Name KEY
Date
Due Date

Chemistry 11

Unit 7 Review – Stoichiometry

1. Given the balanced equation:

$$2\ Si_4H_{10\ (s)} + 13\ O_{2\ (g)} \rightarrow 8\ SiO_{2\ (s)} + 10\ H_2O_{(g)}$$

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

a) What volume of oxygen (STP) is required to react with 204.0 g of Si_4H_{10}?

$$204.0\ g\ Si_4H_{10} \times \frac{1\ mol\ Si_4H_{10}}{122.4\ g\ Si_4H_{10}} \times \frac{13\ mol\ O_2}{2\ mol\ Si_4H_{10}} \times \frac{22.4\ L\ O_2}{1\ mol\ O_2}$$

$$= 242.7\ L\ O_2$$

b) What mass of SiO_2 is formed when 345.0 g of H_20 are formed?

$$345.0\ g\ H_2O \times \frac{1\ mol\ H_2O}{18.0\ g\ H_2O} \times \frac{8\ mol\ SiO_2}{10\ mol\ H_2O} \times \frac{60.1\ g\ SiO_2}{1\ mol\ SiO_2}$$

$$= 921.5\ g\ SiO_2$$

c) How many molecules of H_2O are formed when 17.92 L of O_2 are used at STP?

$$17.92\ L\ O_2 \times \frac{1\ mol\ O_2}{22.4\ L\ O_2} \times \frac{10\ mol\ H_2O}{13\ mol\ O_2} \times \frac{6.02\times10^{23}\ molec.\ H_2O}{1\ mol\ H_2O}$$

$$3.705\times10^{23}\ molec.\ H_2O$$

d) How many moles of Si_4H_{10} are needed to just react with 1.204×10^{26} molecules of oxygen?

$$1.204\times10^{26}\ molec.\ O_2 \times \frac{1\ mol\ O_2}{6.02\times10^{23}\ molec.\ O_2} \times \frac{2\ mol\ Si_4H_{10}}{13\ mol\ O_2} = 30.77\ mol\ Si_4H_{10}$$

2. Given the balanced equation:

L.R. excess

$Al_2C_6 + 6\,H_2O \rightarrow 2\,Al(OH)_3 + 3CH_{4\,(g)}$

a) If 34.5 grams of Al_2C_6 is mixed with 72.0 grams of water, which reactant is in excess? Show by calculations.

$34.5\,g\,Al_2C_6 \times \frac{1\,mol\,Al_2C_6}{126.0\,g\,Al_2C_6} \times \frac{2\,mol\,Al(OH)_3}{1\,mol\,Al_2C_6} \times \frac{78.0\,g\,Al(OH)_3}{1\,mol\,Al(OH)_3} = 42.71\,g\,Al(OH)_3$

$72.0\,g\,H_2O \times \frac{1\,mol\,H_2O}{18.0\,g\,H_2O} \times \frac{2\,mol\,Al(OH)_3}{6\,mol\,H_2O} \times \frac{78.0\,g\,Al(OH)_3}{1\,mol\,Al(OH)_3} = 104.0\,g\,Al(OH)_3$ H_2O is XS

b) If 34.5 grams of Al_2C_6 is mixed with 72.0 grams of water, what mass of $Al(OH)_3$ is formed?

$42.71\,g\,Al(OH)_3$

c) If 34.5 grams of Al_2C_6 is mixed with 72.0 grams of water, what volume of CH_4 is formed at STP? Use LR

$34.5\,g\,Al_2C_6 \times \frac{1\,mol\,Al_2C_6}{126.0\,g\,Al_2C_6} \times \frac{3\,mol\,CH_4}{1\,mol\,Al_2C_6} \times \frac{22.4\,L\,CH_4}{1\,mol\,CH_4} = 18.4\,L\,CH_4$

3. Given the equation: $4\,NH_3 + 5\,O_2 \rightarrow 4\,NO + 6\,H_2O$

When 51.0 grams of NH_3 is burned in an excess of oxygen, 52.65 g of water are produced.

Actual Yield

a) Calculate the theoretical yield of H_2O.

$51.0\,g\,NH_3 \times \frac{1\,mol\,NH_3}{17.0\,g\,NH_3} \times \frac{6\,mol\,H_2O}{4\,mol\,NH_3} \times \frac{18.0\,g\,H_2O}{1\,mol\,H_2O} = 81.0\,g\,H_2O$

b) Calculate the % yield of H_2O.

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

4. Given the equation: $N_2 + 3\,H_2 \rightarrow 2\,NH_3$ When 4.0 grams of hydrogen is combined with an excess of nitrogen, a 92% yield of NH_3 is obtained.

a) Calculate the theoretical yield of NH_3

$4.0\,g\,H_2 \times \frac{1\,mol\,H_2}{2.0\,g\,H_2} \times \frac{2\,mol\,NH_3}{3\,mol\,H_2} \times \frac{17.0\,g\,NH_3}{1\,mol\,NH_3} = 22.67\,g\,NH_3$

b) Calculate the actual yield of NH_3

$AY = \frac{\%\,Y}{100} \times TY = \frac{92}{100} \times 22.67 = 20.86\,g\,NH_3$

KEY

5. Given the balanced equation:

$$3\ HCl_{(aq)} + Fe(OH)_{3\ (aq)} \rightarrow 3\ H_2O_{(l)} + FeCl_{3\ (aq)}$$

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

mol / M|L

Moles HCl = 0.50M × 0.01956 L = 0.00978 mol HCl

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

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

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

Moles HCl = 0.50M × 0.0100 L = 0.00500 mol HCl

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

$$= \boxed{0.178\ \text{g } Fe(OH)_3}$$

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

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

$$= 0.600\ \text{mol HCl}$$

mol / M|L

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