Question 4

A student is doing experiments with CO₂(g). Originally, a sample of the gas is in a rigid container at 299 K and 0.70 atm. The student increases the temperature of the CO₂(g) in the container to 425 K.

(a) Describe the effect of raising the temperature on the motion of the CO₂(g) molecules.

| The average speed of the molecules increases as temperature increases. | 1 point is earned for the correct answer. |

(b) Calculate the pressure of the CO₂(g) in the container at 425 K.

| Both the volume and the number of molecules are constant, therefore \( \frac{P_1}{T_1} = \frac{P_2}{T_2} \implies \frac{0.70 \text{ atm}}{299 \text{ K}} = \frac{P_2}{425 \text{ K}} \implies P_2 = 0.99 \text{ atm} \) | 1 point is earned for the correct answer. |

(c) In terms of kinetic molecular theory, briefly explain why the pressure of the CO₂(g) in the container changes as it is heated to 425 K.

| Faster-moving gas particles collide more frequently with the walls of the container, thus increasing the pressure. OR Faster-moving gas particles collide more forcefully with the walls of the container, thus increasing the pressure. | 1 point is earned for a correct explanation. |

(d) The student measures the actual pressure of the CO₂(g) in the container at 425 K and observes that it is less than the pressure predicted by the ideal gas law. Explain this observation.

| The attractive forces between CO₂ molecules result in a pressure that is lower than that predicted by the ideal gas law. | 1 point is earned for a correct explanation. |