Net Ionic Equations

Unit: Chemical Reactions

MA Curriculum Frameworks (2016): HS-PS1-2

Mastery Objective(s): (Students will be able to...)

• Write chemical equations as net ionic equations.

Success Criteria:

- Soluble ionic compounds are dissociated.
- Insoluble ionic compounds remain together as solids.
- Spectator ions are identified and omitted from the final net ionic equation.

Tier 2 Vocabulary: net, spectator

Language Objectives:

• Review dissociation. Explain how to dissociate a compound and write its ions separately in an equation.

Notes:

<u>net ionic equation</u>: a chemical equation that shows only ions or pure substances that are changed by the reaction.

<u>spectator ion</u>: an ion that remains in solution and does not participate in a chemical reaction.

If you mixed aqueous solutions of calcium chloride $(CaCl_2(aq))$ and sodium nitrate $(NaNO_3(aq))$, you might be tempted to predict that the following (unbalanced) chemical reaction would occur:

 $CaCl_2(aq) + NaNO_3(aq) \rightarrow Ca(NO_3)_2(aq) + NaCl(aq)$

However, recall that aqueous ions dissociate when they dissolve in water:

Symbol	What Actually Happens in H_2O
CaCl ₂ (aq)	Ca ²⁺ (aq) + Cl⁻ (aq)
NaNO₃ (aq)	$Na^+(aq) + NO_3^-(aq)$
Ca(NO ₃) ₂ (aq)	$Ca^{2+}(aq) + NO_{3}^{-}(aq)$
NaCl (aq)	Na ⁺ (aq) + Cl ⁻ (aq)

This means that what we really have in the beaker is:

 $Ca^{2+}(aq) + Cl^{-}(aq) + Na^{+}(aq) + NO_{3}^{-}(aq) \rightarrow Ca^{2+}(aq) + NO_{3}^{-}(aq) + Na^{+}(aq) + Cl^{-}(aq)$ The above is called a detailed ionic equation.

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Big Ideas	Details	Unit: Chemical Reactions	
	In the detailed ionic equation:		
	$Ca^{2+}(aq) + Cl^{-}(aq) + Na^{+}(aq) + NO_{3}^{-}(aq) \rightarrow Ca^{2+}(aq) + NO_{3}^{-}(aq) + Na^{+}(aq)$		
	Notice that the right side and the left side contain exactly words, <i>nothing has changed</i> . If no substances are chang formed or broken—then <u>no chemical reaction has occurrent</u>	y the same ions. In other ed—no chemical bonds are <u>red</u> !	
	Now consider the reaction of aqueous silver nitrate with carbonate:	aqueous sodium	
	$AgNO_{3}(aq) + Na_{2}CO_{3}(aq) \rightarrow Ag_{2}CO_{3}(s) +$	NaNO₃ (aq)	
	Notice that one of the products, silver carbonate, forms	a solid (precipitate).	
	The detailed ionic equation would look like this:		
	$Ag^+(aq) + NO_3^-(aq) + Na^+(aq) + CO_3^{2-}(aq) \rightarrow Ag_2CO_3(aq)$	s) + Na ⁺ (aq) + NO ₃ ⁻ (aq)	
	The spectator ions (ions that remain unchanged by the real of the real of the real of the cross those out:	eaction) are Na⁺ and NO₃⁻.	
	$Ag^{+}(aq) + NO_{3}^{-}(aq) + Na^{+}(aq) + CO_{3}^{2-}(aq) \rightarrow Ag_{2}CO_{3}(aq)$	s) + Na ⁺ (aq) + NO 3 ⁻ (aq)	
	we are left with the <u>unbalanced net ionic equation</u> for this reaction:		
	$Ag^+(aq) + CO_3^{2-}(aq) \rightarrow Ag_2CO_3(q)$	s)	
	Of course, we still need to balance the equation! The <u>ba</u> would therefore be:	d to balance the equation! The <i>balanced net ionic equation</i>	
	$2 \operatorname{Ag}^{+}(\operatorname{aq}) + \operatorname{CO}_{3}^{2^{-}}(\operatorname{aq}) \rightarrow \operatorname{Ag}_{2}\operatorname{CO}_{3}(\operatorname{s})$		
	Notice that the net ionic reaction is much simpler than the because the net ionic equation leaves out everything the equation, allowing you to focus only on the details that a	ne full chemical equation, It does not matter in the are important.	
	If you take AP [®] Chemistry, you will be expected to write net ionic form.	all chemical equations in	

Net Ionic Equations

Big Ideas	Details	Unit: Chemical Reactions	
	Homework Problems		
	For each of the following potential double replacement reactions:		
	a. Predict the products. (Remember to balance the cl	narges!)	
	b. Use your solubility rules to write the phase after ea If the product is soluble, write (aq) after it. If an ion soluble, then it precipitates; write (ppt) after it. If a CO_2), then write (g) after it. If a product is a pure lic write (ℓ) after it.	ch product. iic compound is not product is a gas (such as quid (such as H ₂ O), then	
	c. Rewrite the equation with the aqueous compounds	dissociated (split up).	
	d. Cancel (cross out) any ions that are the same (unch	anged) on both sides.	
	e. Write and balance the net ionic equation as your find that you have crossed out everything, write "N.R."	nal answer. If it turns out ("No Reaction") instead.	
	1. Na ₂ CO ₃ (aq) + CaCl ₂ (aq) \rightarrow		
	2. (NH₄)₃PO₄ (aq) + NaOH (aq) →		
	3. Ba(C ₂ H ₃ O ₂) ₂ (aq) + K ₃ PO ₄ (aq) \rightarrow		
	4. Ca(MnO₄)₂ (aq) + KOH (aq) →		

Net Ionic Equations

Big Ideas	Details		Unit: Chemical Reactions
	5.	$AICI_3 (aq) + H_3PO_4 (aq) \rightarrow$	
	6.	CaSO₄ (aq) + KMnO₄ (aq) →	
	7.	NaN₃ (aq) + Ca(NO₃)₂ (aq) →	
	8.	$Sr(NO_3)_2$ (aq) + K ₂ Cr ₂ O ₇ (aq) \rightarrow	
	9.	NaClO₃ (aq) + MgSO₄ (aq) →	
	10.	Na ₃ BO ₃ (aq) + ZnSO ₄ (aq) →	