

Quantities in Chemical Reactions: Review

Date: _____

Key

Balancing Equations

Basic concepts:

- Matter cannot be created nor destroyed (Law of Conservation of Matter)
- Balanced equations use COEFFICIENTS to show exactly how much reactant and product are involved in a reaction
- Never change SUBSCRIPTS of chemical formulas in order to balance an equation

Practice 1

- a) $__ \text{S}_8 + __ \text{O}_2 \rightarrow __ \text{SO}_3$
 b) $__ \text{Al} + __ \text{FeO} \rightarrow __ \text{Al}_2\text{O}_3 + __ \text{Fe}$
 c) $__ \text{SiCl}_4 + __ \text{H}_2\text{O} \rightarrow __ \text{H}_4\text{SiO}_4 + __ \text{HCl}$
 d) $__ \text{Fe}_2(\text{SO}_4)_3 + __ \text{KOH} \rightarrow __ \text{K}_2\text{SO}_4 + __ \text{Fe}(\text{OH})_3$
 e) $__ \text{Si}_2\text{H}_3 + __ \text{O}_2 \rightarrow __ \text{SiO}_2 + __ \text{H}_2\text{O}_3$

[ans: a) 1, 12, 8; b) 2, 3, 1, 3; c) 1, 4, 1, 4; d) 1, 6, 3, 2; e) 4, 17, 8, 6]

The Mole

Basic concepts:

- One mole is an amount equivalent to 6.02×10^{23} entities (atoms, molecules, or ANYTHING)
- The value 6.02×10^{23} is also known as Avogadro's number
- The mass of one mole of a substance is called its **MOLAR MASS**, and is expressed in grams/mole (g/mol). It is different for each element, and can be obtained from the atomic mass on the periodic table.
- Molar mass of a compound can be obtained by adding up the individual molar masses of its component atoms.

Practice 2

	Number of atoms	Atomic mass (with units)	Molar mass (with units)
a) H ₂ O	H=2 O=1	18.02 amu	18.02 g/mol
b) KNO ₃	K=1 N=1 O=3	101.11 amu	101.11 g/mol
c) C ₃ H ₇ OH	C=3 H=8 O=1	60.11 amu	60.11 g/mol

Basic concepts:

- A molecule's molar mass can be used to convert between molar amounts and gram masses.

Conversion factor:
Molar mass (g/mol)

AMOUNT (moles) \longrightarrow MASS (grams)

Practice 3

	Molar mass	Mass	Amount
a) PCl ₅	208.24 g/mol	135 g	0.650 mol
b) Al ₂ (SO ₄) ₃	342.15 g/mol	344.5 g	1.007 mol
c) NaOH	40.00 g/mol	15.0 g	0.375 mol
d) Br ₂	159.81 g/mol	2.20×10^2 g	1.38 mol
e) MgCl ₂	95.21 g/mol	745 g (0.745 g)	7.82×10^{-3} mol

Molar Solutions

Basic concepts:

- Solute concentrations are usually expressed in moles of solute per litre of solution (mol/L = M)
- The molar concentration of a solution can be used to convert between molar amounts, and millilitre volumes.

Conversion factor:
concentration (mol/L)

AMOUNT (moles) $\xrightarrow{\hspace{2cm}}$ VOLUME (L)

M (g/ml)
58.33
62.03
41.7
34.02

Practice 4

	Concentration	Volume	Amount of solute	Mass of solute
a) Mg(OH) ₂ (aq)	1.58 mol/L	0.375 L	0.593 mol	34.6 g
b) H ₂ CO ₃ (aq)	2.00 mol/L	0.0885 L	0.177 mol	10.979 → 11.0 g
c) NaF (aq)	0.422 mol/L	220 mL	0.0929 mol	3.90 g
d) H ₂ O ₂ (aq)	0.227 mol/L	375 mL	85 mmol	2.89 g

Stoichiometry

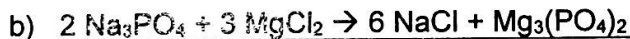
Basic concepts:

- Coefficients in balanced equations reflect not only the molecular ratios between reactants and products, but also the **MOLAR RATIOS**.

Practice 5



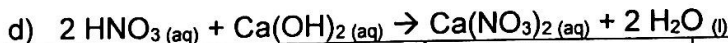
	Fe ₂ O ₃	C	Fe	CO ₂
Moles	8	12	16	12
Mass	1277.60 g	144 g	893.60 g	528.12 g



	Na ₃ PO ₄	MgCl ₂	NaCl	Mg ₃ (PO ₄) ₂
Moles	1	1.5	3	0.5
Mass	163.94 g	142.82 g	175.32 g	131.44 g



	N ₂	H ₂	NH ₃
Moles	1.67	5.00	3.33
Mass	46.79 g	10.10 g	56.74 g



	HNO ₃ (aq)	Ca(OH) ₂ (aq)	Ca(NO ₃) ₂ (aq)	H ₂ O (l)
Moles of solute	0.625 mol	0.313 mol	0.313 mol	0.625 mol
Solution concentration	1.50 mol/L	1.25 mol/L	0.470 mol/L	N/A
Solution volume	0.417 L	0.250 L	0.666 L	N/A

0.417 L

① solve 1st.

0.666 L

then use mole ratio to find other unknowns.