Explaining the Properties of Gases

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

In the development of the gas laws in the previous section, it was necessary to always keep the chemical amount of the gas constant. Suppose a container with a fixed volume contains a certain chemical amount of gas. If the chemical amount of gas is doubled and the temperature kept constant, predict the change in pressure.

Calculate the volume of sulfur dioxide a chemical engineer would predict to react completely with 248 kL of hydrogen sulfide. The gases are measured at 350 °C and 250 kPa.

16 H2S(g) \_ 8 SO2(g) --> 3 S8(s) \_ 16 H2O(g)

The production of nitric acid is important to the fertilizer and explosives industries. Chemical engineers routinely use gas laws to design and control processes such as the Ostwald process.

(a) The production of nitric acid by the Ostwald process begins with the combustion of ammonia:

4 NH3(g) \_ 5 O2(g) --> 4 NO(g) \_ 6 H2O(g)

Predict the volume of oxygen required to react with 100 L of ammonia as well as the volumes of nitrogen oxide and water vapour produced. All gases are measured at 800 °C and 200 kPa.

(b) In another step of the Ostwald process, nitrogen monoxide reacts with oxygen to form nitrogen dioxide. Predict the volume of oxygen at 800 °C and 200 kPa required to produce 750 L of nitrogen dioxide at the same temperature and pressure.

(c) Nitric acid is produced by reacting nitrogen dioxide with water:

3 NO2(g) \_ H2O(l) --> 2 HNO3(aq) \_ NO(g)

Predict the volume of nitrogen monoxide produced by the reaction of 100 L of nitrogen dioxide with excess water. Both gases are measured at the same temperature and pressure as in (b).

(d) A high-nitrogen fertilizer is made by reacting ammonia gas with nitric acid to produce aqueous ammonium nitrate. Can the law of combining volumes be used to predict the volume of ammonia gas required