Net Ionic Equations

Total Ionic Equation - a form of chemical equation that shows dissociated ions of soluble ionic compounds

separated

1. Balanced Chemical Equation:

$AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow NaNO_{3(aq)} + AgCl_{(s)}$

2. Total Ionic Equation (Ionic Equation):

$Ag^+_{(aq)} + NO_3^-{}_{(aq)} + Na^+_{(aq)} + Cl^-_{(aq)} \rightarrow Na^+_{(aq)} + NO_3^-{}_{(aq)} + AgCl_{(s)}$

Spectator Ions - ions that are present in a solution but are not involved in the chemical reaction (spectator ions appear on both sides of the equation)

Na^+ NO_3^-

- eliminate the spectator ions to get the net ionic equation

3. Net Ionic Equation:

$Ag^+_{(aq)} + Cl^-_{(aq)} \rightarrow AgCl_{(s)}$

Net Ionic Equation - a representation of a chemical reaction in a solution that shows only the ions involved in the chemical change

Qualitative Analysis - the process of separating and identifying ions in an aqueous solution
i.e., flame test, colour of an aqueous solution

Predicting Solubility

<u>Factors that Affect the Solubility of Ionic Substances</u>

Ion Charge - compounds of ions with small charges tend to be soluble

- increasing the charge increases the force that holds the ions together 3^+ 2^- (s) versus 1^+ 1^- (aq)

Ion Size - compounds with small ions tend to be less soluble than compounds with large ions

- small ions bond more closely together than large ions and therefore the bond between small ions is stronger than the bond between large ions with the same charge

∞ (s) (aq)

Reactions in Which Precipitates are Formed

- to predict if a precipitate might be formed by a **double displacement** reaction, we need to know if the compounds produced in the reaction are soluble or insoluble in water
- refer to solubility rules reference pg
- insoluble in water → precipitate (s)
- soluble in water → remains in solution (aq) NR no reaction

Ex.1 Write the balanced chemical equation for the reaction of aqueous magnesium chloride and calcium hydroxide.

$MgCl_{2(aq)} + Ca(OH)_{2(aq)} \rightarrow Mg(OH)_{2(s)} + CaCl_{2(aq)}$

Solubility Curves (max concentration vs. temp)

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Writing Ionic Equations and Net Ionic Equations Worksheet

Using your solubility guidelines, decide which of the following combinations of ionic compounds will produce an insoluble precipitate. Write an ionic equation and net-ionic equation for each. Pick out the spectator ions. If no precipitate forms, write NR.

1. Zinc chloride + sodium phosphate → zinc phosphate + sodium chloride

   Balanced Chemical Equation:

   $3\,ZnCl_2(aq) + 2Na_3PO_4(aq) \rightarrow Zn_3(PO_4)_2(s) + 6NaCl(aq)$

   Ionic equation:

   $3\,Zn^{2+}(aq) + 6Cl^-(aq) + 6Na^+(aq) + 2PO_4^{3-}(aq) \rightarrow Zn_3(PO_4)_2(s) + 6Na^+(aq) + 6Cl^-(aq)$

   Net ionic equation:

   $3\,Zn^{2+}(aq) + 2PO_4^{3-}(aq) \rightarrow Zn_3(PO_4)_2(s)$

   Spectator ions:

   $Na^+(aq)\ Cl^-(aq)$

2. Lead(II) nitrate + sodium sulfide → lead(II) sulfide + sodium nitrate

   Balanced Chemical Equation:

   $Pb(NO_3)_2(aq) + Na_2S(aq) \rightarrow PbS(s) + 2NaNO_3(aq)$

   Ionic equation:

   $Pb^{2+}(aq) + 2NO_3^-(aq) + 2Na^+(aq) + S^{2-}(aq) \rightarrow PbS(s) + 2Na^+(aq) + 2NO_3^-(aq)$

   Net ionic equation:

   $Pb^{2+}(aq) + S^{2-}(aq) \rightarrow PbS(s)$

   Spectator ions:

   $Na^+(aq)\ NO_3^-(aq)$

   For questions 3-5 write the balanced chemical equation, ionic equation, net ionic equation and spectator ions if there is a chemical reaction

3. Calcium chloride + ammonium hydroxide →
4. Magnesium chloride + iron(III) nitrate → NR
5. Iron(III) sulfate + lead(II) chlorate →
6. Some natural waters contain iron ions that affect the taste of water and cause rust stains. Aeration converts any iron(II) ions into iron(III) ions. A basic solution (containing hydroxide ions) is added to produce a precipitate.

a. Write the net ionic equation for the reaction of aqueous iron(III) ions and aqueous hydroxide ions.

b. What separation method is most likely to be used during this water treatment process?

3. calcium chloride (aq) + ammonium hydroxide (aq) → calcium hydroxide (s) + ammonium chloride (aq)

$CaCl_2(aq) + 2NH_4OH(aq) \rightarrow Ca(OH)_2(s) + 2NH_4Cl(aq)$

Ionic Equation:

$Ca^{2+}(aq) + 2Cl^-(aq) + 2NH_4^+(aq) + 2OH^-(aq) \rightarrow Ca(OH)_2(s) + 2NH_4^+(aq) + 2Cl^-(aq)$

Net Ionic Equation:

$Ca^{2+}(aq) + 2OH^-(aq) \rightarrow Ca(OH)_2(s)$

NH_4^+, Cl^- } spectator ions

4. Magnesium chloride + iron (III) nitrate → NR

5. iron (III) sulfate + lead (II) chlorate → iron (III) chlorate (aq) + lead (II) sulfate (s)

$Fe_2(SO_4)_3(aq) + 3Pb(ClO_3)_2(aq) \rightarrow 2Fe(ClO_3)_3(aq) + 3PbSO_4(s)$

Ionic Equation:

$2Fe^{3+}(aq) + 3SO_4^{2-}(aq) + 3Pb^{2+}(aq) + 6ClO_3^-(aq) \rightarrow 2Fe^{3+}(aq) + 6ClO_3^-(aq) + 3PbSO_4(s)$

Net Ionic Equation:

$3Pb^{2+}(aq) + 3SO_4^{2-}(aq) \rightarrow 3PbSO_4(s)$

$Pb^{2+}(aq) + SO_4^{2-}(aq) \rightarrow PbSO_4(s)$

Fe^{3+}, ClO_3^- } spectator ions

6. a) $Fe^{3+}(aq) + 3OH^-(aq) \rightarrow Fe(OH)_3(s)$

b) filtration