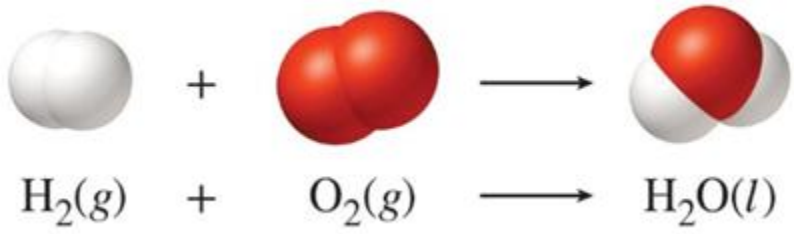
Writing and Balancing Chemical Equations

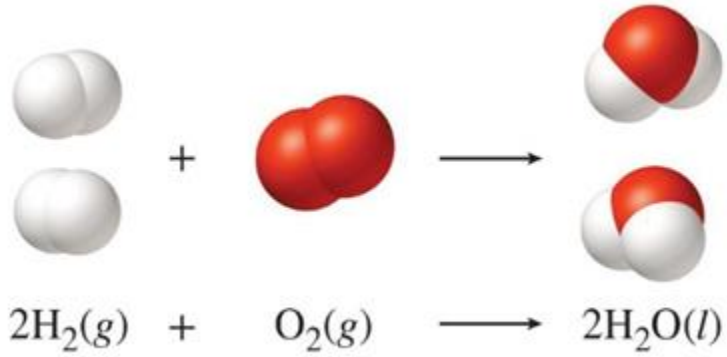
Model 1 - Writing and Balancing Chemical Equations

Chemical equations must be *balanced* so that the law of conservation of mass is obeyed.



$H_2(g) + O_2(g) \longrightarrow H_2O(l)$

Balancing is achieved by writing *stoichiometric coefficients* to the left of the chemical formulas.



$2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$

- Balancing requires a trial-and-error approach.
- Generally, it will facilitate the balancing process if you do the following:

1) Change the coefficients of compounds before changing the coefficients of elements.
2) Treat polyatomic ions that appear on both sides of the equation as units.
3) Count atoms and/or polyatomic ions carefully, and track their numbers each time you change a coefficient.

Writing and Balancing Chemical Equations

Sample Problem:

Within the cylinders of a car's engine, the hydrocarbon octane (C_8H_{18}), one of many components of gasoline, mixes with oxygen from the air and burns to form carbon dioxide and water vapor. Write a balanced equation for this reaction.

PLAN:

translate the statement

balance the atoms

adjust the coefficients

check the atoms balance

specify states of matter

SOLUTION:

$C_8H_{18} + O_2 \rightarrow CO_2 + H_2O$

$C_8H_{18} + \frac{25}{2}O_2 \rightarrow 8\,CO_2 + 9\,H_2O$

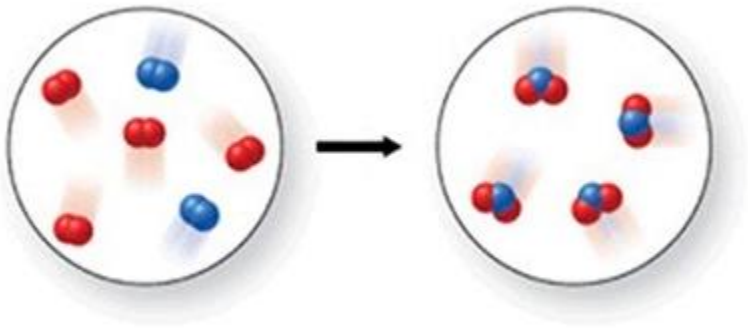
$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$

$2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$

$2C_8H_{18}(l) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(g)$

Exercises:

1. The following figure represents a chemical reaction between elements A and B. Which of the following best represents the balanced equation for the reaction? Be able to explain your reasoning.



A) $4A + 8B \rightarrow 12AB$

B) $2A_2 + 4B_2 \rightarrow 4A_2B$

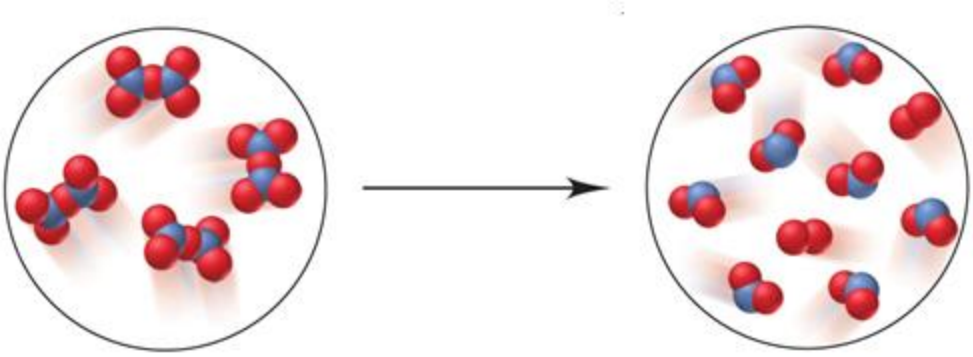
C) $2A_2 + 4B_2 \rightarrow 4AB_2$

D) $A_2 + B_2 \rightarrow AB_2$

E) $A_2 + 2B_2 \rightarrow 2AB_2$

Writing and Balancing Chemical Equations

2. The following molecular scenes depict an important reaction in nitrogen chemistry. The blue spheres represent nitrogen while the red spheres represent oxygen. Write a balanced equation for this reaction.



3. Write balanced equations for each of the following by inserting the correct coefficients in the blanks:

a.) ____$Cu(NO_3)_2(aq)$ + ____$KOH(aq)$ → ____$Cu(OH)_2(s)$ + ____$KNO_3(aq)$

b.) ____$BCl_3(g)$ + ____$H_2O(l)$ → ____$H_3BO_3(s)$ + ____$HCl(g)$

c.) ____$CaSiO_3(s)$ + ____$HF(g)$ → ____$SiF_4(g)$ + ____$CaF_2(s)$ + ____$H_2O(l)$

d.) ____$(CN)_2(g)$ + ____$H_2O(1)$ → ____$H_2C_2O_4(aq)$ + ____$NH_3(g)$

e) ____$SO_2(g)$ + ____$O_2(g)$ → ____$SO_3(g)$

f) ____$Sc_2O_3(s)$ + ____$H_2O(l)$ → ____$Sc(OH)_3(s)$

g) ____$H_3PO_4(aq)$ + ____$NaOH(aq)$ → ____$Na_2HPO_4(aq)$ + ____$H_2O(l)$

h) ____$C_6H_{10}O_5(s)$ + ____$O_2(g)$ → ____$CO_2(g)$ + ____$H_2O(g)$

Writing and Balancing Chemical Equations

4. Convert the following into balanced chemical equations:

a.) When lead (II) nitrate solution is added to a solution of potassium iodide, solid lead (II) iodide forms and potassium nitrate remains in solution.

b.) Liquid disilicon hexachloride reacts with liquid water to form solid silicon dioxide, hydrogen chloride gas, and hydrogen gas.

c.) When nitrogen dioxide is bubbled into water, a solution of nitric acid forms and gaseous nitrogen monoxide is released.

d.) potassium hydroxide and phosphoric acid react to form potassium phosphate and water.

e.) ammonium nitrate reacts to form nitrogen gas and water.

f.) carbon dioxide and potassium hydroxide react to form potassium carbonate and water.