

- 4 (a) (i) State what is meant by the *internal energy* of a system.  
    )

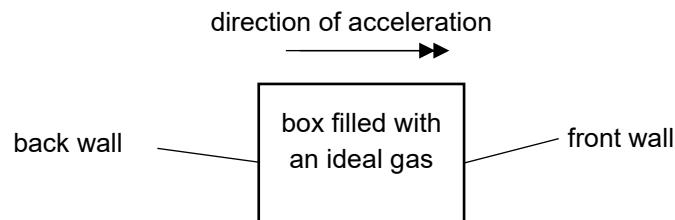
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..... [1]

[1]

- (ii) Explain why, for an ideal gas, the change in internal energy is directly proportional to the change in thermodynamic temperature of the gas.

[3]

- (iii) A box, filled with an ideal gas, is rapidly accelerated horizontally from rest.  
}



**Fig. 4.1**

Suggest, with a reason, how the internal energy of the gas would vary from the back wall to the front wall of the box during the acceleration.

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[2]

- (b) A cylinder of volume  $1.8 \times 10^4 \text{ cm}^3$  contains helium gas at pressure  $6.4 \times 10^6 \text{ Pa}$  and temperature  $25^\circ\text{C}$ . The root-mean-square speed of the helium gas atoms is  $336 \text{ m s}^{-1}$ . Helium gas may be considered to be an ideal monatomic gas.

(i) Calculate the number of helium atoms in the cylinder.

number = ..... [2]

(ii) Calculate the density of helium atoms in the cylinder.

density = .....  $\text{kg m}^{-3}$  [2]

