Chem I Review - Chang, Chpt. 3

11, 13, 15, 19, 21, 27, 29, 33, 34, 41, 43, 47, 63, 77, 81, 89, 93

3.11 $6.9\times10^{9}\ \text{people} \times \frac{2\ \text{particles}}{1\ \text{second}} \times ?\ \text{seconds} = 6.02\times10^{23}\ \text{particles}$

$$?\ \text{seconds} = \frac{6.02\times10^{23}\ \text{particles}}{1.38\times10^{10}\ \text{particles/second}} = 4.347826087\times10^{13}\ \text{sec}$$

$$4.347826087\times10^{13}\ \text{sec} \times \frac{1\ \text{min}}{60\ \text{sec}} \times \frac{1\ \text{hr}}{60\ \text{min}} \times \frac{1\ \text{day}}{24\ \text{hr}} \times \frac{1\ \text{yr}}{365\ \text{d}} = 1378686.608\ \text{yr}$$

$1300000\ \text{yr}$

1.3 million yrs

3.13 $5.10\ \text{mol} \times \frac{6.022\times10^{23}\ \text{atoms}}{1\ \text{mol}} = 3.07\times10^{24}\ \text{atoms}$

3.15 $77.4\ \text{g Ca} \times \frac{1\ \text{mol}}{40.08\ \text{g}} = 1.93113772\ \text{mol}$ → 1.93 mol

3.19 $1.00\times10^{12}\ \text{Pb atoms} \times \frac{1\ \text{mol}}{6.022\times10^{23}\ \text{atoms}} \times \frac{207.2\ \text{g}}{1\ \text{mol}} = 3.440717737\times10^{-10}\ \text{g}$

$3.44\times10^{-10}\ \text{g}$

3.21 (H) $1.10\ \text{g} \times \frac{1\ \text{mol}}{1.01\ \text{g}} = 1.09\ \text{mol}$ (MORE!) (Cr) $14.7\ \text{g} \times \frac{1\ \text{mol}}{52.00\ \text{g}} = 0.283\ \text{mol}$ Less!!

If you converted to atoms, that's fine, but you don't need to because whichever has more moles will also have more atoms

(FYI: $H = 6.56\times10^{23}$ atoms, $Cr = 1.70\times10^{23}$ atoms)

3.27 $1.50\ \text{g} \times \frac{1\ \text{mol}}{180.18\ \text{g}} \times \frac{6.022\times10^{23}\ \text{molecules}}{1\ \text{mol}} = 5.013320013\times10^{21}\ \text{molecules}$

5.01×10^{21} molecules = 3.01×10^{22} atoms of C
6.02×10^{22} atoms of H
3.01×10^{22} atoms of O

3.29 C = 12.01 × 19 = 228.19
H = 1.01 × 38 = 38.38
O = 16.00 × 1 = 16.00
282.57 g/mol

$$1.0\times10^{-12}\ \text{g} \times \frac{1\ \text{mol}}{282.57\ \text{g}} \times \frac{6.022\times10^{23}\ \text{molec.}}{1\ \text{mol}}$$

$= 2131153343$ molec. → SF → 2.1×10^{9} molecules

3.33 Two peaks, one at a mass value of 88 u and one at a mass of 89. (If F had other isotopes there would be many more combinations.)

3.34 Both $^2H \rightarrow 36, 37, 38, 40$; ^{32}S, ^{33}S, ^{34}S, ^{36}S

1 each ^1H, $^2H \rightarrow 35, 36, 37, 39$

7 peaks:
1. 34 ($^1H\,^1H\,^{32}S$)
2. 35 ($^1H\,^1H\,^{33}S$) and ($^1H\,^2H\,^{32}S$)
3. 36 ($^2H\,^2H\,^{32}S$), ($^1H\,^1H\,^{34}S$), and ($^1H\,^2H\,^{33}S$)
4. 37 ($^2H\,^2H\,^{33}S$) and ($^1H\,^2H\,^{34}S$)
5. 38 ($^2H\,^2H\,^{34}S$) and ($^1H\,^1H\,^{36}S$)
6. 39 ($^1H\,^2H\,^{36}S$)
7. 40 ($^2H\,^2H\,^{36}S$)

3.41 $C_9H_{10}O$

$C = 12.01 \times 9 = 108.09 / 134.19 \times 100 =$ 80.55% C
$H = 1.01 \times 10 = 10.10 / 134.19 \times 100 =$ 7.53% H
$O = 16.00 \times 1 = 16.00 / 134.19 \times 100 =$ 11.92% O
$134.19\ g/mol$

@ 80.55% C, 7.53% H, 11.92% O

@ $0.469\,g \times \frac{1\,mol}{134.19\,g} \times \frac{6.022 \times 10^{23}\ molec.}{1\,mol} = 2.104715702 \times 10^{21}\ molec.$

2.10×10^{21} molecules

3.43

C $44.4\% \times \frac{1\,mol}{12.01\,g} = 3.6969\ mol / 0.616 = 6$
H $6.21\% \times \frac{1\,mol}{1.01\,g} = 6.149\ mol / 0.616 = 9.98 \approx 10$
S $39.5\% \times \frac{1\,mol}{32.07\,g} = 1.232\ mol / 0.616 = 2$
O $9.86\% \times \frac{1\,mol}{16.00\,g} = 0.616\ mol / 0.616 = 1$

@ Emp. Form $C_6H_{10}S_2O$
EW = 162.30

@ $\frac{MM}{EM} = \frac{162}{162.30} \approx 1$

Mol. Form. $C_6H_{10}S_2O$

3.47 $2Al + 3I_2 \rightarrow 2AlI_3$

$20.4\,g\,Al \times \frac{1\,mol}{26.98\,g} \times \frac{3\,I_2}{2\,Al} \times \frac{253.80\,g}{1\,mol} = 287.853\,g$

288 g

3.63 $(8A + 4B \rightarrow 4C + 4D) \div 4$

$2A + B \rightarrow C + D$ (C)

3.77 $2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$ (1.00×10^5 kg = 1.00×10^8 g)

N = 14.01 × 2 = 28.02
H = 1.01 × 8 = 8.08
S = 32.07 × 1 = 32.07
O = 16.00 × 4 = 64.00
132.17 g/mol

$1.00\times10^8 g \times \frac{1 mol}{132.17 g} \times \frac{2 NH_3}{1 (NH_4)_2SO_4} \times \frac{17.04 g}{1 mol}$

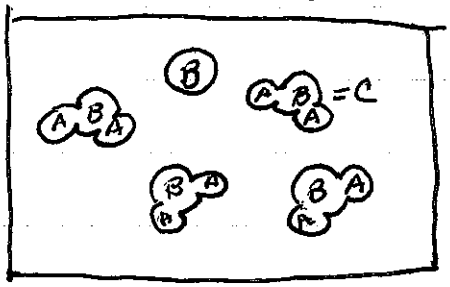
$= 25784973.9 g$

$2.58\times10^7 g$ or 2.58×10^4 kg

3.81 $2A + B \rightarrow C$

$8A + 5B \rightarrow 4C + 1B$ left over

(a) A is the L.R.



3.89 6.00 kg CaF_2 + excess $H_2SO_4 \rightarrow CaSO_4 + 2HF$ (2.86 kg)

Ca 40.08
2F 38.00
78.08

$6000 g\ CaF_2 \times \frac{1 mol}{78.08 g} \times \frac{2 HF}{1 CaF_2} \times \frac{20.01 g}{1 mol} = 3075.307377 g$

3080 g → 3.08 kg

% Yield = $\frac{2.86 kg}{3.08 kg} \times 100 =$ 92.9%

3.93 $6Li + N_2 \rightarrow 2Li_3N$

12.3 g Li, 33.6 g N_2

$12.3 g\ Li \times \frac{1 mol}{6.94 g} = 1.772334294 mol\ Li \times \frac{1\ N_2}{6 Li} = \frac{needs}{0.295389049 mol\ N_2}$

$33.6 g\ N_2 \times \frac{1 mol}{28.01 g} = \frac{have}{1.199571582 mol\ N_2}$ N_2 is in excess, so Li is the L.R.

$1.772334294 mol\ Li \times \frac{2 Li_3N}{6 Li} \times \frac{34.83 g}{1 mol} = 20.57680115 g$ (20.6 g Li_3N)

$\frac{5.89 g}{20.6 g} \times 100 =$ 28.6% Yield