Chem 1390G
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Basics of Ionic Equations

Ionic compound – contains a metal + a nonmetal *or* contains ammonium ion (NH_4^+) + a nonmetal; will always be a strong electrolyte
Covalent (molecular) compound – contains two nonmetals; will be an electrolyte if it is an acid or base, strong acid or base = strong electrolyte

Precipitation reactions:
Reaction of two (usually aqueous) ionic compounds, usually forms one soluble and one insoluble product.
To write a precipitation reaction:
1. Determine the correct formulas of the reactants (usually given).
2. Determine the formulas of the products.
    a. the reactants exchange partners, polyatomic ions stay as the same polyatomic ion (*memorize* them)
    b. the charges of the ions must cancel out in the formula of each product
3. Determine which (if any) product is insoluble using the solubility rules (*memorize*, Table 4.1).
4. Balance the equation being sure only to change coefficients (*not subscripts*).
5. The equation you have just written is the molecular equation for the reaction.

Ionic equations:
Equation where all aqueous electrolytes are written out in the form of ions; may be written for precipitation, neutralization, or redox reactions.
To write an ionic equation:
1. Write out the molecular equation.
2. Rewrite the reaction but split all the aqueous species into ions.
    a. coefficients from balancing the equation apply to every ion in a compound
    b. subscripts telling the number of each ion in a compound become coefficients in the new equation
    c. polyatomic ions stay as the same polyatomic ion (*memorize* them)
3. Any solid, liquid or gaseous reactants or products remain written as entire molecules (no ions).
4. Remember to write in the charges for all the ions and the state symbols for all species.

Net ionic equations:
Remove all spectator ions from the ionic equation. Spectator ions are ions that are written out *exactly* the same in both the reactants and products; can be written for any reaction where you could write an ionic equation.
To write a net ionic equation:
1. Write out the ionic equation.
2. Circle all of the spectator ions.
3. Rewrite the equation exactly the same but leave out the spectator ions.

Examples: on back

Write molecular, ionic and net ionic equations for the reaction of sodium sulfide with iron(II) chloride.

Molecular:
1. Determine formulas of reactants:
sodium sulfide = $Na^+ + S^{2-} = Na_2S$, charges come from group of the periodic table, subscripts come from making the total + charge equal the total – charge, Na_2S will be (aq) from solubility rules (S^{2-} is insoluble, but group 1A elements such as sodium are an exception).
iron(II) chloride = $Fe^{2+} + Cl^- = FeCl_2$, iron charge is from the Roman numeral in the name, Cl^- charge is from group of the periodic table, $FeCl_2$ will be (aq) from the solubility rules (Cl^- is soluble)
2. Determine formulas of products:
a. Ions mix and match so Na^+ will be with Cl^- and Fe^{2+} will be with S^{2-}.
b. Work out formulas:
NaCl, FeS – both pairs of ions have equal but opposite charges so they can combine in a 1:1 ratio.
3. Determine states of products:
NaCl is (aq) because all group 1A ions are soluble.
FeS is insoluble because S^{2-} is insoluble.
4. Write out and balance the equation:
Na_2S (aq) + $FeCl_2$ (aq) → 2 NaCl (aq) + FeS (s)

Ionic:
2 Na^+ (aq) + S^{2-} (aq) + Fe^{2+} (aq) + 2 Cl^- (aq) → 2 Na^+ (aq) + 2 Cl^- (aq) + FeS (s)

Net ionic:
Identify spectator ions in ionic equation: Na^+, Cl^-
Write ionic equation without the spectator ions:
S^{2-} (aq) + Fe^{2+} (aq) → FeS (s)

Complete the following molecular equation and write ionic and net ionic equations: K_2CO_3 (aq) + $ZnBr_2$ (aq) → ?

Molecular:
Products will be K+Br and Zn+CO_3^{2-}, recognize CO_3^{2-} as a polyatomic ion because the compound K_2CO_3 has a metal plus more than one nonmetal.
Formulas are KBr (K is in group 1A so it is +1; Br is in Group 7A so it is –1.) and $ZnCO_3$ (Zn always has a +2 charge and CO_3^{2-} always has a –2 charge, both must be memorized.).
KBr will be soluble because all group 1A compounds are soluble and K is in group 1A. $ZnCO_3$ will be insoluble since carbonates are insoluble.
Write and balance the molecular equation: K_2CO_3 (aq) + $ZnBr_2$ (aq) → 2 KBr (aq) + $ZnCO_3$ (s)

Ionic:
2 K^+ (aq) + CO_3^{2-} (aq) + Zn^{2+} (aq) + 2 Br^- (aq) → 2 K^+ (aq) + 2 Br^- (aq) + $ZnCO_3$ (s)

Net ionic:
Spectator ions are K^+ and Br^- so eliminate them.
CO_3^{2-} (aq) + Zn^{2+} (aq) → $ZnCO_3$ (s)