[TP] When aqueous solutions of copper(II) chloride and sodium carbonate are combined, ...

0% 1. no precipitate will form
0% 2. $CuCO_3$ will precipitate
0% 3. NaCl will precipitate
0% 4. both $CuCO_3$ and NaCl will precipitate

Lecture 19 CH101 A1 (MWF 9:05 am)

Friday, October 20, 2017

For today ...

- Precipitation reactions
- Concentrations after precipitation

Next lecture: Concentrations after precipitation; ionization of molecular solutes; Self-ionization of water; Acid-base reactions: Competition for H^+; Balancing oxidation-reduction equations; Complexation as Lewis acid-base reaction

Precipitation reactions

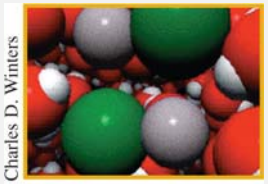
NaCl and $AgNO_3$ are both soluble in water, but AgCl is not.

If aqueous solutions of NaCl and $AgNO_3$, are mixed, the $Ag^+(aq)$ and $Cl^-(aq)$ ions can encounter one another.

(b) Initially the Ag^+ ions (silver colour) and Cl^- ions (green) are widely separated.

Precipitation reactions

When $Ag^+(aq)$ and $Cl^-(aq)$ ions do encounter one another, they will pair up as a lattice of $AgCl(s)$

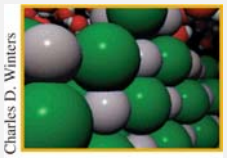


(c) Ag^+ and Cl^- ions approach and form ion pairs.

Precipitation reactions

As more pairs form, they will aggregate so much that solid AgCl settles out of the solution, so that no AgCl(aq) remains in solution.

This process is called precipitation.



(d) As more and more Ag^+ and Cl^- ions come together, a precipitate of solid AgCl forms.

[TP] When aqueous solutions of copper(II) chloride and sodium carbonate are combined, ...

0% 1. no precipitate will form
0% 2. $CuCO_3$ will precipitate
0% 3. NaCl will precipitate
0% 4. both $CuCO_3$ and NaCl will precipitate

[Quiz] Some solid sodium carbonate and solid potassium nitrate are placed together into pure water. After thorough stirring and allowing things to settle, ...

0% 1. $NaNO_3(s)$ will have precipitated
0% 2. $K_2CO_3(s)$ will have precipitated
0% 3. Neither Na_2CO_3 and nor KNO_3 will dissolve, and so will have settled as solids to the bottom of the solution
0% 4. Everything will dissolve, no precipitate will form, and so the solution will be clear

Concentrations before and after precipitation

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?

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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.

$$(NH_4)_2CO_3(s) \rightarrow 2\ NH_4^+(aq) + CO_3^{2-}(aq)$$
$$BaI_2(s) \rightarrow Ba^{2+}(aq) + 2\ I^-(aq)$$

$NH_4^+(aq)$	$Ba^{2+}(aq)$	$CO_3^{2-}(aq)$	$I^-(aq)$

BOSTON UNIVERSITY

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.

$$(NH_4)_2CO_3(s) \rightarrow 2\ NH_4^+(aq) + CO_3^{2-}(aq)$$
$$BaI_2(s) \rightarrow Ba^{2+}(aq) + 2\ I^-(aq)$$

$NH_4^+(aq)$	$Ba^{2+}(aq)$	$CO_3^{2-}(aq)$	$I^-(aq)$
$2 \times 0.20\ M \times 0.150\ L = 0.060\ mol$	$0.40\ M \times 0.150\ L = 0.060\ mol$	$0.20\ M \times 0.150\ L = 0.030\ mol$	$2 \times 0.40\ M \times 0.150\ L = 0.120\ mol$

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[Quiz] 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. $BaI_2(s)$
17% 2. $(NH_4)_2CO_3(s)$
17% 3. $NH_4^+(aq)$
17% 4. $Ba^{2+}(aq)$
17% 5. $CO_3^{2-}(aq)$
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.

These solutions are mixed and a precipitate forms

$$(NH_4)_2CO_3(s) \rightarrow 2\ NH_4^+(aq) + CO_3^{2-}(aq)$$
$$BaI_2(s) \rightarrow Ba^{2+}(aq) + 2\ I^-(aq)$$
$$Ba^{2+}(aq) + CO_3^{2-}(aq) \rightarrow BaCO_3(s)$$

	$Ba^{2+}(aq)$	$CO_3^{2-}(aq)$	$BaCO_3(s)$
start	0.060 mol	0.030 mol	0
change			
end			

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?

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

$$(NH_4)_2CO_3(s) \rightarrow 2\ NH_4^+(aq) + CO_3^{2-}(aq)$$
$$BaI_2(s) \rightarrow Ba^{2+}(aq) + 2\ I^-(aq)$$
$$Ba^{2+}(aq) + CO_3^{2-}(aq) \rightarrow BaCO_3(s)$$

	$Ba^{2+}(aq)$	$CO_3^{2-}(aq)$	$BaCO_3(s)$
start	0.060 mol	0.030 mol	0
change			
end			

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

$$(NH_4)_2CO_3(s) \rightarrow 2\ NH_4^+(aq) + CO_3^{2-}(aq)$$
$$BaI_2(s) \rightarrow Ba^{2+}(aq) + 2\ I^-(aq)$$
$$Ba^{2+}(aq) + CO_3^{2-}(aq) \rightarrow BaCO_3(s)$$

	$Ba^{2+}(aq)$	$CO_3^{2-}(aq)$	$BaCO_3(s)$
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

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?

Is the final solution electrically neutral?

[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 (excess total positive charge)
25% 2. will be electrically neutral (equal total positive and negative charge)
25% 3. will be negatively charged (excess total negative charge)
25% 4. More information needed

	$Ba^{2+}(aq)$	$CO_3^{2-}(aq)$	$BaCO_3(s)$
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

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. After the precipitation, the total electrical charge due to the ions remaining in solution is 0.

	Moles of ions	Moles of charge
$NH_4^+(aq)$	0.060	0.060 "+"
$I^-(aq)$	0.120	0.120 "−"
$Ba^{2+}(aq)$	0.030	0.060 "+"
Total		0

