Name:_____ Class Period:_____

**AP Chemistry 2019 Free Response Question #4**

A student is doing experiments with $CO_2(g)$. 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 $CO_2(g)$ in the container to 425 K.

(a) Describe the effect of raising the temperature on the motion of the $CO_2(g)$ molecules.

(b) Calculate the pressure of the $CO_2(g)$ in the container at 425 K.

(c) In terms of kinetic molecular theory, briefly explain why the pressure of the $CO_2(g)$ in the container changes as it is heated to 425 K.

(d) The student measures the actual pressure of the $CO_2(g)$ in the container at 425 K and observes that it is less than the pressure predicted by the ideal gas law. Explain this observation.

**AP Chemistry 2019 Scoring Guidelines: Question #4**

A student is doing experiments with $CO_2(g)$. 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 $CO_2(g)$ in the container to 425 K.

(a) Describe the effect of raising the temperature on the motion of the $CO_2(g)$ molecules.

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

(b) Calculate the pressure of the $CO_2(g)$ in the container at 425 K.

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

(c) In terms of kinetic molecular theory, briefly explain why the pressure of the $CO_2(g)$ in the container changes as it is heated to 425 K.

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| Faster-moving gas particles collide more frequently with the walls of the container, thus increasing the pressure.<br>OR<br>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 $CO_2(g)$ 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 $CO_2$ molecules result in a pressure that is lower than that predicted by the ideal gas law. | 1 point is earned for a correct explanation. |