Reactions and Balancing Key

1. What are the 3 things conserved during a chemical reaction?

mass, charge, & energy

2. How would you identify if something is a physical or a chemical change from a chemical equation?

formulas of reactants & products are different in chem. change

3. Balance each of the following chemical equations and identify the type of reaction:

a. 2 $Fe(OH)_3$ → ___ Fe_2O_3 + 3 H_2O ① Balance Fe 1st -type: decomp.

Fe: ≠2 / O: ≠6 / H: ≠6 → Fe: 2 / O: ≠6 / H: ≠6

② Balance H b/c only in 1 product

③ Balance O.

b. nitrogen gas combines with hydrogen to produce ammonia (NH_3) -type: Synth.

(*) Don't forget about diatomic elements

N_2 + 3 H_2 → 2 NH_3

N_2 diatomic

(*) Keep polyatomic ion together

c. 2 Fe + 3 H_2SO_4 → 3 H_2 + ___ $Fe_2(SO_4)_3$ -type: single replace.

Fe: ≠2 / H: ≠6 / SO_4: ≠3 → Fe: 2 / H: ≠6 / SO_4: 3

d. ___ $MgCl_2$ + 2 $AgNO_3$ → 2 AgCl + ___ $Mg(NO_3)_2$ -type: double replace.

Mg: 1 / Cl: 2 / Ag: ≠2 / NO_3: ≠2 → Mg: 1 / Cl: ≠2 / Ag: ≠2 / NO_3: 2

e. 2 C_4H_{10} + 13 O_2 → ~~8~~ 8 CO_2 + ~~10~~ 10 H_2O -type: combustion

C: ≠8 / H: ≠20 / O: ≠13 → C: ≠8 / H: ≠20 / O: ≠26

(*) For combustion, balance C, then H, then O. double products & balance O.

Moles

4. Calculate the percent composition of oxygen in $C_4H_8O_4$. (gfm = 120.0 g/mol)

O: 4 × 16.0 = 64.0g

$$\%O = \frac{\text{mass O in compound}}{\text{gfm compound}} \times 100\% = \frac{64.0}{120.0} \times 100 = \boxed{53.3\%}$$

5. What is the mass of 5.00 moles of Fe_2O_3? (gfm = 159.6 g/mol)

moles → mass

1 mol = gfm

1 mol = 159.6g

$$5.00\ \text{mol} \times \frac{159.6\ \text{g}}{1\ \text{mol}} = \boxed{798\ \text{g}}$$

3 sf × 4 sf = 3 sf

(*) For × or ÷, round answer to # of s.f. as the value w/ fewest s.f.

6. How many moles of argon gas are present in 11.2 L? (gfm = 39.9 g/mol)

L → mol

22.4 L = 1 mol

$11.2\ \text{L} \times \frac{1\ \text{mol}}{22.4\ \text{L}} = 0.500\ \text{mol}$

3 sf; ∞ sf; ∞ sf

7. How many molecules are present in 4.00 moles of glucose, $C_6H_{12}O_6$ (gfm = 180.0 g/mol)

mol → molecules

$1\ \text{mol} = 6.02 \times 10^{23}\ \text{molecules}$

$4.00\ \text{mol} \times \frac{6.02 \times 10^{23}\ \text{molecules}}{1\ \text{mol}} = 2.408 \times 10^{24} = 2.41 \times 10^{24}\ \text{molecules}$

3sf → 3sf

a. How many atoms of carbon?

$1\ \text{molecule } C_6H_{12}O_6 = 6\ \text{C atoms}$

$2.41 \times 10^{24}\ \text{molecules of } C_6H_{12}O_6 \times \frac{6\ \text{C atoms}}{1\ \text{molecule } C_6H_{12}O_6} = 1.45 \times 10^{26}\ \text{C atoms}$

8. How many molecules of CCl4 are there in 16.8 grams of CCl_4? (gfm = 154 g/mol)

grams → moles → molecules

$154\ \text{g} = 1\ \text{mol}$ $1\ \text{mol} = 6.02 \times 10^{23}\ \text{molecules}$

$16.8\ \text{g} \times \frac{1\ \text{mol}}{154\ \text{g}} \times \frac{6.02 \times 10^{23}\ \text{molecules}}{1\ \text{mol}} = 6.57 \times 10^{22}\ \text{molecules}$

9. A gaseous compound has a percent composition of 83.4% nitrogen and 17.6% hydrogen. What is the empirical formula of the gas?

① Divide % by gfm of element, keep decimals

② Divide each answer by the smaller of the #s

③ Round to nearest whole # & make subscripts in empirical formula

÷14.0 = 5.95714 ÷5.95714 = 1

÷1 = 17.6 ÷5.95714 = 2.95 ← make whole #

N_1H_3 or NH_3

10. A compound has an empirical formula of CH_2O. Its molecular mass is 180.0 g/mol. What is the molecular formula?

↳ emp. mass = C: 1 × 12.0 = 12.0; H: 2 × 1.0 = 2.0; O: 1 × 16.0 = 16.0 } 30.0 g

$\frac{\text{molecular mass}}{\text{empirical mass}}$ to find factor by which to multiply all subscripts

$\frac{180.0}{30.0} = 6$ $C_1H_2O_1 \rightarrow C_6H_{12}O_6$ (×6, ×6, ×6)