Gas Problems

Name _____
Last First

1. A compound contains only hydrogen and nitrogen and is 12.6% hydrogen by mass. A gaseous sample of the compound has density of 0.925 g/L at 690 torr and 110 ºC. What is the molecular formula of the compound?

Setup:

Answer_____

2. CaO(s) reacts with SO_2 (g) according to the following equation:

$CaO\ (s) + SO_2\ (g) \rightarrow CaSO_3\ (s)$

A 8.85 g mixture containing CaO(s) is placed in a 3.00-L container. The container is filled with SO_2 (g) to a pressure of 749. torr, at 20.0 ºC. After the reaction has gone to completion, the pressure inside the flask is 390. torr, also at 20.0 ºC. What is the mass of $CaSO_3$ (s) produced? Assume that only CaO(s) in the mixture reacts with SO_2 (g).

Setup:

Answer_____

3. A 4.430 g mixture containing $CaCO_3$ (s) is heated until all $CaCO_3$ (s) is decomposed completely.

$CaCO_3$ (s) → CaO (s) + CO_2 (g)

(molar mass: $CaCO_3$=100.0, CaO=56.1, CO_2= 44.0 g/mole)

The CO_2 (g) liberated from the above reaction is collected over water at 27 ºC and a total pressure of 750. torr. The volume of CO_2 (g) is 432 ml and the vapor pressure of water at 27 ºC is 26.7 torr. Calculate the percent $CaCO_3$ (s) in the mixture

Setup:

Answer_____

4. At 0.483 atm and 52 ºC, the density of gas ***X*** is 2.35 g/L. A volume of 45.0 ml of gas ***X*** effuses through an apparatus in 3.60 seconds. The rate of effusion of gas ***Y*** through the same apparatus and under the same conditions is 18.4 ml/sec. What is the molar mass of ***Y***?

Setup:

Answer _____

5. Calculate the density of a gas at STP, if a given volume of the gas effuses through an apparatus in 6.60 min and the same volume of nitrogen at the same temperature and pressure, effuses through this apparatus in 8.50 minutes.

Setup:

Answer_____

6. If 34.0 L of Cl_2O gas at 25.0 Celsius at 760.0 mm Hg decomposes to chlorine gas and oxygen gas. What is the total pressure after the reaction?

Setup:

Answer_____

7. Hydrogen gas and nitrogen gas combines to produce ammonia gas.

What is the total pressure at the end of the reaction if 3.0 grams of hydrogen gas reacts with 1.0 L of nitrogen gas at 10.0 atm at a 25.0 Celsius ?

Setup:

Answer_____

8. Consider the following reaction:

$$2\ Al(s) + 3\ S(g) \rightarrow Al_2S_3\ (s)$$

3.66 g of Al(s) is placed in a 7.46 L cylinder in an atmosphere of S(g) at 1.75 atm and a temperature of 160. ºC. Two minutes later, the pressure has dropped to 1.21 atm and the temperature had dropped to 120. ºC.

a. Calculate the mass of Al(s) left unreacted.

Answer_____

b. Calculate the mass of Al_2S_3 (s) formed.

Setup:

Answer _____

9. A chemist wants to find the empirical formula and the molecular formula of a compound that contains only carbon, hydrogen, and nitrogen. Complete combustion of 35.0 g of the compound produced 41.1 g H_2O.
A 65.2 g sample of the compound was analyzed for nitrogen, giving 35.6 L N_2 (g) at 740 torr and 25 ºC.
The effusion rate of the compound as a gas was measured and found to be 38.2 ml/min. The effusion rate of argon gas under identical conditions in 58.0 ml/min.
Find the empirical formula and the molecular formula of the compound.
Setup:

10. A compound contains only C, H, and N only. A chemist analyzes it by doing the following experiments. Complete combustion of 84.0 g of the compound converted all its carbon into 80.4 g CO_2 (g). A 156.5 g sample of the compound was analyzed for nitrogen, giving 85.44 L N_2 (g) at 740 torr and 25 ºC. Calculate the empirical formula of the compound.

Setup:

Answer_____

11. I37.0 g of solid Mercury (II) oxide decomposes to mercury metal and oxygen gas. What is the final pressure in a 4.0 L container at 35.0 Celsius?

Setup:

Answer_____

12. A 60.0 ml cylinder is filled with a mixture of an unknown element M(g) and Cl_2(g) to partial pressures of 3.07 atm and 37.2 atm respectively, and a temperature of 30.0 ºC. The cylinder is heated to a high temperature at which the binary compound, M_xCl_y is produced. The cylinder is then cooled to a temperature at which Cl_2 is a gas and the binary compound, M_xCl_y, is solid. The remaining Cl_2 gas is transferred to another 60.0 ml cylinder, where the pressure at 30.0 ºC is 28.0 atm. Assuming that the unknown element, M, has reacted completely, find the empirical formula of the binary compound, M_xCl_y.
Setup: