Chapter 13
Multiple choice and quick questions

1. A molecule of mass *m* travelling horizontally at velocity + *u* hits a vertical wall and rebounds along the original path at the same speed.

   Which one of **A** to **E** below is the change in the momentum of the molecule?

   A $-mu^2$ **B** $-mu$ **C** zero **D** mu **E** $2mu$

2. Which one of **A** to **E** below is the change in the kinetic energy of the molecule in an elastic collision?

   A $-mu^2$ **B** $-1/2mu^2$ **C** zero **D** $1/2mu^2$ **E** mu^2

3. A sample of the gas Argon is in a sealed container. Only one isotope of the gas is in the sample.
   Which of the following statements about the molecules of the gas is/are correct?

   1. The temperature of the gas is proportional to the mean square velocity of the molecules.
   2. All the molecules have the same mass.
   3. The forces between the gas molecules are negligible except during collisions.

   A 1, 2 and 3 **B** 1 and 2 only **C** 2 and 3 only **D** 1 only

4. An inflated car tyre has a slow puncture. The air is escaping so slowly that the temperature of the tyre remains constant.

   Which one of the quantities **A** to **E** is **NOT** decreasing?

   A the pressure of the air in the tyre

   B the density of the air in the tyre

   C the number of air molecules per unit volume in the tyre

   D the number of air molecule collisions per second with the inside wall of the tyre

   E the root mean square speed of the air molecules in the tyre

5. A car of total mass 1.0 tonne travelling at 30 ms^{-1} has 4 disc brakes.
   Each disc is made of material of specific heat capacity 450 $Jkg^{-1}K^{-1}$ and has a mass of 6.0 kg.
   Assume that all of the car's kinetic energy is converted to internal energy in the discs when its brakes stop the car.
   Which one of **A** to **E** below is the rise in temperature, in K, of the discs?

   A 1.5×10^{-3} **B** 2.4×10^{-2} **C** 4.2×10^{-2} **D** 42 E: 170

6. A sealed container holds a mixture of argon and bromine gas in thermal equilibrium at 300K. The mass of a bromine molecule is four times that of an argon molecule. The root mean square speed of the argon molecules is v.
Which one of A to E is the root mean square of the bromine molecules?

A $v/4$ **B** $v/2$ **C** v **D** $3v/4$ **E** $4v$

7. The container is now heated to 400K. Which one of **A** to **E** is the new root mean square speed of the argon molecules?

A $4/3\sqrt{v}$ **B** $v\sqrt{3/4}$ **C** $v\sqrt{4/3}$ **D** $4v/3$ **E** $16v/9$

8. Which one of the following properties of an ideal gas is/are the same when a box of the gas is taken to the Moon from the Earth if the temperature, pressure and volume of the gas are unchanged?

1. the mass of a molecule of the gas
2. the average momentum change when a mole cule of the gas rebounds from the wall of the container
3. the average kinetic energy of a molecule of the gas

A 1 only **B** 2 only **C** 1 and 3 only **D** 2 and 3 only **E** 1, 2 and 3

9. This question is about experiments with boiling water.
A 3000W electric kettle with boiling water in it has a mass of 1.487 kg. After it has been left boiling for 2.00 minutes, its mass drops to 1.343 kg.

(i) Us these results to calculate the energy required to vaporise 1.00 mole of water. (Molar mass of water = 0.0180 kg).

(ii) The accepted value for this energy is 4.07×10^4 J. Suggest why the data Above gave a different result.

10. This question is about gases under pressure.
One mole of helium gas is in a sealed container at 300 K and at a pressure of 2.0×10^5 Pa. The gas is slowly compressed to one third of its original volume without a temperature change. It behaves as an ideal gas.

(a) Calculate the new pressure of the gas.

(b) Calculate the root mean square speed c_{rms} of the molecules at this temperature. (Molar mass of helium = 4g mol^{-1}).

11. The kinetic theory of gases has led to the equation $pV = 1/3\ Nmv^2$.

From this equation it is possible to calculate the average speed of gas molecules. For air at room temperature this is about 500 m/s; for bromine at room temperature it is about 200 m/s.

(a) (i) What will happen to the temperature of gas in a cylinder if energy is supplied to it?
(ii)What would you expect to happen to the average speed of the gas molecules in this case? Explain.

(b) Explain in terms of energy, why bromine molecules travel more slowly than air molecules at the same temperature.

(c) What is the total distance travelled by an average bromine molecule in 500 seconds?