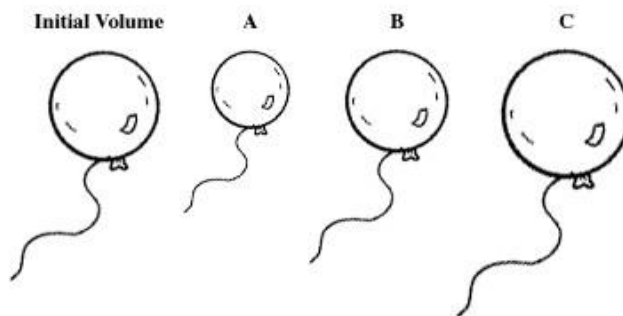


REVIEW QUESTIONS

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?

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

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?

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

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?

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

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?

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

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 (CH₄) occupy at STP?

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

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

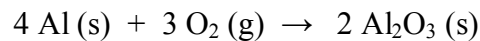
10. Calculate the number of moles of CO₂ in 4.00 L of CO₂ gas at STP.

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

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:



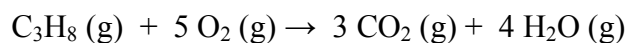
$$12.0 \text{ L O}_2 \times \frac{1 \text{ mol O}_2}{22.4 \text{ L}} \times \frac{4 \text{ mol Al}}{3 \text{ mol O}_2} \times \frac{27.0 \text{ g}}{1 \text{ mol}} = 19.3 \text{ g Al}$$

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

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

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

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:



$$12.0 \text{ L C}_3\text{H}_8 \times \frac{5 \text{ L O}_2}{1 \text{ L C}_3\text{H}_8} = 60.0 \text{ L O}_2$$

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?

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

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

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

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?

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

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?

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

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

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

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