

Name of the Student: _____

Max. Marks : 21 Marks

Time : 21 Minutes

Q1.

- (a) In the kinetic theory model, it is assumed that there are many identical particles moving at random.

State **two** other assumptions made in deriving the equation $pV = \frac{1}{3}Nm (c_{\text{rms}})^2$.

1 _____

2 _____

(2)

- (b) Explain why molecules of a gas exert a force on the walls of a container.
Refer to Newton's laws of motion in your answer.

(3)

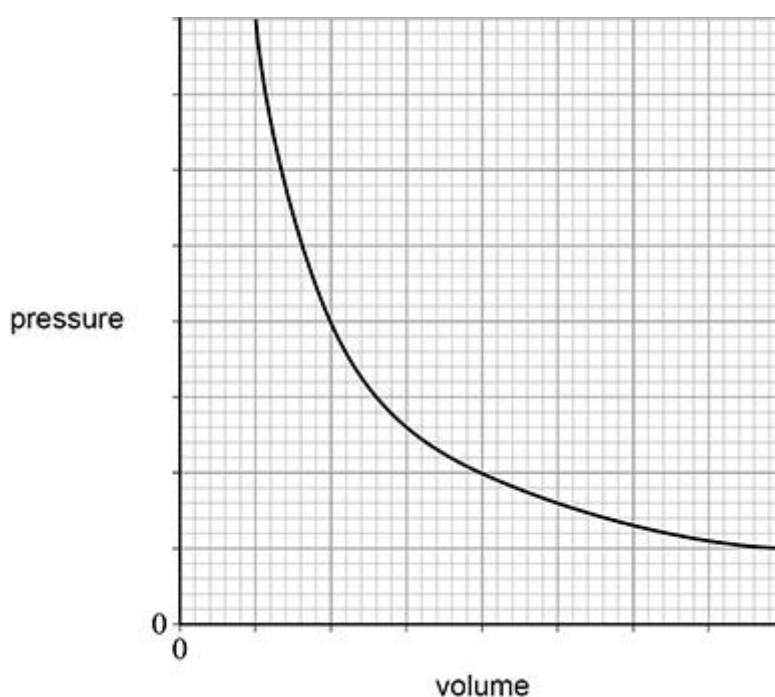
- (c) A sealed flask of volume 0.35 m^3 contains an ideal gas at a pressure of 220 kPa.
The mean kinetic energy of the gas molecules is $6.7 \times 10^{-21} \text{ J}$.

Calculate the amount of gas in the container.

amount of gas = _____ mol
(3)

- (d) The figure below shows the variation of pressure with volume for a fixed mass of an ideal gas at constant absolute temperature T .

Draw, on the figure below, the graph for the same gas at temperature $2T$.



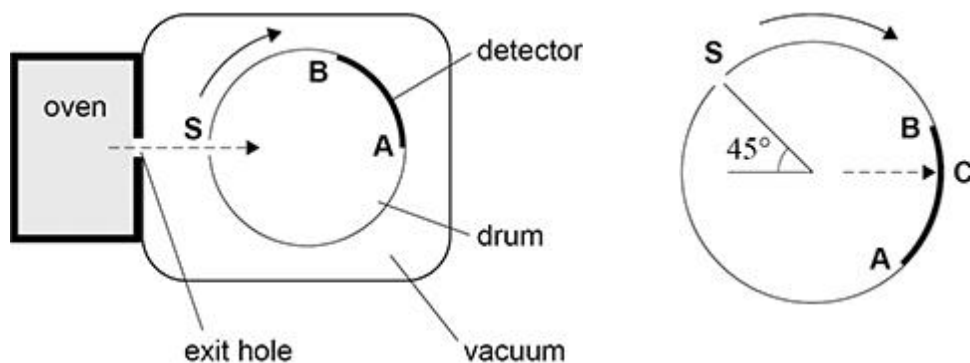
(2)
(Total 10 marks)

Q2.

Figure 1 and **Figure 2** show apparatus used in an experiment to confirm the distribution of atom speeds in a gas at a particular temperature.

Figure 1

Figure 2



The oven contains an ideal gas kept at a constant temperature. Atoms of the gas emerge from the oven and some pass through the narrow slit **S** in a rapidly rotating drum. The drum is in a vacuum.

- (a) Explain why the drum must be in a vacuum.

(1)

One atom leaves the oven, enters the drum through **S** and travels in a straight line across the drum. In the time taken for the atom to move from **S** to the detector **AB**, the drum rotates through 45° . The atom hits the detector at point **C**, as shown in **Figure 2**.

drum diameter = distance from **S** to **A** = 0.500 m
 drum rotational speed = 120 revolutions per second

- (b) Show that the atom is moving at a speed of about 500 m s^{-1} .

(2)

- (c) The speed of the atom in part (b) is equal to c_{rms} , the root mean square speed of the atoms of the gas in the oven.
 The molar mass of the gas is $0.209 \text{ kg mol}^{-1}$.

Calculate the temperature of the gas in the oven.

temperature = _____ K
(3)

- (d) The oven temperature is kept constant during the experiment but the pressure in the oven decreases as atoms leave through the exit hole.

Explain, using the kinetic theory, why the pressure decreases.

(2)

- (e) The pressure of gas in the oven is initially 5.0×10^4 Pa.
The volume of the oven is $2.7 \times 10^{-2} \text{ m}^3$.
During the experiment the pressure in the oven decreases to 4.5×10^4 Pa.

Calculate, in mol, the amount of gas that has emerged from the oven.

amount of gas = _____ mol
(1)

- (f) Atoms enter the drum every time **S** passes the exit hole. The detector darkens at the point where an atom strikes it.
After a time, the detector is removed from the drum.
Figure 3 shows the appearance of the detector.

Figure 3



A new detector is placed in the drum and the experiment is repeated with a new sample of the

same gas at a higher temperature.

Describe and explain the appearance of this detector when the experiment is repeated.

(2)

(Total 11 marks)