

## Predicting precipitation reactions

### Ionic reactions of two solutions are double replacement reactions

- ▶ The ions switch partners in a double replacement reaction.
- ▶ **barium chlorate + silver sulfate**
- ▶ **barium sulfate + silver chlorate**
- ▶  $\text{Ba}(\text{ClO}_3)_2 + \text{Ag}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + \text{AgClO}_3$
- ▶ (we are not balancing yet)
- ▶ Remember there will still be a cation with an anion. You can't have 2 cations or anions together.

### Example

- ▶ Calcium Nitrate and **Potassium Phosphate**
- ▶  $\text{Ca}(\text{NO}_3)_2 + \text{K}_3\text{PO}_4 \rightarrow ?$
- ▶ It helps to say the names of the ionic compounds
- ▶ Switch partners
- ▶  $\rightarrow$  Calcium **Phosphate** and **Potassium Nitrate**
- ▶  $\rightarrow \text{Ca}_3(\text{PO}_4)_2 + \text{KNO}_3$
- ▶ What is the formula of these ionic compounds?
- ▶  $\text{Ca}(\text{NO}_3)_2 + \text{K}_3\text{PO}_4 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + \text{KNO}_3$

### Full Molecular Equation and Net Ionic Equation

- ▶  $\text{Ca}(\text{NO}_3)_2 + \text{K}_3\text{PO}_4 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + \text{KNO}_3$
- ▶ This is the **full molecular equation**.
- ▶ Write the **net ionic equation** for this reaction
- ▶ First determine what is soluble and what is insoluble

### Answer Net Ionic Equation

- ▶ This is the **full molecular equation**.
- ▶  $\text{Ca}(\text{NO}_3)_2 + \text{K}_3\text{PO}_4 \rightarrow \text{Ca}_3(\text{PO}_4)_2 + \text{KNO}_3$
- ▶  $\text{Ca}(\text{NO}_3)_2 (\text{aq}) + \text{K}_3\text{PO}_4 (\text{aq}) \rightarrow \text{Ca}_3(\text{PO}_4)_2 (\text{s}) + \text{KNO}_3 (\text{aq})$
- ▶  $\text{Ca}^{2+} + 2\text{NO}_3^- + 3\text{K}^+ + \text{PO}_4^{3-} \rightarrow \text{Ca}_3(\text{PO}_4)_2 (\text{s}) + \text{K}^+ + \text{NO}_3^-$
- ▶  $\text{Ca}^{2+} (\text{aq}) + \text{PO}_4^{3-} (\text{aq}) \rightarrow \text{Ca}_3(\text{PO}_4)_2 (\text{s})$
- ▶ This is the **net ionic equation** for this reaction
- ▶  **$3 \text{Ca}^{2+} (\text{aq}) + 2 \text{PO}_4^{3-} (\text{aq}) \rightarrow \text{Ca}_3(\text{PO}_4)_2 (\text{s})$**

### DO NOT!!!!

- ▶ A common mistake is to try and carry the subscript over from the reactant side
- ▶ It helps to say the name of the compound because you have to write the appropriate ionic formula.
- ▶  $\text{Ca}(\text{NO}_3)_2 + \text{K}_3\text{PO}_4$
- ▶  $\rightarrow \text{Ca}_2\text{PO}_4 + \text{K}_3(\text{NO}_3)_2$
- ▶ The charges don't cancel out!!!!

### Predict the full molecular and net ionic equation between

- ▶ Copper II acetate and lithium sulfite
- ▶ Ammonium oxalate and cobalt II chloride
- ▶ Aluminum nitrate and sodium carbonate
- ▶ Hydrochloric acid and silver I nitrate

### Predict the full molecular and net ionic equation between

- ▶ Copper II acetate and lithium sulfite
- ▶  $\text{Cu}(\text{CH}_3\text{COO})_2 + \text{Li}_2\text{SO}_3 \rightarrow \text{CuSO}_3 + \text{LiCH}_3\text{COO}$
- ▶  $\text{Cu}(\text{CH}_3\text{COO})_2 (\text{aq}) + \text{Li}_2\text{SO}_3 (\text{aq}) \rightarrow \text{CuSO}_3 (\text{s}) + \text{LiCH}_3\text{COO} (\text{aq})$
- ▶  $\text{Cu}^{2+} + 2 \text{CH}_3\text{COO}^- + 2 \text{Li}^+ + \text{SO}_3^{2-} \rightarrow \text{CuSO}_3 + \text{Li}^+ + \text{CH}_3\text{COO}^-$
- ▶  **$\text{Cu}^{2+} (\text{aq}) + \text{SO}_3^{2-} (\text{aq}) \rightarrow \text{CuSO}_3 (\text{s})$**

### Predict the full molecular and net ionic equation between

- ▶ Ammonium oxalate and cobalt II chloride
- ▶  $(\text{NH}_4)_2\text{C}_2\text{O}_4 + \text{CoCl}_2 \rightarrow \text{CoC}_2\text{O}_4 + \text{NH}_4\text{Cl}$
- ▶  $(\text{NH}_4)_2\text{C}_2\text{O}_4 (\text{aq}) + \text{CoCl}_2 (\text{aq}) \rightarrow \text{CoC}_2\text{O}_4 (\text{s}) + \text{NH}_4\text{Cl} (\text{aq})$
- ▶  $2 \text{NH}_4^+ + \text{C}_2\text{O}_4^{2-} + \text{Co}^{2+} + 2\text{Cl}^- \rightarrow \text{CoC}_2\text{O}_4 + \text{NH}_4^+ + \text{Cl}^-$
- ▶  $\text{Co}^{2+} + \text{C}_2\text{O}_4^{2-} \rightarrow \text{CoC}_2\text{O}_4$
- ▶  **$\text{Co}^{2+} (\text{aq}) + \text{C}_2\text{O}_4^{2-} (\text{aq}) \rightarrow \text{CoC}_2\text{O}_4 (\text{s})$**

Predict the full molecular and net ionic equation between

- ▶ Aluminum nitrate and sodium carbonate
- ▶  $\text{Al}(\text{NO}_3)_3 + \text{Na}_2\text{CO}_3 \rightarrow \text{Al}_2(\text{CO}_3)_3 + \text{NaNO}_3$
- ▶  $\text{Al}(\text{NO}_3)_3 \text{ (aq)} + \text{Na}_2\text{CO}_3 \text{ (aq)} \rightarrow \text{Al}_2(\text{CO}_3)_3 \text{ (s)} + \text{NaNO}_3 \text{ (aq)}$
- ▶  $\text{Al}^{3+} + 3\text{NO}_3^- + 2\text{Na}^+ + \text{CO}_3^{2-} \rightarrow \text{Al}_2(\text{CO}_3)_3 + \text{Na}^+ + \text{NO}_3^-$
- ▶  $\text{Al}^{3+} + \text{CO}_3^{2-} \rightarrow \text{Al}_2(\text{CO}_3)_3$
- ▶  $2\text{Al}^{3+} \text{ (aq)} + 3\text{CO}_3^{2-} \text{ (aq)} \rightarrow \text{Al}_2(\text{CO}_3)_3 \text{ (s)}$

Predict the full molecular and net ionic equation between

- ▶ Hydrochloric acid and silver I nitrate
- ▶  $\text{HCl} + \text{AgNO}_3 \rightarrow \text{HNO}_3 + \text{AgCl}$
- ▶  $\text{HCl} \text{ (aq)} + \text{AgNO}_3 \text{ (aq)} \rightarrow \text{HNO}_3 \text{ (aq)} + \text{AgCl} \text{ (s)}$
- ▶  $\text{H}^+ + \text{Cl}^- + \text{Ag}^+ + \text{NO}_3^- \rightarrow \text{H}^+ + \text{NO}_3^- + \text{AgCl}$
- ▶  $\text{Ag}^+ \text{ (aq)} + \text{Cl}^- \text{ (aq)} \rightarrow \text{AgCl} \text{ (s)}$

Predict full molecular and net ionic equation

- ▶ Copper II acetate and lithium sulfite
- ▶  $\text{Cu}(\text{CH}_3\text{COO})_2 \text{ (aq)} + \text{Li}_2\text{SO}_3 \text{ (aq)} \rightarrow \text{CuSO}_3 \text{ (s)} + \text{LiCH}_3\text{COO} \text{ (aq)}$
- ▶  $\text{Cu}^{2+} \text{ (aq)} + \text{SO}_3^{2-} \text{ (aq)} \rightarrow \text{CuSO}_3 \text{ (s)}$
- ▶ Ammonium oxalate and cobalt II chloride
- ▶  $(\text{NH}_4)_2\text{C}_2\text{O}_4 \text{ (aq)} + \text{CoCl}_2 \text{ (aq)} \rightarrow \text{CoC}_2\text{O}_4 \text{ (s)} + \text{NH}_4\text{Cl} \text{ (aq)}$
- ▶  $\text{Co}^{2+} \text{ (aq)} + \text{C}_2\text{O}_4^{2-} \text{ (aq)} \rightarrow \text{CoC}_2\text{O}_4 \text{ (s)}$
- ▶ Aluminum nitrate and sodium carbonate
- ▶  $\text{Al}(\text{NO}_3)_3 \text{ (aq)} + \text{Na}_2\text{CO}_3 \text{ (aq)} \rightarrow \text{Al}_2(\text{CO}_3)_3 \text{ (s)} + \text{NaNO}_3 \text{ (aq)}$
- ▶  $2\text{Al}^{3+} \text{ (aq)} + 3\text{CO}_3^{2-} \text{ (aq)} \rightarrow \text{Al}_2(\text{CO}_3)_3 \text{ (s)}$
- ▶ Hydrochloric acid and silver I nitrate
- ▶  $\text{HCl} \text{ (aq)} + \text{AgNO}_3 \text{ (aq)} \rightarrow \text{HNO}_3 \text{ (aq)} + \text{AgCl} \text{ (s)}$
- ▶  $\text{Ag}^+ \text{ (aq)} + \text{Cl}^- \text{ (aq)} \rightarrow \text{AgCl} \text{ (s)}$