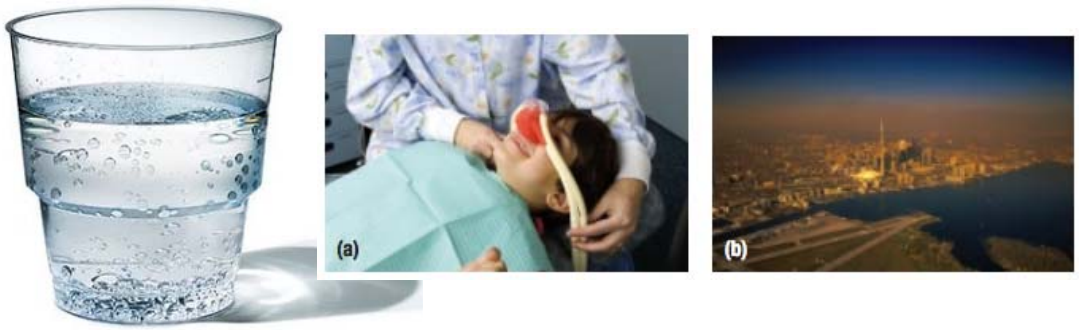
Grade 10 Science

Chemical Reactions

Class 2

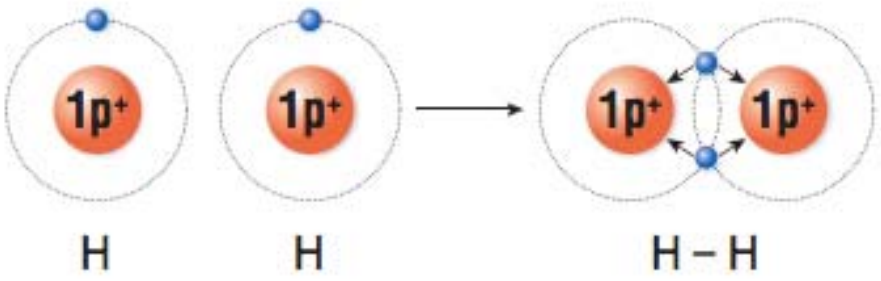
Covalent Molecules

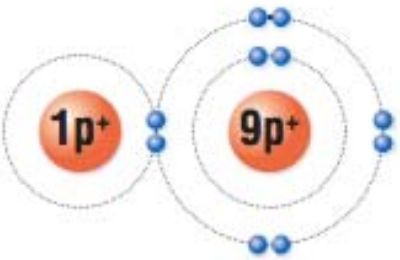
- Covalent Molecules – a pure substance formed from two or more non-metals
  - Ex: H_2O, N_2O (anaesthesia), NO_2 (smog)



Covalent Bonds

- Covalent bond – the bond between non-metals
  - Share electrons because neither has a strong enough attraction for the other's electrons
- **Diatomic Molecules** – molecules that consist of two atoms joined with a single covalent bond
  - Ex: I_2 Br_2 Cl_2 F_2 O_2 N_2 H_2
    (I Bring Clay For Our New House)





Naming Covalent Molecules

- Name CO_2
  1. Write the name of the elements.

     Carbon Oxygen

  2. Add a prefix to represent the number of atoms.

     Carbon dioxygen

  3. Change the ending to –ide.

     Carbon dioxide

Number	Prefix
1	Mon(o)-
2	Di-
3	Tri-
4	Tetr(a)-
5	Pent(a)-
6	Hex(a)-
7	Hept(a)-
8	Oct(a)-
9	Non(a)-
10	Dec(a)-

Writing Molecular Formulas

- Write the molecular formula for sulfur dioxide
  1. Write the element symbol.

     S O

  2. Add subscripts to the symbol for the prefix.

     S_1 O_2 = SO_2

  3. Do not simplify covalent compounds.

Checkpoint

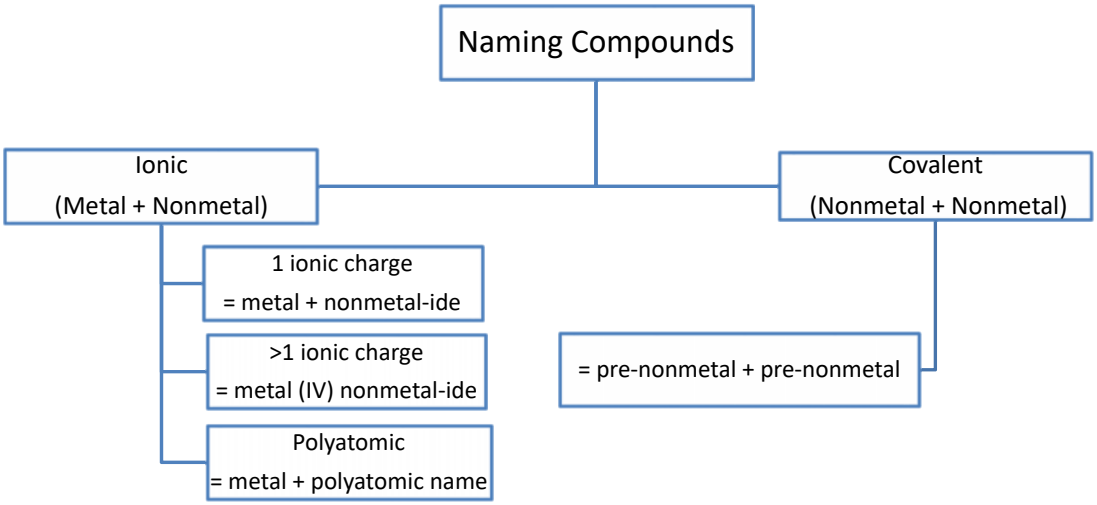
Name the following:

a) CO
b) PF_5
c) N_2O

Write the chemical formula:

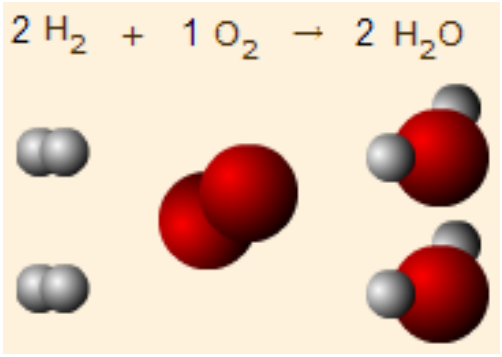
d) Sulfur tetroxide
e) Dinitrogen tetroxide
f) Carbon disulfide

Summary



Law of Conservation of Mass

- In any given reaction, the total mass of the reactants equals the total mass of the products
- Atoms cannot be created or destroyed



Chemical Reactions

	Reactants	yields	Products
Word equation:	iron + sulfur	→	iron(II) sulfide + energy
Chemical equation:	Fe + S	→	FeS + energy

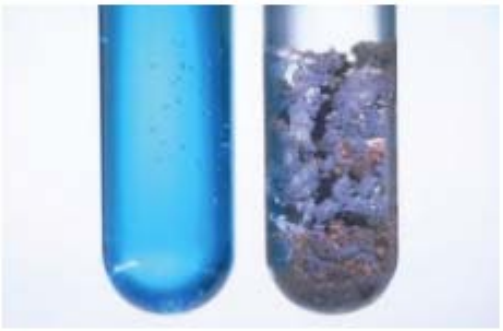
- Chemical reactions creates a chemical change
- Reactants – the materials used up
- Products – the materials made

State Symbols

- State symbols are often written behind the chemical formula to indicate the state of the substance

$$Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s) + \text{energy}$$

State symbol	Meaning
(s)	solid
(l)	liquid
(g)	gaseous
(aq)	aqueous (dissolved in water)



Balancing Equations

Skeleton Question: $H_2 + Cl_2 \rightarrow HCl$

Number of Atoms: 2H + 2Cl 1H + 1Cl

Add Coefficients: $H_2 + Cl_2 \rightarrow 2HCl$

*Coefficients vs. Subscripts

- Coefficients give the ratio of reactants and products in a **reaction**
- Subscripts give the ratio of elements in a **chemical formula** and cannot change in a reaction

Checkpoint

Balance the following chemical reactions:

a) __K_2O → __K + __O_2

b) __$KClO_3$ → __KCl + __O_2

c) __$AlCl_3$ + __Na_2CO_3 → __$Al_2(CO_3)_3$ + __NaCl

d) __NaOH + __H_2SO_4 → __Na_2SO_4 + __H_2O

e) __N_2O_5 → __N_2O_4 + __O_2

Checkpoint

Write the balanced chemical reaction of:

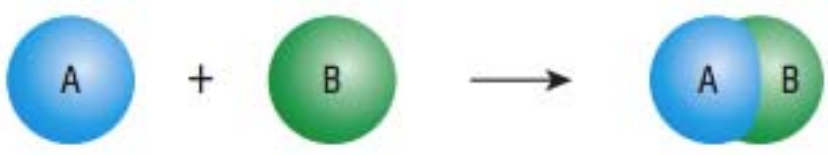
a) Magnesium with oxygen

b) Methane (CH_4) burns in oxygen to produce carbon dioxide and water

c) Zinc metal reacts in silver nitrate solution to produce zinc nitrate and silver metal

Types of Chemical Reactions

- Synthesis – 2 reactants → 1 product



- Decomposition – 1 reactant → 2 products

Types of Chemical Reactions

- Synthesis
- Decomposition
- Single Displacement
- Double Displacement
- Combustion
- Neutralization

Applications of Decomposition

- Airbags
  - Contain Sodium Azide (NaN_3)
  - During an accident, electricity triggers the decomposition of Sodium Azide to produce Nitrogen gas and Sodium metal

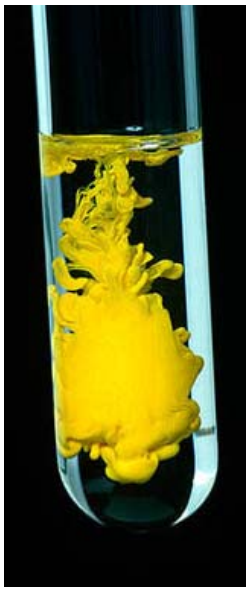
$2NaN_3 \rightarrow 3N_2(g) + 2Na(s)$

Types of Reactions

- Single Displacement - A + BC → AC + B

- Double Displacement – AB + CD → AD + CB

Precipitate



- Precipitate – a solid formed from the reaction of two solutions
- Many double displacement reactions form a precipitate

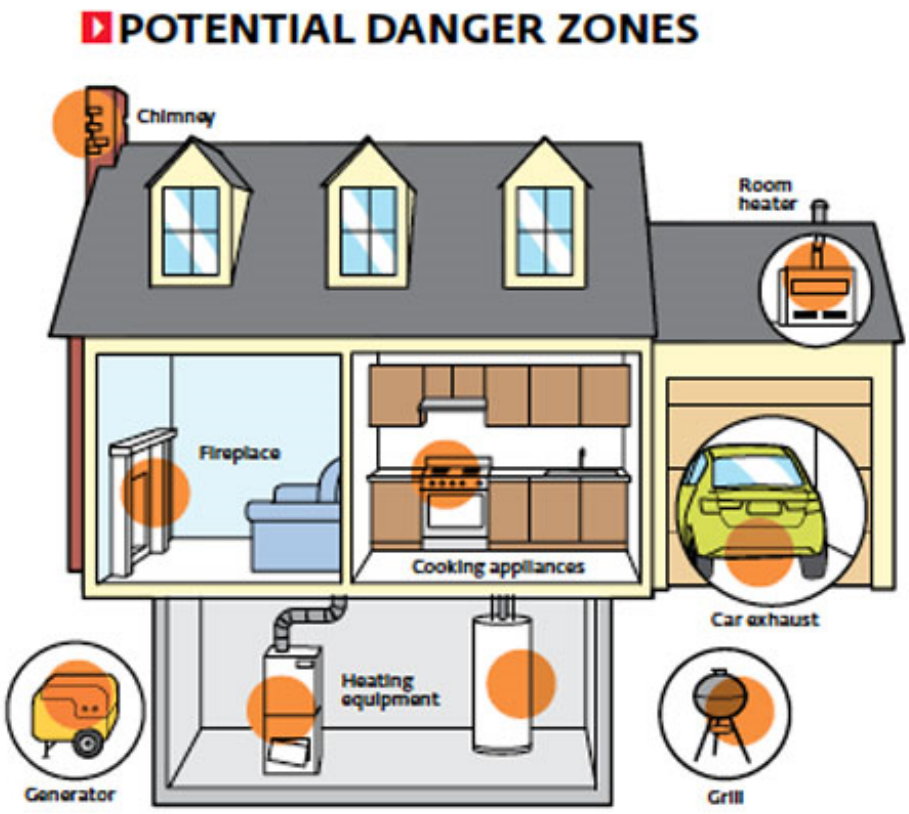
$Pb(NO_3)_2\,(aq) + 2KI(aq) \rightarrow$
$\mathbf{PbI_2(s)} + 2KNO_3(aq)$

Combustion of Hydrocarbons

- **Complete Combustion** – occurs when there is enough oxygen to form CO_2, water and energy
  - Ex: $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$ + energy
- **Incomplete Combustion** – occurs where oxygen supply is limited to form CO_2, CO, carbon soot, water and energy
  - Ex: $C_4H_{10} + 5O_2 \rightarrow 2CO_2 + 5H_2O + CO + C$ + energy

Dangers of Carbon Monoxide

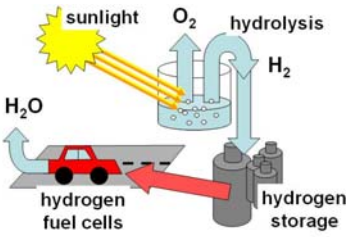
- Carbon monoxide displaces oxygen in the blood and deprives the heart, brain, and other vital organs of oxygen
- Carbon monoxide is colourless, odourless, and tasteless
- Symptoms of Carbon monoxide poisoning:
  - Headache
  - Fatigue
  - Dizziness
  - Drowsiness



Carbon Monoxide: Silent Killer

- On Oct. 24, 1993, Robert Latimer killed his 13-year old daughter Tracy by placing her in the family truck and piping the exhaust fumes containing carbon monoxide into it
- Tracy had a severe form of cerebral palsy and suffered considerable pain
  - Father killed her to relieve her of her pain
- Triggered debates around health ethics and euthanasia

Other Forms of Combustion



Combustion of Hydrogen

$2H_2(g) + O_2(g) \rightarrow 2H_2O(g) + \text{energy}$

- Hydrogen is the fuel; derived from the reverse reaction

Combustion of Phosphorus

$P_4(s) + 5O_2(g) \rightarrow P_4O_{10}(g) + \text{energy}$

- Red phosphorus is on the striking strip of a matchbox; heat ignites the chemicals in the head of the match

Checkpoint

Balance the following combustion reactions:

a) Propane (C_3H_8)

b) Ethene (C_2H_4)

c) Octane (C_8H_{18})

Corrosion

- Corrosion – the breakdown of a metal due to chemical reactions with its environment
- Benefits of Corrosion:
  - Ex: Al_2O_3 is a hard substance that prevents the underlying aluminum metal from corroding
  - Ex: Patina – the green coating that forms when copper is exposed to air

Disadvantages of Corrosion:

- Rust (Fe_2O_3) – corrosion of iron when exposed to water and oxygen
  - – Rust is porous and flakes off allowing further corrosion to occur until the underlying metal is completely corroded
  - – Salt speeds up the process

Preventing Corrosion

- **Protective Coatings** – cover the metal with paint, chrome or plastic coating
- **Corrosion-Resistant Materials** – use plastic or alloys (stainless steel – iron, carbon, nickel and chromium)
- **Galvanizing** – steel coated with a thin layer of zinc; zinc corrodes and forms a protective oxide layer

Checkpoint

Balance and classify the following reactions:

a) __Al + __$CuCl_2$ → __$AlCl_3$ + __Cu

b) __H_2O → __H_2 + __O_2

c) __Cu + __Cl_2 → __CuCl

d) __$SrCl_2$ + __Al_2O_3 → __SrO + __$AlCl_3$

e) __C_6H_{14} + __O_2 → __CO_2 + __H_2O