Marks 3

- A cylinder fitted with a piston contains 5.00 L of a gas at a pressure of 4.0×10^5 Pa. The entire apparatus is maintained at a constant temperature of 25 °C. The piston is released and the gas expands against a pressure of 1.0×10^5 Pa. Assuming ideal gas behaviour, calculate the final volume occupied by the gas.

As the number of moles and the temperature is constant, the initial and final pressures and volumes are related by:

$$V_1P_1 = V_2P_2$$

Hence,

$$V_2 = V_1P_1 / P_2 = (5.00\ \text{L}) \times (4.0 \times 10^5\ \text{Pa}) / (1.0 \times 10^5\ \text{Pa}) = 20.\ \text{L}$$

Answer: **20. L**

Calculate the amount of work done by the gas expansion.

The gas expands from 5.00 to 20. L: it expands by 15 L. As 1 m^3 = 1000 L, this corresponds to 15×10^{-3} m^3.

The work done by a gas expanding against an external pressure is given by:

$$w = -P_{ext}\,\Delta V = -(1.0 \times 10^5\ \text{Pa}) \times (15 \times 10^{-3}\ \text{m}^3) = -1.5 \times 10^3\ \text{J}$$

Answer: **-1.5×10^3 J**