2003 B

A rigid 5.00 L cylinder contains 24.5 g of $N_2(g)$ and 28.0 g of $O_2(g)$

(a) Calculate the total pressure, in atm, of the gas mixture in the cylinder at 298 K.

(b) The temperature of the gas mixture in the cylinder is decreased to 280 K. Calculate each of the following.

 (i) The mole fraction of $N_2(g)$ in the cylinder.

 (ii) The partial pressure, in atm, of $N_2(g)$ in the cylinder.

(c) If the cylinder develops a pinhole-sized leak and some of the gaseous mixture escapes, would the ratio $\dfrac{N_2(g)}{O_2(g)}$ in the cylinder increase, decrease, or remain the same? Justify your answer.

A different rigid 5.00 L cylinder contains 0.176 mol of $NO(g)$ at 298 K. A 0.176 mol sample of $O_2(g)$ is added to the cylinder, where a reaction occurs to produce $NO_2(g)$.

(d) Write the balanced equation for the reaction.

(e) Calculate the total pressure, in atm, in the cylinder at 298 K after the reaction is complete.

2001 B

Answer the following questions about acetylsalicylic acid, the active ingredient in aspirin.

(a) The amount of acetylsalicylic acid in a single aspirin tablet is 325 mg, yet the tablet has a mass of 2.00 g. Calculate the mass percent of acetylsalicylic acid in the tablet.

(b) The elements contained in acetylsalicylic acid are hydrogen, carbon, and oxygen. The combustion of 3.000 g of the pure compound yields 1.200 g of water and 3.72 L of dry carbon dioxide, measured at 750. mm Hg and 25°C. Calculate the mass, in g, of each element in the 3.000 g sample.

(c) A student dissolved 1.625 g of pure acetylsalicylic acid in distilled water and titrated the resulting solution to the equivalence point using 88.43 mL of 0.102 M NaOH(aq). Assuming that acetylsalicylic acid has only one ionizable hydrogen, calculate the molar mass of the acid.

2002 D Required

Use the principles of atomic structure and/or chemical bonding to explain each of the following. In each part, your answer must include references to both substances.

(a) The atomic radius of Li is larger than that of Be.

(b) The second ionization energy of K is greater than the second ionization energy of Ca.

(c) The carbon-to-carbon bond energy in C_2H_4 is greater than it is in C_2H_6.

(d) The boiling point of Cl_2 is lower than the boiling point of Br_2.

Extra Problem

A solution containing 0.600 mol of barium nitrate is combined with another solution containing also 0.600 mol of phosphoric acid (H_3PO_4). As soon as the solutions combine, a precipitate forms. The total volume of both solutions is 5.00 L

(a) Write the balanced equation for this precipitation reaction

(b) Determine the mass of precipitate formed

(c) Determine $[H^+]$ (concentration of H^+ ions) after the reactants are combined

(d) Determine $[NO_3^-]$ after the precipitate forms