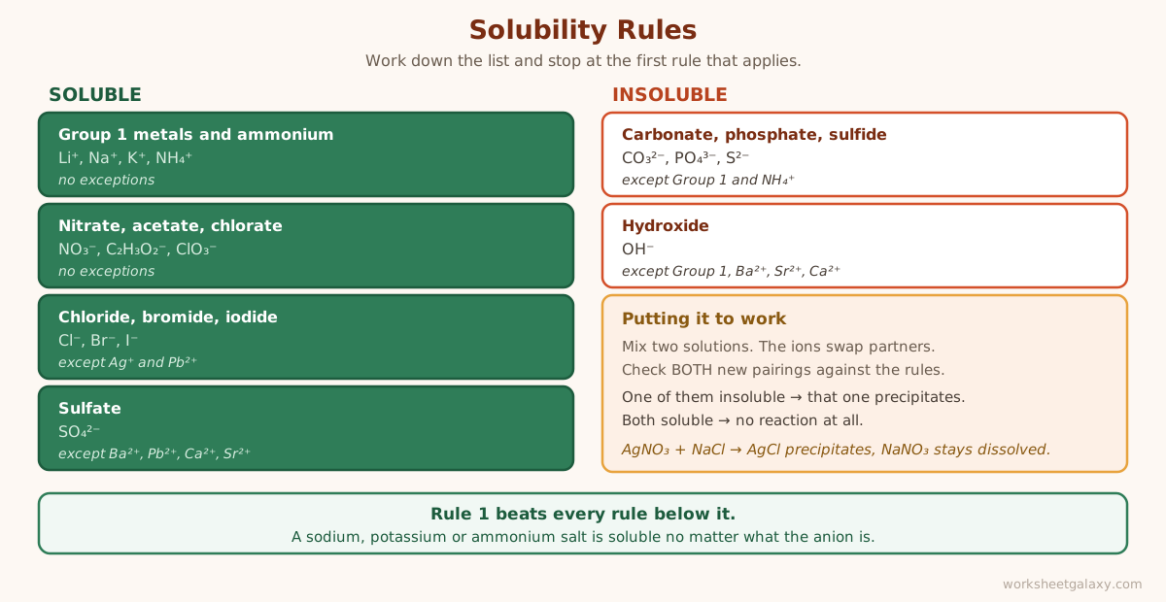
Solubility Rules and Precipitation Worksheet

Grade 11 Chemistry · Solubility rules, predicting precipitates, and writing the equations

Name: Date: Score: / 24



Before you start: work down the rules in order and stop at the first one that applies. A Group 1 or ammonium salt is soluble whatever the anion, so that rule is checked first.

Part A · Soluble or Insoluble? Write soluble or insoluble, and name the rule you used.

#	Compound	Rule used	Soluble or insoluble
1	NaCl		
2	AgCl		
3	$BaSO_4$		
4	KNO_3		
5	$CaCO_3$		
6	$(NH_4)_2S$		
7	PbI_2		
8	$Mg(OH)_2$		

Part B · Name the Precipitate Two solutions are mixed. Swap the partners and check both new pairings.

#	Solutions mixed	Precipitate
1	$AgNO_{3(aq)} + NaCl_{(aq)}$	

2	$BaCl_{2(aq)} + Na_2SO_{4(aq)}$	
3	$Pb(NO_3)_{2(aq)} + KI_{(aq)}$	
4	$CaCl_{2(aq)} + Na_2CO_{3(aq)}$	
5	$FeCl_{3(aq)} + NaOH_{(aq)}$	
6	$Pb(NO_3)_{2(aq)} + Na_2SO_{4(aq)}$	

Part C · Write the Equation Balanced, with (aq) and (s) on every substance.

1. **$AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow ?$**

Answer: _____

2. **$BaCl_{2(aq)} + Na_2SO_{4(aq)} \rightarrow ?$**

Answer: _____

3. **$Pb(NO_3)_{2(aq)} + KI_{(aq)} \rightarrow ?$**

Answer: _____

4. **$CaCl_{2(aq)} + Na_2CO_{3(aq)} \rightarrow ?$**

Answer: _____

Part D · Does Anything Happen? Not every mixture reacts. Say what forms, or write "no reaction".

1. **$NaCl_{(aq)} + KNO_{3(aq)}$**

Answer: _____

2. **$MgSO_{4(aq)} + BaCl_{2(aq)}$**

Answer: _____

3. **$KBr_{(aq)} + NaNO_{3(aq)}$**

Answer: _____

Part E · Challenge Identification, net ionic equations, and why nothing happens.

1. An unknown solution contains a single metal ion. Adding sodium sulfate gives a precipitate. Adding sodium chloride gives none. Adding sodium carbonate gives a precipitate. Explain how each test narrows down the possibilities, and say which cations are still possible at the end. Can these three tests identify it exactly?

Answer: _____

2. For the reaction $AgNO_3$ + NaCl → AgCl + $NaNO_3$, write the net ionic equation. Identify the spectator ions and say why they are left out.

Answer: _____

3. A student mixes $NaCl_{(aq)}$ and $KNO_{3(aq)}$ and expects a reaction because the ions can swap partners. Explain why nothing happens.

Answer: _____

Answer Key · Solubility Rules and Precipitation

Full worked solutions — Grade 11 Chemistry

Part A · Soluble or Insoluble?

1. Group 1 or ammonium, so soluble whatever the anion
   NaCl is soluble
2. halides are soluble except with silver and lead
   AgCl is insoluble
3. sulfates are soluble except with barium, lead, calcium and strontium
   $BaSO_4$ is insoluble
4. Group 1 or ammonium, so soluble whatever the anion
   KNO_3 is soluble
5. carbonates, phosphates and sulfides are insoluble except with Group 1 and ammonium
   $CaCO_3$ is insoluble
6. Group 1 or ammonium, so soluble whatever the anion
   $(NH_4)_2S$ is soluble
7. halides are soluble except with silver and lead
   PbI_2 is insoluble
8. hydroxides are insoluble except Group 1, barium, strontium and calcium
   $Mg(OH)_2$ is insoluble

Part B · Name the Precipitate

1. possible pairings: AgCl and $NaNO_3$; $NaNO_3$ is soluble
   $AgCl_{(s)}$
2. possible pairings: $BaSO_4$ and NaCl; NaCl is soluble
   $BaSO_{4(s)}$
3. possible pairings: PbI_2 and KNO_3; KNO_3 is soluble
   $PbI_{2(s)}$
4. possible pairings: $CaCO_3$ and NaCl; NaCl is soluble
   $CaCO_{3(s)}$
5. possible pairings: $Fe(OH)_3$ and NaCl; NaCl is soluble
   $Fe(OH)_{3(s)}$
6. possible pairings: $PbSO_4$ and $NaNO_3$; $NaNO_3$ is soluble
   $PbSO_{4(s)}$

Part C · Write the Equation

1. **$AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow AgCl_{(s)} + NaNO_{3(aq)}$**
2. **$BaCl_{2(aq)} + Na_2SO_{4(aq)} \rightarrow BaSO_{4(s)} + 2NaCl_{(aq)}$**
3. **$Pb(NO_3)_{2(aq)} + 2KI_{(aq)} \rightarrow PbI_{2(s)} + 2KNO_{3(aq)}$**

4. **$CaCl_{2(aq)} + Na_2CO_{3(aq)} \rightarrow CaCO_{3(s)} + 2NaCl_{(aq)}$**

Part D · Does Anything Happen?

1. $NaNO_3$ and KCl are both soluble

   No reaction

2. $BaSO_4$ is insoluble

   $MgSO_{4(aq)} + BaCl_{2(aq)} \rightarrow MgCl_{2(aq)} + BaSO_{4(s)}$

3. KNO_3 and NaBr are both soluble

   No reaction

Part E · Challenge

1. • adding Na_2SO_4 gives a precipitate, so the cation is one of the exceptions to the SO_4 rule
   • adding NaCl gives nothing, so the cation is not one of the exceptions to the Cl rule
   • adding Na_2CO_3 gives a precipitate, so the cation is one of the exceptions to the CO_3 rule

   No — the tests narrow it to Ca^{2+}, Sr^{2+}, Ba^{2+}, but cannot separate them. The rules treat all three the same way for sulfate, chloride and carbonate.

2. • the full equation is $AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow AgCl_{(s)} + NaNO_{3(aq)}$
   • AgCl is the only solid; everything else stays dissociated in solution
   • the ions that appear unchanged on both sides are spectators and are cancelled

   $Ag^+_{(aq)} + Cl^-_{(aq)} \rightarrow AgCl_{(s)}$

3. • the possible new pairings are $NaNO_3$ and KCl
   • $NaNO_3$ is soluble and so is KCl
   • with nothing to leave solution, every ion is still floating about exactly as it was before the two beakers were combined

   No reaction. Both possible products are soluble, so no solid forms and nothing has changed.