4

Reactions in Aqueous Solutions

Worksheet C

A. Write a balanced net ionic equation for the reaction between 0.10 M aqueous solutions of the following pairs of compounds.

1. nickel sulfate and aluminum chloride
2. nitrous acid and lithium hydroxide
3. sodium hydroxide and magnesium sulfate
4. periodic acid and ammonia
5. hydrochloric acid and sodium fluoride

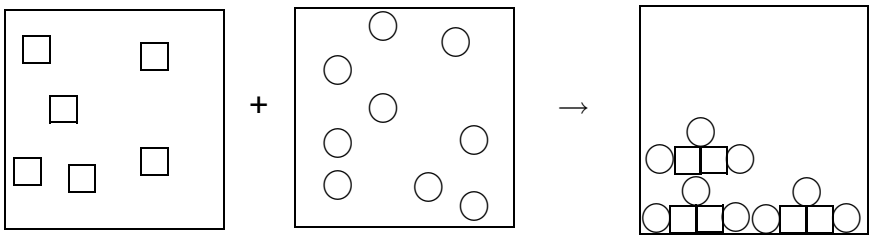
B. Consider the following unbalanced reaction:

$$S_8\,(s) + Cr_2O_7^{2-}\,(aq) \rightarrow SO_4^{2-}\,(aq) + Cr_2O_3\,(s)$$

1. What is the oxidizing agent? _____
2. What species is the reducing agent? _____
3. Write balanced reduction and oxidation half-reactions in both acid and base media.
4. Write a balanced net ionic equation (using smallest whole number coefficients) for the reaction in both acid and base media.

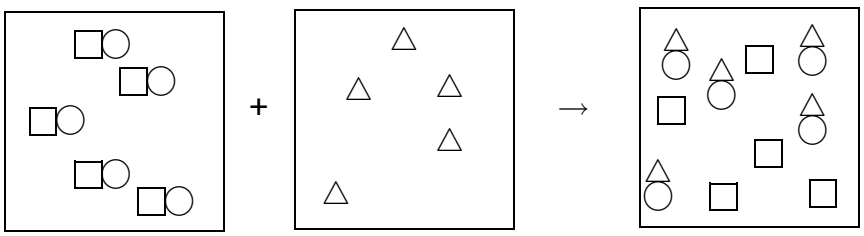
C. Write balanced equations to represent the reactions (if they occur) represented pictorially below.

1.



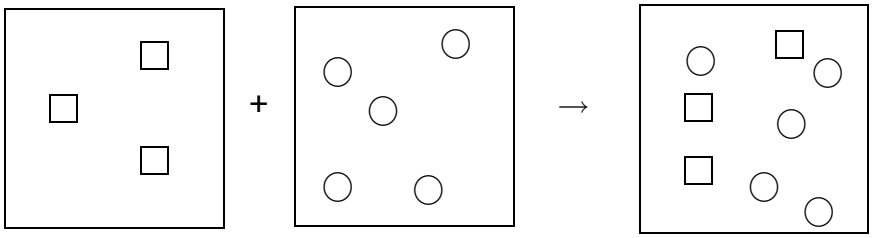
□ = anion (A) ○ = cation (B)

2.



□ = C^+
○ = D^-
△ = E^+

3.



□ = anion (F)
○ = cation (G)

D. Cyanide ions (CN^-) reduce permanganate ions in basic medium to manganese(IV) oxide. The cyanide ions are oxidized to cyanate ions, CNO^-. The balanced equation for this redox reaction is

$$2\,MnO_4^-\,(aq) + 3\,CN^-\,(aq) + H_2O \rightarrow 3\,CNO^-\,(aq) + 2\,MnO_2\,(s) + 2\,OH^-\,(aq)$$

When a 0.2500 M solution of calcium cyanide is added to an excess of permanganate ions, 12.32 g of MnO_2 ($\mathcal{M}$ = 86.94 g/mol) are obtained. What volume of calcium cyanide is added? Assume 100% yield.

E. When a solution of sodium oxalate ($Na_2C_2O_4$) is added to a solution of lanthanum(III) chloride, lanthanum oxalate ($\mathcal{M}$ = 541.86 g/mol) precipitates. The balanced equation for the reaction is

$$3\,C_2O_4^{2-}\,(aq) + 2\,La^{3+}\,(aq) \rightarrow La_2(C_2O_4)_3\,(s)$$

Thirty mL of 0.2000 M sodium oxalate are added to to 25.00 mL of 0.1500 M $LaCl_3$.

1. How many grams of $La_2(C_2O_4)_3$ (s) are obtained, assuming 100% yield?
2. What are the concentrations (M) of La^{3+} , $C_2O_4^{2-}$, Na^+ , and Cl^- after reaction is complete? Assume that volumes are additive.