

**Chapter 4 Practice Worksheet:  
Reactions in Aqueous Solutions**

1. List the three general classes of chemical reactions: precipitation, acid-base neutralization, and redox reactions

2. How can you identify each of the three reaction types above (e.g., what characteristic defines each one)??

Precipitation reactions have solid products, also all reactants and products are ionic compounds; Acid-base reactions react an acid with a base to produce a salt (ionic compound) and water; Redox reactions result in a change in oxidation numbers of two species.

3. List one strong electrolyte from Table 4.1 and describe/draw how it reacts when placed in water.

Completely dissociates in water. Ex: NaCl will dissolve to produce  $\text{Na}^+$  ions (surrounded by water) and  $\text{Cl}^-$  ions (surrounded by water). When salt dissolves in water, the ions separate from each other to form a solution that conducts an electrical current.

4. List one weak electrolyte from Table 4.1 and describe/draw how it reacts when placed in water.

Only partially dissociates in water. Ex: Most molecules of HF will stay bonded together but some will dissociate to produce  $\text{H}^+$  ions (surrounded by water) and  $\text{F}^-$  ions (surrounded by water).

5. List one nonelectrolyte from Table 4.1 and describe/draw how it reacts when placed in water.

Does not dissociate in water. Ex:  $\text{C}_6\text{H}_{12}\text{O}_6$  will stay bonded together as a complete molecule when placed in water. When sugar dissolves in water, molecules become separated from each other, but the molecules themselves remain intact.

6. Determine if the following compounds will be soluble or insoluble in water:

$\text{CrPO}_4$       insoluble (s)

$\text{Na}_2\text{S}$       soluble (aq)

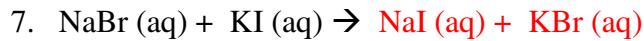
$\text{PbBr}_2$       insoluble (s)

$\text{Ag}_2\text{SO}_4$       insoluble (s)

$\text{Ca}(\text{ClO}_3)_2$       soluble (aq)

$\text{K}_3\text{PO}_4$       soluble (aq)

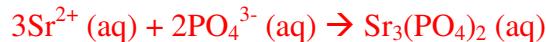
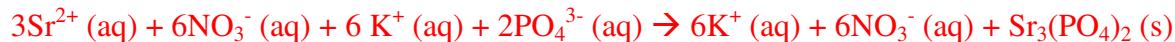
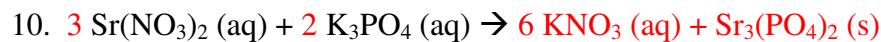
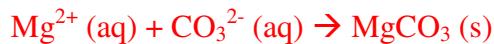
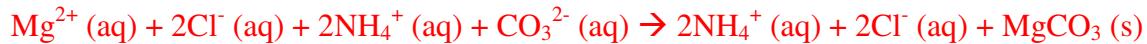
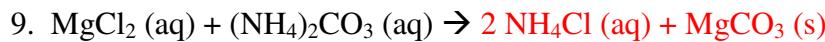
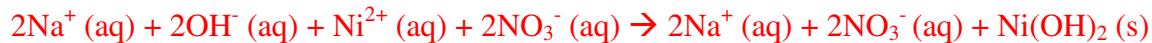
For the following double-displacement reactions, complete the equation and determine if there are any insoluble products (precipitates). If there is a precipitate, write the balanced ionic and net ionic equations. If there is no precipitate, write the balanced molecular and ionic equations.



No net ionic equation

Name: KEY

Section: \_\_\_\_\_



11. Give Arrhenius' definitions of an acid and a base. Give an example of each in a reaction.

Acids dissociate in water to produce hydrogen ions ( $\text{H}^+$ , aka protons). Ex:  $\text{HCl} + \text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{Cl}^-$

Bases dissociate in water to produce hydroxide ions ( $\text{OH}^-$ ). Ex:  $\text{NH}_3 + \text{H}_2\text{O} \rightarrow \text{NH}_4^+ + \text{OH}^-$

12. Identify each of the following substances as acids or bases (or both):

HCl      acid

KOH      base

NaOH      base

HNO<sub>3</sub>      acid

HF      acid

H<sub>2</sub>O      both (amphoteric)

Ca(OH)<sub>2</sub>      base

13. Identify the oxidation numbers of **each element** in the following compounds or ions:

$\text{H}_3\text{PO}_4$       H: +1; P: +5; O: -2

Zn (s)

Zn: 0

$\text{K}_2\text{O}_2$       K: +1; O: -1

$\text{SrSO}_4$

Sr: +2; S: +6; O: -2

$\text{O}_2(\text{g})$        $\text{O}_2$ : 0

$\text{NiCO}_3$

Ni: +2; C: +4; O: -2

$\text{CoCl}_2$       Co: +2; Cl: -1

$\text{OH}^-$

O: -2; H: +1

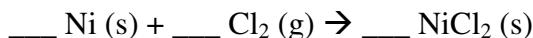
$\text{FeBO}_3$       Fe: +3; B: +3; O: -2

$\text{Mg}(\text{NO}_3)_2$

Mg: +2; N: +5; O: -2

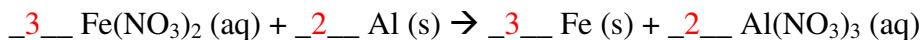
14. List the three types of redox reactions and describe how you can identify them:  
 Combination (two or more elements or compounds combine to form a single product); Decomposition (one compound decomposes, usually with heat, to give off a gas and another substance); Single-replacement (one element and one compound react to give one element and one compound)

15. For the following redox reactions, identify the species being oxidized, the species being reduced, the oxidizing agent, and the reducing agent:



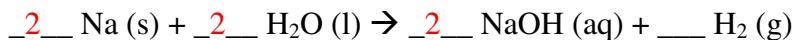
Ni is oxidized / reducing agent

$\text{Cl}_2$ : reduced / oxidizing agent



$\text{Fe}^{2+}$  in  $\text{Fe(NO}_3)_2$  is reduced /  $\text{Fe(NO}_3)_2$  is oxidizing agent

Al is oxidized and is reducing agent

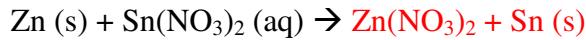
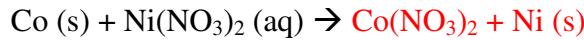
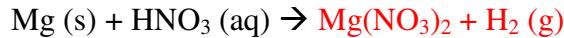
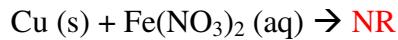
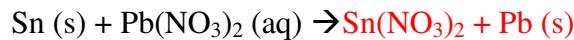
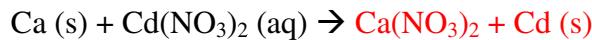


Na is oxidized / reducing agent

$\text{H}^+$  in  $\text{H}_2\text{O}$  is reduced /  $\text{H}_2\text{O}$  is oxidizing agent

16. Describe when to use the Solubility Rules and when to use the Activity Series of Metals.  
 Solubility rules are used to determine precipitates in double-replacement reactions. The Activity Series of Metals is used to determine if a reaction will occur in a single-replacement reaction.

17. For the following reactions, use the Activity Series of Metals to determine if a reaction will occur and if so, what the products will be. If no reaction will occur, write NR for the product.



Complete, balance, and identify the reaction type for each of the following equations:

	<u>Type</u>
18. $\text{MgO} (\text{s}) + \text{H}_2\text{O} (\text{l}) \rightarrow \text{Mg(OH)}_2 (\text{s})$	combo.
19. $\text{Zn} (\text{s}) + \text{Cu(NO}_3)_2 (\text{aq}) \rightarrow \text{Zn(NO}_3)_2 (\text{aq}) + \text{Cu} (\text{s})$	SR, metal
20. $\text{Ba(NO}_3)_2 (\text{aq}) + \text{MgSO}_4 (\text{aq}) \rightarrow \text{BaSO}_4 (\text{s}) + \text{Mg(NO}_3)_2 (\text{aq})$	precipitation
21. $\text{H}_2\text{SO}_4 (\text{aq}) + 2 \text{NaOH} (\text{aq}) \rightarrow \text{Na}_2\text{SO}_4 (\text{aq}) + 2 \text{H}_2\text{O} (\text{aq})$	acid-base neut.
22. $\text{H}_2\text{CO}_3 (\text{aq}) \text{ (heated)} \rightarrow \text{H}_2\text{O} (\text{l}) + \text{CO}_2 (\text{g})$	decomposition
23. $4 \text{Al} (\text{s}) + 3 \text{O}_2 (\text{g}) \rightarrow 2 \text{Al}_2\text{O}_3 (\text{aq})$	combination
24. $\text{Cu(OH)}_2 (\text{s}) + 2 \text{HClO}_4 (\text{aq}) \rightarrow \text{Cu(ClO}_4)_2 (\text{aq}) + 2 \text{H}_2\text{O} (\text{l})$	acid-base neut.
25. $\text{Mn} (\text{s}) + 2 \text{HBr} (\text{aq}) \rightarrow \text{MnBr}_2 (\text{aq}) + \text{H}_2 (\text{g})$	SR, hydrogen
26. $2 \text{HgO} (\text{s}) \text{ (heated)} \rightarrow 2 \text{Hg} (\text{l}) + \text{O}_2 (\text{g})$	decomposition