MINISTRY OF EDUCATION

SECONDARY ENGAGEMENT PROGRAMME

GRADE 10

CHEMISTRY

WEEK 10 **LESSON 2**

Topic: Writing Equatiions

Sub-topic: Writing Ionic Equations

Objective: Given the information and worked examples students will write balanced net ionic equations getting at least 15 out of 20 correct.

Content

In addition to writing molecular equations for chemical reactions, we can also write complete ionic and net ionic equations.

- The molecular equation is the full balance chemical equation.
- The complete ionic equation is the entire chemical equation with *all aqueous* substances dissociated into their respective ions.
  NOTE: gases, solids, and liquids DO NOT dissociate and remain in their molecular forms.
- The net ionic equation is what is left at the end of the reaction after the spectator ions have been eliminated.

NOTE: spectator ions are ions that appear on both sides of the chemical equation that are eliminated before the *net ionic equation* is written. Like spectators at a sporting event, they are not directly involved and are therefore not part of the main attraction.

Example:

Molecular Equation:

$Co(NO_3)_2\ (aq) + 2\ NaOH\ (aq) \rightarrow 2\ NaNO_3\ (aq) + Co(OH)_2\ (s)$

Complete Ionic Equation:

$Co^{2+}\ (aq) + 2NO_3^-\ (aq) + 2Na^+\ (aq) + 2OH^-\ (aq) \rightarrow 2Na^+\ (aq) + 2NO_3^-\ (aq) + Co(OH)_2\ (s)$

Net Ionic Equation:

$Co^{2+}(aq) + 2NO_3^-(aq) + 2Na^+(aq) + 2OH^-(aq) \rightarrow 2Na^+(aq) + 2NO_3^-(aq) + Co(OH)_2(s)$

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

Notice how the net ionic equation gives you the essence of the reaction: a precipitate was formed with Co and OH reacted. It's the bottom line of the reaction.

Example 2: A typical precipitation reaction occurs when an aqueous solution of barium chloride is mixed with one containing sodium sulfate. The **complete chemical equation** can be written to describe what happens, and such an equation is useful in making chemical calculations.

$$\underbrace{BaCl_2(aq) + Na_2SO_4(aq) \longrightarrow BaSO_4(s) + 2\,NaCl(aq)}_{\text{Complete Chemical Equation}} \qquad (7.7.1)$$

However, Equation 7.7.1 does not really represent the microscopic particles (that is, the ions) present in the solution. Thus we might write below the complete ionic equation

$$\underbrace{Ba^{2+}(aq) + \overbrace{2\,Cl^-(aq)}^{\text{spectator}} + \overbrace{2\,Na^+(aq)}^{\text{spectator}} + SO_4^{2-}(aq) \longrightarrow BaSO_4(s) + \overbrace{2\,Na^+(aq)}^{\text{spectator}} + \overbrace{Cl^-(aq)}^{\text{spectator}}}_{\text{Complete Ionic Equation}} \qquad (7.7.2)$$

Equation 7.7.2 is rather cumbersome and includes so many different ions that it may be confusing. In any case, we are often interested in the independent behavior of ions, not the specific compound from which they came. A precipitate of $BaSO_4(s)$ will form when *any* solution containing $Ba^{2+}(aq)$ is mixed with *any* solution containing $SO_4^{2-}(aq)$ (provided concentrations are not extremely small). This happens independently of the $Cl^-(aq)$ and $Na^+(aq)$ ions in Equation 7.7.2. These ions are called **spectator ions** because they do not participate in the reaction. When we want to emphasize the independent behavior of ions, a **net ionic equation** is written, omitting the spectator ions. For precipitation of $BaSO_4$ the net ionic equation is

$$\underbrace{Ba^{2+}(aq) + SO_4^{2-}(aq) \longrightarrow BaSO_4(s)}_{\text{Net Ionic Equation}} \qquad (7.7.3)$$