

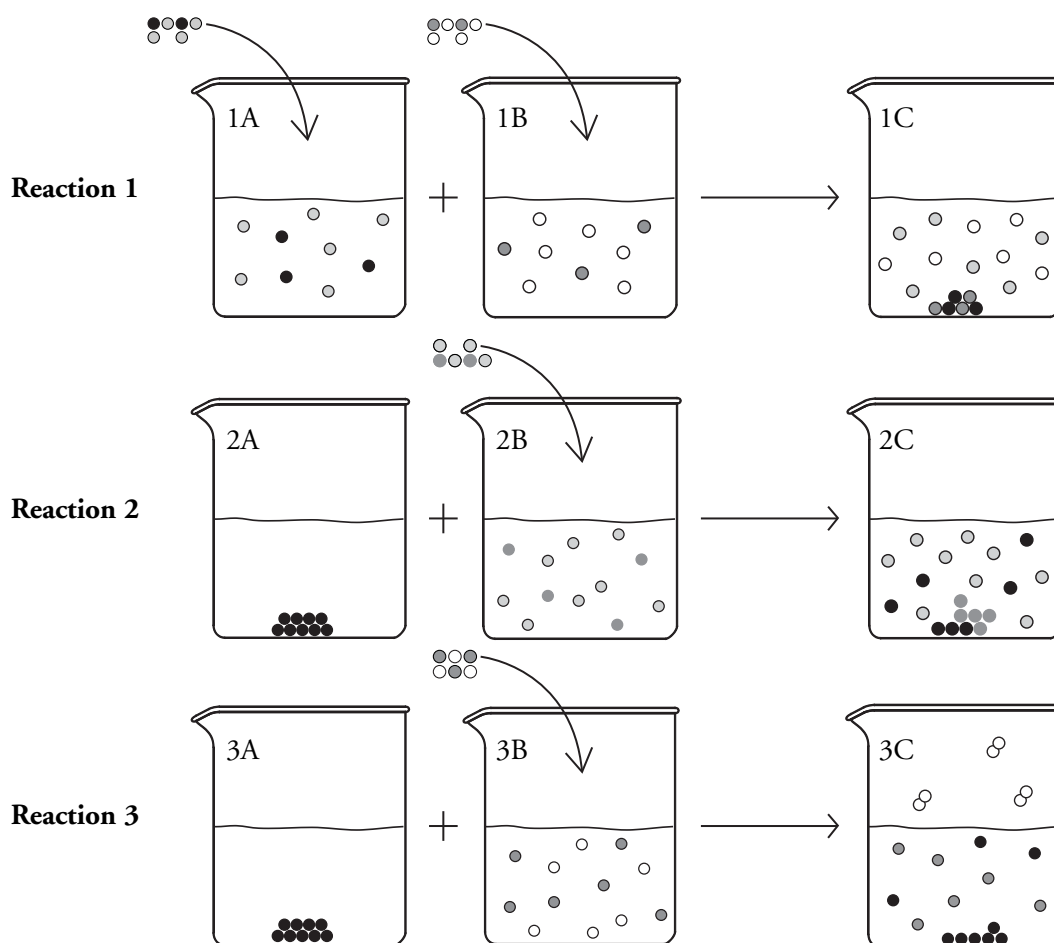
# Net Ionic Equations

Do all reactant species participate in a reaction?

## Why?

If you were to attend a sporting event on any random weekend you would find there are two types of people in attendance—players and spectators. Although both are important in their own right, they have different functions. This is also the case in chemical reactions. Although a species may be shown in a chemical reaction, it might only be a spectator. In other words it does not actually participate in the breaking and forming of chemical bonds that define the chemical reaction.

## Model 1 – Three Reactions



1. Consider the three reactions in Model 1.
  - a. Which beakers in the model contain solid, insoluble substances?
  - b. What evidence is provided in the model to show that these substances are solids?

- c. Which beakers in the model contain solutions of ionic substances?
- d. What evidence is provided in the model to show that these substances are ionic compounds?
2. Which of the reactions in Model 1 produces a gas?
3. Three reactions are provided below. Indicate which reaction in Model 1 corresponds to each reaction below. Discuss with your group members the evidence you used from Model 1 to match the reactions, and be prepared to support your choices to the class. Do not assume the reactions are stoichiometric. That is, one reactant may be present in excess.
- $$\text{Zn(s)} + 2\text{HCl(aq)} \rightarrow \text{ZnCl}_2\text{(aq)} + \text{H}_2\text{(g)}$$
- $$\text{Zn(s)} + \text{Cu(NO}_3)_2\text{(aq)} \rightarrow \text{Zn(NO}_3)_2\text{(aq)} + \text{Cu(s)}$$
- $$\text{Zn(NO}_3)_2\text{(aq)} + \text{Na}_2\text{CO}_3\text{(aq)} \rightarrow \text{ZnCO}_3\text{(s)} + 2\text{NaNO}_3\text{(aq)}$$
4. For each of the reactions in Model 1, write a complete sentence that describes the specific chemical change that occurred.



5. In each of the reactions in Model 1, there are ions present in the solutions that do not participate in the chemical reaction. In other words, they exist in the same form both before and after the reaction. These substances are called **spectator ions**. Identify the spectator ions for each reaction.

## Model 2 – Writing a Reaction Three Ways

<b>Molecular Equation</b>	$\text{Zn (s)} + \text{Cu(NO}_3)_2\text{(aq)} \rightarrow \text{Zn(NO}_3)_2\text{(aq)} + \text{Cu (s)}$
<b>Ionic Equation</b>	$\text{Zn (s)} + \text{Cu}^{2+}\text{(aq)} + 2\text{NO}_3^{1-}\text{(aq)} \rightarrow \text{Zn}^{2+}\text{(aq)} + 2\text{NO}_3^{1-}\text{(aq)} + \text{Cu (s)}$
<b>Net Ionic Equation</b>	$\text{Zn (s)} + \text{Cu}^{2+}\text{(aq)} \rightarrow \text{Zn}^{2+}\text{(aq)} + \text{Cu (s)}$

6. Consider the equations in Model 2.

*a.* Which equation represents the ionic substances as bonded together in the solution?

*b.* Which equation represents the ionic substances as separate ions in solution?

*c.* Which of the two equations from parts *a* and *b* is a better representation of how the species take part in the reaction?

7. Compare the **net ionic equation** in Model 2 to the other two equations.

*a.* What chemical species is missing in the net ionic equation?

*b.* Explain why it is valid to remove this species from the equation.



8. Work as a group to write a definition for a net ionic equation.

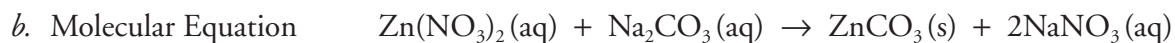


9. Write ionic and net ionic equations for the remaining reactions in Model 1.



Ionic Equation

Net Ionic Equation



Ionic Equation

Net Ionic Equation

## Read This!

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When writing an ionic or net ionic equation for a reaction you must consider what species will divide into ions in solution. For example, strong acids like hydrochloric acid or sulfuric acid will be represented as ions, but weak acids remain mostly in molecular form so these are not divided. Similarly, only soluble ionic substances are represented as separate ions in solution. If the substance is insoluble, it remains written in the molecular form.

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10. Write a molecular, ionic and net ionic equation for the reaction between acetic acid and sodium hydroxide.

11. Write a molecular, ionic and net ionic equation for the reaction between solid magnesium carbonate and sulfuric acid.



## Extension Questions

12. Choose either Question 10 or 11, and draw a picture representing the reaction at the atomic level.
13. Is the law of conservation of mass obeyed in net ionic reactions? Support your answer with evidence from this activity.
14. In molecular equations, all substances are written as neutral, but in net ionic equations several of the species have charges. Is charge conserved in a net ionic equation? Support your answer with evidence from this activity.
15. What are the advantages and disadvantages to using a net ionic equation to represent a chemical change rather than a molecular equation?