Chapter 5 Homework key

5.46 Balance each equation:

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

Mg 1	Mg 1
H ~~x~~ 2	H 2
Br ~~x~~ 2	Br 2

b. $2\left[CO_{(g)} + \frac{1}{\underline{2}}O_{2(g)} \longrightarrow CO_{2(g)}\right]$

C 1	C 1
O ~~3~~2	O 2

$$2CO + O_2 \longrightarrow 2CO_2$$

c. $2\left[PbS_{(s)} + \frac{3}{\underline{2}}O_{2(g)} \longrightarrow PbO_{(s)} + SO_{2(g)}\right]$

Pb 1	Pb 1
S 1	~~O~~S 1
O ~~2~~3	O 3

$$2PbS_{(s)} + 3O_{2(g)} \longrightarrow 2PbO_{(s)} + 2SO_{2(g)}$$

d. $H_2SO_4 + \underline{\underline{2}}NaOH \longrightarrow Na_2SO_4 + \underline{\underline{2}}H_2O$

H ~~3~~4	H ~~2~~4
S 1	S 1
O ~~8~~6	O ~~8~~6
Na ~~x~~ 2	Na 2

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

H	~~8~~ ~~9~~ 12	H	~~2~~ ~~12~~ ~~18~~ 12
P	x 2	P	2
O	~~16~~ ~~10~~ 14	O	~~8~~ ~~14~~ ~~17~~ 14
Ca	x 3	Ca	3

~~$Al_2(SO_4)_3$~~ Error in Book

must be getting tired ☺

5.48 MTBE ($C_5H_{12}O$) is a high-octane gasoline additive with a sweet, nauseating odor. Because small amounts of MTBE have contaminated the drinking water in some towns, it is now banned as a fuel additive in some states. MTBE reacts with O_2 to form CO_2 and H_2O. Write a balanced equation for the combustion of MTBE.

$$2\left[C_5H_{12}O + \frac{15}{2}O_2 \longrightarrow 5CO_2 + 6H_2O\right]$$

C	5	C	x 5
H	12	H	~~2~~ 12
O	~~1~~ 16	O	~~3~~ ~~11~~ 16

$$2C_5H_{12}O + 15O_2 \longrightarrow 10CO_2 + 12H_2O$$

5.80 Iron, like most metals, does not occur naturally as the pure metal. Rather, it must be produced from iron ore, which contains iron(III) oxide, according to the given balanced equation.

$$Fe_2O_3 + 3CO_{(g)} \longrightarrow 2Fe_{(s)} + 3CO_{2(g)}$$

a. How many grams of Fe are formed from 10.0 g of Fe_2O_3?

Road Map: g Fe_2O_3 → moles Fe_2O_3 → moles Fe → g Fe

Required: Molar Mass Fe_2O_3
Molar Mass Fe

Molar Mass Fe_2O_3

Fe	$2 \times 55.845 =$	111.69
O	$3 \times 15.9994 =$	+ 47.9982
		159.6882 use long ⇒ just Rember good to 5 sig fig

$$10.0\,g\,Fe_2O_3 \times \frac{1\,mole\,Fe_2O_3}{159.6882\,g\,Fe_2O_3} \times \frac{2\,mole\,Fe}{1\,mole\,Fe_2O_3} \times \frac{55.845\,g\,Fe}{1\,mole\,Fe} = 6.99\,425\,5\,g\,Fe$$

$$= \boxed{6.99\,g\,Fe}$$

b. How many ~~grames~~ grams ~~of~~ Fe are formed from 25.0 g Fe_2O_3?

$$25.0\,g\,Fe_2O_3 \times \frac{1\,mole\,Fe_2O_3}{159.6882\,g\,Fe_2O_3} \times \frac{2\,mole\,Fe}{1\,mole\,Fe_2O_3} \times \frac{55.845\,g\,Fe}{1\,mole\,Fe} = 17.485\,637\,6\,g\,Fe$$

$$= \boxed{17.5\,g\,Fe}$$

5.86 Methanol (CH_4O), which is used as a fuel source in high performance racing cars, burns in the presence of O_2 to form CO_2 and H_2O. The molar masses for all substances are given under the balanced equation.

$$\underset{32.0\ g/mol}{2\,CH_4O} + \underset{32.0\ g/mol}{3\,O_2} \longrightarrow \underset{44.0\ g/mol}{2\,CO_2} + \underset{18.0\ g/mol}{4\,H_2O}$$

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

Road Map: g CH_4O → mole CH_4O → mole CO_2 → g CO_2

$$48.0\ g\ CH_4O \times \frac{1\ mole\ CH_4O}{32.0\ g\ CH_4O} \times \frac{2\ mole\ CO_2}{2\ mole\ CH_4O} \times \frac{44.0\ g\ CO_2}{1\ mole\ CO_2} = \boxed{66.0\ g\ CO_2}$$

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

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

$$= \frac{48.0\ g\ CO_2}{66.0\ g\ CO_2} \times 100 = 72.7272\ \%$$

$$= \boxed{72.7\ \%}$$

5.96 The reaction of aluminium metal (Al) with oxygen (O_2) forms Al_2O_3. Write a balanced equation for this redox reaction. Write two half reactions to show how many electrons are gained or lost by each species.

Ox# Charge

$$\underline{4}\,Al^{0} + \underline{3}\,O_2^{0} \longrightarrow \underline{2}\,Al_2^{3+}O_3^{2-}$$

Half Reaction is represented by the pairs

$$Al^{0} \longrightarrow Al^{3+} + 3e^-$$

$$4e^- + O_2^{0} \longrightarrow 2O^{2-}$$

Extra Info: Redox equations are balanced by the number of e^- gained and lost.

$$\cancel{2}\,4\,Al^{0} \longrightarrow 4\,Al^{3+} + 12e^-$$

$$+ \quad 12e^- + 3O_2 \longrightarrow 6O^{2-}$$

$$12\cancel{e^-} + 4\,Al + 3O_2 \longrightarrow 4\,Al^{3+} + 6O^{2-} + \cancel{12e^-}$$

$$4\,Al + 3O_2 \longrightarrow 2Al_2O_3$$

just thought you might like to see where the e^- go.

5.102 How many moles of sucrose (table sugar $C_{12}H_{22}O_{11}$, Molar Mass 342.3 g/mole) are contained in a 5-lb bag of sugar.

Road Map: 5 lb → g → moles

$$5\text{ lb} \times \frac{453.6\text{ g}}{1\text{ lbs}} \times \frac{1\text{ mole } C_{12}H_{22}O_{11}}{342.3\text{ g } C_{12}H_{22}O_{11}} = 6.626\text{ mole } C_{12}H_{22}O_{11}$$

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

* The two worksheets handed out in lab titled

VIII The Mole & XIII Stoichiometry

are much better preparation than the problems here.