

- 2 (a) One mole of hydrogen at a temperature of 420 K is mixed with one mole of oxygen at 320 K. After a short period of time the mixture is in *thermal equilibrium*. tension  $T_2 = \dots\dots\dots$  N [2]

(i) Explain what is meant by *thermal equilibrium*.

$\dots\dots\dots$  [1]

(ii) The kinetic theory of gases leads to the derivation of the equation

$$pV = \frac{1}{3} Nm \langle c^2 \rangle .$$

Using the formula above and the ideal gas equation, derive an expression for the mean kinetic energy of an ideal gas molecule in terms of the Boltzmann constant,  $k$ , and the temperature  $T$ .

[2]

(iii) Hence determine the average kinetic energy of a hydrogen molecule *before* the two gases are mixed.

- kinetic energy = .....J [1]
- (b) (i) Two different gases at the same temperature have molecules with different mean square speeds. Explain why this is so.

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- (ii) Explain why in the earth's atmosphere, there is hardly any hydrogen, compared to oxygen molecules.

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