Chapter 4:

Solve for the molarity of the following titration problems:

1. What is the molarity of HCl when 37.5ml of 0.25M KOH is titrated with 23.4ml of HCl?

$M = \frac{mol}{L}$

$Mol = M \cdot L$

$HCl\ (aq) + KOH\ (aq) \rightarrow H_2O\ (l) + KCl\ (aq)$

$mol = 0.25\frac{mol}{L} \cdot 0.0375L$

$mol = 0.0094$

$0.0094 mol\ KOH \left| \frac{1 mol\ HCl}{1 mol\ KOH} \right. = 0.0094 mol\ HCl$

$M = \frac{0.0094 mol}{0.0234L} = 0.40M\ HCl$

2. What is the molarity of $Mg(OH)_2$ when 56.7ml of 0.025M of HCl is titrated with 103ml of $Mg(OH)_2$?

$2\ HCl\ (aq) + Mg(OH)_2\ (aq) \rightarrow 2\ H_2O\ (l) + MgCl_2\ (aq)$

$mol = 0.025\frac{mol}{L} \cdot 0.0567L$

$= 0.014 mol\ HCl$

$0.014 mol\ HCl \left| \frac{1 mol\ Mg(OH)_2}{2 mol\ HCl} \right. = 0.0070 mol\ Mg(OH)_2$

$M = \frac{0.0070 mol}{.103L} = 0.068M\ Mg(OH)_2$

3. What is the molarity of HCl when 1.73L of 0.05M $Fe(OH)_3$ is titrated with 0.0512L of HCl?

$3\ HCl\ (aq) + Fe(OH)_3\ (aq) \rightarrow 3\ H_2O\ (l) + FeCl_3\ (aq)$

$mol = 0.05\frac{mol}{L} \cdot 1.73L$

$= 0.09 mol\ Fe(OH)_3$

$0.09 mol\ Fe(OH)_3 \left| \frac{3 mol\ HCl}{1 mol\ Fe(OH)_3} \right. = 0.3 mol\ HCl$

$M = \frac{0.3 mol}{0.0512L} = 6.\ M\ HCl$

Solve for the molarity of the following dilution problems:

1. 1.05L of 2.00M HCl dilutes with water to be 3.67L?

$M_C \cdot V_C = M_D \cdot V_D$

$M_D = \frac{2.00M \cdot 1.05L}{3.67L}$

$M_D = 0.572M\ HCl$

2. 365ml of 0.50M KOH dilutes with water to 1.85L?

$M_C \cdot V_C = M_D \cdot V_D$

$M_D = \frac{.365L \cdot 0.50M}{1.85L}$

$= 0.099M\ KOH$

3. What was the concentration of 485ml of NaOH when it was diluted to 1.250L of 0.350M NaOH?

$M_C \cdot V_C = M_D \cdot V_D$

$M_C = \frac{1.250L \cdot 0.350M}{.485L}$

$M_C = 0.902\ M\ NaOH$

4. What was the concentration of 2.03L of HCl when it was diluted to 5.34L of 0.670M of HCl?

$M_C V_C = M_D \cdot V_D$

$M_C = \frac{5.34L \cdot 0.670M}{2.03L}$

$M_C = 1.76\ M\ HCl$

5. 535ml of 5.0 H_2SO_4 diluted to 6.66L?

$M_C \cdot V_C = M_D \cdot V_D$

$M_D = \frac{.535L \cdot 5.0M}{6.66L}$

$M_D = 0.40\ M\ H_2SO_4$

Chapter 5:

Use the energy formula to calculate the missing variable in the questions below:

1. A system gains 1500 J of heat and does 649 J of work on the system. What is the amount of energy made by the system above?

$\Delta E = q + w$

$\Delta E = +1500\,J + 649\,J$

$\Delta E = 2149\,J$

2. A system loses 1247 J of heat and the system and has 567 J of work done by system. What is the amount of energy made by system above?

$\Delta E = -1247\,J + (-567)\,J$

$\Delta E = -1814$

3. A system gains 137 J of heat and the system does 137 J of work done by the system. What is the amount of energy made by the system above?

$\Delta E = q + w$

$\Delta E = 137\,J - 137\,J$

$\Delta E = 0$

Determine if the following is exothermic or endothermic:

1. An ice cube melting. Endo/Exo

2. Burning a match. Endo/Exo

3. A reaction producing steam. Endo/Exo

4. Hothands producing heat once exposed to air. Endo/Exo

Calculate the heat in the following reactions given moles of a reactant:

1. HCl (aq) + KOH (aq)→ H_2O (l)+ KCl (aq) ΔH=-56.3J, given 24.5g of HCl

1.008
+35.45
36.458

$$24.5\text{g HCl} \left| \frac{1\text{mol HCl}}{36.458\text{g HCl}} \right| \left| \frac{-56.3\text{J}}{1\text{mol HCl}} \right| = -37.8\text{J}$$

2. 2 HCl (aq)+ $Mg(OH)_2$ (aq)→ 2 H_2O (l)+ $MgCl_2$ (aq) ΔH=-259.5 J, given 130.g of $Mg(OH)_2$

24.305g
+ 15.999·2g
+ 1.008·2g

$$130.\text{g Mg(OH)}_2 \left| \frac{1\text{mol Mg(OH)}_2}{58.319\text{g Mg(OH)}_2} \right| \left| \frac{-259.5\text{J}}{1\text{mol Mg(OH)}_2} \right| = -578\text{J}$$

3. 3 HCl (aq)+ $Fe(OH)_3$ (aq)→ 3 H_2O (l)+ $FeCl_3$ (aq) ΔH= -456.3 J, given 45.6g of HCl

$$45.6\text{g HCl} \left| \frac{1\text{mol HCl}}{36.458\text{g HCl}} \right| \left| \frac{-456.3\text{J}}{3\text{mol HCl}} \right| = -190.\text{J}$$

Use the formula $q=mC_s\Delta T$ to solve the following equations:

1. Given 45.7g of Aluminum, with a specific heat of 0.921 J/(g◦C), what was the change in temperature of the reaction if 495.7J of energy was produced?

$q = mC_s\Delta T$

$\Delta T = \frac{q}{mC_s} = \frac{495.7\,J}{(45.7\,g)(0.921\,J/(g\cdot°C))} = 11.8°C$

2. Given 109.5g of Aluminum, with a specific heat of 0.921 J/(g◦C), what is the energy produced from the reaction if the temperature changes from 25◦C to 83◦C?

$q = mC_s\Delta T$

$q = (109.5\,g)\cdot(0.921\,J/(g\cdot°C))(58°C)$

$q = 5800\,J$

3. If the specific heat of copper is 0.377 J/(g◦C), and the temperature rose from 37◦C to 98◦C and produced 562.2J of energy, how much copper was used?

$q = mC_s\Delta T$

$m = \frac{q}{C_s\Delta T}$ $\quad m = \frac{562.2\,J}{(0.377\,J/(g\cdot°C))(61°C)} = 24.\,g$

4. Given 137.5g of copper, with a specific heat of 0.377 J/(g◦C), and the temperature rose from 41◦C to 78◦C, how much energy was produced?

$q = mC_s\Delta T$

$q = 137.5\,g\cdot 0.377\,J/(g\cdot°C)\cdot 37°C = 1900\,J$

5. If 3623.7J of heat is produced from a temperature rise of 53◦C and 136.2g of Ni what is the specific heat capacity

$q = m C_s \Delta T$

$C_s = \frac{q}{m \Delta T} = \frac{3623.7\,J}{136.2\,g\,Ni \cdot 53^\circ C} = 0.50\,J/g \cdot ^\circ C$

Use Hess's Law to solve for the enthalpy:

1.

no change $C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = -393.5$ kJ/mol

×2 $S(s) + O_2(g) \rightarrow SO_2(g)$ $\Delta H = -296.8$ kJ/mol

flip $C(s) + 2S(s) \rightarrow CS_2(l)$ $\Delta H = +87.9$ kJ/mol

$CS_2(l) + 3O_2(g) \rightarrow CO_2(g) + 2SO_2(g)$ $\Delta H = ???$

$C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = -393.5$ kJ/mol

$2S(s) + 2O_2(g) \rightarrow 2SO_2(g)$ $\Delta H = -593.6$ kJ/mol

$CS_2(l) \rightarrow C(s) + 2S(s)$ $\Delta H = -87.9$ kJ/mol

$CS_2(l) + 3O_2(g) \rightarrow CO_2(g) + 2SO_2(g)$ $\Delta H = -1080$ kJ/mol

2.

flip $SrO(s) + CO_2(g) \rightarrow SrCO_3(s)$ $\Delta H = -234$ kJ

$\times 1/2$ $2SrO(s) \rightarrow 2Sr(s) + O_2(g)$ $\Delta H = +1184$ kJ

flip, $\times \frac{1}{2}$ $2SrCO_3(s) \rightarrow 2Sr(s) + 2C\ (s, gr) + 3O_2(g)$ $\Delta H = +2440$ kJ

$C\ (s, gr) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = ???$

$SrCO_3(s) \rightarrow SrO(s) + CO_2(g)$ $\Delta H = 234$ kJ

$SrO(s) \rightarrow Sr(s) + \frac{1}{2}O_2(g)$ $\Delta H = 592$ kJ

$2 \cdot \frac{3}{2}O_2(g) + C(s,gr) + Sr(s) \rightarrow SrCO_3(s)$ $\Delta H = -1220$ kJ

$O_2(g) + C(s,gr) \rightarrow CO_2(g)$ $\Delta H = -394$ kJ

3.

flip, $\frac{3}{2}\times$ $2NO(g) + O_2(g) \rightarrow 2NO_2(g)$ $\Delta H = -116$ kJ

$\times \frac{1}{2}$ $2N_2(g) + 5O_2(g) + 2H_2O(l) \rightarrow 4HNO_3(aq)$ $\Delta H = -256$ kJ

flip $N_2(g) + O_2(g) \rightarrow 2NO(g)$ $\Delta H = +183$ kJ

$3NO_2(g) + H_2O(\ell) \rightarrow 2HNO_3(aq) + NO(g)$ $\Delta H = ???$

$3NO_2(g) \rightarrow 3NO(g) + \frac{3}{2}O_2(g)$ $\Delta H = 174$ kJ

$N_2(g) + \frac{5}{2}O_2(g) + H_2O(l) \rightarrow 2HNO_3(aq)$ $\Delta H = -128$ kJ

$2NO(g) \rightarrow N_2(g) + O_2(g)$ $\Delta H = -183$ kJ

$3NO_2(g) + H_2O(l) \rightarrow NO(g) + 2HNO_3(aq)$ $\Delta H = -137$ kJ