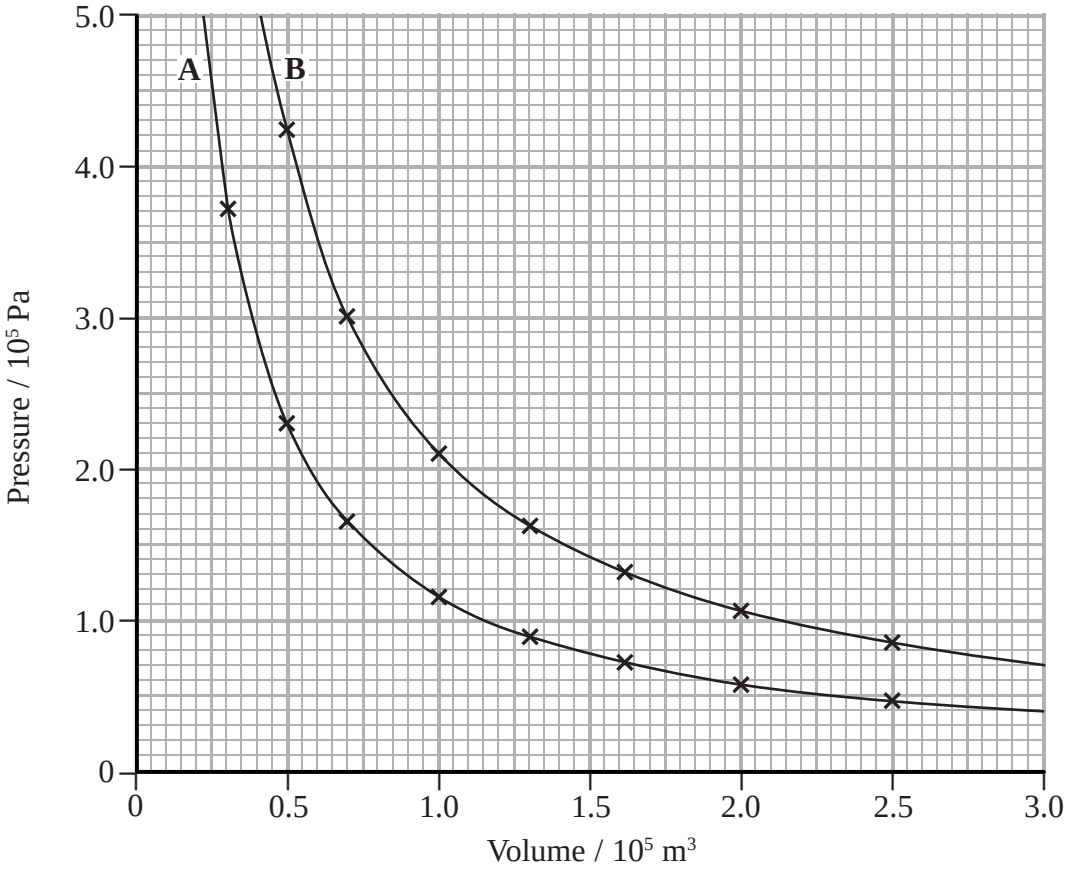
1 The graph shows the variation of pressure with volume for a sample of air at two different fixed temperatures. The air behaves as an ideal gas under these conditions. The number of molecules of air in the sample is constant. For curve A the temperature of the sample is 25 °C.



(a) (i) Use the graph to determine the number of molecules of air in the sample.

(4)

Number of molecules of air in sample =

(ii) Use the graph to determine the temperature of the sample for curve B.

(2)

Temperature of sample =

*(b) When the sample of air is cooled at constant volume, the pressure exerted by the air decreases as the temperature falls.

Explain, including ideas of momentum, why the pressure exerted by the air decreases.

(4)

(Total for Question = 10 marks)

2 A gas cylinder of volume 0.052 m^3 contains oxygen gas at a temperature of 22 °C and a pressure of 2.0×10^5 Pa.
Some of the oxygen in the cylinder is used and the gas pressure falls to 1.6×10^5 Pa.
The temperature remains constant.

Calculate the number of molecules removed from the cylinder.

(3)

Number of molecules removed =

(Total for Question = 3 marks)

3 A bicycle tyre contains air at 20 °C. The volume occupied by the air is 2.9×10^{-4} m^3. Assume that this volume remains fixed.

(a) The pressure of the air in the tyre is 5.8×10^5 Pa. In an attempt to improve performance air is pumped into the tyre until the pressure at 20 °C is 6.5×10^5 Pa.

Calculate the number of air molecules that must be pumped into the tyre.

(3)

Number of molecules =

(b) After cycling in a race the air pressure in the tyre has risen from 6.5×10^5 Pa to 6.8×10^5 Pa.

Calculate the increase in temperature of the air in the tyre.

(3)

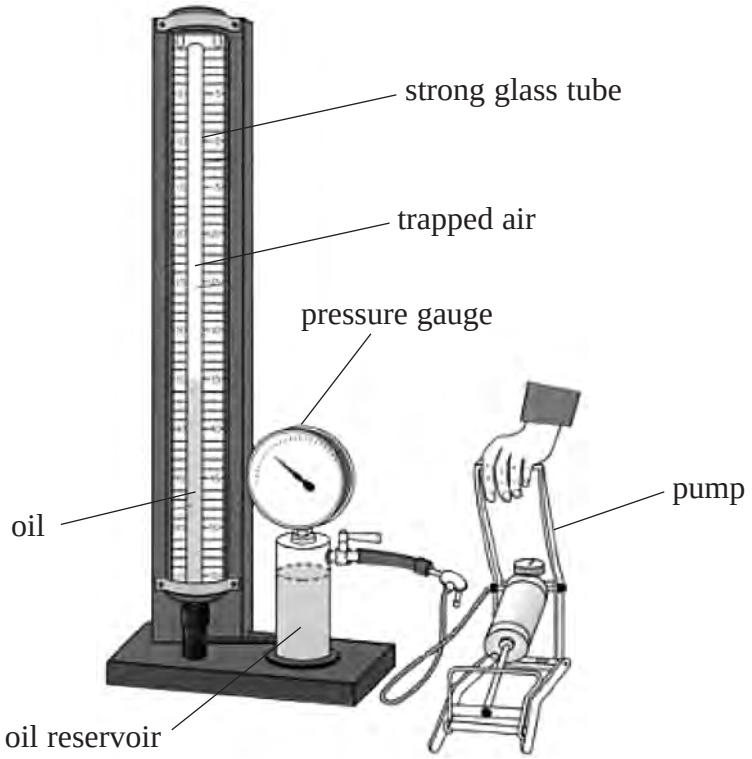
Increase in temperature =

(c) Explain why the pressure increases when the air is heated in a tyre of fixed volume.

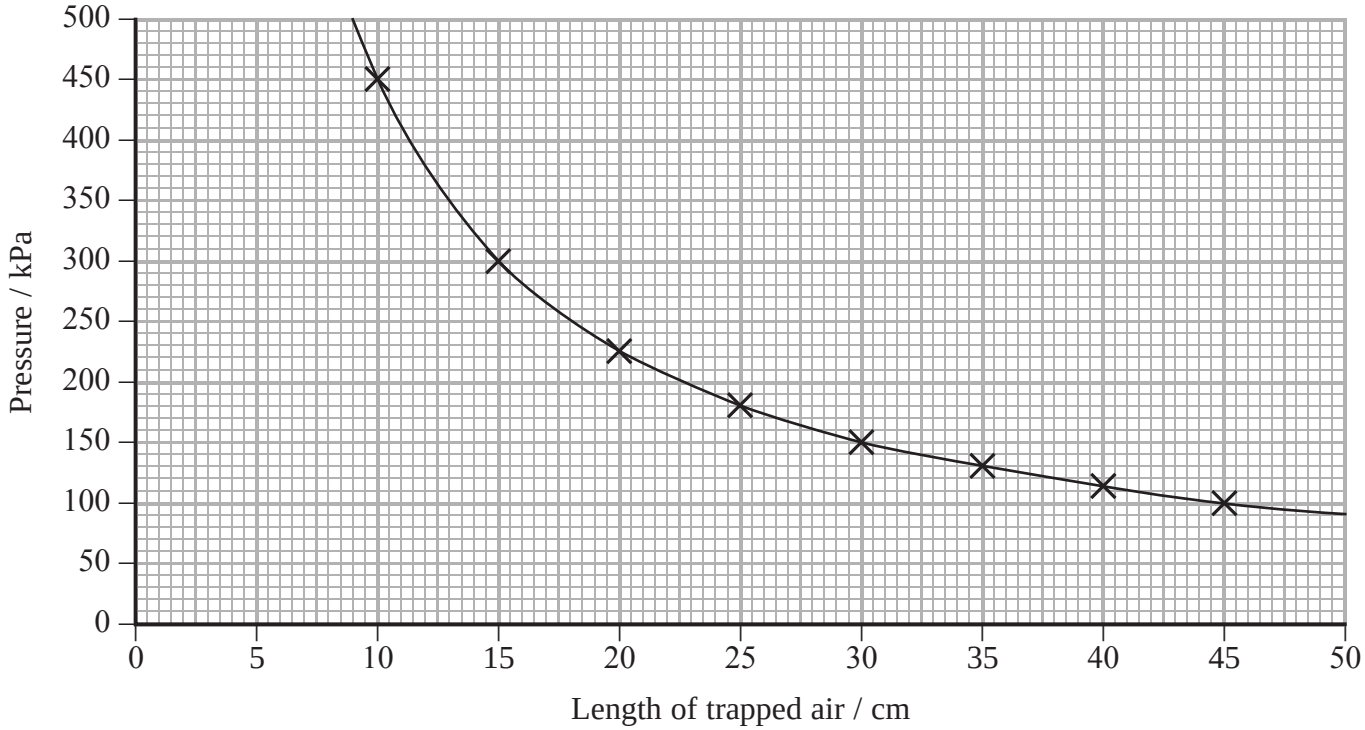
(3)

(Total for Question = 9 marks)

4 A student uses the apparatus shown to investigate the relationship between pressure and volume of a gas.



Air is trapped in a glass tube of uniform cross-sectional area. As the pressure of the trapped air is increased, the length of trapped air decreases. The student collects data and plots the following graph.



(a) State the variables that should be controlled in this investigation.

(2)

(b) Theory suggests that, for the air trapped in the tube, the pressure p is inversely proportional to the volume V.

Use the graph to show that this relationship is correct. State an assumption that you are making.

(4)

(c) On the day that the investigation was carried out, the temperature in the laboratory was 20 °C.

Calculate the number of air molecules trapped in the tube.

cross-sectional area of tube = 7.5×10^{-5} m^2

(3)

Number of air molecules =

(d) State how the graph would change if

(i) the air molecules in the tube were replaced by the same number of molecules of hydrogen gas.

(1)

(ii) the temperature of the laboratory was substantially higher.

(2)

(Total for Question = 12 marks)