

Chapter 4:

Solve for the molarity of the following titration problems:

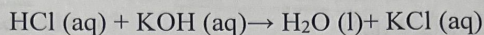
1. What is the molarity of HCl when 37.5ml of 0.25M KOH is titrated with 23.4ml of HCl?

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

$$\text{mol} = M \cdot L$$

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

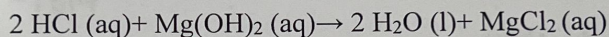
$$\text{mol} = 0.009375$$



$$\frac{0.009375 \text{ mol KOH}}{1 \text{ mol KOH}} \cdot \frac{1 \text{ mol HCl}}{1 \text{ mol KOH}} = 0.009375 \text{ mol HCl}$$

$$M = \frac{0.009375 \text{ mol}}{0.0234 L} = 0.40 \text{ M HCl}$$

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 ?



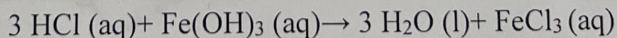
$$\text{mol} = 0.025 \frac{\text{mol}}{L} \cdot 0.0567 L$$

$$= 0.0014175 \text{ mol HCl}$$

$$\frac{0.0014175 \text{ mol HCl}}{2 \text{ mol HCl}} \cdot \frac{1 \text{ mol Mg(OH)}_2}{1 \text{ mol Mg(OH)}_2} = 0.00070875 \text{ mol Mg(OH)}_2$$

$$M = \frac{0.00070875 \text{ mol}}{0.103 L} = 0.00688 \text{ M Mg(OH)}_2$$

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



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

$$= 0.0865 \text{ mol Fe(OH)}_3$$

$$\frac{0.0865 \text{ mol Fe(OH)}_3}{1 \text{ mol Fe(OH)}_3} \cdot \frac{3 \text{ mol HCl}}{1 \text{ mol Fe(OH)}_3} = 0.2595 \text{ mol HCl}$$

$$M = \frac{0.2595 \text{ mol}}{0.0512 L} = 5.07 \text{ M HCl}$$

Solve for the molarity of the following dilution problems:

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

$$M_c \cdot V_c = M_d \cdot V_d$$
$$M_d = \frac{2.00M \cdot 1.05L}{3.67L}$$

$$M_d = 0.572M \text{ HCl}$$

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

$$M_c \cdot V_c = M_d \cdot V_d$$
$$M_d = \frac{0.365L \cdot 0.50M}{1.85L}$$
$$= 0.099M \text{ KOH}$$

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

$$M_c \cdot V_c = M_d \cdot V_d$$
$$M_c = \frac{1.250L \cdot 0.350M}{0.485L}$$

$$M_c = 0.902M \text{ NaOH}$$

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

$$M_c \cdot V_c = M_d \cdot V_d$$
$$M_c = \frac{5.34L \cdot 0.670M}{2.03L}$$

$$M_c = 1.76M \text{ HCl}$$

5. 535ml of 5.0 H₂SO₄ diluted to 6.66L?

$$M_c \cdot V_c = M_d \cdot V_d$$
$$M_d = \frac{0.535L \cdot 5.0M}{6.66L}$$

$$M_d = 0.40M \text{ H}_2\text{SO}_4$$

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?

$$\Delta E = q + w$$

$$\Delta E = +1500\text{ J} + 649\text{ J}$$

$$\Delta E = 2149\text{ J}$$

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?

$$\Delta E = -1247\text{ J} + (-567\text{ J})$$

$$\Delta E = -1814$$

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?

$$\Delta E = q + w$$

$$\Delta E = 137\text{ J} - 137\text{ J}$$

$$\Delta E = 0$$

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. $\text{HCl (aq)} + \text{KOH (aq)} \rightarrow \text{H}_2\text{O (l)} + \text{KCl (aq)}$ $\Delta H = -56.3 \text{ J}$, given 24.5g of HCl

$$\begin{array}{r} 1.608 \\ + 35.45 \\ \hline 36.458 \end{array}$$

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

2. $2 \text{ HCl (aq)} + \text{Mg(OH)}_2 \text{ (aq)} \rightarrow 2 \text{ H}_2\text{O (l)} + \text{MgCl}_2 \text{ (aq)}$ $\Delta H = -259.5 \text{ J}$, given 130.g of Mg(OH)_2

$$\begin{array}{r} 24.305 \text{ g} \\ + 15.999 \text{ g} \\ + 1.608 \text{ g} \\ \hline \end{array}$$

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

3. $3 \text{ HCl (aq)} + \text{Fe(OH)}_3 \text{ (aq)} \rightarrow 3 \text{ H}_2\text{O (l)} + \text{FeCl}_3 \text{ (aq)}$ $\Delta H = -456.3 \text{ J}$, given 45.6g of HCl

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

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?

$$q = mC_s\Delta T$$

$$\Delta T = \frac{q}{mC_s} = \frac{495.7\cancel{J}}{(45.7\cancel{g})(0.921\cancel{J/(g^\circ C)})} = 11.8^\circ C$$

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?

$$q = mC_s\Delta T$$

$$q = (109.5\cancel{g}) \cdot (0.921\cancel{J/(g^\circ C)}) (58^\circ\cancel{C})$$

$$q = 5800\cancel{J}$$

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?

$$q = mC_s\Delta T$$

$$m = \frac{q}{C_s\Delta T} \quad m = \frac{562.2\cancel{J}}{(0.377\cancel{J/(g^\circ C)})(61^\circ\cancel{C})} = 24.\cancel{g}$$

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?

$$q = mC_s\Delta T$$

$$q = 137.5\cancel{g} \cdot 0.377\cancel{J/(g^\circ C)} \cdot 37^\circ\cancel{C} = 1900\cancel{J}$$

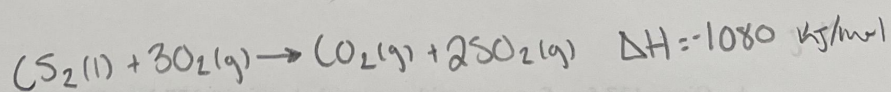
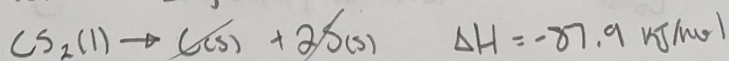
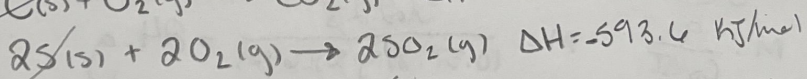
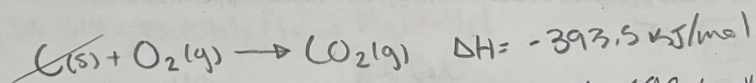
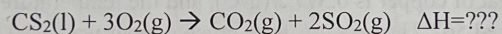
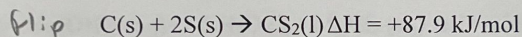
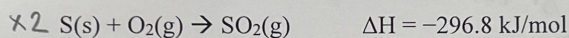
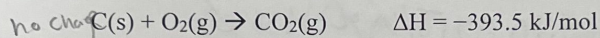
5. If 3623.7J of heat is produced from a temperature rise of 53°C and 136.2g of Ni what is the specific heat capacity

$$q = m C_p \Delta T$$

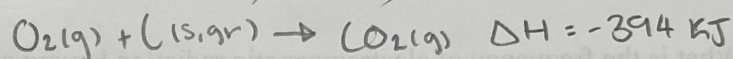
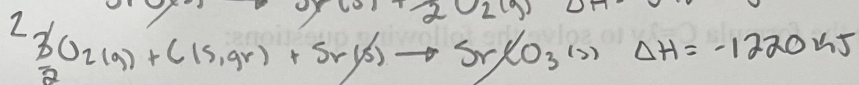
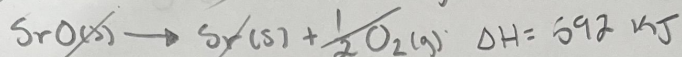
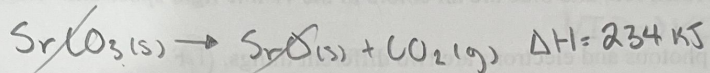
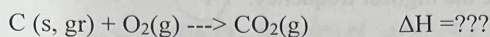
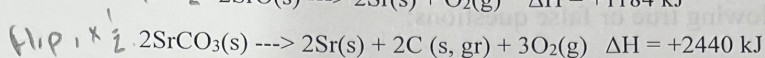
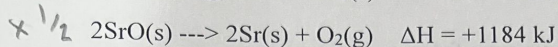
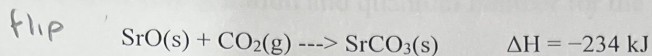
$$C_s = \frac{q}{m \Delta T} = \frac{3623.7 \text{ J}}{136.2 \text{ g Ni} \cdot 53^\circ \text{C}} = 0.505 \text{ J/g}^\circ \text{C}$$

Use Hess's Law to solve for the enthalpy:

1.



2.



3.

