

Key - unit 4 Review - Chemical Reactions, moles, Stoichiometry

Types of Reactions

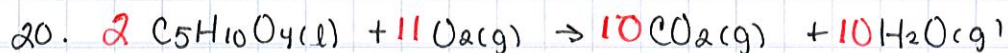
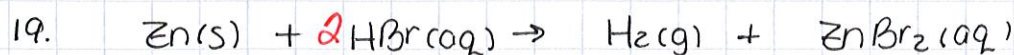
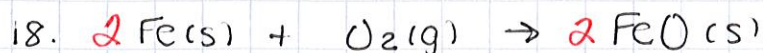
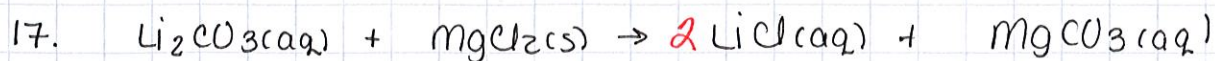
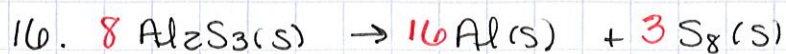
- $\text{AlCl}_3 + \text{Na}_2\text{SO}_4 \rightarrow \text{Al}_2(\text{SO}_4)_3 + \text{NaCl}$ double-replacement
- $\text{Zn} + \text{S}_8 \rightarrow \text{ZnS}$ (one product) synthesis
- $\text{H}_2\text{SO}_4 + \text{Fe} \rightarrow \text{H}_2 + \text{FeSO}_4$ single-replacement
- $\text{C}_5\text{H}_{12} + \text{O}_2 \rightarrow \text{H}_2\text{O} + \text{CO}_2$ combustion
- $\text{Al}_2\text{S}_3 \rightarrow \text{Al} + \text{S}_8$ (one reactant) decomposition
- $\text{Li}_2\text{CO}_3 + \text{MgCl}_2 \rightarrow \text{LiCl} + \text{MgCO}_3$ double-replacement
- $\text{Fe} + \text{O}_2 \rightarrow \text{FeO}$ (one product) synthesis
- $\text{Zn} + \text{HBr} \rightarrow \text{H}_2 + \text{ZnBr}_2$ single-replacement
- $\text{C}_5\text{H}_{10}\text{O}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$ combustion
- $\text{MgO} \rightarrow \text{Mg} + \text{O}_2$ (one reactant) decomposition

Law of Conservation of Mass

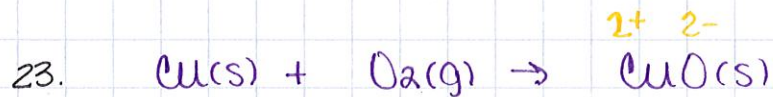
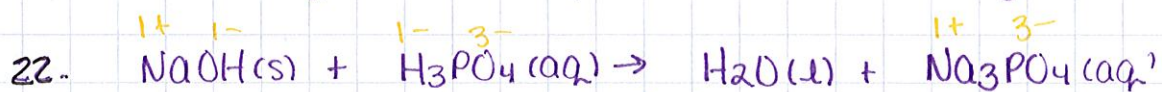
- Mass cannot be created or destroyed in a chemical reaction, only rearranged.

Balancing Chemical Equations

- $2 \text{AlCl}_3(\text{aq}) + 3 \text{Na}_2\text{SO}_4(\text{aq}) \rightarrow \text{Al}_2(\text{SO}_4)_3(\text{s}) + 6 \text{NaCl}(\text{aq})$
- $8 \text{Zn}(\text{s}) + \text{S}_8(\text{s}) \rightarrow 8 \text{ZnS}(\text{s})$
- $\text{H}_2\text{SO}_4(\text{aq}) + \text{Fe}(\text{s}) \rightarrow \text{H}_2(\text{g}) + \text{FeSO}_4(\text{aq})$ already balanced.
- $\text{C}_5\text{H}_{12}(\text{l}) + 8 \text{O}_2(\text{g}) \rightarrow 6 \text{H}_2\text{O}(\text{g}) + 5 \text{CO}_2(\text{g})$

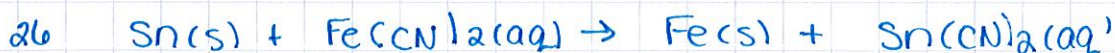
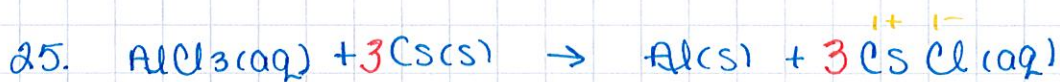
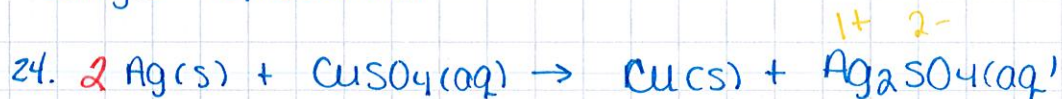


Skeleton Equations

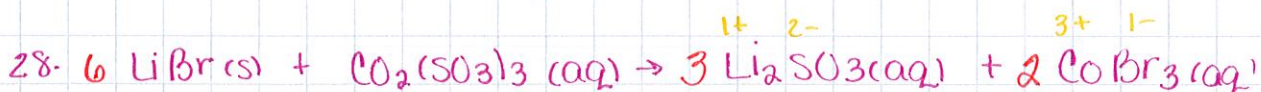
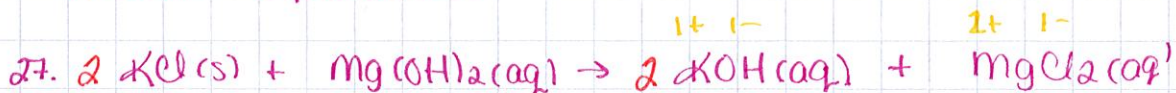


Predicting Products

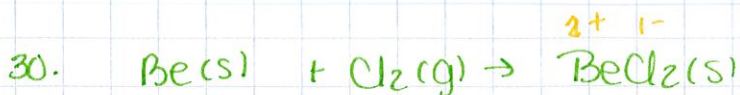
- single-replacement



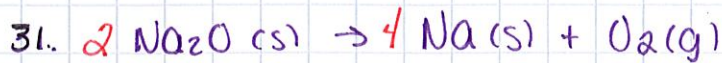
- double-replacement



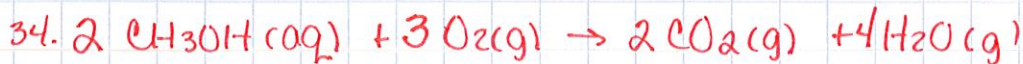
- synthesis



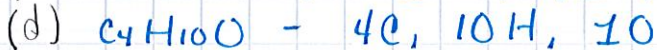
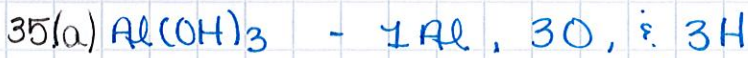
- decomposition



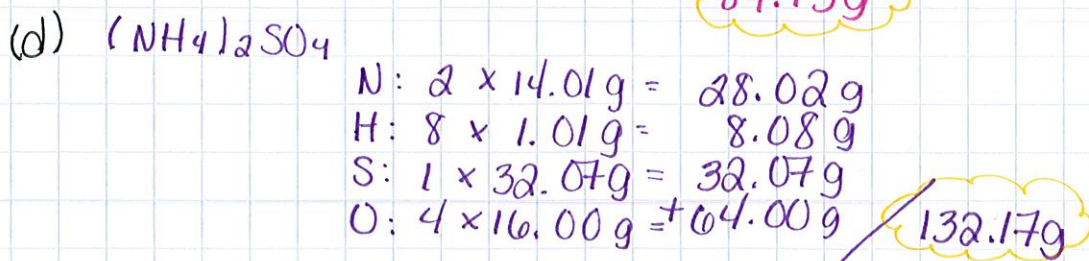
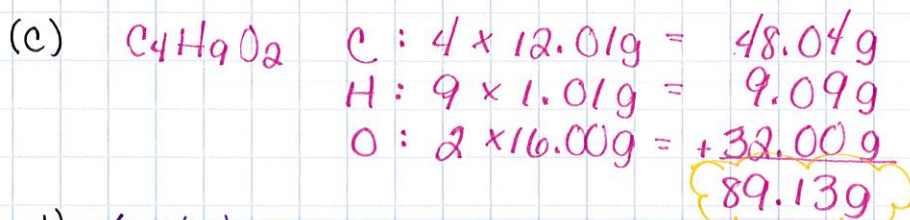
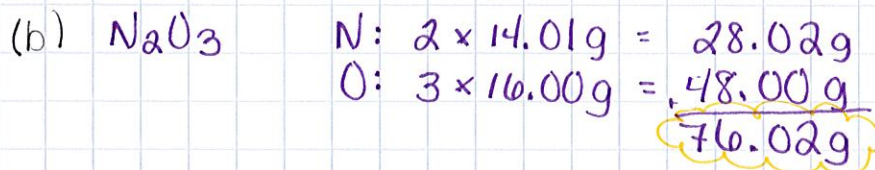
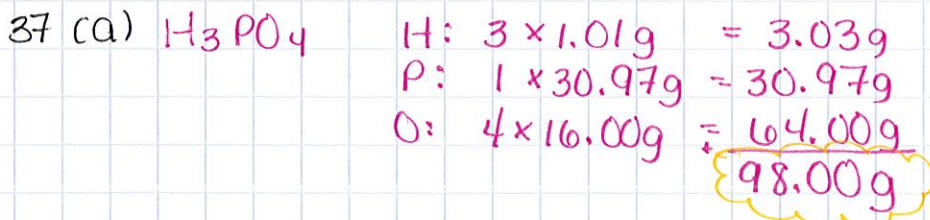
- combustion



moles



36. Each compound contains 6.02×10^{23} molecules because 1.00 moles of any substance contains 6.02×10^{23} particles.



38. (a) $\frac{15.5 \text{ g SiO}_2}{60.09 \text{ g}} \times 1 \text{ mol} = 0.258 \text{ mol SiO}_2$

Si: 28.09 g
2 O: 32.00 g
60.09 g

(b) $\frac{0.0688 \text{ g AgCl}}{143.32 \text{ g}} \times 1 \text{ mol} = 0.000480 \text{ mol AgCl}$

Ag: 107.87 g
Cl: 35.45 g
143.32 g

39. (a) $\frac{780 \text{ mol Ca(CN)}_2}{1 \text{ mol}} \times 92.12 \text{ g} = 71.9 \text{ g Ca(CN)}_2$

Ca: 40.08 g
2 C: 24.02 g
2 N: 28.02 g
92.12 g

(b) $\frac{7.00 \text{ mol H}_2\text{O}_2}{1 \text{ mol}} \times 34.02 \text{ g} = 238 \text{ g H}_2\text{O}_2$

2 H: 2.02 g
2 O: 32.00 g
34.02 g

40. (a) $\frac{7.6 \text{ mol Ar}}{1 \text{ mol}} \times 22.4 \text{ L} = 170 \text{ L Ar}$

(b) $\frac{0.44 \text{ mol C}_2\text{H}_6}{1 \text{ mol}} \times 22.4 \text{ L} = 9.86 \text{ L C}_2\text{H}_6$

41 (a) $\frac{14.4 \text{ L F}_2}{22.4 \text{ L}} \times 1 \text{ mol} = 0.643 \text{ mol F}_2$

(b) $\frac{3.21 \times 10^2 \text{ L CO}_2}{22.4 \text{ L}} \times 1 \text{ mol} = 14.3 \text{ mol CO}_2$

42 (a) $\frac{3.00 \text{ mol Sn}}{1 \text{ mol}} \times 6.02 \times 10^{23} \text{ atoms} = 1.81 \times 10^{24} \text{ atoms Sn}$

(b) $\frac{0.400 \text{ mol KCl}}{1 \text{ mol}} \times 6.02 \times 10^{23} \text{ f.units} = 2.41 \times 10^{23} \text{ f.units KCl}$

43 (a) $\frac{4.80 \times 10^{20} \text{ f.units NaI}}{6.02 \times 10^{23} \text{ f.units}} \times 1 \text{ mol} = 0.000797 \text{ mol NaI}$

(b) $\frac{7.50 \times 10^{24} \text{ molecules SO}_2}{6.02 \times 10^{23} \text{ molecules}} \times 1 \text{ mol} = 12.5 \text{ mol SO}_2$

44. (a) $\frac{835 \text{ g SO}_3}{80.07 \text{ g/mol}} \times \frac{22.4 \text{ L}}{1 \text{ mol}} = 234 \text{ L SO}_3$

S: 32.07g
3 O: 48.00g
80.07g

9C 108.09g
8H 8.08g
4O 64.00g
180.17g

(b) $\frac{1 \text{ molecule C}_9\text{H}_8\text{O}_4}{6.02 \times 10^{23} \text{ molecules/mol}} \times \frac{180.17 \text{ g}}{1 \text{ mol}} = 3 \times 10^{-22} \text{ C}_9\text{H}_8\text{O}_4$

(c) $\frac{146 \text{ g O}_3}{22.4 \text{ L/mol}} \times \frac{6.02 \times 10^{23} \text{ molecules/mol}}{1 \text{ mol}} = 3.92 \times 10^{24} \text{ molecules O}_3$

45 (a) H₂S

% H = $\frac{2.02 \text{ g}}{34.07 \text{ g}} \times 100 = 5.93\%$

2 H: 2.02g
S: 32.07g
34.07g

% S = $\frac{32.07 \text{ g}}{34.07 \text{ g}} \times 100 = 94.1\%$

(b) Mg(OH)₂

% Mg = $\frac{24.31 \text{ g}}{58.33 \text{ g}} \times 100 = 41.7\%$

Mg: 24.31g
2 O: 32.00g
2 H: + 2.02g
58.33g

% O = $\frac{32.00 \text{ g}}{58.33 \text{ g}} \times 100 = 54.9\%$

% H = $\frac{2.02 \text{ g}}{58.33 \text{ g}} \times 100 = 3.46\%$

46 (a) S₂Cl₂ is an M.F.

(b) C₆H₁₀O₄ is an M.F.

(c) Na₂SO₃ is an E.F.

(d) C₅H₁₀O₅ is an M.F.

(e) C₁₇H₁₉NO₃ is an E.F.

(f) (NH₄)₂CO₃ is an E.F.

47 (a) $\frac{79.8 \text{ g C}}{12.01 \text{ g/mol}}$

$\frac{20.2 \text{ g H}}{1.01 \text{ g/mol}}$

= $\frac{6.6446 \text{ mol C}}{6.6446 \text{ mol}}$

= $\frac{20.00 \text{ mol H}}{6.6446 \text{ mol}}$

= 1 C

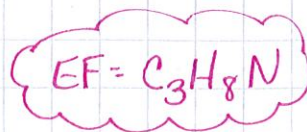
= 3 H

E.F. = CH₃

$$47(b) \quad \frac{62.1 \text{ g C}}{12.01 \text{ g/mol}}$$

$$\frac{13.8 \text{ g H}}{1.01 \text{ g/mol}}$$

$$\frac{24.1 \text{ N}}{14.01 \text{ g/mol}}$$



$$= \frac{5.17069 \text{ mol C}}{1.7202 \text{ mol}}$$

$$\frac{13.6634 \text{ mol H}}{1.7202 \text{ mol}}$$

$$\frac{1.7202 \text{ mol N}}{1.7202 \text{ mol}}$$

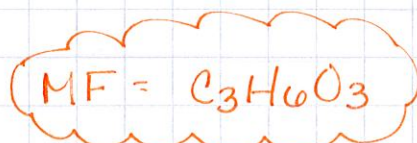
$$= 3 \text{ C}$$

$$= 8 \text{ H}$$

$$= 1 \text{ N}$$

48 (a) EF - CH₂O
 MM C: 12.01g
 2H: 2.02g
 O: 16.00g
 30.03g

$$\frac{90}{30} = 3$$



(b) EF - HgCl
 MM Hg: 200.59g
 Cl: 35.45g
 236.04g

$$\frac{472}{236} = 2$$



49. $\frac{58.8 \text{ g C}}{12.01 \text{ g/mol}}$

$$\frac{9.8 \text{ g H}}{1.01 \text{ g/mol}}$$

$$\frac{31.4 \text{ g O}}{16.00 \text{ g/mol}}$$

$$\text{EF} = \text{C}_5\text{H}_{10}\text{O}_2$$

$$\text{MM } 5\text{C}: 60.05\text{g}$$

$$10\text{H}: 10.10\text{g}$$

$$2\text{O}: 32.00\text{g}$$

$$102.15\text{g}$$

$$= \frac{4.89592 \text{ mol C}}{1.9625 \text{ mol}}$$

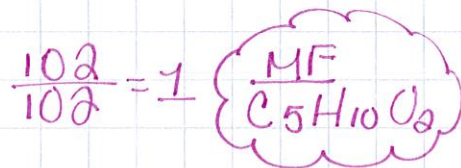
$$= \frac{9.70297 \text{ mol H}}{1.9625 \text{ mol}}$$

$$= \frac{1.9625 \text{ mol O}}{1.9625 \text{ mol}}$$

$$2 = (2.5 \text{ C})$$

$$2 = (5 \text{ H})$$

$$2 = (1 \text{ O})$$



50. $\frac{81.78 \text{ g C}}{12.01 \text{ g/mol}}$

$$\frac{6.1133 \text{ g H}}{1.01 \text{ g/mol}}$$

$$\frac{12.1056 \text{ g O}}{16.00 \text{ g/mol}}$$

$$\text{EF} = \text{C}_9\text{H}_8\text{O}$$

$$\text{MM } 9\text{C}: 108.09\text{g}$$

$$8\text{H}: 8.08\text{g}$$

$$\text{O}: 16.00\text{g}$$

$$132.17\text{g}$$

$$= \frac{6.80933 \text{ mol C}}{.7566 \text{ mol}}$$

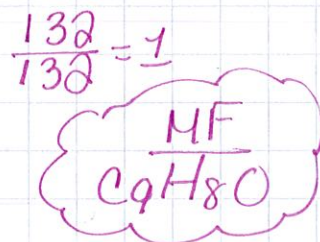
$$= \frac{6.05277 \text{ mol H}}{.7566 \text{ mol}}$$

$$= \frac{.7566 \text{ mol O}}{.7566 \text{ mol}}$$

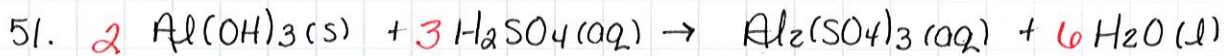
$$= 9 \text{ C}$$

$$= 8 \text{ H}$$

$$= 1 \text{ O}$$



Stoichiometry



(a) $\frac{.88 \text{ mol Al(OH)}_3}{2 \text{ mol Al(OH)}_3} \times \frac{6 \text{ mol H}_2\text{O}}{1} = 2.6 \text{ mol H}_2\text{O}$

(b) $\frac{.88 \text{ g Al(OH)}_3}{78.01 \text{ g Al(OH)}_3} \times \frac{1 \text{ mol Al(OH)}_3}{2 \text{ mol Al(OH)}_3} \times \frac{1 \text{ mol Al}_2(\text{SO}_4)_3}{1} = .0056 \text{ mol Al}_2(\text{SO}_4)_3$

Al: 26.98g
3 O: 48.00g
3 H: + 3.03g

78.01g

(c) $\frac{.88 \text{ g H}_2\text{O}}{18.02 \text{ g H}_2\text{O}} \times \frac{1 \text{ mol H}_2\text{O}}{6 \text{ mol H}_2\text{O}} \times \frac{1 \text{ mol Al}_2(\text{SO}_4)_3}{1} \times \frac{342.17 \text{ g Al}_2(\text{SO}_4)_3}{1 \text{ mol Al}_2(\text{SO}_4)_3} = 2.8 \text{ g Al}_2(\text{SO}_4)_3$

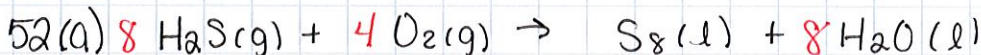
2H: 2.02g
O: 16.00g

18.02g

2Al: 53.96g
3S: 96.21g
12O: 192.00g

342.17g

8S: 256.56g

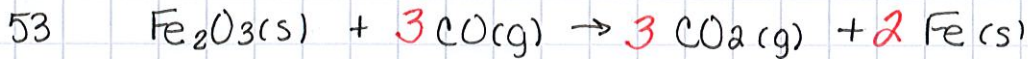


$\frac{102.27 \text{ g H}_2\text{S}}{34.09 \text{ g H}_2\text{S}} \times \frac{1 \text{ mol H}_2\text{S}}{8 \text{ mol H}_2\text{S}} \times \frac{1 \text{ mol S}_8}{1} \times \frac{256.56 \text{ g S}_8}{1 \text{ mol S}_8} = 96.210 \text{ g S}_8$

$\frac{64.00 \text{ g O}_2}{32.00 \text{ g O}_2} \times \frac{1 \text{ mol O}_2}{4 \text{ mol O}_2} \times \frac{1 \text{ mol S}_8}{1} \times \frac{256.56 \text{ g S}_8}{1 \text{ mol S}_8} = 128.28 \text{ g S}_8$

TY = 96.210 g S₈ LR = H₂S ER = O₂

(b) % yield = $\frac{84.78 \text{ g S}_8}{96.210 \text{ g S}_8} \times 100 = 88.12\%$



C: 12.01g
O: 16.00g
28.01g

(a) $\frac{150.0\text{g Fe}_2\text{O}_3}{159.70\text{g Fe}_2\text{O}_3} \times \frac{1\text{mol Fe}_2\text{O}_3}{1\text{mol Fe}_2\text{O}_3} \times \frac{3\text{mol CO}}{3\text{mol CO}} \times \frac{28.01\text{g CO}}{1\text{mol CO}} = 78.93\text{g CO}$

2Fe: 111.70g
3O: 48.00g
159.70g

(b) $\frac{2.50\text{mol CO}}{3\text{mol CO}} \times \frac{2\text{mol Fe}}{1\text{mol Fe}} \times \frac{55.85\text{g Fe}}{1\text{mol Fe}} = 93.1\text{g Fe}$

C: 12.01g
O: 16.00g
44.01g

(c) $\frac{100.0\text{g Fe}_2\text{O}_3}{159.70\text{g Fe}_2\text{O}_3} \times \frac{1\text{mol Fe}_2\text{O}_3}{1\text{mol Fe}_2\text{O}_3} \times \frac{3\text{mol CO}_2}{3\text{mol CO}_2} \times \frac{44.01\text{g CO}_2}{1\text{mol CO}_2} = 82.67\text{g CO}_2$

$\frac{100.0\text{g CO}}{28.01\text{g CO}} \times \frac{1\text{mol CO}}{1\text{mol CO}} \times \frac{3\text{mol CO}_2}{3\text{mol CO}} \times \frac{44.01\text{g CO}_2}{1\text{mol CO}_2} = 157.1\text{g CO}_2$

TY = 82.67g CO₂ LR = Fe₂O₃ TY = CO

(d) $\% \text{ yield} = \frac{60.5\text{g CO}_2}{82.67\text{g CO}_2} \times 100 = 73.2\%$