Chemical Equations

Unit: Chemical Reactions

NGSS Standards/MA Curriculum Frameworks (2016): HS-PS1-7

Mastery Objective(s): (Students will be able to…)

- Read, write, and interpret chemical equations.

Success Criteria:

- Equations have reactants and products on the correct sides of the arrow.
- Physical states, heat, solvents, catalysts, *etc.* are present when appropriate.

Tier 2 Vocabulary: equation

Language Objectives:

- Define the symbols used in chemical equations.

Notes:

chemical equation: a set of symbols that describe a chemical reaction. For example:

$$2\,H_2\,(g) + O_2\,(g) \xrightarrow[\Delta]{} 2\,H_2O\,(\ell) + \text{heat}$$

reactants: the starting materials; chemicals (and things like energy) that react. In a chemical equation, the reactants are before the arrow (on the left). In the above equation, the reactants are $H_2\,(g)$ and $O_2\,(g)$.

products: chemicals (and other things like energy) that are produced. In a chemical equation, the products are after the arrow (on the right). In the above equation, the products are $H_2O\,(\ell)$ and heat.

Use this space for summary and/or additional notes:

state of matter: the symbols in parentheses after a compound indicates the physical state of that compound. Some of the common ones are listed in the following table:

States of Matter Used in Chemical Equations

Symbol	Meaning
(s)	solid
(ℓ)	liquid (A script "L" is often used to avoid confusion between the letter "l" and the number "1".)
(g)	gas or vapor
(cd)	condensed phase (*i.e.,* either solid or liquid)
(fl)	fluid phase (*i.e.,* either liquid or gas)
(cr)	crystalline (solid is in the form of crystals)
(lc)	liquid crystal
(vit)	vitreous (glass-like)
(ads)	adsorbed onto a substrate
(sln)	solution
(aq)	aqueous solution (dissolved in water)
(am)	amorphous solid
(ppt)	precipitate (solid) formed by the reaction

reaction conditions: anything that doesn't take part in the reaction, but is needed to make the reaction happen. Reaction condition information is placed above and/or below the arrow. Two common ones are:

- Δ under the arrow means that heat is required in order for the reaction to take place.
- A chemical formula under the arrow usually indicates the solvent that the reaction takes place in.

For example, the equation:

$$2\,H_2\ (g) + O_2\ (g) \xrightarrow[\Delta]{} 2\,H_2O\ (\ell) + \text{heat}$$

is equivalent to the following statement:

> "Two molecules of hydrogen gas and 1 molecule of oxygen gas were heated to produce 2 molecules of liquid water and heat."

Use this space for summary and/or additional notes:

Homework Problems

Write each of the following chemical equations in words.

1. $2\ H_2\ (g) + O_2\ (g) \xrightarrow[\Delta]{} 2\ H_2O\ (\ell) + 572\ kJ$

2. $CaC_2\ (cr) + 2\ H_2O\ (\ell) \longrightarrow C_2H_2\ (g) + Ca(OH)_2\ (ppt)$

3. $2\ C_2H_2\ (g) + 5\ O_2\ (g) \xrightarrow[\Delta]{} 4\ CO_2\ (g) + 2\ H_2O\ (\ell) + 2\,600\ kJ$

4. $3\ CaCl_2\ (aq) + 2\ K_3PO_4\ (aq) \longrightarrow Ca_3(PO_4)_2\ (ppt) + 6\ KCl\ (aq)$

Use this space for summary and/or additional notes:

Write each of the following word problems as a chemical equation.

5. One molecule of silicon dioxide gas reacts with four molecules of aqueous hydrofluoric acid to produce a molecule of silicon tetrafluoride gas and two molecules of liquid water.

6. Two moles of aqueous potassium chlorate decompose to produce two moles of aqueous potassium chloride and three moles of oxygen gas.

7. Four moles of solid antimony are heated in the presence of three moles of oxygen gas to form one mole of solid antimony (III) oxide.

8. When 2 moles of liquid octane (C_8H_{18}) are burned in the presence of 25 moles of oxygen gas, 16 moles of carbon dioxide gas and 18 moles of liquid water are formed, and 10 150 kJ of heat is produced.

Use this space for summary and/or additional notes: