Communicating Information in Chemical Equations

States of matter can be communicated in a balanced chemical equation.

(s) = solid

(l) = liquid

(g) = gas

(aq) = aqueous (in solution -- dissolved in water)

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Ionic Equations

-- used for ions that are in aqueous solutions

-- different from chemical equations because it shows the substances as ions in the equation

-- will almost always be double replacement reactions

-- precipitate: insoluble solid, will not dissolve in water

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Ionic Equations

Types

complete ionic equation: shows all the particles in the solution as they exist

net ionic equation: include only the particles that participate in the equation

Vocab

spectator ions: ions that do not participate in the reaction

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Ionization

-- when ionic compounds break apart into their ions

-- ions do this when they are in solution (in water)

-- (aq) means that the compound will break into its ions

examples:

NaOH (aq) $Na^+_{(aq)} + OH^-_{(aq)}$

$3CuCl_2$ (aq) $3Cu^{2+}_{(aq)} + 6Cl^-_{(aq)}$

$Al(NO_3)_3$ (aq) $Al^{3+}_{(aq)} + 3NO_3^-{}_{(aq)}$

Li_2CO_3 (aq) $2Li^+_{(aq)} + CO_3^{2-}{}_{(aq)}$

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Writing Net Ionic Equations

Step #1: Complete and balance the chemical equation (molecular equation).

$2NaOH + CuCl_2 \longrightarrow Cu(OH)_2 + 2NaCl$

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Writing Net Ionic Equations

Step #2: Determine the states of matter.

$2NaOH + CuCl_2 \longrightarrow Cu(OH)_2 + 2NaCl$

USE YOUR SOLUBILITY RULES!

$2NaOH_{(aq)} + CuCl_{2(aq)} \longrightarrow Cu(OH)_{2(s)}$ (ppt) $+ 2NaCl_{(aq)}$

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Writing Net Ionic Equations

Step #3: Write the complete ionic equation by determining what dissociates and what doesn't.

$2NaOH\ (aq) + CuCl_2\ (aq) \longrightarrow Cu(OH)_2\ (s) + 2NaCl\ (aq)$

$2Na^+_{(aq)} + 2OH^-_{(aq)} + Cu^{2+}_{(aq)} + 2Cl^-_{(aq)} \longrightarrow Cu(OH)_{2(s)}$ (ppt) $+ 2Na^+_{(aq)} + 2Cl^-_{(aq)}$

complete ionic equation

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Writing Net Ionic Equations

Step #4: Cancel out the spectator ions (the ones that are the same on both sides).

$2\ Na^+\ (aq) + 2\ OH^-\ (aq) + Cu^{2+}\ (aq) + 2\ Cl^-\ (aq) \longrightarrow Cu(OH)_2\ (s) + 2\ Na^+\ (aq) + 2\ Cl^-\ (aq)$

spectator ions

$2\ OH^-_{(aq)} + Cu^{2+}_{(aq)} \longrightarrow Cu(OH)_{2(s)}$ (ppt)

net ionic equation

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Practice

Write the molecular, complete ionic and net ionic equations for the reaction of zinc chloride and potassium sulfide.

$ZnCl_2 + K_2S \rightarrow 2KCl + ZnS$ ppt

$ZnCl_2(aq) + K_2S(aq) \rightarrow 2KCl(aq) + ZnS(s)$

$Zn^{2+}(aq) + 2Cl^-(aq) + 2K^+(aq) + S^{2-}(aq) \rightarrow 2K^+(aq) + 2Cl^-(aq) + ZnS(s)$

$Zn^{2+}(aq) + S^{2-}(aq) \rightarrow ZnS(s)$

Solubility Rules

NO_3^-	All nitrates are soluble
Cl-	All chlorides are soluble except AgCl, Hg_2Cl_2, $PbCl_2$
SO_4^{2-}	Most sulfates are soluble; exceptions include $SrSO_4$, $BaSO_4$, and $PbSO_4$, $CaSO_4$ is slightly soluble
CO_3^{2-}	All carbonates are insoluble except those in group 1 elements and NH_4^+
OH^-	All hydroxides are insoluble except those of group 1 elements, $Sr(OH)_2$ and $Ba(OH)_2$; $Ca(OH)_2$ is slightly soluble
S^{2-}	All sulfides except those of group 1 and 2 elements and NH_4^+ are insoluble

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Practice

molecular equation

$AgNO_3(aq) + KCl(aq) \rightarrow AgCl(s) + KNO_3(aq)$

$Ag^+(aq) + NO_3^-(aq) + K^+(aq) + Cl^-(aq) \rightarrow AgCl(s) + K^+(aq) + NO_3^-(aq)$ ppt

$Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$

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