

9 • Chemical Equations Equation Terms (1 of 8)

equation	condensed statement of facts about a chemical reaction.
reactants	substances that exist before a chemical reaction. Written on the left of the arrow.
products	substances that come into existence as a result of the reaction. Written to the right of the arrow.
word equation	an equation describing a chemical change using the names of the reactants and products.
coefficients	a number preceding atoms, ions, or molecules in balanced chemical equations that showing relative #'s.

9 • Chemical Equations Types of Reactions and other Terms (2 of 8)

synthesis	$A + B \rightarrow C$
decomposition	$AB \rightarrow A + B$
single replacement	$AB + C \rightarrow A + BC$
double replacement	$AB + CD \rightarrow AD + CB$
precipitate	solid that is formed during a reaction
spectator ions	ion that undergoes no chemical change during a reaction
molecular equation	equation with reactants and products written as whole molecules
ionic equation	equation with soluble salts written as individual ions
net ionic equation	equation with spectator ions removed

9 • Chemical Equations Energy Changes (3 of 8)

EXOTHERMIC

- reaction **gives off energy**
- energy is written as a product on the **right** side of arrow
- reaction mixture generally gets **warmer** or must be **cooled**
[combustion] $CH_4 + 2 O_2 \rightarrow CO_2 + 2 H_2O + \text{energy}$
[freezing] $H_2O(l) \rightarrow H_2O(s) + \text{energy}$

ENDOTHERMIC

- reaction **requires** or **takes in** energy
 - energy is written as a reactant on the **left** side of the arrow
 - reaction mixture **takes warmth** from surroundings or **must be warmed...** for example
[electrolysis of water] $2 H_2O + \text{energy} \rightarrow 2 H_2 + O_2$
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9 • Chemical Equations Showing Phases in Equations (4 of 8)

We have seen the **phases of matter** in earlier chapters. See page 212 for atomic pictures.

- | | | |
|-------------|---|---|
| (s) | solid phase | may be used to show a ppt. |
| (l) | liquid phase | |
| (g) | gaseous phase | |
| (aq) | aqueous phase -- solid or gas dissolved in water | |
| (ppt) | precipitate -- solid (s) formed during a reaction | use Appendix D or solubility rules to predict when a product is a precipitate. |
| (l) vs (aq) | sugar(l) would be melted sugar | sugar(aq) would be sugar water (dissolved) |
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9 • Chemical Equations
Molecular, Ionic, Net Ionic Equations
(5 of 8)

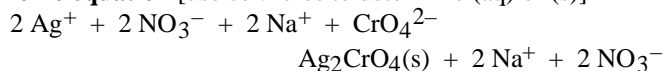
Consider the compounds: silver nitrate + sodium chromate



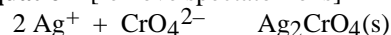
molecular equation [balance at this stage]
(use double replacement pattern to predict the products)



ionic equation [use sol. rules to determine (aq) or (s)]

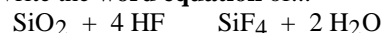


net ionic equation [remove spectator ions]



9 • Chemical Equations
Writing Word Equations
Things To Remember
(6 of 8)

Example: Write the **word equation** of...



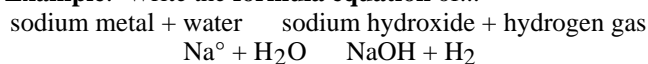
silicon dioxide + hydrofluoric acid

silicon tetrafluoride + water

- **molecular compounds** must be named using mono-, di-, tri-, tetra-, penta-, hexa-, hepta-, octa-, nona-, deca-.
 - watch for **acids** (ionic compounds ... positive ion is **H⁺**)
acid naming rules apply (-ide = hydro---ic acid, etc.)
 - **ionic compounds** do **NOT** use di-, tri-, etc. unless they are part of the ion name (e.g. **dichromate**, $\text{Cr}_2\text{O}_7^{2-}$)
ionic cmpds are named as the positive and negative ion.
Stock names may be used.
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9 • Chemical Equations
Writing Formula Equations
Things To Remember
(7 of 8)

Example: Write the **formula equation** of...

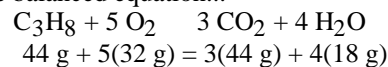


- **metals** often are written with the $^\circ$ symbol to emphasize that the metal is in the neutral elemental state, not an ion.
 - some compounds have **common names** that you should just know... water, H_2O ; ammonia, NH_3 ; methane, CH_4
 - remember the seven **diatomic** elements so they can be written as diatomic molecules when they appear in their elemental form. Other elemental substances are written as **single atoms** (e.g. sodium metal or helium gas, He)
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9 • Chemical Equations
Miscellaneous:
Law of Conservation of Mass
and Complete Combustion Reactions
(8 of 8)

The **law of conservation of mass** can be shown by comparing the **total masses of reactants** and **products**..:

Example: Show that the law of conservation of mass applies to the balanced equation...



Combustion (burning) implies a **fuel** and three chemicals: **O₂**, **CO₂**, and **H₂O**. **Example:** combustion of C_3H_8 above.

Careful when balancing: $\text{C}_2\text{H}_5\text{OH}$... Notice: 6H's and an O.

Use **fractions** to show **odd #'s** of O atoms, $\frac{3}{2} \text{O}_2 = 3$ atoms
