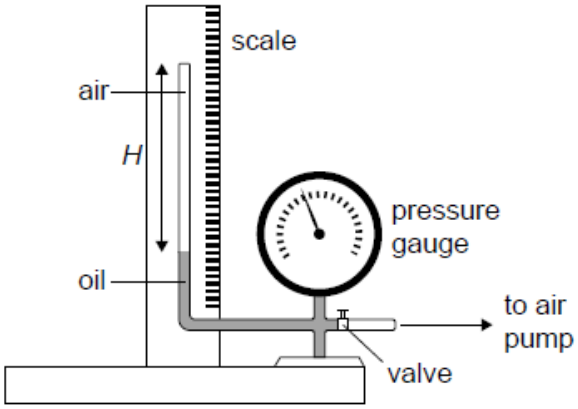
SL Paper 3

The equipment shown in the diagram was used by a student to investigate the variation with volume, of the pressure *p* of air, at constant temperature.

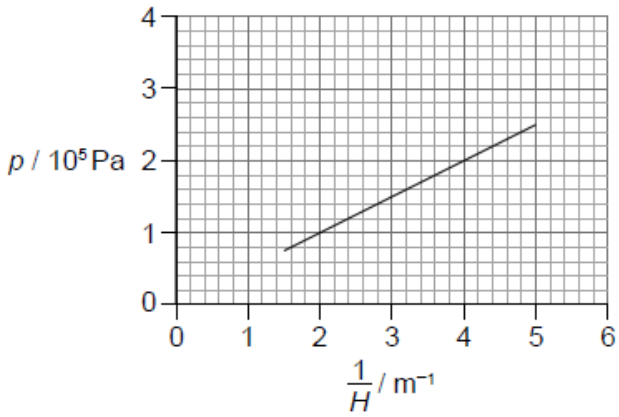
The air was trapped in a tube of constant cross-sectional area above a column of oil.



The pump forces oil to move up the tube decreasing the volume of the trapped air.

a. The student measured the height *H* of the air column and the corresponding air pressure *p*. After each reduction in the volume the student waited for some time before measuring the pressure. Outline why this was necessary. [1]

b. The following graph of *p* versus — was obtained. Error bars were negligibly small. [3]



The equation of the line of best fit is —.

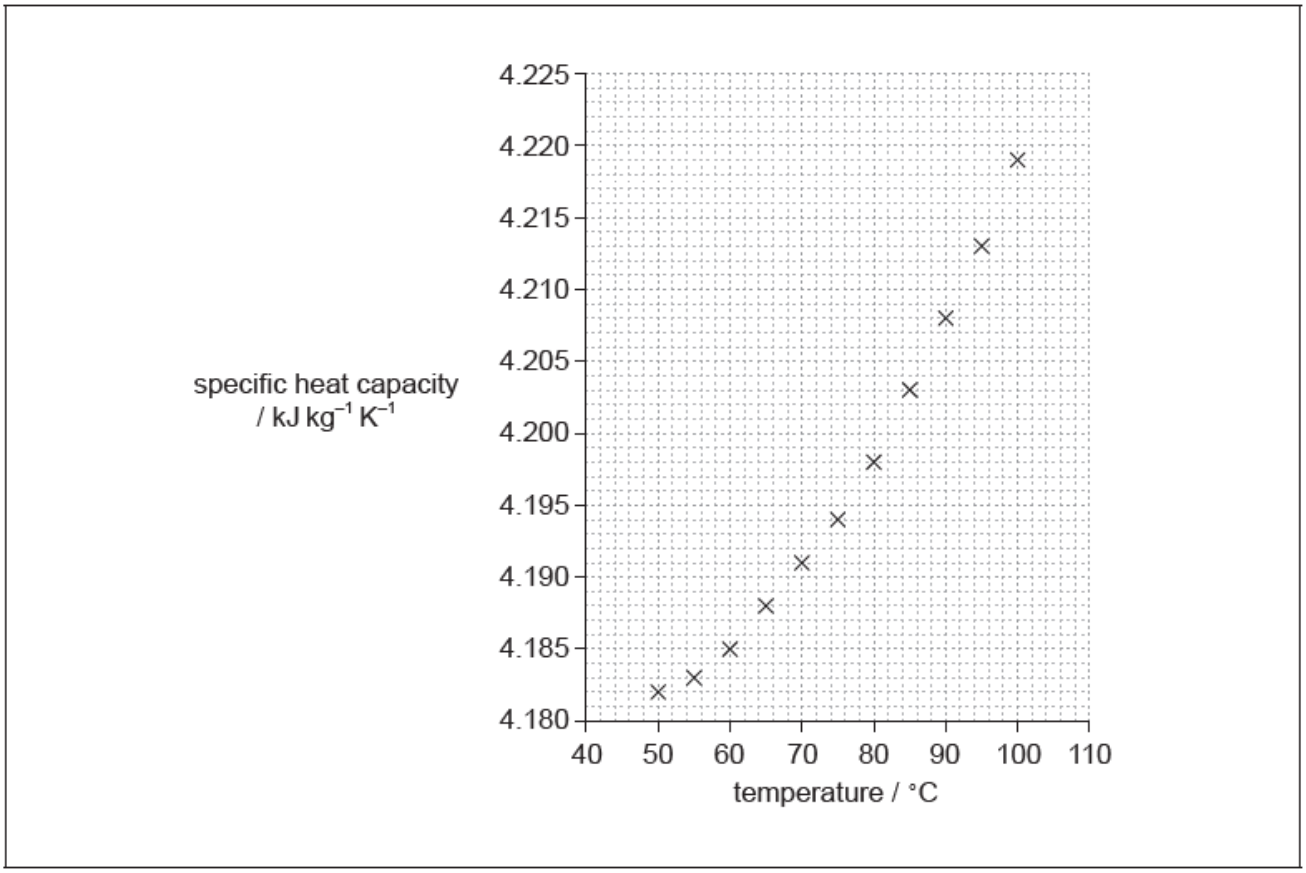
Determine the value of *b* including an appropriate unit.

c. Outline how the results of this experiment are consistent with the ideal gas law at constant temperature. [2]

d. The cross-sectional area of the tube is $1.3 \times 10^{-3}\,m^2$ and the temperature of air is 300 K. Estimate the number of moles of air in the tube. [2]

e. The equation in (b) may be used to predict the pressure of the air at extremely large values of —. Suggest why this will be an unreliable estimate of the pressure. [2]

In an experiment, data were collected on the variation of specific heat capacity of water with temperature. The graph of the plotted data is shown.



The uncertainty in the values for specific heat capacity is 5%.

Water of mass (100 ± 2) g is heated from (75.0 ± 0.5) °C to (85.0 ± 0.5) °C.

a. Draw the line of best-fit for the data. [1]

b.i. Determine the gradient of the line at a temperature of 80 °C. [3]

b.ii. State the unit for the quantity represented by the gradient in your answer to (b)(i). [1]

c.i. Calculate the energy required to raise the temperature of the water from 75 °C to 85 °C. [1]

c.ii. Using an appropriate error calculation, justify the number of significant figures that should be used for your answer to (c)(i). [3]