IBC-I/DC—Gas Stoich Wkst 2 Name: Answer key

Answer the following questions by showing ALL your work:

1. A 2.086 g sample of a compound contains 0.884 g of cobalt, 0.482 g of sulfur and 0.720 g of oxygen. What is the empirical formula for the compound?

$0.884\text{ g Co} \times \frac{1\text{ mol Co}}{58.93\text{ g Co}} = 0.0150\text{ mol Co}$

$0.482\text{ g S} \times \frac{1\text{ mol S}}{32.07\text{ g S}} = 0.0150\text{ mol S}$

$0.720\text{ g O} \times \frac{1\text{ mol O}}{16.00\text{ g}} = 0.045\text{ mol O}$

$\frac{0.045}{0.0150}$

$CoSO_3$

2. If 6.6 g of fluorine reacts with 5.6 g of chlorine to produce 8.5 g of chlorine trifluoride. What is the percent yield of this reaction?

$3F_{2(g)} + Cl_{2(g)} \rightarrow 2ClF_3$

$6.6\text{ g } F_2 \times \frac{1\text{ mol } F_2}{38.00\text{ g } F_2} \times \frac{2\text{ mol } ClF_3}{3\text{ mol } F_2} \times \frac{92.45\text{ g } ClF_3}{1\text{ mol } ClF_3} = 10.7\text{ g } ClF_3$ (theoretical)

$6.6\text{ g } F_2 \times \frac{1\text{ mol } F_2}{38.00\text{ g}} \times \frac{1\text{ mol } Cl_2}{3\text{ mol } F_2} \times \frac{70.9\text{ g } Cl_2}{1\text{ mol } Cl_2} = 4.10\text{ g } Cl_2$

less than $5.6\text{ g } Cl_2$ = excess

$\%\text{ yield} = \frac{8.5\text{ g } ClF_3}{11\text{ g } ClF_3} = 77\%$

3. A 14.5 g sample of sodium carbonate undergoes thermal decomposition in a 2.50 L container. Calculate the partial pressure of the gas produced if the temperature of the products is 68.2 °C.

$Na_2CO_{3(s)} \xrightarrow{\Delta} Na_2O_{(s)} + CO_2\uparrow$

$P = \frac{nRT}{V}$

$14.5\text{ g } Na_2CO_3 \times \frac{1\text{ mol } NaCO_3}{105.99\text{ g}} \times \frac{1\text{ mol } CO_2}{1\text{ mol } Na_2CO_3} \times \frac{0.0821\text{ L·atm}}{\text{mol·K}} \times \frac{(68.2+273.15)\text{ K}}{2.50\text{ L}} = 1.53\text{ atm } CO_2$

4. A vessel containing helium at 10.0 psi is immersed into boiling water (at normal boiling point). The vessel then is transferred into liquid nitrogen at its boiling point. Calculate the pressure of the helium in the vessel while immerse in liquid nitrogen.

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$P_2 = \frac{P_1 T_2}{T_1}$

$\frac{10.0\text{ psi} \times 77.36\text{ K}}{(100+273.15)\text{ K}} = 2.07\text{ psi}$

5. Aluminum metal is placed in a solution sulfuric acid and allowed to react. Hydrogen gas is produced as one of the products. How much aluminum is needed to produce 1.50 liter of H_2 collected over water at 735 torr and 18.6 °C?

$2Al_{(s)} + 3H_2SO_{4(aq)} \rightarrow Al_2(SO_4)_{3(aq)} + 3H_2$

$n = \frac{PV}{RT}$

$735\text{ torr} \times \frac{1\text{ atm}}{760\text{ torr}} \times 1.50\text{ L} \times \frac{\text{mol K}}{0.0821\text{ L·atm}} \times \frac{1}{(18.6+273.15)\text{ K}} \times \frac{2\text{ mol Al}}{3\text{ mol } H_2} \times \frac{26.98\text{ g Al}}{1\text{ mol Al}} = 1.09\text{ g Al}$

If $P_{H_2} = 735$ torr & $P_T = 735$ torr

$735\text{ torr} - (2.1978\text{ kPa} \times \frac{760\text{ torr}}{101.325\text{ kPa}}) \times \frac{1\text{ atm}}{760\text{ torr}} \times 1.50\text{ L} \times \frac{\text{mol K}}{0.0821\text{ L·atm}} \times \frac{1}{(18.6+273.15)\text{ K}} \times \frac{2\text{ mol Al}}{3\text{ mol } H_2} \times \frac{26.98\text{ g Al}}{1\text{ mol Al}} = 1.06\text{ g Al}$