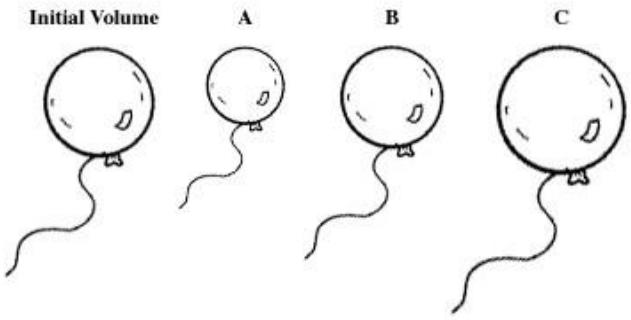
REVIEW QUESTIONS
Chapter 7

Gas Laws:

1. Indicate which diagram represents the volume of the gas sample in a balloon when each of the following changes takes place:



A) The temperature increases at constant pressure: **C** **(Charles's Law)**

B) The pressure increases at constant temperature: **A** **(Boyle's Law)**

C) Both the pressure and the absolute temperature are doubled: **B**

2. The pressure of a sample of gas with a volume of 125 mL is decreased from 2.50 atm to 1.50 atm. What is the new volume?

$$V_2 = V_1 \times \frac{P_1}{P_2} = 125\ \text{mL} \times \frac{2.50\ \text{atm}}{1.50\ \text{atm}} = 208\ \text{mL}$$

3. A sample of nitrogen gas with a volume of 10.0 L has a temperature of –78.0°C. What is the volume of this gas at 25.0°C at constant pressure?

$$V_2 = V_1 \times \frac{T_2}{T_1} = 10.0\ \text{L} \times \frac{298\ \text{K}}{195\ \text{K}} = 15.3\ \text{L}$$

4. The pressure of 1.50 L of a gas is doubled and its absolute temperature is increased 3 times. What will the final volume of the gas be?

$$V_2 = V_1 \times \frac{P_1}{P_2} \times \frac{T_2}{T_1} = 1.50\ L \times \frac{1}{2} \times \frac{3}{1} = 2.25\ L$$

5. The volume of air in a person's lungs is 615 mL at a pressure of 760 mmHg. When inhalation occurs, the pressure in the lungs drops to 752 mmHg. To what volume did the lungs expand during inhalation?

$$V_2 = V_1 \times \frac{P_1}{P_2} = 615\ mL \times \frac{760\ mmHg}{752\ mmHg} = 622\ mL$$

6. A gas in an aerosol container has a pressure of 1.40 atm at 12°C. What is the pressure in the container if the temperature increases to 35°C?

$$P_2 = P_1 \times \frac{T_2}{T_1} = 1.40\ atm \times \frac{308\ K}{285\ K} = 1.51\ atm$$

7. A scuba diver 40 ft below the ocean surface inhales 50.0 mL of compressed air in a scuba tank at a pressure of 3.00 atm at a temperature of 8.0°C. What is the pressure of the air in the lungs if the gas expands to 150.0 mL at a body temperature of 37°C?

$$P_2 = P_1 \times \frac{V_1}{V_2} \times \frac{T_2}{T_1} = 3.00\ atm \times \frac{50.0\ mL}{150.0\ mL} \times \frac{310\ K}{281\ K} = 1.10\ atm$$

STP & Molar Volume:

8. A gas has a volume of 125 mL at 630 mmHg and 27°C. What will the volume be at STP?

$$V_2 = V_1 \times \frac{P_1}{P_2} \times \frac{T_2}{T_1} = 125 \text{ mL} \times \frac{630 \text{ mmHg}}{760 \text{ mmHg}} \times \frac{273 \text{ K}}{300 \text{ K}} = 94.3 \text{ mL}$$

9. What volume will 30.0 g of methane gas (CH_4) occupy at STP?

$$\text{mol solute} = 30.0 \text{ g} \times \frac{1 \text{ mol}}{16.04 \text{ g}} = 1.87 \text{ mol}$$

$$1.87 \text{ mol} \times \frac{22.4 \text{ L}}{1 \text{ mol}} = 41.9 \text{ L}$$

10. Calculate the number of moles of CO_2 in 4.00 L of CO_2 gas at STP.

$$4.00 \text{ L} \times \frac{1 \text{ mol}}{22.4 \text{ L}} = 0.179 \text{ mol}$$

11. Calculate the volume (mL) occupied by 50.0 g of neon gas at STP.

$$50.0 \text{ g} \times \frac{1 \text{ mol}}{20.18 \text{ g}} \times \frac{22.4 \text{ L}}{1 \text{ mol}} \times \frac{10^3 \text{ mL}}{1 \text{ L}} = 5.55 \times 10^4 \text{ mL}$$

12. How many grams of aluminum will react with 12.0 L of oxygen at STP as shown below:

$$4\ Al\ (s)\ +\ 3\ O_2\ (g)\ \rightarrow\ 2\ Al_2O_3\ (s)$$

$$\mathbf{12.0\ L\ O_2\ x\ \frac{1\ mol\ O_2}{22.4\ L}\ x\ \frac{4\ mol\ Al}{3\ mol\ O_2}\ x\ \frac{27.0\ g}{1\ ,ol} = 19.3\ g\ Al}$$

13. What is the molar mass of a gas if 1.15 g of the gas has a volume of 225 mL at STP?

$$\mathbf{225\ mL\ x\ \frac{1\ L}{10^3\ mL}\ x\ \frac{1\ mol}{22.4\ L} = 0.0100\ mol}$$

$$\mathbf{molar\ mass = \frac{1.15\ g}{0.0100\ mol} = 115\ g/mol}$$

14. How many liters of oxygen gas are required to completely react with 12.0 L of propane at constant temperature and pressure, as shown below:

$$C_3H_8\ (g)\ +\ 5\ O_2\ (g) \rightarrow\ 3\ CO_2\ (g) +\ 4\ H_2O\ (g)$$

$$\mathbf{12.0\ L\ C_3H_8\ x\ \frac{5\ L\ O_2}{1\ L\ C_3H_8} = 60.0\ L\ O_2}$$

Ideal Gas Law:

15. What volume is occupied by 15.0 g of HCl gas at 715 mmHg and 90°C?

$$\text{mol HCl} = 15.0\text{ g} \times \frac{1\text{ mol}}{36.46\text{ g}} = 0.411\text{ mol}$$

$$\text{Volume} = 715\text{ mmHg} \times \frac{1\text{ atm}}{760\text{ mmHg}} = 0.941\text{ atm}$$

$$\text{Temp.} = 273+90 = 363\text{ K}$$

$$V = \frac{nRT}{P} = \frac{(0.411\text{ mol})(0.0821\frac{\text{L atm}}{\text{mol K}})(363\text{ K})}{0.941\text{ atm}} = 13.0\text{ L}$$

16. A 10.0-g sample of krypton has a temperature of 25°C at 575 mmHg. What is the volume (mL) of this gas at these conditions?

$$n = 10.0\text{ g} \times \frac{1\text{ mol}}{83.8\text{ g}} = 0.119\text{ mol}$$

$$V = \frac{nRT}{P} = \frac{(0.119\text{ mol})(0.0821\frac{\text{L atm}}{\text{mol K}})(298\text{ K})}{\frac{575}{760}\text{ atm}} = 3.85\text{ L} = 3850\text{ mL}$$

17. A sample of gas occupies 855 mL at 1.20 atm and 18°C. How many moles of gas are present in this sample?

$$n = \frac{PV}{RT} = \frac{(1.20\text{ atm})(0.855\text{ L})}{(0.0821\text{ Latm/molK})(291\text{ K})} = 0.0430\text{ mol}$$

18. A steel cylinder with a volume of 15.0 L is filled with 50.0 g of nitrogen gas at 25°C. What is the pressure of the nitrogen gas in the cylinder?

$$n = 50.0\text{ g} \times \frac{1\text{ mol}}{28.0\text{ g}} = 1.786\text{ mol}$$

$$P = \frac{nRT}{V} = \frac{(1.786\text{ mol})(0.0821\frac{\text{L atm}}{\text{mol K}})(298\text{ K})}{15.0\text{ L}} = 2.91\text{ atm}$$

Partial Pressure:

19. An anesthetic consists of a mixture of cyclopropane gas (C_3H_6) and oxygen gas. If the mixture has a total pressure of 1.09 atm, and the partial pressure of the cyclopropane is 73 mmHg, what is the partial pressure of the oxygen in mmHg?

$$P_{total} = P_{C_3H_6} + P_{O_2}$$

$$P_{total} \text{ (in mmHg)} = 1.09 \text{ atm} \times \frac{760 \text{ mmHg}}{1 \text{ atm}} = 828 \text{ mmHg}$$

$$P_{O_2} = P_{total} - P_{C_3H_6} = 828 \text{ mmHg} - 73 \text{ mmHg} = 755 \text{ mmHg}$$

20. A gas mixture consists of nitrogen (425 torr), oxygen (115 torr) and helium (225 torr). What is the total pressure of this mixture in torrs?

$$P_{total} = P_1 + P_2 + P_3 = 425 \text{ torr} + 115 \text{ torr} + 225 \text{ torr} = 765 \text{ torr}$$

21. A gas mixture contains helium and argon gases with a total pressure of 1.20 atm. If there is twice as much helium in the mixture as argon, what is the partial pressure of each gas in the mixture?

$$P_{total} = P_{He} + P_{Ar}$$

$$P_{He} = 2\ P_{Ar}$$

$$P_{He} = 2/3\ P_{total} = 2/3\ (1.20 \text{ atm}) = 0.80 \text{ atm}$$

$$P_{Ar} = 1/3\ P_{total} = 1/3\ (1.20 \text{ atm}) = 0.40 \text{ atm}$$