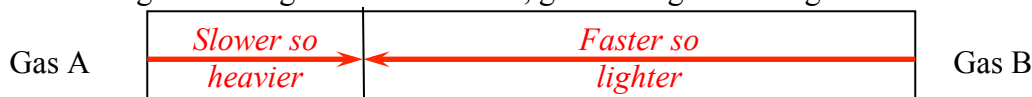


Refer to p. 351-355 in your Modern Chemistry Textbook by Holt for help on this worksheet.

**PART I: Concepts of Temperature, Kinetic Energy and Effusion**

**True or False:** Note--Temperature is a measure of the average kinetic energy of all molecules.

- F 1) When at the same temperature, all O<sub>2</sub> gas molecules move at the same speed.  
T 2) When at the same temperature, lighter molecules move, on average, faster than heavier molecules.  
F 3) According to the diagram shown below, gas A is lighter than gas B.



Products of  
Gas A + Gas B reaction.

$$\frac{v_x}{v_y} = \frac{2}{1} = \frac{\sqrt{MM_y}}{\sqrt{MM_x}} \text{ so } \sqrt{MM_x} = 2\sqrt{MM_y} \text{ and } MM_x = 4(MM_y)$$

- F 4) If Gas X effuses through a tube at twice the speed of Gas Y, then Gas Y is twice as heavy as Gas X.

**PART II: Graham's Law Calculations (Problems taken from Holt, p359 #39-42)**

$$\frac{\text{rate of effusion of Gas A}}{\text{rate of effusion of Gas B}} = \frac{\text{velocity of Gas A}}{\text{velocity of Gas B}} = \frac{\sqrt{\text{molar mass of Gas B}}}{\sqrt{\text{molar mass of Gas A}}}$$

- 5) What is the ratio of the rate of effusion of hydrogen gas (H<sub>2</sub>) to that of nitrogen gas (N<sub>2</sub>)?

$$\frac{v_{H_2}}{v_{N_2}} = \frac{\sqrt{MM_{N_2}}}{\sqrt{MM_{H_2}}} = \frac{\sqrt{28.0 \text{ g/mol}}}{\sqrt{2.0 \text{ g/mol}}} = \frac{3.72}{1} = \boxed{3.72}$$

- 6) What is the ratio of the velocity of hydrogen molecules (H<sub>2</sub>) to that of Ne atoms (Ne)?

$$\frac{v_{H_2}}{v_{Ne}} = \frac{\sqrt{MM_{Ne}}}{\sqrt{MM_{H_2}}} = \frac{\sqrt{20.2 \text{ g/mol}}}{\sqrt{2.0 \text{ g/mol}}} = \frac{3.16}{1} = \boxed{3.16}$$

- 7) At a certain temperature and pressure, chlorine molecules (Cl<sub>2</sub>) have an average velocity of 0.0380 m/s. What is the average velocity of sulfur dioxide molecules (SO<sub>2</sub>) under the same conditions?

$$\frac{v_{SO_2}}{v_{Cl_2}} = \frac{\sqrt{MM_{Cl_2}}}{\sqrt{MM_{SO_2}}} \Rightarrow \frac{v_{SO_2}}{0.0380 \text{ m/s}} = \frac{\sqrt{71.0 \text{ g/mol}}}{\sqrt{64.1 \text{ g/mol}}} = 1.052 \Rightarrow v_{SO_2} = 1.052 \times 0.0380 \text{ m/s} = \boxed{0.0400 \text{ m/s}}$$

- 8) A sample of helium (He) effuses through a porous container 6.50 times faster than does unknown Gas X. What is the molar mass of the unknown gas?

$$\frac{v_{He}}{v_X} = \frac{\sqrt{MM_X}}{\sqrt{MM_{He}}} \Rightarrow \frac{6.50}{1} = \frac{\sqrt{MM_X}}{\sqrt{4.00 \text{ g/mol}}} \Rightarrow (6.50)^2 = \frac{MM_X}{4.00 \text{ g/mol}} \text{ so } MM_X = \boxed{169 \text{ g/mol}}$$