

2 A container contains an ideal gas at a thermodynamic temperature T . The kinetic theory of gas assumes that the molecules of the gas behave as hard, identical spheres that are in continuous random motion. The theory shows that

- the pressure exerted on the wall of the container by the gas is due to the elastic collisions of the molecules with the wall of the container
- the pressure is proportional to the mean-square speed of the molecules
- the mean translational kinetic energy of a molecule is $E_K = \frac{3}{2}kT$ where k is the Boltzmann constant.

(a) Explain why the internal energy of the gas is equal to the total kinetic energy of the molecules of the gas.

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[3]

(b) A container with 1.2 mol of an ideal gas. The gas has a mass of 0.0384 kg.

During the heating of the gas,

- the volume of the gas increases (the container does not have a fixed volume)
- the pressure of the gas remains constant
- the temperature of the gas changes from 280K to 460K
- the gas does 1.3×10^3 J of work.

(i) Explain, in terms of the force produced by the molecules of the gas, how the pressure remains constant as the volume increases.

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- (ii) Use the first law of thermodynamics to determine the specific heat capacity of the gas.

specific heat capacity = J kg⁻¹ K⁻¹ [4]

- (c) The container in (b) is now replaced with one that has a fixed volume. Thermal energy is supplied to the gas to increase its temperature from 280K to 460K.

Suggest, with a reason, how the specific heat capacity of the gas would now compare with the value in (b)(ii).

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[2]

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[Turn over