

## Significant Digits

- Significant Digits: the digits we know for certain or precisely plus an estimated digit which accounts for errors
- GENERAL RULES AND DEALING WITH ZEROS

- All digits 1-9 count as a significant digit
- Leading zeros are NOT significant digits

0.07206

4 sig. figs.

020113

5 sig. figs.

- Trailing zeros (to the right of the decimal) DO count as significant digits

0.02080000

5 sig. figs.

9000

3 sig. figs.

- ONLY round to the answer to correct significant digits when the entire problem is solved
  - Significant digits is your very last step in completing all calculations
- ADDITION AND SUBTRACTION RULES

- Out of all the numbers being added/subtracted, the number that has the least amount of decimal places (ie. least precise) is the number that determines the significant digits for the record answer
- When adding/subtracting, the significant digits are determined only by the number of decimal places

$$\begin{array}{r} 627.1 \\ + 659 \quad \leftarrow \text{least precise} \\ + 27.25 \\ \hline 1313.35 \end{array}$$

correct sig figs  $\Rightarrow$  1313

$$\begin{array}{r} 536.1 \quad \leftarrow \text{least precise} \\ - 64.039 \\ \hline 472.061 \end{array}$$

correct sig. figs  $\Rightarrow$  472.1

or 4.721 x 10<sup>2</sup>



# Review

## Binary Compounds

- Name the metal first (elements found on the left side of the staircase line on periodic table)
- Name the non-metal last, giving an "ide" ending to the non-metal. Non-metals are found on the right side of the staircase line on the periodic table
- Use the prefix below when necessary
  - mono - 1 (often not used)
  - di - 2
  - tri - 3
  - tetra - 4
  - penta - 5
  - hexa - 6
  - poly - many
- Examples

NaCl sodium chloride

CO<sub>2</sub> carbon dioxide

CO carbon monoxide

AlBr<sub>3</sub> aluminum bromide

calcium oxide CaO

copper (II) chloride CuCl<sub>2</sub>

silicon dioxide SiO<sub>2</sub>

## Ionic Compounds

- Positive ions (cations) are usually metals
  - sodium ion Na<sup>+</sup>
  - zinc ion Zn<sup>2+</sup>
- Negative ions (anions) are non-metals
  - chlorine Cl<sup>-</sup>
  - sulphide ion S<sup>2-</sup>
  - simple anions end in "ide"

# Review

- Complex (or polyatomic) ions are a group of atoms that act as a unit, carrying either a positive or negative charge

ammonium  $\text{NH}_4^+$

hydroxide ion  $\text{OH}^-$

cyanide ion  $\text{CN}^-$

- Complex anions usually have a "ate" or "ite" ending

sulphate ion  $\text{SO}_4^{2-}$

sulphite ion  $\text{SO}_3^{2-}$

nitrate ion  $\text{NO}_3^-$

nitrite ion  $\text{NO}_2^-$

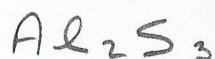
- Do not need to memorize these complex ions, found in the data book

- Naming and formulas

- Write/name the positive ion first and the negative ion last
- Balance the positive charges and the negative charges because compounds are electrically neutral with no charge

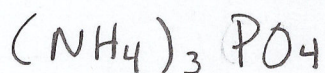
- Examples

1. Write the chemical formula and name the compound formed between aluminum and sulphur.



aluminum sulphide

2. Write the chemical formula and name the compound formed between the ammonium ion ( $\text{NH}_4^+$ ) and the phosphate ion ( $\text{PO}_4^{3-}$ ).

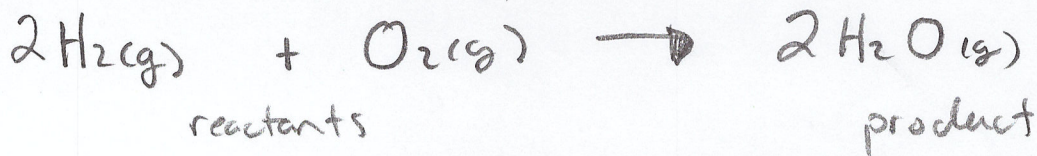


ammonium phosphate

## Chemical Reactions and Equations

### Chemical Equations

- Substances reacting (reactants) are written on the left side of an arrow
- Substance produced (products) are written on the right side of an arrow
- The brackets following each substance represent the phase
  - (g) - gas phase
  - (l) - liquid phase
  - (s) - solid phase
  - (aq) - aqueous/in water solution
- Example

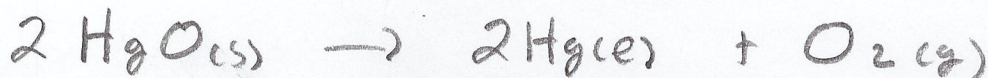


### Types of Reactions

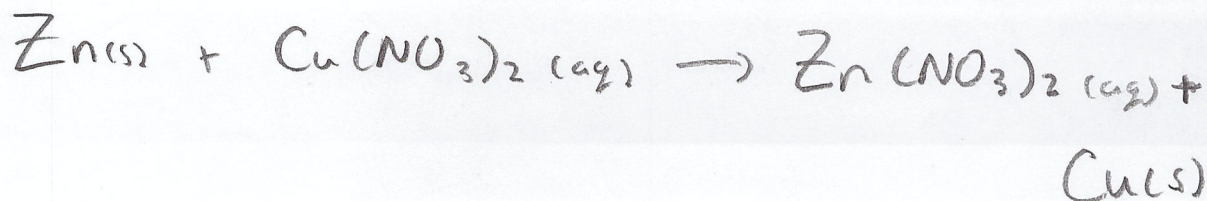
- Simple Composition or Formation
  - Two elements combine to form a compound



- Simple Decomposition
  - A compound decomposes into two elements

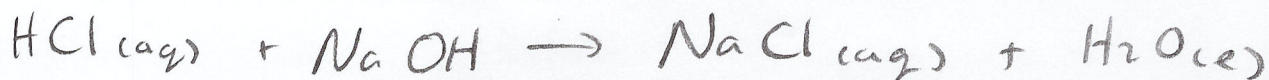


- Single Replacement
  - An element and a compound react to form a different element and compound



# Review

- Double Replacement
  - Two compounds react to form two new compounds



- Combustion
  - A hydrocarbon reacts with oxygen gas to form carbon dioxide gas and water vapour



## Balanced Equations

- All atoms are conserved; for every type of atom on the reactant side, there must be an equal number on the product side
- Coefficients are the numbers out in front of each element/compound that must be written in to balance the equation
- Example: Write out the balanced reaction for the combustion of propane ( $\text{C}_3\text{H}_8\text{(g)}$ ).



## **Stoichiometry**

### Molecular Molar Mass (Molar Mass)

- The molar mass is simply the sum of the masses of all atoms found in a mole of molecules (measured in grams)
  - 1 mole =  $6.02 \times 10^{23}$  molecules
- Molar mass is recorded as two decimal places because the atomic masses on the periodic table are to two decimal places

# Review

- Example: What is the molar mass of carbon dioxide?



$$\text{C}: 12.01 \text{ g/mol} \times 1 \text{ mol}$$

$$+ \text{O}: 16.00 \text{ g/mol} \times 2 \text{ mol}$$

$$\boxed{44.01 \text{ g/mol}}$$

## Moles and Mass

- Molar mass is a weight, measured in grams/mol
- Moles is a specific number of particles/molecules (measured in mol)
- Molecules is how many particles/molecules there are in total (no units)
- Formula

$$m = Mn$$

where

m is the mass of substance (grams -g)

M is the molar mass of the substance  
(g/mol)

n is the amount of moles (mol)

- Example: How many moles are in 5.56g of chlorine gas?

$$m = Mn$$

$$\frac{m}{M} = n$$

$$\frac{5.56 \text{ g}}{70.90 \text{ g/mol}} = n$$

$$\rightarrow \boxed{0.0784 \text{ mol} = n}$$

↓



$$M = 35.45 \text{ g/mol} \times 2 \text{ mol}$$

$$M = 70.90 \text{ g/mol}$$

## Stoichiometry

- Need to use a balanced reaction to determine the amount of a product produced or the amount of reactant required
  - "want over have"
  - comparison of the number of moles
  - need to consider the coefficients in the balance reaction

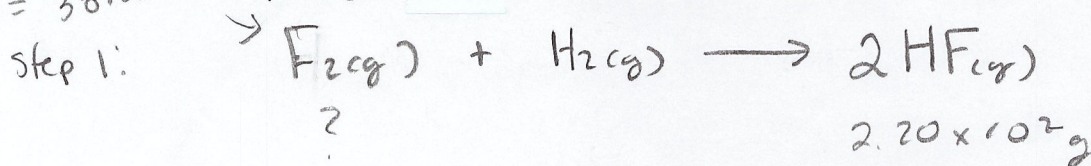
# Review

## • Examples:

1. What mass of fluorine gas is required to produce  $2.20 \times 10^2$  g of hydrogen fluoride?

$$M = 2 \times 19.00 \\ = 38.00$$

$$M = 1.01 + 19.00 \\ = 20.01$$



Step 2: Find # of moles

$$n = \frac{m}{M} = \frac{2.20 \times 10^2 \text{g}}{20.01 \text{g/mol}} = 10.9945 \text{ mol}$$

Step 3: "want over have" ratio

$$n_{\text{F}_2} = \left(\frac{1}{2}\right) (10.9945 \text{ mol}) = 5.49725 \text{ mol}$$

Step 4: Convert moles into mass

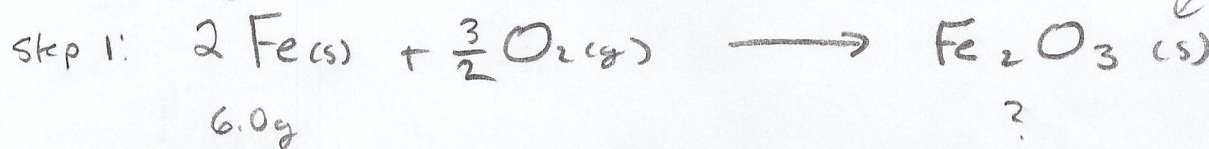
$$m_{\text{F}_2} = nM = (5.49725 \text{ mol}) ($$

$$m_{\text{F}_2} = 209 \text{ g}$$

2. Iron reacts with oxygen to produce rust (iron(III) oxide). If 6.0g of your car (which is iron) has rusted, find the mass of iron(III) oxide produced?

$$M = 55.85 \\ \text{g/mol}$$

$$M = 2 \times 55.85 \\ + 3 \times 16.00 \\ \hline 159.70 \\ \text{g/mol}$$



Step 2:

$$n = \frac{m}{M} = \frac{6.0\text{g}}{55.85 \text{g/mol}} = 0.107 \text{ mol}$$

Step 3:

$$n_{\text{Fe}_2\text{O}_3} = \left(\frac{1}{2}\right) 0.107 \text{ mol} = 0.0537 \text{ mol}$$

Step 4:

$$m_{\text{Fe}_2\text{O}_3} = nM = (0.0537 \text{ mol}) (159.70 \text{g/mol})$$

$$m_{\text{Fe}_2\text{O}_3} = 8.6 \text{ g}$$