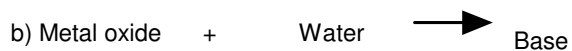
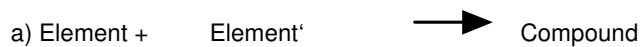


UNIT ONE SOME TYPES OF CHEMICAL REACTIONS

1) COMBINATION REACTIONS:



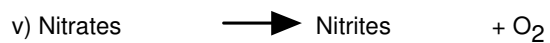
2) DECOMPOSITION REACTIONS:

(The starting material must be a compound; the products may be elements or compounds)

a) Binary compounds:

b) Decomposition of compounds containing polyatomic ions:

Rules:



(OVER)

3) SINGLE REPLACEMENT REACTIONS:
(A more active element displaces a less active element)
ACTIVITY SERIES:

4) DOUBLE- DISPLACEMENT REACTIONS (METATHESIS or ION-EXCHANGE REACTIONS):
(This type of reactions will take place if a precipitate, gas, or a weakly ionized compound (as water, weak acid or weak base) is formed .

5) COMBUSTION REACTIONS:

STOICHIOMETRY: CHEMICAL FORMULA

Consider the compound, Cl_2O_7 , dichlorine heptoxide, to answer the questions given below:

(Molar mass: Cl= 35.50, O=16.00 g/mole)

1) The number of moles of chlorine atoms that would combine with 0.056 mole O atoms.

1) Ans: 0.016 mole Cl

2) The moles of chlorine atoms that would produce 0.129 mole Cl_2O_7 molecules.

2) Ans: 0.258 mole Cl

3) The grams of oxygen that would combine with 1.88 grams of chlorine.

3) Ans: 2.97 g O

4) The grams of chlorine that would combine with 0.380 mole oxygen atoms.

4) Ans: 3.85 g Cl

5) The number of chlorine atoms in 8 moles Cl_2O_7 .

5) Ans: 1×10^{25} atoms Cl

6) The number of oxygen atoms that are needed to produce 0.256 mole Cl_2O_7 .

6) Ans: 1.08×10^{24} atoms O

7) The grams of oxygen that would produce 13.4 g Cl_2O_7 molecules.

7) Ans: 8.20 g O

8) The mass of oxygen required to produce 17.4×10^{25} molecules Cl_2O_7 .

8) Ans: 3.24×10^4 g O

STOICHIOMETRY: CHEMICAL EQUATION

A) PROBLEMS: SET 1

1) LIMITING REAGENT :

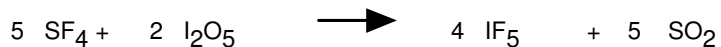
A reaction mixture containing 72.00 g SF₄ and 80.00 g I₂O₅ is allowed to react completely.

a) Calculate the mass of IF₅ produced after the reaction is complete

a) Find the reactant left over after the reaction is complete.

b) Calculate the mass of the left over reactant.

(Molar mass: SF₄ = 108.0, I₂O₅ = 333.8, IF₅ = 221.9, SO₂ = 64.00 g/mole)



- a) The reactant left over is _____
b) The mass of the left over reactant is _____
c) The mass of IF₅ produced is _____

2) LIMITING REAGENT AND PERCENT YIELD:

The reaction of 113.4 g of I_2O_5 with 132.2 g of BrF_3 is found to produce 97.0 g of IF_5 . The reaction is:



(Molar mass: $I_2O_5 = 333.8$, $BrF_3 = 136.9$, $IF_5 = 221.9$, $O_2 = 32.00$, $F_2 = 38.00$)

What is the percent yield of IF_5 .

The percent yield is _____

3) A 0.8640 g sample of a compound containing only C, H, and O is burned in a combustion apparatus. The mass of CO_2 produced is 1.727 g, and the mass of H_2O produced is 0.7068 g. What is the empirical formula of the compound?

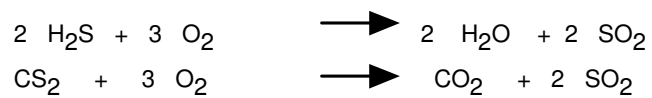
4) By analysis, a compound with the formula, AsH_3O_x , is found to contain 52.78 % by mass arsenic. What is the value of the integer, x ?

5) A certain compound contains only lead, carbon and hydrogen. if it contains 64.07 % lead by mass, and if there are **two** carbon atoms present for every **five** hydrogen atoms, what is the empirical formula ?

6) A mixture consists of 22.0 % $\text{Cu}(\text{NO}_3)_2$ and 78.0 % $\text{Fe}(\text{NO}_3)_3$ by mass. What is the total number of nitrate **ions** in 25.00 g of mixture?

7) A certain alloy of Au, Cu, and Ni contains these elements in the atomic proportions 3: 2: 1 , respectively. What is the mass, in grams, of this alloy containing a total of 1.00×10^{24} atoms?

8) A sample of a mixture of H_2S and CS_2 is burned in oxygen. The equations for the reactions are:



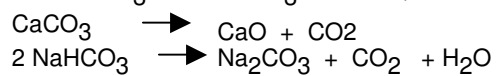
7.32 g of SO_2 , and 0.577 g of CO_2 are produced along with some H_2O .

a) What percentage, by mass, of the original sample is H_2S ?

b) What is the percent CS_2 in the mixture?

B) PROBLEMS: SET 2

1) A sample of mixture of CaCO_3 and NaHCO_3 is heated, and the compounds decomposed as follows:



The decomposition of the sample produced 3.52 g CO_2 and 0.873 g H_2O . (Molar mass: CaCO_3 100.1, CaO =56.1, CO_2 =44.00, NaHCO_3 =84.00, Na_2CO_3 =106.0, H_2O =18.00 g/mole)

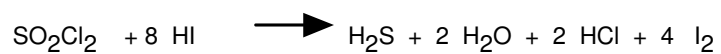
a) What was the mass of CaCO_3 in the sample?

b) Calculate the % CaCO_3 in the mixture.

2) A certain alloy of Sn, Pb, and Bi contains these elements in the atomic proportions, 2 : 4: 3, respectively. What is the mass, in grams, of a sample of this alloy containing a total of 5.00×10^{20} atoms?

- 3) A 7.221 g sample of a compound containing only C, H, and S is burned completely in oxygen. The products are CO_2 , H_2O and SO_2 . If the mass of CO_2 is 6.601 g and that of H_2O is 5.406 g :
- Calculate the mass of SO_2 produced.
 - What is the empirical formula of the compound?
 - Balance the equation for the above reaction.

4) 50.0 g of SO_2Cl_2 and 200.0 g of HI are allowed to react according to the equation:



(Molar mass : $\text{SO}_2\text{Cl}_2 = 135.0$, $\text{HI} = 127.9$, $\text{H}_2\text{S} = 34.00$, $\text{H}_2\text{O} = 18.00$, $\text{HCl} = 36.50$, $\text{I}_2 = 253.0$ g/mole)

What is the percent yield, if 148.0 g of I_2 is produced?

5) A mixture consists of KCl and SrCl_2 only. The percent KCl is 42.00 %. What is the total number of chloride ions in 425.0 g of the mixture? (Molar mass: $\text{KCl} = 74.60$, $\text{SrCl}_2 = 158.6$)

6) By analysis, a compound with the formula, $C_3H_6O_x$, is found to contain 48.6 % by mass carbon. What is the value of the integer, x ?

7) A certain compound contains only carbon, hydrogen and oxygen. If it contains 47.4 % by mass carbon, and if there is **one** oxygen atom present for every **four** hydrogen atoms, what is the empirical formula?

8) Treatment of 10.00 g of XCl_2 with excess chlorine forms 12.55 g XCl_4 . Calculate the molar mass of the element, X.

9) A carbon containing compound is treated chemically to convert all its carbon into CaC_2O_4 (s). A 17.88 g sample of the compound gave 15.04 g CaC_2O_4

a) What is the percent of carbon in the compound?

b) Calculate the molar mass of the compound, if there are 7 carbon atoms in each molecule of the compound. (Molar mass : $CaC_2O_4 = 128.08$ g/mole) .

10) A compound contains 42.85 % chlorine. If it is found that **each** molecule of the compound contains **four** atoms of chlorine, what is the molar mass of the compound?

11) 67.72 g of a compound of N, As, and O is subjected to chemical analysis. All nitrogen in the compound is converted to $\text{NH}_3(\text{g})$. The mass of $\text{NH}_3(\text{g})$ produced is 8.192 g. Another sample of the same compound is found to contain 71.07 % by mass arsenic. Calculate the empirical formula of the compound.

- 12) 3.9104 g sample of a compound composed of carbon, hydrogen, nitrogen, and oxygen is burned completely. 3.820 g CO_2 and 3.125 g H_2O are produced. Analysis of nitrogen showed that the compound contain 46.62 % by mass nitrogen. The molar mass of the compound is about 170 ± 15 g/mole.
- Calculate the empirical formula of the compound.
 - What is the molecular formula of the compound?

- 13) Suppose that 50.32 g of a metal nitride, M_3N_5 , reacts with H_2 to produce the metal, M, and 9.550 g NH_3 only.
- Write a balanced equation for the reaction.
 - Calculate the molar mass of the metal, M.

