

Ch. 13.1 & 14 Extra Review Problems **Answer Key**

1. Pressure

What is the height of a column of Hg that would be supported by a pressure of 110.8 kPa?

Note that this is essentially asking what the pressure would be in mmHg (on a barometer):

$$? \text{ mm Hg} = 110.8 \text{ kPa} \times \frac{760 \text{ mm Hg}}{101.3 \text{ kPa}} = \boxed{831.3 \text{ mm Hg}}$$

2. Partial Pressure

If the total pressure of a gas mixture (N<sub>2</sub>, O<sub>2</sub> & He) is 1.23 atm, and the pressure of N<sub>2</sub> is 0.34 atm and O<sub>2</sub> is 0.77 atm, what is the pressure of He?

$$P_{\text{He}} = 1.23 \text{ atm} - (0.34 \text{ atm} + 0.77 \text{ atm}) \\ = \boxed{0.12 \text{ atm}}$$

3. Boyle's Law

A sample of neon gas occupies a volume of 2.8 L at 1.8 atm. What will its volume be at 1.2 atm?

$$P_1V_1 = P_2V_2; (1.8 \text{ atm})(2.8 \text{ L}) = (1.2 \text{ atm})V_2; V_2 = \frac{(1.8 \text{ atm})(2.8 \text{ L})}{1.2 \text{ atm}} = \boxed{4.2 \text{ L}}$$

4. Charles's Law

A balloon full of air has a volume of 2.75 L at 18.0°C. What is its volume at 45.0°C?

$$T_1 = 18.0^\circ\text{C} + 273 = 291 \text{ K}; T_2 = 45.0^\circ\text{C} + 273 = 318 \text{ K}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}; \frac{2.75 \text{ L}}{291 \text{ K}} = \frac{V_2}{318 \text{ K}}; V_2 = \frac{(2.75 \text{ L})(318 \text{ K})}{291 \text{ K}} = \boxed{3.01 \text{ L}}$$

5. Gay-Lussac's Law

A cylinder of He gas has a pressure of 4.40 atm at 25.0°C. At what temperature, in °C, will it reach a pressure of 6.50 atm?

$$T_1 = 25.0^\circ\text{C} + 273 = 298 \text{ K}$$

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}; \frac{4.40 \text{ atm}}{298 \text{ K}} = \frac{6.50 \text{ atm}}{T_2}; T_2 = \frac{(298 \text{ K})(6.50 \text{ atm})}{4.40 \text{ atm}} = 440 \text{ K} - 273 = 167^\circ\text{C}$$

6. Combined Gas Law

A sample of H<sub>2</sub> gas has a volume of 65.0 mL at 0.992 atm and 16.0°C. What is its volume at 0.984 atm and 25.0°C?

$$T_1 = 16.0^\circ\text{C} + 273 = 289 \text{ K}; T_2 = 25.0^\circ\text{C} + 273 = 298 \text{ K};$$

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}; \frac{(0.992 \text{ atm})(65.0 \text{ mL})}{289 \text{ K}} = \frac{(0.984 \text{ atm})V_2}{298 \text{ K}}; V_2 = \frac{(0.992 \text{ atm})(65.0 \text{ mL})(298 \text{ K})}{(0.984 \text{ atm})(289 \text{ K})} = \boxed{67.6 \text{ mL}}$$

7. Avogadro's Principle

What is the volume of 45.8 g of Kr at STP?

$$? \text{ L Kr} = 45.8 \text{ g Kr} \times \frac{1 \text{ mol Kr}}{83.8 \text{ g Kr}} \times \frac{22.4 \text{ L}}{1 \text{ mol}} = \boxed{12.2 \text{ L Kr}}$$

8. Ideal Gas Law

What is the pressure, in kPa, of 5.00 mol CO in a 20.0 L cylinder at 0.00°C?

$$T = 0.00^\circ\text{C} + 273 = 273 \text{ K}; P = \frac{nRT}{V} = \frac{(5.00 \text{ mol})(0.0821 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}})(273 \text{ K})}{20.0 \text{ L}} = 5.60 \text{ atm};$$

$$P = 5.60 \text{ atm} \times \frac{101.3 \text{ kPa}}{1 \text{ atm}} = \boxed{568 \text{ kPa}}$$

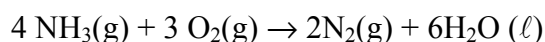
### 9. Molar Mass Calculations

What is the molar mass of a gas if 6.45 g of the gas in a 20.0 L cylinder has a pressure of 0.241 atm at 0.00°C?

$$n = \frac{PV}{RT} = \frac{(0.241 \text{ atm})(20.0 \text{ L})}{(0.0821 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}})(273 \text{ K})} = 0.215 \text{ mol}; \text{ MM} = \frac{6.45 \text{ g}}{0.215 \text{ mol}} = \boxed{30.0 \text{ g/mol}} \quad \text{-OR-}$$

$$\text{PM} = DRT; \text{ M} = \frac{DRT}{P} = \frac{\left(\frac{6.45 \text{ g}}{20.0 \text{ L}}\right)(0.0821 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}})(273 \text{ K})}{0.241 \text{ atm}} = \boxed{30.0 \text{ g/mol}}$$

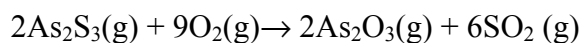
### 10. Volume-Volume Calculations



If 1.78 L of O<sub>2</sub> reacts, what volume of nitrogen can be produced at the same T & P?

$$? \text{ L N}_2 = 1.78 \text{ L of O}_2 \times \frac{2 \text{ N}_2}{3 \text{ O}_2} = \boxed{1.19 \text{ L N}_2}$$

### 11. Mass-Volume Calculations



If 89.5 g of As<sub>2</sub>S<sub>3</sub> reacts with excess O<sub>2</sub>, what volume of SO<sub>2</sub> can be produced at STP?

$$\text{MM As}_2\text{S}_3 = 2(74.92 \text{ g}) + 3(32.07 \text{ g}) = 246.05 \text{ g}$$

$$? \text{ L SO}_2 = 89.5 \text{ g As}_2\text{S}_3 \times \frac{1 \text{ mol As}_2\text{S}_3}{246.05 \text{ g As}_2\text{S}_3} \times \frac{6 \text{ mol SO}_2}{2 \text{ mol As}_2\text{S}_3} \times \frac{22.4 \text{ L SO}_2}{1 \text{ mol SO}_2} = \boxed{24.4 \text{ L SO}_2}$$