

Exercise 4.5

Precipitation Reactions

Name: _____

Date: _____ Per: _____

Part A - Solubility

When ionic compounds dissolve the dissociated ions become available to form new compounds. Combining two solutions with certain dissociated ions may result in the formation of a new solid compound. This new solid is called a precipitate (Ppt) and the reaction is called a precipitation reaction.

Predicting whether a precipitate will form requires the use of a solubility table or set of solubility rules. By considering the possible new combinations of ions and comparing them to the solubility rules, one can predict if a precipitate will form. If the combination is insoluble or partially soluble, a precipitate will form. When a precipitate forms, the ions that remain in solution are called spectator ions. If all combinations of ions are soluble, no precipitate will form.

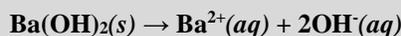
DIRECTIONS: Using the solubility rules at right, determine the solubility of each of the following:

- Hg(NO₃)₂ _____
- FeCO₃ _____
- SnS _____
- K₃PO₄ _____
- PbCl₂ _____
- Al(OH)₃ _____
- Al₂(CO₃)₃ _____
- Co(NO₃)₂ _____

Soluble	Exceptions (are insoluble)
NO ₃ ⁻	
C ₂ H ₃ O ₂ ⁻ , HCO ₃ ⁻ , ClO ₃ ⁻	
Li ⁺ , Na ⁺ , K ⁺ , Rb ⁺ , Cs ⁺ & NH ₄ ⁺	
Cl ⁻ , Br ⁻ , I ⁻	Ag ⁺ , Hg ₂ ²⁺ , Pb ²⁺
SO ₄ ²⁻	Ag ⁺ , Hg ₂ ²⁺ , Pb ²⁺ , Ca ²⁺ , Sr ²⁺ , & Ba ²⁺
Insoluble Compounds	Exceptions (are soluble)
CO ₃ ²⁻ , PO ₄ ²⁻ , CrO ₄ ²⁻ , & S ²⁻	Li ⁺ , Na ⁺ , K ⁺ , Rb ⁺ , Cs ⁺ & NH ₄ ⁺
OH ⁻	Li ⁺ , Na ⁺ , K ⁺ , Rb ⁺ , Cs ⁺ & NH ₄ ⁺ & Ba ²⁺

Part B – Dissociation Equations

The process of ionic dissociation may be represented using a dissociation equation. The ionic solid is the only reactant shown and the component ions are the products. These equations, like all equations, must be balanced. Showing the physical state of each species is critical.



DIRECTIONS: Using the solubility rules write the dissociation equations for those only ionic compounds that dissolve.

- | | |
|---|--|
| 9. FeS _____ | 13. NH ₄ OH _____ |
| 10. Ca(NO ₃) ₂ _____ | 14. Sn(OH) ₂ _____ |
| 11. K ₂ SO ₄ _____ | 15. Pb(C ₂ H ₃ O ₂) ₂ _____ |
| 12. SrCl ₂ _____ | 16. Cu(ClO ₃) ₂ _____ |

DIRECTIONS: Identify the two possible compounds which form if the solutions in following table were mixed. **CIRCLE** the formula of the compounds which would precipitate from the solutions.

	KBr	Na ₂ CO ₃	CaS	NH ₄ OH
AgNO ₃				
BaCl ₂				
Al(NO ₃) ₃				
CuSO ₄				

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Part C – Precipitation Reactions

Precipitation reactions may be represented by a molecular equation (the type of equation usually associated with a chemical reaction), which shows each compound's formula and physical state. A complete ionic equation shows each soluble compound as dissociated into ions in the aqueous (*aq*) state. Insoluble substances are shown as compounded in the solid (*s*) state. Ions present in both the reactants and products are not involved in the precipitation reaction and are referred to as spectator ions. If the equation is rewritten excluding these spectator ions, the result is a net ionic equation.

Dissociation Equations: $\text{Ba(OH)}_2(s) \rightarrow \text{Ba}^{2+}(aq) + 2\text{OH}^-(aq)$ & $\text{AlCl}_3(s) \rightarrow \text{Al}^{3+}(aq) + 3\text{Cl}^-(aq)$

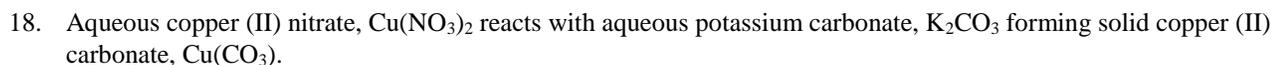
Molecular Equation: $3\text{Ba(OH)}_2(aq) + 2\text{AlCl}_3(aq) \rightarrow 3\text{BaCl}_2(aq) + 2\text{Al(OH)}_3(s)$

Complete Ionic Eq: $3\text{Ba}^{2+}(aq) + 6\text{OH}^-(aq) + 2\text{Al}^{3+}(aq) + 6\text{Cl}^-(aq) \rightarrow 3\text{Ba}^{2+}(aq) + 6\text{Cl}^-(aq) + 2\text{Al(OH)}_3(s)$

$3\text{Ba}^{2+}(aq) + 6\text{OH}^-(aq) + 2\text{Al}^{3+}(aq) + 6\text{Cl}^-(aq) \rightarrow 3\text{Ba}^{2+}(aq) + 6\text{Cl}^-(aq) + 2\text{Al(OH)}_3(s)$

Net Ionic Equation: $2\text{Al}^{3+}(aq) + 6\text{OH}^-(aq) \rightarrow 2\text{Al(OH)}_3(s)$

DIRECTIONS: Write the complete ionic equation for each of the following.



DIRECTIONS: Predict whether a precipitate will form from each of the following aqueous combinations. If there is a precipitation reaction complete the molecular equation and write the ionic and net ionic equations.

