# Chapter 7 Homework Key

7.1

4) Balance the following equations

a) $\underline{\underline{4}}Ag + \underline{\underline{2}}H_2S + O_2 \rightarrow \underline{\underline{2}}Ag_2S + \underline{\underline{2}}H_2O$

| | | | |
|---|---|---|---|
| Ag | $\cancel{1}$ 4 | Ag | $\cancel{2}$ 4 ✓ |
| H | $\cancel{2}$ 4 | H | $\cancel{2}$ 4 ✓ |
| S | $\cancel{1}$ 2 | S | $\cancel{1}$ 2 ✓ |
| O | 2 | O | $\cancel{1}$ 2 ✓ |

b) $P_4 + \underline{5}O_2 \rightarrow P_4O_{10}$

| | | | |
|---|---|---|---|
| P | 4 | P | 4 ✓ |
| O | $\cancel{2}$ 10 | O | 10 ✓ |

c) $^*\underline{\underline{2}}[Pb + H_2O + \frac{1}{\underline{2}}O_2 \rightarrow P(OH)_2]$

| | | | |
|---|---|---|---|
| Pb | 1 | Pb | 1 ✓ |
| H | 2 | H | 2 ✓ |
| O | $\cancel{3}$ 2 | O | 2 ✓ |

$2Pb + 2H_2O + O_2 \rightarrow 2Pb(OH)_2$

* must clear the fraction

d) $\underline{3}\,Fe + \underline{4}\,H_2O \longrightarrow Fe_3O_4 + \underline{4}\,H_2$

| | | | |
|---|---|---|---|
| Fe | $\cancel{1}$ 3 | Fe | 3 ✓ |
| H | $\cancel{2}$ 8 | H | $\cancel{2}$ 8 ✓ |
| O | $\cancel{1}$ 4 | O | 4 ✓ |

e) $Sc_2O_3 + \underline{3}\,SO_3 \longrightarrow Sc_2(SO_4)_3$

| | | | |
|---|---|---|---|
| Sc | 2 | Sc | 2 ✓ |
| O | $\cancel{6}$ 12 | O | 12 ✓ |
| S | $\cancel{1}$ 3 | S | 3 ✓ |

f) $Ca_3(PO_4)_2 + \underline{4}\,H_3PO_4 \longrightarrow \underline{3}\,Ca(H_2PO_4)_2$

| | | | |
|---|---|---|---|
| Ca | 3 | Ca | $\cancel{1}$ 3 ✓ |
| P | $\cancel{3}$ 6 | P | $\cancel{2}$ 6 ✓ |
| O | $\cancel{12}$ 24 | O | $\cancel{8}$ 24 ✓ |
| H | $\cancel{3}$ 12 | H | $\cancel{4}$ 12 ✓ |

Tough Counting on this one

g) $\underline{2}\,Al + \underline{3}\,H_2SO_4 \longrightarrow Al_2(SO_4)_3 + \underline{3}\,H_2$

| | | | |
|---|---|---|---|
| Al | $\cancel{1}$ 2 | Al | 2 ✓ |
| H | $\cancel{2}$ 6 | H | $\cancel{2}$ 3 ✓ |
| S | $\cancel{1}$ 3 | S | 3 ✓ |
| O | $\cancel{4}$ 12 | O | 12 ✓ |

h) $TiCl_4 + \underline{2}H_2O \longrightarrow TiO_2 + \underline{4}HCl$

Ti 1
Cl 4
H ~~2~~ 4
O ~~1~~ 2

Ti 1 ✓
Cl ~~1~~ 4 ✓
H ~~1~~ 4 ✓
O 2 ✓

5) Write a balanced molecular equation describing each of the following chemical reactions:

a) Solid calcium carbonate is heated and decomposes to Solid Calcium Oxide and Carbon dioxide gas

$CaCO_{3(s)} \longrightarrow CaO_{(s)} + CO_{2(g)}$

Calcium Carbonate

$Ca^{2+} | CO_3^{2-}$
$2+ \quad 2-$

Balance ionic formula 1st

Calcium Oxide

$Ca^{2+} | O^{2-}$
$2+ \quad 2-$

Same here

Carbon dioxide

↑
Covalent
⇒ no charges

Now balance the Coefficients

$CaCO_{3(s)} \longrightarrow CaO_{(s)} + CO_{2(g)}$

Ca 1
C 1
O 3

Ca 1 ✓
C 1 ✓
O 3 ✓

Turns out already balanced.

b) Gaseous butane ($C_4H_{10}$) reacts with diatomic oxygen gas to yield gaseous carbon dioxide and water vapor.

Butane + diatomic oxygen → Carbon dioxide + water

$$\underline{\underline{2}}\left[C_4H_{10(g)} + \underline{\underline{\tfrac{13}{2}}}O_{2(g)} \longrightarrow \underline{4}CO_{2(g)} + \underline{\underline{5}}H_2O_{(g)}\right]$$

C 4
H 10
O ~~2~~ 13

C ~~1~~ 4
H ~~2~~ 10
O ~~3~~ ~~9~~ 13

$$2C_4H_{10(g)} + 13O_{2(g)} \longrightarrow 8CO_{2(g)} + 10H_2O_{(g)}$$

c) Aqueous solutions of magnesium chloride and sodium hydroxide react to produce solid magnesium hydroxide and aqueous sodium chloride.

magnesium chloride + sodium hydroxide → magnesium hydroxide + sodium chloride

$\begin{array}{c|c} Mg^{2+} & Cl^- \\ & Cl^- \\ \hline 2+ & 2- \end{array}$ $\quad\begin{array}{c|c} Na^+ & OH^- \\ \hline + & - \end{array}$ $\quad\begin{array}{c|c} Mg^{2+} & OH^- \\ & OH^- \\ \hline 2+ & 2- \end{array}$ $\quad\begin{array}{c|c} Na^+ & Cl^- \\ \hline + & - \end{array}$

$$MgCl_{2(aq)} + \underline{\underline{2}}NaOH_{(aq)} \longrightarrow Mg(OH)_{2(s)} + \underline{\underline{2}}NaCl_{(aq)}$$

$Mg^{2+}$ 1
$Cl^-$ 2
$Na^+$ ~~1~~ 2
$OH^-$ ~~1~~ 2

$Mg^{2+}$ 1 ✓
$Cl^-$ ~~1~~ 2 ✓
$Na^+$ ~~1~~ 2 ✓
$OH^-$ 2 ✓

11) From the balanced molecular equations, write Complete ionic and net ionic equations for the following:

a) $K_2C_2O_{4(aq)} + Ba(OH)_2 \rightarrow 2KOH_{(aq)} + BaC_2O_{4(s)}$

Ionic $\underline{2K^{+}_{(aq)}} + C_2O_{4(aq)}^{2-} + Ba^{2+}_{(aq)} + \underline{2OH^{-}_{(aq)}} \rightarrow \underline{2K^{+}_{(aq)}} + \underline{2OH^{-}_{(aq)}} + BaC_2O_{4(s)}$

net Ionic $Ba^{2+}_{(aq)} + C_2O_{4(aq)}^{2-} \rightarrow BaC_2O_{4(s)}$

b) $Pb(NO_3)_{2(aq)} + H_2SO_{4(aq)} \rightarrow PbSO_{4(s)} + 2HNO_{3(aq)}$

This one is harder. Treat H here as group 1A cation.

Ionic $Pb^{2+}_{(aq)} + \underline{2NO_{3(aq)}^{-}} + \underline{2H^{+}_{(aq)}} + SO_{4(aq)}^{2-} \rightarrow PbSO_{4(s)} + \underline{2H^{+}_{(aq)}} + \underline{2NO_{3(aq)}^{-}}$

$Pb^{2+}_{(aq)} + SO_{4(aq)}^{2-} \rightarrow PbSO_{4(s)}$

c) $CaCO_{3(s)} + H_2SO_{4(aq)} \rightarrow CaSO_{4(s)} + CO_{2(g)} + H_2O_{(l)}$

*Remember - only (aq) get dissociated, solid, liquid, gas stay together!

Ionic $CaCO_{3(s)} + 2H^{+}_{(aq)} + SO_{4(aq)}^{2-} \rightarrow CaSO_{4(s)} + CO_{2(g)} + H_2O_{(l)}$

net Ionic $CaCO_{3(s)} + 2H^{+}_{(aq)} + SO_{4(aq)}^{2-} \rightarrow CaSO_{4(s)} + CO_{2(g)} + H_2O_{(l)}$

* There are no spectator ions here so the ionic & net ionic are identical.

# 7.2

13) Indicate what type, or types, of reaction each of the following represent:

a) $Ca_{(s)} + Br_{2(l)} \rightarrow CaBr_{2(s)}$

$A + B \rightarrow C$ Combination Rxn

b) $Ca(OH)_{2(aq)} + 2HBr_{(aq)} \rightarrow CaBr_{2(aq)} + 2H_2O_{(l)}$

Base + Acid → Salt + $H_2O$ Neutralization

Also fits double displacement

c) $C_6H_{12(l)} + 9O_{2(g)} \rightarrow 6CO_{2(g)} + 6H_2O_{(g)}$

$C_xH_yO_z + O_2 \rightarrow CO_2 + H_2O$ Combustion

16) Determin the oxidation states of the elements in each of the following:

a) $NaI = \overset{+1}{Na^{+}} + \overset{-1}{I^{-}}$ ← Same as monatomic charge

b) $CdCl_3 = \overset{+3}{Cd^{3+}} + \overset{-1}{Cl^{-}}$ ← Same as monatomic charge

c) $LiNO_3 = \overset{+1}{Li^{+}} + \overset{+5\ -2}{NO_3^{-}}$ ← oxygen always -2

N + 3 Oxygen = -1

$N + 3(-2) = -1$

$N - 6 = -1$

$N = 5$

d) $\overset{+1}{H_2}\overset{-2}{Se}$ ← Covalent ⇒ no charges must use rule for hydrogen and Solve for Selinium

$Se + 2H = 0$

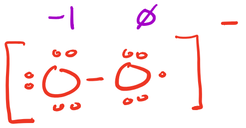
$Se + 2(1) = 0$

$Se + 2 = 0$

$Se = -2$

e) $Mg_2Si = \overset{+2}{Mg^{2+}}\ \ \overset{-4}{Si^{4-}}$ ← Same as monatomic Charge

f) $RbO_2 = \overset{+1}{Rb^{+}}\ \ O_2^{-}$ ← Super oxide



Seriously, don't do this one.

g) $HF = \overset{+1}{H}-\overset{-1}{F}$

you can treat as ionic or Covalent, the rules work out the Same either way.

HF is usually considered Covalent though the ΔEN = 1.9 (Ionic).

19) Classify the following as acid-base reactions or oxidation-reduction reactions.

a) $Na_2S_{(aq)} + 2HCl_{(aq)} \rightarrow 2NaCl_{(aq)} + H_2S_{(g)}$

Two ways to do this

- Calculate redox #'s
  - Change in #'s = Redox
  - no change = acid-base
- Look for acid-base pattern of trading proton $H^+$

#1 $\overset{+1}{Na_2}\overset{-2}{S_{(aq)}} + 2\overset{+1}{H}\overset{-1}{Cl_{(aq)}} \rightarrow 2\overset{+1}{Na}\overset{-1}{Cl_{(aq)}} + \overset{+1}{H_2}\overset{-2}{S_{(g)}}$ ← no changes in #'s

#2 $\overset{\text{Base}}{Na_2S_{(aq)}} + \underset{\text{Acid}}{2HCl_{(aq)}} \rightarrow \underset{\text{Base}}{2NaCl_{(aq)}} + \overset{\text{Acid}}{H_2S_{(g)}}$

$Na^+$ spectator

$\Rightarrow$ Acid - Base Rxn

b) $2Na_{(s)} + 2HCl_{(aq)} \rightarrow 2NaCl_{(aq)} + H_{2(g)}$

Reduction

#1 $2\overset{0}{Na}_{(s)} + 2\overset{+1}{H}\overset{-1}{Cl}_{(aq)} \rightarrow 2\overset{+1}{Na}\overset{-1}{Cl}_{(aq)} + \overset{0}{H}_{2(g)}$

Oxidation

$\Rightarrow$ Redox Reaction

c) $Mg_{(s)} + Cl_{2(g)} \longrightarrow MgCl_{2(s)}$

Reduction

#1 $\overset{0}{Mg}_{(s)} + \overset{0}{Cl}_{2(g)} \longrightarrow \overset{+2}{Mg}\overset{-1}{Cl}_{2(s)}$

Oxidation

$\Rightarrow$ Redox Reaction

d) $MgO_{(s)} + 2HCl_{(aq)} \rightarrow MgCl_{2(aq)} + H_2O_{(l)}$

#1 $\overset{+2}{Mg}\overset{-2}{O}_{(s)} + 2\overset{+1}{H}\overset{-1}{Cl}_{(aq)} \rightarrow \overset{+2}{Mg}\overset{-1}{Cl}_{2(aq)} + \overset{+1}{H}_2\overset{-2}{O}_{(l)}$

no changes $\Rightarrow$ not redox

#2 $\underset{\text{Base}}{MgO_{(s)}} + \overset{\text{Acid}}{2HCl_{(aq)}} \rightarrow \overset{\text{Base}}{MgCl_{2(aq)}} + \underset{\text{Acid}}{H_2O_{(l)}}$

$Mg^{2+}$ spectator

$\Rightarrow$ Acid-Base Reaction

e) $K_3P_{(s)} + 2O_{2(g)} \rightarrow K_3PO_{4(s)}$

#1

$$\overset{+1}{K_3}\overset{-3}{P}_{(s)} + 2\overset{0}{O_2}_{(g)} \rightarrow \overset{+1}{K_3}\overset{\overset{+5}{?}}{P}\overset{-2}{O_4}_{(s)}$$

$K_3PO_4^{\,0}$

$3K + P + 4O = 0$

$3(1) + P + 4(-2) = 0$

$3 + P - 8 = 0$

$P = +5$

or

$PO_4^{\,3-}$

$P + 4O = -3$

$P + 4(-2) = -3$

$P - 8 = -3$

$P = +5$

$P = +5 \leftarrow$ same $\rightarrow P = +5$

Reduction

$$\overset{+1}{K_3}\overset{-3}{P}_{(s)} + 2\overset{0}{O_2}_{(g)} \rightarrow \overset{+1}{K_3}\overset{+5}{P}\overset{-2}{O_4}_{(s)}$$

oxidation

f) $3KOH_{(aq)} + H_3PO_{4(aq)} \rightarrow K_3PO_{4(aq)} + 3H_2O_{(l)}$

#1 $3\overset{+1}{K}\overset{-2}{O}\overset{+1}{H}_{(aq)} + \overset{+1}{H_3}\overset{+5}{P}\overset{-2}{O}_{4(aq)} \rightarrow \overset{+1}{K_3}\overset{+5}{P}\overset{-2}{O}_{4(aq)} + 3\overset{+1}{H_2}\overset{-2}{O}_{(l)}$

no changes in oxidation #

#2 $\underset{\text{Base}}{3KOH_{(aq)}} + \overset{\text{Acid}}{H_3PO_{4(aq)}} \rightarrow \overset{\text{Base}}{K_3PO_{4(aq)}} + \underset{\text{Acid}}{3H_2O_{(l)}}$

$K^+$ Spectator Ion

⇒ Acid-Base Reaction

20) Identify the atoms that are oxidized and reduced, the change in oxidation State, and the oxidizing and reducing agents in each of the following:

a) $\overset{0}{Mg}_{(s)} + \overset{+2}{Ni}\overset{-1}{Cl}_{2(aq)} \rightarrow \overset{+2}{Mg}\overset{-1}{Cl}_{2(aq)} + \overset{0}{Ni}_{(s)}$

Reduction ($NiCl_2 \rightarrow Ni$)

oxidation ($Mg \rightarrow MgCl_2$)

Mg oxidized $\quad$ oxidizing agent $NiCl_2$

Ni Reduced $\quad$ Reducing agent Mg

Reduction

b) $\overset{+3\ \ -3}{PCl_{3(l)}} + \overset{0}{Cl_{2(g)}} \longrightarrow \overset{+5\ \ -1}{PCl_{5(s)}}$

oxidation

P oxidized    oxidizing agent = $Cl_2$

Cl Reduced    Reducing agent = $PCl_3$

Reduction    $O^{-2}$ in both

c) $\overset{-2\ \ +1}{C_2H_{4(g)}} + 3\overset{0}{O_{2(g)}} \longrightarrow 2\overset{+4\ \ -2}{CO_{2(g)}} + 2\overset{+1\ \ -2}{H_2O_{(g)}}$

oxidation

$2C + 4H = 0$

$2C + 4(1) = 0$

$2C + 4 = 0$

$2C = -4$

$C = -2$

$C + 2O = 0$

$C + 2(-2) = 0$

$C - 4 = 0$

$C = +4$

C oxidized    oxidizing agent = $O_2$

O Reduced    Reducing agent = $C_2H_4$

Reduction

d) $\overset{0}{Zn}_{(s)} + \overset{+1}{H}_2S\overset{-2}{O}_{4(aq)} \rightarrow \overset{+2}{Zn}\overset{+6}{S}\overset{-2}{O}_{4(aq)} + \overset{0}{H}_{2(g)}$

Oxidation

$2H+S+4O=0$

$2(1)+S+4(-2)=0$

$2+S-8=0$

$S=+6$

$S+4O=-2$

$S+4(-2)=-2$

$S-8=-2$

$S=+6$

Zn Oxidized    oxidizing agent $H_2SO_4$

H reduced    reducing agent Zn

e) $2\,\overset{+1}{K}_2\overset{-1/+5}{S}_2\overset{-2}{O}_{3(s)} + \overset{0}{I}_{2(s)} \longrightarrow \overset{+1}{K}_2\overset{0/+5}{S}_4\overset{-2}{O}_{6(s)} + 2\,\overset{+1}{K}\overset{-1}{I}_{(s)}$

$2S+3O = 2-$

$2S+3(-2) = -2$

$2S-6=-2$

$2S=+4$

$S=+2$ Average

$4S+6O=-2$

$4S+6(-2)=-2$

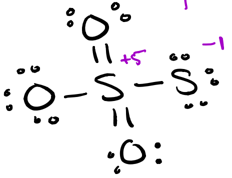
$4S-12=-2$

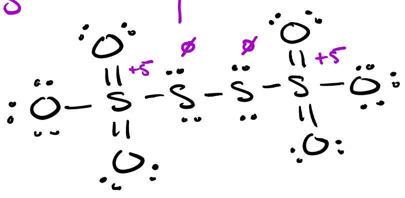
$4S=10$

$S = \frac{10}{4} = \frac{5}{2}$ Average

* <u>note</u>: These are average oxidation numbers. The true picture is a little different.

This is the oxidation change from $S^{-1}$ to $S^{0}$





Continued from e . . .

S is Oxidized Oxidizing agent $I_2$

I is Reduced Reducing agent $K_2S_2O_3$

f)

Reduction

$$3\overset{0}{Cu}_{(s)} + 8\overset{+1}{H}\overset{+4}{N}\overset{-2}{O}_{3(aq)} \longrightarrow 3\overset{+2}{Cu}(\overset{+4}{N}\overset{-2}{O}_3)_{2(aq)} + 2\overset{+2}{N}\overset{-2}{O}_{(g)} + 4\overset{+1}{H}_2\overset{-2}{O}_{(l)}$$

Oxidation

$H + N + 3O = 0$

$1 + N + 3(-2) = 0$

$1 + N - 6 = 0$

$N = +4$

$N + 3O = -1$

$N + 3(-2) = -1$

$N - 6 = -1$

$N = +4$

Cu is oxidized Oxidizing agent $HNO_3$

N is Reduced Reducing agent Cu

21) Complete and balance the following acid - base equations.

a) HCl gas reacts with solid $Ca(OH)_2$.

$$HCl_{(g)} + Ca(OH)_{2(s)} \rightarrow CaCl_2 + H_2O$$

Follows double-displacement pattern
& Then Balance the equation.

$$\underline{2}\,HCl_{(g)} + Ca(OH)_{2(s)} \rightarrow CaCl_{2(s)} + \underline{2}\,H_2O_{(l)}$$

b) A solution of $Sr(OH)_2$ is added to a solution of $HNO_3$.

$$Sr(OH)_{2(aq)} + \underline{2}\,HNO_{3(aq)} \rightarrow Sr(NO_3)_{2(aq)} + \underline{2}\,H_2O_{(l)}$$

28) Write the chemical, ionic, and net ionic equations for the following reactions:

a) $Ca(OH)_{2(aq)} + HC_2H_3O_{2(aq)} \rightarrow$

Follow double-displacement & Balance.

Chemical

$$Ca(OH)_{2(aq)} + \underline{\underline{2}}\,HC_2H_3O_{2(aq)} \rightarrow Ca(C_2H_3O_2)_{2(aq)} + \underline{\underline{2}}\,H_2O_{(l)}$$

Ionic

$$\underline{Ca}^{2+}_{(aq)} + 2OH^-_{(aq)} + 2H^+_{(aq)} + 2\underline{C_2H_3O}^-_{2(aq)} \rightarrow \underline{Ca}^{2+}_{(aq)} + 2\underline{C_2H_3O}^-_{2(aq)} + 2H_2O_{(l)}$$

net ionic

$$2H^+_{(aq)} + 2OH^-_{(aq)} \rightarrow 2H_2O_{(l)}$$

or

$$H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$$

b) $H_3PO_{4(aq)} + CaCl_{(aq)} \rightarrow$

Follow double-displacement, balance, apply Solubility.

Chemical

$$\underline{\underline{2}}\,H_3PO_{4(aq)} + \underline{3}\,CaCl_{2(aq)} \rightarrow Ca_3(PO_4)_{2(s)} + \underline{\underline{6}}\,HCl_{(aq)}$$

Ionic

$$\underline{6H}^+_{(aq)} + 2PO^{3-}_{4(aq)} + 3Ca^{2+}_{(aq)} + \underline{6Cl}^-_{(aq)} \rightarrow Ca_3(PO_4)_{2(s)} + \underline{6H}^+_{(aq)} + \underline{6Cl}^-_{(aq)}$$

net Ionic

$$3\,Ca^{2+}_{(aq)} + 2\,PO^{3-}_{4(aq)} \rightarrow Ca_3(PO_4)_{2(s)}$$

## 7.3

The problems in the book are not well written for this section. I'll put suplemental problems on Canvas to give you practice in this section. I'll also put up a seperate key to those problems.

## 7.4

64) A Sample of 0.53g of Carbon dioxide was obtained by heating 1.31 g of Calcium carbonate. What is the percent yield for this reaction?

$$CaCO_{3\,(s)} \xrightarrow{Heat} CaO_{(s)} + CO_{2\,(g)}$$

1.31g

0.53g actual

Theoretical?

**Road Map**

$g\ CaCO_3 \rightarrow$ mole $CaCO_3 \rightarrow$ mole $CO_2 \rightarrow g\ CO_2$ Theoretical

Then $\%\ yield = \frac{actual}{Theoretical} \times 100$

Molar mass $CaCO_3$

Ca 1×40.08 = 40.08
C 1×12.01 = 12.01
O 3×16.00 = 48.00
100.09 g/mol

molar mass $CO_2$

C 1×12.01 = 12.01
O 2×16.00 = 32.00
44.01 g/mol

Theoretical

$$1.31\,g\ CaCO_3 \times \frac{1\ mole\ CaCO_3}{100.09\,g\ CaCO_3} \times \frac{1\ mole\ CO_2}{1\ mole\ CaCO_3} \times \frac{44.01\,g\ CO_2}{1\ mole\ CO_2} = 0.576|0126\ g\ CO_2$$

$$= 0.576\ g\ CO_2$$

$$\%\ yield = \frac{0.53\,g\ CO_2\ actual}{0.576\,g\ CO_2\ Theoretical} \times 100 = 92\%$$

$$\boxed{\%\ yield = 92\%}$$

67) Toluene, $C_7H_8$, is oxidized by air under carefully controlled conditions to benzoic acid, $HC_7H_5O_2$, which is used to prepare the food preservative sodium benzoate, $NaC_7H_5O_2$. What is the percent yield of a reaction that converts 1.000 kg of toluene to 1.21 kg of benzoic acid?

$$2C_7H_{8(l)} + 3O_{2(g)} \rightarrow 2HC_7H_5O_{2(s)} + 2H_2O_{(l)}$$

1.000 kg

1.21 kg actual yield

Theoretical ?

Road Map

$$kg\ C_7H_8 \rightarrow g\ C_7H_8 \rightarrow mole\ C_7H_8 \rightarrow mole\ HC_7H_5O_2 \rightarrow g\ HC_7H_5O_2 \rightarrow kg\ HC_7H_5O_2$$

molar mass toluene $7 \times 12.01 + 8 \times 1.008 = 92.13\,g/mol$

molar mass benzoic acid $7 \times 12.01 + 6 \times 1.008 + 2 \times 16.00 = 122.12\,g/mol$

Theoretical yield

$$\overset{4}{1.000\,kg\,C_7H_8} \times \overset{exact}{\frac{1000\,g\,C_7H_8}{1\,kg\,C_7H_8}} \times \overset{4}{\frac{1\,mole\,C_7H_8}{92.13\,g\,C_7H_8}} \times \overset{exact}{\frac{2\,mole\,HC_7H_5O_2}{2\,mole\,C_7H_8}} \times \overset{5}{\frac{122.12\,g\,HC_7H_5O_2}{1\,mole\,HC_7H_5O_2}} \times \overset{exact}{\frac{1\,kg\,HC_7H_5O_2}{1000\,g\,HC_7H_5O_2}} =$$

$$= 1.325|5183\,kg\,HC_7H_5O_2$$

$$= 1.326\,kg\,HC_7H_5O_2$$

$$\%\,yield = \frac{1.21\,kg\,HC_7H_5O_2\ actual}{1.326\,kg\,HC_7H_5O_2\ Theoretical} \times 100$$

$$= \boxed{91.3\,\%\ yield}$$

72) What is the limiting reactant when 1.50 g of lithium and 1.50 g of nitrogen combine to form lithium nitride, a component of advanced batteries, according to the following unbalanced equation?

$$Li + N_2 \rightarrow Li_3N$$

* It is key that you see that the equation is unbalanced. You must balance the equation befor anything else.

$$\underline{\underline{6}}\,Li_{(s)} + N_{2(g)} \rightarrow \underline{\underline{2}}\,Li_3N_{(s)}$$

Li ~~1~~ 6
N 2

Li ~~3~~ 6 ✓
N ~~1~~ 2 ✓

$$6Li + N_2 \longrightarrow 2Li_3N$$

1.50g 1.50g ?? which is smaller?

## Road Maps

$g\,Li \rightarrow \text{mole}\,Li \rightarrow \text{mole}\,Li_3N \rightarrow g\,Li_3N$

$g\,N_2 \rightarrow \text{mole}\,N_2 \rightarrow \text{mole}\,Li_3N \rightarrow g\,Li_3N$

Need molar mass:

$Li = 6.941 g/mole$

$N_2 = 28.02 g/mole$

$Li_3N = 3 \times 6.941 + 14.01 = 34.83 g/mole$

#1 Limiting

Smaller

$$\boxed{1.50g\,Li} \times \frac{1\text{ mole }Li}{6.941g\,Li} \times \frac{2\text{ mole }Li_3N}{6\text{ mole }Li} \times \frac{34.83g\,Li_3N}{1\text{ mole }Li_3N} = \boxed{2.51g\,Li_3N}$$

#2

$$1.50g\,N_2 \times \frac{1\text{ mole }N_2}{28.02g\,N_2} \times \frac{2\text{ mole }Li_3N}{1\text{ mole }N_2} \times \frac{34.83g\,Li_3N}{1\text{ mole }Li_3N} = 3.73g\,Li_3N$$

Li is limiting reagent
producing 2.51g $Li_3N$