Homework 5 Answer key

Chapter 5 - 45, 50, 51, 52, 59, 61, 63, 64, 65, 66, 67, 73, 75, 79, 81, 84, 85, 87, 89, 93, 94, 97, 101, 107, 108, 109.

50) Balance each equation

a. $Mg_{(s)} + 2\,HBr_{(aq)} \rightarrow MgBr_{2(s)} + H_{2(g)}$

Mg	1	1
H	✗ 2	2
Br	✗ 2	2

b. $2\,CO_{(g)} + O_{2(g)} \rightarrow 2\,CO_{2(g)}$

C	✗ 2	✗ 2
O	✗ 4	✗ 4

c. $2\,PbS_{(s)} + 3\,O_{2(g)} \rightarrow 2\,PbO_{(s)} + 2\,SO_{2(g)}$

Pb	✗ 2	✗ 2
S	✗ 2	✗ 2
O	✗ 6	✗ 6

* This one is hard w/o using the trick. watch:

Here it is again a different way

$2\left[PbS + \frac{3}{2}O_2 \rightarrow PbO + SO_2\right]$

Pb	1	1
S	1	1
O	✗ 3	3

use fraction w/ diatomic & then clear fraction.

$2PbS + 3O_2 \rightarrow 2PbO + 2SO_2$

50)

d. $H_2SO_4 + 2\,NaOH \longrightarrow Na_2SO_4 + 2\,H_2O$

H	~~3~~ 4	~~2~~ 4
S	1	1
O	~~5~~ 6	~~5~~ 6
Na	~~1~~ 2	2

e. $2\,H_3PO_4 + 3\,Ca(OH)_2 \longrightarrow Ca_3(PO_4)_2 + 6\,H_2O$

H	~~5~~ ~~9~~ 12	~~12~~ 12
P	~~1~~ 2	2
O	~~6~~ ~~10~~ 14	~~9~~ 14
Ca	~~1~~ 3	3

52) Balance the equation for the overall conversion drawn below.

$$2\left[S_{(s)} + \tfrac{3}{2}O_{2(g)} + H_2O_{(l)} \rightarrow H_2SO_{4(l)}\right]$$

S	1	1 ✓
O	~~3~~ 4	4 ✓
H	2	2 ✓

* use fraction trick!

$$2\,S_{(s)} + 3\,O_{2(g)} + 2\,H_2O_{(l)} \rightarrow 2\,H_2SO_{4(l)}$$ ✓

(4) Fill in the needed reactant or product for each of the following reaction types, and balance the equation.

a. Combination: $N_2 + \boxed{Mg} \longrightarrow Mg_3N_2$

Mg is monatomic on periodic table. As a reactant it appears as a single element.

Balance

$$N_2 + \underline{3}Mg \longrightarrow Mg_3N_2$$

b. Decomposition: $SO_3 \longrightarrow SO_2 + \boxed{O_2}$

Oxygen is a diatomic element (HOFBrINCl) and must be written as O_2

Balance

$$\underline{2}\left[SO_3 \longrightarrow SO_2 + \tfrac{1}{\underline{2}}O_2\right]$$

S 1 1

O 3 $\times 3$

$$2SO_3 \longrightarrow 2SO_2 + O_2$$

c. Single Replacement: $Ag + CuBr_2 \longrightarrow \boxed{AgBr} + \boxed{Cu}$

Copper monatomic and Silver forms a +1 cation to combine 1:1 with bromide

$Ag^+ \mid Br^-$

$+ \quad -$

Balance

$$\underline{2}Ag + CuBr_2 \longrightarrow \underline{2}AgBr + Cu$$

(64) d. Double Replacement $NaOH + HBr \rightarrow \boxed{NaBr} + \boxed{H_2O}$

$Na^+ | Br^-$ (+ | −) $H^+ | OH^-$ (+ | −)

Balance

$$NaOH + HBr \rightarrow NaBr + H_2O$$

(66) Identify the species that is oxidized and the species that is reduced in each reaction. Write out two half reactions to show how many electrons are gained or lost by each species.

ox # ∅ +2 Reduction +2 ∅

a. $Mg + Fe^{2+} \rightarrow Mg^{2+} + Fe$

Oxidation

ox # → Elements = 0
Monatomic ion = same as charge

Half Rxns

∅ +2 2+ ∅

$Mg \rightarrow Mg^{2+} + 2e^-$

2e⁻ less; add e⁻ back

e⁻ product = loss
Oxidation is loss

add e⁻ back; 2e⁻ less +2 2+

$2e^- + Fe^{2+} \rightarrow Fe$

e⁻ reactant = gain
Reduction is gain

66) b. $Cu^{2+} + Sn \rightarrow Sn^{2+} + Cu$

ox # : $+2$ $\quad$ 0 $\quad$ $+2$ $\quad$ 0

Oxidation: $Sn \rightarrow Sn^{2+}$

Reduction: $Cu^{2+} \rightarrow Cu$

ox # → Elements = 0
Monatomic ions = same as charge

Half Rxns

add e^- back ↩ $2e^- + Cu \rightarrow Cu$ ($2e^-$ less: $+2 \rightarrow 2+$)

e^- reactant = gain

Reduction is gain

$Sn \rightarrow Sn^{2+} + 2e^-$ ($2e^-$ less: $0 \rightarrow +2$ / 2+)

↑ e^- product = loss

Oxidation is loss

c. $4\,Na + O_2 \rightarrow 2\,Na_2O$

ox # : 0 $\quad$ 0 $\quad$ $+1$ $\quad$ -2

Oxidation: $Na \rightarrow Na^+$

Reduction: $O_2 \rightarrow O^{2-}$

Elements

Na^+	O^{2-}
Na^+	
$+2$	-2

Ionic Compound = Monatomic ions

Half Rxns

ox # : 0 $\quad$ $+1$

$Na \rightarrow Na^+ + e^-$ ($1e^-$ less: $0 \rightarrow +1$ / 1+)

add e^- back

↑ e^- as product = loss

Oxidation is loss

ox # : 0 $\quad$ -2 / $2-$

$4e^- + O_2 \rightarrow 2O^{2-}$

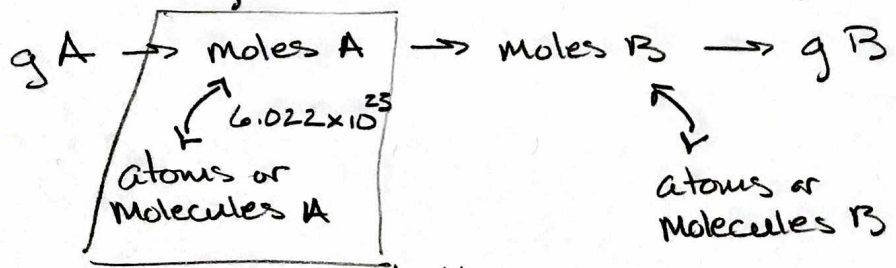
$2e^-$ extra × 2 = $4e^-$
⇒ add $4e^-$ to other side

e^- as product = gain

Reduction is gain

diatomic so must keep subscript add balance with

84) How many moles of pentane (C_5H_{12}) are contained in the following number of molecules?



we need just this road map

moles C_5H_{12} $\longleftrightarrow$ molecules C_5H_{12}

6.022×10^{23} = 1 mole

a. 5.00×10^{19} molecules

$$5.00 \times 10^{19} \text{ molecules } C_5H_{12} \times \frac{1 \text{ mole } C_5H_{12}}{6.022 \times 10^{23} \text{ molecules } C_5H_{12}} = 8.302888 94 \times 10^{-5}$$

$$= \boxed{8.30 \times 10^{-5} \text{ moles } C_5H_{12}}$$

b. 6.51×10^{28} molecules $C_5H_2 \times \frac{1 \text{ mole } C_5H_{12}}{6.022 \times 10^{25} \text{ molecules } C_5H_{12}} = 1.08 10362 \times 10^{5}$

$$= \boxed{1.08 \times 10^{5} \text{ moles } C_5H_{12}}$$

c. 8.32×10^{21} molecules $C_5H_{12} \times \frac{1 \text{ mole } C_5H_{12}}{6.022 \times 10^{23} \text{ molecules } C_5H_{12}} = 1.38 16008 \times 10^{-2}$

$$= \boxed{1.38 \times 10^{-2} \text{ moles } C_5H_{12}}$$

d. 3.10×10^{20} molecules $C_5H_{12} \times \frac{1 \text{ mole } C_5H_{12}}{6.022 \times 10^{23} \text{ molecules } C_5H_{12}} = 5.14 77914 \times 10^{-4}$

$$= \boxed{5.15 \times 10^{-4} \text{ moles } C_5H_{12}}$$

* Quick Check $\Rightarrow$ When dividing scientific notation

$$\frac{3.10 \times 10^{20}}{6.022 \times 10^{23}} = \times 10^{20-23} = \times 10^{-3} \text{ approximately}$$

94)

$$2\,CH_4O_{(l)} + 3\,O_{2(g)} \rightarrow 2\,CO_{2(g)} + 4\,H_2O_{(l)}$$

32.04 g/mol 32.00 g/mol 44.01 g/mol 18.02 g/mol

a. What is the theoretical yield of CO_2 from 48.0 g CH_4O?

$$2\,CH_4O + 3\,O_2 \rightarrow 2\,CO_2 + 4\,H_2O$$

48.0 g ? g

Road Map g A → mole A → mole B → g B

g CH_4O → mole CH_4O → mole CO_2 → g CO_2

$$48.0\text{ g } CH_4O \times \frac{1\text{ mole } CH_4O}{32.04\text{ g } CH_4O} \times \frac{2\text{ mole } CO_2}{2\text{ mole } CH_4O} \times \frac{44.01\text{ g } CO_2}{1\text{ mole } CO_2} = 65.9325842\text{ g}$$

(3 sig figs; 4 sig figs; exact; 4 sig figs)

$$= \boxed{65.9\text{ g } CO_2}$$

b. What is the percent yield if 48.0 g of CO_2 are formed?

$$\%\text{ yield} = \frac{\text{Actual yield}}{\text{Theoretical yield}} \times 100$$

$$= \frac{48.0\text{ g } CO_2}{65.9\text{ g } CO_2} \times 100 = 72.8376328\,\%$$

$$= \boxed{72.8\,\%\text{ yield } CO_2}$$

108) How many moles of Sucrose ($C_{12}H_{22}O_{11}$), molar mass 342.3 g/mol, are contained in 5-lb bag of Sugar?

other mass unit A → g A → mole A → mole B → g B

This is the part we need

lbs $C_{12}H_{22}O_{11}$ → g $C_{12}H_{22}O_{11}$ → mole $C_{12}H_{22}O_{11}$

1 SF!

$$5 \text{ lbs } C_{12}H_{22}O_{11} \times \frac{453.6 \text{ g } C_{12}H_{22}O_{11}}{1 \text{ lbs } C_{12}H_{22}O_{11}} \times \frac{1 \text{ mole } C_{12}H_{22}O_{11}}{342.3 \text{ g } C_{12}H_{22}O_{11}} = 6.6257669 \text{ mole}$$

(4 sig figs)

$$= \boxed{7 \text{ mole } C_{12}H_{22}O_{11}}$$

(1 sig fig)