Chemistry – Chapter 14 Study Guide

KEY

1. Describe the general properties of gases.
repel each other, no definite shape or volume
2. What 3 factors affect gas pressure?
temperature, volume + # of moles
3. Know the SI unit for pressure and force. Be able to convert between units of pressure (mmHg, kPa and atm)

a. 1 atm = 760 mmHg = 101.3 kPa

4. Know what STP means and what values are assigned with STP.
Standard Temp + Pressure → 273 K and 1 atm
5. When dealing with temperature and gas law you must always convert Celsius to Kelvin
Know the conversion to do so. $K = °C + 273$

$P_1V_1 = P_2V_2$

6. State Boyle's Law. Use it to solve problems involving pressure and volume. Know what variable must be held constant in Boyle's Law. For a given mass at constant temperature, the volume varies inversely w/pressure
Temp. held constant

a. If 2.5L of a gas at 110.0kPa is expanded to 4.0L at constant temperature and pressure, what is the new pressure?

$$\frac{2.5L \times 110\,kPa}{4.0L} = P_2$$

b. If 650 mL of hydrogen is stored in a cylinder with a moveable piston at 225kPa and the pressure is increased to 545kPa at constant temperature, what is the new volume?

$$\frac{650mL \times 225kPa}{545kPa} = V_2$$

$\frac{V_1}{T_1} = \frac{V_2}{T_2}$

7. State Charles' Law. Use it to solve problems involving temperature and volume. Know what variable is held constant in Charles' Law. The volume of a gas is directly proportional to temp if pressure is kept constant

a. A balloon filled with a volume of 15.5L is inflated in a room at 20.0°C and then taken outside where the temperature is 7.0°C, what will be the new volume of the balloon if the pressure remains constant?

$$280K \times \frac{15.5L}{293K} = V_2$$

b. The volume of gas in a syringe is 15.0mL at 23.5°C. What will the volume of the gas be at 72.5°C if the pressure is held constant?

$\frac{273}{345.5}$ $\frac{15.0mL}{296.5K} \times 345.5K = V_2$

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$

8. State Gay Lussac's Law. Use it to solve problems involving pressure and temperature. Know what variable is held constant in Gay Lussac's Law. The pressure of a gas is directly proportional to the temperature if the volume remains constant

Gay Lussac's Law continued...practice problems

a. The pressure in a tire is 101kPa at 10.0°C, what will the pressure of the tire be at 45.0°C?

$\frac{101\ kPa}{283K} \times 318K = P_2$

b. The pressure in a bottle of soda pop is 505kPa at 20.0°C. What is the new pressure if someone warms the sealed bottle to 65.0°C?

$\frac{505\ kPa}{293K} \times 338K = P_2$

9. State the Combined Gas Law. Use it to solve problems involving pressure, temperature and volume. Combines all 3 gas laws - nothing held constant

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

a. Calculate the final pressure of a gas initially at 122kPa pressure that is expanded from 4.50L at 56°C to 18.0L at 124°C.

$\frac{122kPa \times 4.5L}{329K} \times 18.0L \times 397K = P_2$

b. A weather balloon has a volume of 3.5kL at 1.01atm and 18°C. What is the balloon's volume at a pressure of 0.420atm and -18°C?

$\frac{1.01\ atm \times 3.5kL}{291K} \times 255K \div 0.42atm = V_2$

10. What is the ideal gas law? Be able to solve problems using it.

$PV=nRT$ includes all 4 variables (including moles)

where... $R = 8.31 \frac{L \cdot kPa}{K \cdot mol}$

a. How many moles of gas are in a balloon that has a volume of 15.9L at a pressure of 149kPa and a temperature of 28°C?

$n = \frac{149kPa \times 15.9L}{8.31 \times 301K}$

b. How many moles of ammonia, NH_3, is required to fill a 14.88L bottle to a pressure of 199kPa at 25°C?

$n = \frac{199kPa \times 14.88L}{8.31 \times 298K}$

c. What is the volume of 4.35 moles of a gas at a pressure of 85.6kPa and 26.0°C?

$V = \frac{4.35\ mol \times 8.31 \times 299K}{85.6kPa}$

10. Explain diffusion and effusion.

Diffusion - a gas spreading from high to low concentration areas

Effusion - a gas seeping out of a small opening

12. What is Graham's Law of diffusion? Explain why Helium would effuse faster than Nitrogen at the same temperature.

↓ Lower molar masses move at higher velocities. Helium is lighter than N_2

13. What is partial pressure? Explain Dalton's Law of Partial Pressure.

↳ You can add all pressures to get the P_{total}.

↓ The contribution each gas in a mixture makes to the total pressure. $P_{total} = P_1 + P_2 + P_3 + \ldots$