

Name \_\_\_\_\_  
 Date \_\_\_\_\_  
 Due Date \_\_\_\_\_

KEY

## Chemistry 11

### Unit 7 Review – Stoichiometry

1. Given the balanced equation:



$$\uparrow \\ 4(28.1) + 10(1.0) = 122.4$$

a) What volume of oxygen (STP) is required to react with 204.0 g of  $\text{Si}_4\text{H}_{10}$ ?

$$204.0 \text{ g Si}_4\text{H}_{10} \times \frac{1 \text{ mol Si}_4\text{H}_{10}}{122.4 \text{ g Si}_4\text{H}_{10}} \times \frac{13 \text{ mol O}_2}{2 \text{ mol Si}_4\text{H}_{10}} \times \frac{22.4 \text{ L O}_2}{1 \text{ mol O}_2}$$

$$= \underline{242.7 \text{ L O}_2}$$

b) What mass of  $\text{SiO}_2$  is formed when 345.0 g of  $\text{H}_2\text{O}$  are formed?

$$345.0 \text{ g H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{18.0 \text{ g H}_2\text{O}} \times \frac{8 \text{ mol SiO}_2}{10 \text{ mol H}_2\text{O}} \times \frac{60.1 \text{ g SiO}_2}{1 \text{ mol SiO}_2}$$

$$= \underline{921.5 \text{ g SiO}_2}$$

c) How many molecules of  $\text{H}_2\text{O}$  are formed when 17.92 L of  $\text{O}_2$  are used at STP?

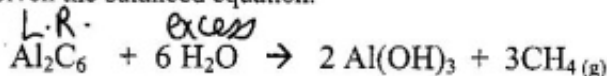
$$17.92 \text{ L O}_2 \times \frac{1 \text{ mol O}_2}{22.4 \text{ L O}_2} \times \frac{10 \text{ mol H}_2\text{O}}{13 \text{ mol O}_2} \times \frac{6.02 \times 10^{23} \text{ molec. H}_2\text{O}}{1 \text{ mol H}_2\text{O}}$$

$$= \underline{3.705 \times 10^{23} \text{ molec. H}_2\text{O}}$$

d) How many moles of  $\text{Si}_4\text{H}_{10}$  are needed to just react with  $1.204 \times 10^{26}$  molecules of oxygen?

$$1.204 \times 10^{26} \text{ molec. O}_2 \times \frac{1 \text{ mol O}_2}{6.02 \times 10^{23} \text{ molec. O}_2} \times \frac{2 \text{ mol Si}_4\text{H}_{10}}{13 \text{ mol O}_2} = \underline{30.77 \text{ mol Si}_4\text{H}_{10}}$$

2. Given the balanced equation:



a) If 34.5 grams of  $\text{Al}_2\text{C}_6$  is mixed with 72.0 grams of water, which reactant is in excess? Show by calculations.

$$34.5 \text{ g Al}_2\text{C}_6 \times \frac{1 \text{ mol Al}_2\text{C}_6}{126.0 \text{ g Al}_2\text{C}_6} \times \frac{2 \text{ mol Al}(\text{OH})_3}{1 \text{ mol Al}_2\text{C}_6} \times \frac{78.0 \text{ g Al}(\text{OH})_3}{1 \text{ mol Al}(\text{OH})_3} = 42.71 \text{ g Al}(\text{OH})_3$$

$$72.0 \text{ g H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{18.0 \text{ g H}_2\text{O}} \times \frac{2 \text{ mol Al}(\text{OH})_3}{6 \text{ mol H}_2\text{O}} \times \frac{78.0 \text{ g Al}(\text{OH})_3}{1 \text{ mol Al}(\text{OH})_3} = 104.0 \text{ g Al}(\text{OH})_3 \quad \boxed{\text{H}_2\text{O is XS}}$$

b) If 34.5 grams of  $\text{Al}_2\text{C}_6$  is mixed with 72.0 grams of water, what mass of  $\text{Al}(\text{OH})_3$  is formed?

$$\boxed{42.71 \text{ g Al}(\text{OH})_3}$$

c) If 34.5 grams of  $\text{Al}_2\text{C}_6$  is mixed with 72.0 grams of water, what volume of  $\text{CH}_4$  is formed at STP? Use LR

$$34.5 \text{ g Al}_2\text{C}_6 \times \frac{1 \text{ mol Al}_2\text{C}_6}{126.0 \text{ g Al}_2\text{C}_6} \times \frac{3 \text{ mol CH}_4}{1 \text{ mol Al}_2\text{C}_6} \times \frac{22.4 \text{ L CH}_4}{1 \text{ mol CH}_4} = \boxed{18.4 \text{ L CH}_4}$$

3. Given the equation:  $4 \text{NH}_3 + 5 \text{O}_2 \rightarrow 4 \text{NO} + 6 \text{H}_2\text{O}$

When 51.0 grams of  $\text{NH}_3$  is burned in an excess of oxygen, 52.65 g of water are produced.

a) Calculate the theoretical yield of  $\text{H}_2\text{O}$ .

$$51.0 \text{ g NH}_3 \times \frac{1 \text{ mol NH}_3}{17.0 \text{ g NH}_3} \times \frac{6 \text{ mol H}_2\text{O}}{4 \text{ mol NH}_3} \times \frac{18.0 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 81.0 \text{ g H}_2\text{O}$$

b) Calculate the % yield of  $\text{H}_2\text{O}$ .

$$\% \text{ yield} = \frac{\text{AY}}{\text{TY}} \times 100\% = \frac{52.65 \text{ g}}{81.0 \text{ g}} \times 100\% = \boxed{65\% \text{ yield}}$$

4. Given the equation:  $\text{N}_2 + 3 \text{H}_2 \rightarrow 2 \text{NH}_3$  When 4.0 grams of hydrogen is combined with an excess of nitrogen, a 92% yield of  $\text{NH}_3$  is obtained.

a) Calculate the theoretical yield of  $\text{NH}_3$

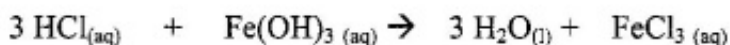
$$4.0 \text{ g H}_2 \times \frac{1 \text{ mol H}_2}{2.0 \text{ g H}_2} \times \frac{2 \text{ mol NH}_3}{3 \text{ mol H}_2} \times \frac{17.0 \text{ g NH}_3}{1 \text{ mol NH}_3} = 22.67 \text{ g NH}_3$$

b) Calculate the actual yield of  $\text{NH}_3$

$$\text{AY} = \frac{\% \text{ Y}}{100} \times \text{TY} = \frac{92}{100} \times 22.67 = \underline{\underline{20.86 \text{ g NH}_3}}$$

KEY

5. Given the balanced equation:



a) It takes 19.56 mL of 0.50 M HCl to titrate a 25.0 mL sample of a solution of  $\text{Fe}(\text{OH})_3$ . Calculate the  $[\text{Fe}(\text{OH})_3]$



$$\text{moles HCl} = 0.50 \text{ M} \times 0.01956 \text{ L} = 0.00978 \text{ mol HCl}$$

$$\text{mole Fe}(\text{OH})_3 = 0.00978 \text{ mol HCl} \times \frac{1 \text{ mol Fe}(\text{OH})_3}{3 \text{ mol HCl}} = \frac{0.00326 \text{ mol}}{\text{Fe}(\text{OH})_3}$$

$$[\text{Fe}(\text{OH})_3] = \frac{0.00326 \text{ mol Fe}(\text{OH})_3}{0.0250 \text{ L Fe}(\text{OH})_3} = \boxed{0.130 \text{ M}}$$

b) What mass of  $\text{Fe}(\text{OH})_3$  is needed to completely react with 10.0 mL of 0.50M HCl solution?

$$\text{moles HCl} = 0.50 \text{ M} \times 0.0100 \text{ L} = 0.00500 \text{ mol HCl}$$

$$0.00500 \text{ mol HCl} \times \frac{1 \text{ mol Fe}(\text{OH})_3}{3 \text{ mol HCl}} \times \frac{106.8 \text{ g Fe}(\text{OH})_3}{1 \text{ mol Fe}(\text{OH})_3} = \boxed{0.178 \text{ g Fe}(\text{OH})_3}$$

c) What volume of 0.50M HCl is required to titrate a 21.36 gram sample of iron (III) hydroxide?

$$21.36 \text{ g Fe}(\text{OH})_3 \times \frac{1 \text{ mol Fe}(\text{OH})_3}{106.8 \text{ g Fe}(\text{OH})_3} \times \frac{3 \text{ mol HCl}}{1 \text{ mol Fe}(\text{OH})_3} = 0.600 \text{ mol HCl}$$



$$\text{L} = \frac{\text{mol}}{\text{M}} = \frac{0.600 \text{ mol}}{0.50 \text{ M}} = \boxed{1.20 \text{ L}}$$