

## Question 7: Short Answer

4 points

(a) For the correct calculated value: 1 point

Accept one of the following:

$$\bullet \quad 0.325 \text{ mol O}_2 \times \frac{32.00 \text{ g O}_2}{1 \text{ mol O}_2} = 10.4 \text{ g O}_2$$

$$D = \frac{m}{V} = \frac{10.4 \text{ g}}{7.95 \text{ L}} = 1.31 \text{ g/L}$$

$$\bullet \quad D = \frac{m}{V} = \frac{P(MM)}{RT} = \frac{(1.0 \text{ atm})(32.00 \text{ g/mol})}{(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(298 \text{ K})} = 1.31 \text{ g/L}$$

(b) For the correct answer and a valid justification: 1 point

Accept one of the following:

- *No, the density of the gas remains constant because P, R, and T remain constant AND the mass and volume of O<sub>2</sub> decrease proportionately.*
- *A mathematical justification is shown below.*

$$D = \frac{m}{V} = \frac{n \text{ moles of O}_2 \times \text{molar mass of O}_2}{\frac{nRT}{P}} = \frac{P \times (\text{molar mass of O}_2)}{RT}$$

(c) For a valid explanation: 1 point

Accept one of the following:

- *As the gas cools, the average kinetic energy (speed) of the O<sub>2</sub> molecules decreases. The molecules rebound with less energy when they collide with each other and the walls of the container. The spacing between particles decreases, causing the volume occupied by the gas to decrease.*
- *As the gas cools, the average kinetic energy (speed) of the O<sub>2</sub> molecules decreases. The molecules rebound with less energy when they collide with each other and the walls of the container. The only way for the molecules to maintain a constant rate of collisions with the walls of the container (maintaining a pressure of 1.00 atm) is for the volume of the gas to decrease.*

(d) For a valid explanation: 1 point

*The ideal gas law assumes that gas particles do not experience interparticle attractions. As a real gas cools further, the intermolecular forces have greater effect as the average speed of the molecules decreases, resulting in inelastic collisions. To maintain a gas pressure of 1.00 atm, the volume must decrease to accommodate more collisions with less energy.*

Total for question 7 4 points