

Lecture 19 CH101 A1 (MWF 9 am) Fall 2016

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[TP] You are given 150 mL of a 0.20 M aqueous solution of **ammonium carbonate** and 150 mL of 0.40 M aqueous solution of **barium iodide**. These solutions are mixed and a precipitate forms. After the precipitation, the solution ...

- 25% 1. will be positively charged
 25% 2. will be electrically neutral
 25% 3. will be negatively charged
 25% 4. More information needed



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Friday, October 21, 2016

- Complete: Concentrations after precipitation
- Ionization of molecular solutes
- Self-ionization of water
- Acid-base reactions: Competition for H⁺;

Next lecture: Complete acid-base reactions: Competition for H⁺; balancing oxidation-reduction equations; complexation as Lewis acid-base reaction



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[TP] You are given 150 mL of a 0.20 M aqueous solution of **ammonium carbonate** and 150 mL of 0.40 M aqueous solution of **barium iodide**. These solutions are mixed and a precipitate forms. The **limiting reagent** is

- 17% 1. BaI₂(s)
 17% 2. (NH₄)₂CO₃(s)
 17% 3. NH₄⁺(aq)
 17% 4. Ba²⁺(aq)
 17% 5. CO₃²⁻(aq)
 17% 6. I⁻(aq)



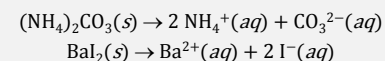
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A comprehensive example

You are given 150 mL of a 0.20 M aqueous solution of **ammonium carbonate** and 150 mL of 0.40 M aqueous solution of **barium iodide**.



NH ₄ ⁺ (aq)	Ba ²⁺ (aq)	CO ₃ ²⁻ (aq)	I ⁻ (aq)
2 × 0.20 M × 0.150 L = 0.060 mol	0.40 M × 0.150 L = 0.060 mol	0.20 M × 0.150 L = 0.030 mol	2 × 0.40 M × 0.150 L = 0.120 mol



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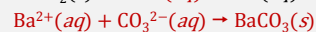
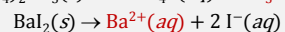
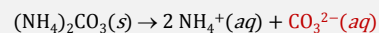
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A comprehensive example

You are given 150 mL of a 0.20 M aqueous solution of **ammonium carbonate** and 150 mL of 0.40 M aqueous solution of **barium iodide**.

These solutions are mixed and a **precipitate forms**



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A comprehensive example

You are given 150 mL of a 0.20 M aqueous solution of **ammonium carbonate** and 150 mL of 0.40 M aqueous solution of **barium iodide**. These solutions are mixed and a precipitate forms.

Write the **net-ionic equation** for this process.

What are the **spectator ions** for this process?

What is the **limiting reactant**?

How many moles of the **solid precipitate** are formed?

After precipitation, what are the **molarities (M)** of each ion **in solution**?



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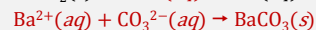
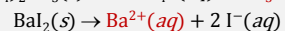
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A comprehensive example

You are given 150 mL of a 0.20 M aqueous solution of **ammonium carbonate** and 150 mL of 0.40 M aqueous solution of **barium iodide**.

These solutions are mixed and a **precipitate forms**



	$\text{Ba}^{2+}(aq)$	$\text{CO}_3^{2-}(aq)$	$\text{BaCO}_3(s)$
start	0.060 mol	0.030 mol	0
change			
end			



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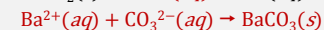
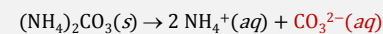
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A comprehensive example

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	$\text{Ba}^{2+}(aq)$	$\text{CO}_3^{2-}(aq)$	$\text{BaCO}_3(s)$
start	0.060 mol	0.030 mol	0
change	-0.030 mol	-0.030 mol	+0.030 mol
end	0.030 mol	0	0.030 mol



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A comprehensive example

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Write the **net-ionic equation** for this process.

What are the **spectator ions** for this process?

What is the **limiting reactant**?

How many moles of the **solid precipitate** are formed?

After precipitation, what are the **molarities (M)** of each ion **in solution**?

Is the final solution **electrically neutral**?



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Ionization of molecular (non-ionic) solutes

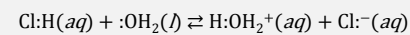


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Ionization of molecular solutes



Nearly **complete reaction** (~ 100 % theoretical yield)



Charles D. Winters

Strong electrolyte



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Note: Unlike $\text{NaCl}(aq)$, $\text{HCl}(aq)$ does exist

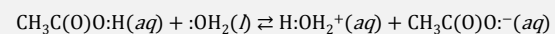


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Ionization of molecular solutes



Only a **little reaction** (< 100 % theoretical yield)



Weak electrolyte

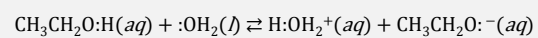


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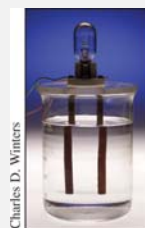
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Ionization of molecular solutes



Almost **no reaction** (<<< 100 % theoretical yield)



Non-electrolyte

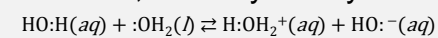


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Water self-ionizes, but only a very little



Almost **no reaction** (<<< 100 % theoretical yield)



Non-electrolyte



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Water self-ionizes, but only a very little

$$\text{HO:H}(aq) + \text{:OH}_2(l) \rightleftharpoons \text{H:OH}_2^+(aq) + \text{HO:}^-(aq)$$

In pure water at 25 °C, there is only a **tiny, tiny amount** of self-ionization,
 $\sim 10^{-7}$ mol/L



Charles D. Winters

Non-electrolyte

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Water self-ionizes, but only a very little

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In pure water at 25 °C, there is only a **tiny, tiny amount** of self-ionization,
 $\sim 10^{-7}$ mol/L.

In pure water, how many water molecules are there for every OH⁻ ion?

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[TP] In pure water, how many water molecules are there for every OH⁻ ion?

14% 1. 1
 14% 2. 10
 14% 3. 100
 14% 4. 10,000
 14% 5. 1,000,000
 14% 6. 10,000,000
 14% 7. More than 10,000,000

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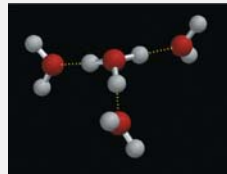
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In pure water at 25 °C, there is only a **tiny, tiny amount** of self-ionization,
 $\sim 10^{-7}$ mol/L.

H:OH₂⁺(aq), usually written H₃O⁺(aq), is typically **hydrogen bonded to several other water molecules**, with the partners **continually exchanging** with other water molecules.



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