***Chemistry***

**9: Gases**

**9.4: Effusion and Diffusion of Gases**

81. A balloon filled with helium gas is found to take 6 hours to deflate to 50% of its original volume. How long will it take for an identical balloon filled with the same volume of hydrogen gas (instead of helium) to decrease its volume by 50%?

Solution

Use the rate of effusion equation:





83. Starting with the definition of rate of effusion and Graham’s finding relating rate and molar mass, show how to derive the Graham’s law equation, relating the relative rates of effusion for two gases to their molecular masses.

Solution

Effusion can be defined as the process by which a gas escapes through a pinhole into a vacuum. Graham’s law states that with a mixture of two gases A and B:. Both A and B are in the same container at the same temperature, and therefore will have the same kinetic energy:

KEA=KEB KE = 

Therefore,







85. Which of the following gases diffuse more slowly than oxygen? F2, Ne, N2O, C2H2, NO, Cl2, H2S

Solution

Gases with molecular masses greater than that of oxygen (31.9988 g/mol) will diffuse more slowly than O2. These gases are F2 (37.9968 g/mol), N2O (44.0128 g/mol ), Cl2 (70.906 g/mol), and H2S (34.082 g/mol).

87. Calculate the relative rate of diffusion of(molar mass 2.0 g/mol) compared to that of  (molar mass 4.0 g/mol) and the relative rate of diffusion of O2 (molar mass 32 g/mol) compared to that of O3 (molar mass 48 g/mol).

Solution





89. When two cotton plugs, one moistened with ammonia and the other with hydrochloric acid, are simultaneously inserted into opposite ends of a glass tube that is 87.0 cm long, a white ring of NH4Cl forms where gaseous NH3 and gaseous HCl first come into contact. (Hint: Calculate the rates of diffusion for both NH3 and HCl, and find out how much faster NH3 diffuses than HCl.)



At approximately what distance from the ammonia‑moistened plug does this occur?

Solution

Rate of diffusion for NH3 is proportional to  = 0.242250792

Rate of diffusion for HCl is proportional to  = 0.165611949, = 1.4627.

Set up an algebraic expression, letting *x* represent the distance travelled by the HCl: *x* + 1.4627*x* = 87, *x* = 35.3, so the distance travelled by the NH3 is (1.4627)*x* = 51.7 cm.

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