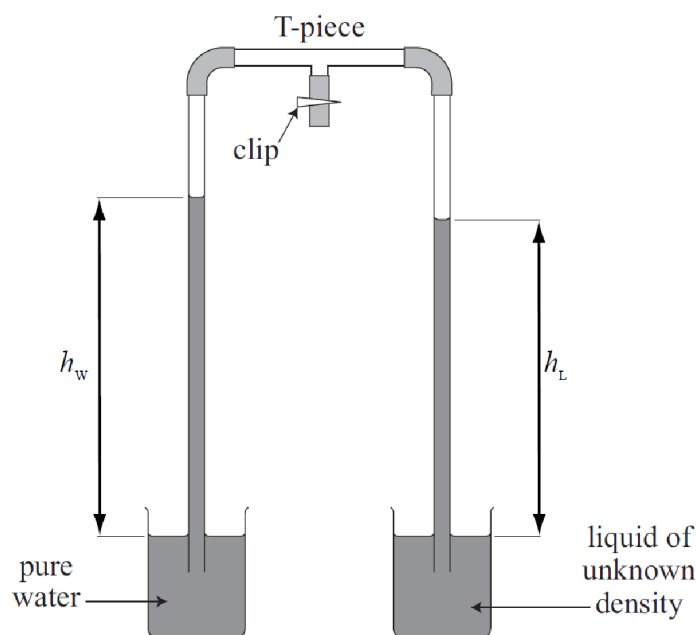


Physics Practical Work: Skills and Concepts Practice

Based on AQA practical tasks from 2009 and 2013.

1. A student researches methods of comparing the densities of two liquids, and discovers a method known as *Hare's apparatus*. The apparatus includes two vertical glass tubes connected at the top by a glass T-piece.



The tubes dip into two beakers, one containing a liquid of unknown density and one containing pure water with a density of 998 kg m^{-3} . Air is pumped out of the centre limb of the T-piece and the clip is closed. Removing the air causes the liquids to rise up their respective tubes, but the difference in the densities means that the liquids are raised through different heights, h_L and h_w .

The formula for Hare's apparatus is

$$\text{density of water} \cdot h_w = \text{density of the liquid} \cdot h_L.$$

By briefly opening and then closing the clip the student acquires the data shown below:

h_L/cm	h_w/cm
71.0	74.2
65.9	68.9
51.2	53.5
40.9	42.8
37.7	36.0
24.1	25.2

- 1 (a) Identify one possible source of random error in the measurements in the student's experiment, and explain how this error can be overcome.
You may wish to use a sketch to illustrate your answer



- 1 (b) State and explain how the student could use the data to determine the density of the liquid by a graphical method.



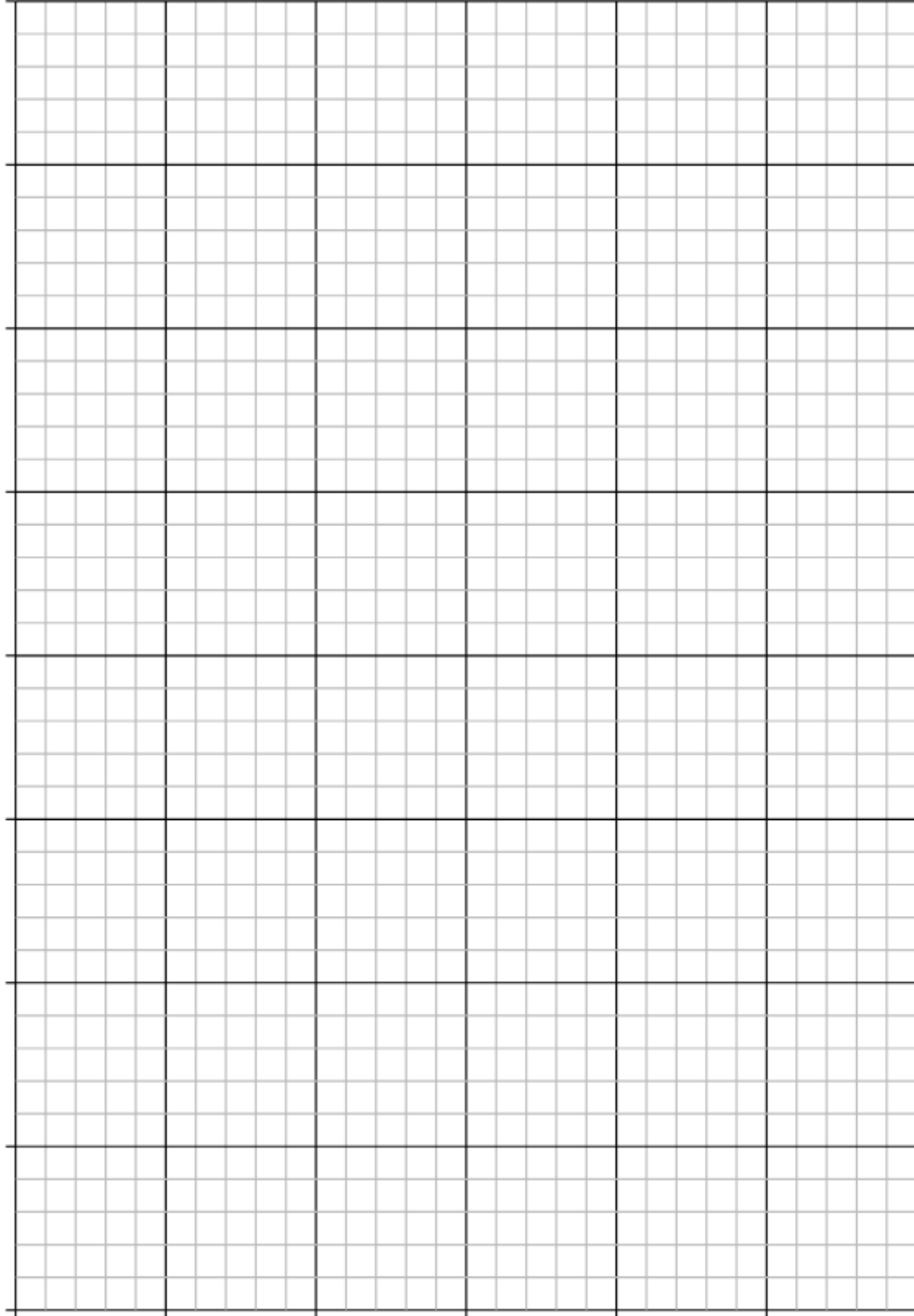
- 1 (b) (i) On the grid provided on the next page, plot a graph to implement your procedure using the student's data. Draw a line of best fit, ignoring any unreliable data.



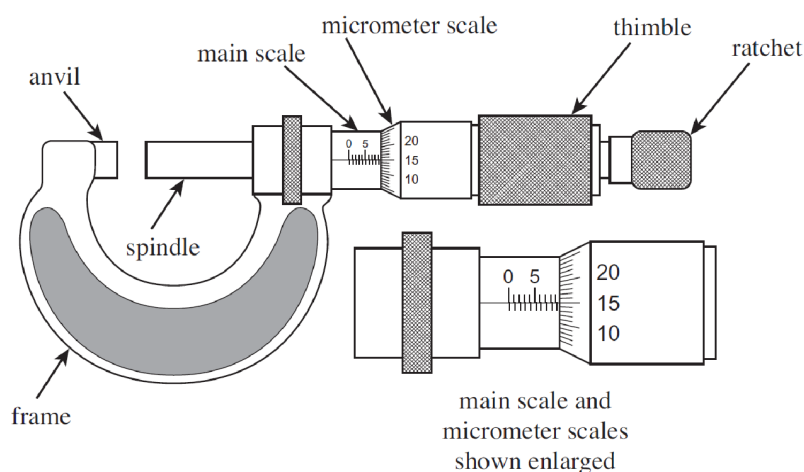
- 1 (b) (ii) Use your graph to determine the density of the unknown liquid. Show your method and calculations below.

$\rho = \dots\dots\dots \text{kg m}^{-3}$





2. A student uses a micrometer screw gauge to measure the diameter of a copper wire. The figure shows the instrument in question:



- 2 (a) (i) What is the precision of the main scale on the micrometer screw gauge?
- 2 (a) (ii) What reading is indicated in the figure?
- 2 (a) (iii) Why is it important to close the gap between the anvil and the spindle of the micrometer using the ratchet and not the thimble?
- 2 (a) (iv) State a procedure to detect a possible systematic error in the micrometer readings.
- 2 (b) The student obtains the following readings for the diameter of the wire, d :
- 1.03m, 1.02 mm, 1.05 mm, 1.01 mm, 1.02 mm
- 2 (b) (i) Determine the average value of d and the absolute uncertainty in that value.

$d = \dots \pm \dots \text{ mm}$

2 (b) (ii) State the percentage uncertainty in d .

