Key

Solution Problems Review

1. Determine if the following reactions will occur between the given compounds. If they will, write out the complete balanced chemical equation (with state of matter denotations). Also write out the net ionic equation for each reaction that occurs.

a. hydrochloric acid with sodium carbonate

$2HCl_{(aq)} + Na_2CO_{3(aq)} \rightarrow 2NaCl_{(aq)} + H_2O_{(l)} + CO_{2(g)}$

$2H^+_{(aq)} + CO_3^{-2}{}_{(aq)} \rightarrow H_2O_{(l)} + CO_{2(g)}$

b. ammonium sulfate with calcium choride

$(NH_4)_2SO_{4(aq)} + CaCl_{2(aq)} \rightarrow 2NH_4Cl_{(aq)} + CaSO_{4(s)}$

$SO_4^{-2}{}_{(aq)} + Ca^{+2}{}_{(aq)} \rightarrow CaSO_{4(s)}$

c. copper (II) nitrate with zinc

$Cu(NO_3)_{2(aq)} + Zn_{(s)} \rightarrow Cu_{(s)} + Zn(NO_3)_2$

$Cu^{+2}{}_{(aq)} + Zn_{(s)} \rightarrow Cu_{(s)} + Zn^{+2}{}_{(aq)}$

d. lithium hydroxide with potassium sulfate

$LiOH_{(aq)} + K_2SO_{4(aq)} \rightarrow Li_2SO_{4(aq)} + KOH_{(aq)}$

No Reaction

e. sodium fluoride with magnesium acetate

$2NaF_{(aq)} + Mg(C_2H_3O_2)_{2(aq)} \rightarrow MgF_{2(s)} + 2NaC_2H_3O_{2(aq)}$

$2F^-{}_{(aq)} + Mg^{+2}{}_{(aq)} \rightarrow MgF_{2(s)}$

f. potassium hydroxide with nitric acid

$KOH_{(aq)} + HNO_{3(aq)} \rightarrow H_2O_{(l)} + KNO_{3(aq)}$

$H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$

2. What volume of 0.125 M oxalic acid, $H_2C_2O_4$, is required to react with 35.2 mL of 0.546 M NaOH?

$H_2C_2O_{4(aq)} + 2NaOH_{(aq)} \rightarrow 2H_2O_{(l)} + Na_2C_2O_{4(s)}$

$.546\ M\ NaOH = \frac{x}{.0352\ L}$

$x = .0192\ \text{mol NaOH} \left| \frac{1\ \text{mol}\ H_2C_2O_4}{2\ \text{mol NaOH}} \right. = 9.61 \times 10^{-3}\ \text{mol}\ H_2C_2O_4$

$.125\ M\ H_2C_2O_4 = \frac{9.61 \times 10^{-3}\ \text{mol}}{V}$

$V = .0769\ L = 76.9\ mL$

3. If you dilute 25 mL of 1.5 M hydrochloric acid to 500 mL, what is the molar concentration of the dilute acid?

$M_1V_1 = M_2V_2$

$1.5(25) = M_2(500)$

$M_2 = .075\ M\ HCl$

4. Describe how you would make 250 mL of 0.4 M sodium hydroxide if you have anhydrous sodium hydroxide and distilled water.

$.4\ M\ NaOH = \frac{x}{.25L}$

Dissolve 4 g NaOH in water then dilute to 250 mL.

$x = .1\ mol\ NaOH \left| \frac{40\ g\ NaOH}{1\ mol\ NaOH} \right. = 4\ g\ NaOH$

5. You mix 25 mL of 0.234 M Iron (III) chloride with 42.5 mL of 0.453 M NaOH.

a. What mass of iron (III) hydroxide precipitates? $.625\ g\ Fe(OH)_3$

b. What will be the molar concentration of the excess reactant remaining in solution after the maximum mass of iron(III) hydroxide has formed?

$FeCl_{3(aq)} + 3NaOH_{(aq)} \rightarrow 3NaCl_{(aq)} + Fe(OH)_{3(s)}$

$.234 = \frac{x}{.025L}$ LR

$x = 5.85 \times 10^{-3}\ mol\ FeCl_3 \left| \frac{3\ mol\ NaOH}{1\ mol\ FeCl_3} \right. = .0176\ mol\ NaOH$

$.453\ M\ NaOH = \frac{x}{.0425}$

$x = .0193\ mol\ NaOH$

$5.85 \times 10^{-3}\ mol\ FeCl_3 \left| \frac{1\ mol\ Fe(OH)_3}{1\ mol\ FeCl_3} \right| \frac{106.8\ g\ Fe(OH)_3}{1\ mol\ Fe(OH)_3} = .625\ g\ Fe(OH)_3$

b.) started with .0193 mol NaOH

used - .0176 mol NaOH

.0017 mol NaOH remain

$M = \frac{.0017\ mol}{(.025L + .0425L)} = .025\ M\ NaOH$

6. Sodium bicarbonate and acetic acid react to form sodium acetate, carbon dioxide, and water. Suppose you add 15 g of sodium bicarbonate to 125 mL of 0.15 M acetic acid. What volume of carbon dioxide would be produced if the reaction takes place at STP?

$NaHCO_{3(s)} + HC_2H_3O_{2(aq)} \rightarrow NaC_2H_3O_{2(aq)} + CO_{2(g)} + H_2O_{(l)}$

15 g .15 M 125 mL ? L

$15\ g\ NaHCO_3 \left| \frac{1\ mol\ NaHCO_3}{84\ g\ NaHCO_3} \right. = .179\ mol\ NaHCO_3$

$.15\ M = \frac{x}{.125L}$ LR

$x = .0188\ mol\ HC_2H_3O_2$

$.0188\ mol\ HC_2H_3O_2 \left| \frac{1\ mol\ CO_2}{1\ mol\ HC_2H_3O_2} \right| \frac{22.4\ L\ CO_2}{1\ mol\ CO_2} = .42\ L\ CO_2$