1.15 $A \xrightarrow{\Delta} B + C$ ($C + O_2$)

A is a compound, because it can be separated

B - not enough info.

C - compound, made from Carbon and oxygen.

1.21 a) Sugar and sand can be separated by dissolving the sugar in H_2O. b) Iron can be magnetically separated from S.

1.25 a) $25.5\,mg \rightarrow g$

$1\,mg$

$1 \times 10^{-3}\,g = 1\,mg$

$25.5\,mg \left(\frac{1 \times 10^{-3}\,g}{1\,mg}\right) = \boxed{25.5 \times 10^{-3}\,g} = \boxed{2.55 \times 10^{-2}\,g}$

b) $4.0 \times 10^{-10}\,m \rightarrow nm$

$1\,nm = 10^{-9}\,m$

$4.0 \times 10^{-10}\,m \left(\frac{1\,nm}{10^{-9}\,m}\right) = \boxed{4.0 \times 10^{-1}\,nm} = \boxed{0.40\,nm}$

c) $.575\,mm \rightarrow \mu m$

$1\,mm = 10^{-3}\,m$, $1\,\mu m = 10^{-6}\,m$

$.575\,mm \left(\frac{10^{-3}\,m}{1\,mm}\right)\left(\frac{1\,\mu m}{10^{-6}\,m}\right) = \boxed{0.575 \times 10^{3}\,\mu m} = \boxed{575\,\mu m}$

1.29

a) $D = \frac{m}{V} = \frac{38.5\,g}{45\,mL} = 0.86\,g/mL \approx \boxed{0.866\,g/mL}$ ∴ Toluene (paint thinner)

b) $V = \frac{m}{D} = \frac{45.0\,g}{1.114\,g/mL} = \boxed{40.4\,mL}$ ethylene glycol

c) $V = (5.00\,cm)^3 = 125\,cm^3$, $D = 8.90\,g/cm^3 = \frac{m}{V}$

$m = D \cdot V = (8.90\,g/cm^3)(125\,cm^3) = \boxed{1110\,g\ Nickel} = \boxed{1.11 \times 10^{3}\,g\ Ni}$

1.47 a) 5.00 days → s

1 day = 24 h 1 h = 60 min. 1 min = 60 s

$$5\ \text{days}\left(\frac{24\ \text{h}}{1\ \text{day}}\right)\left(\frac{60\ \text{min}}{1\ \text{h}}\right)\left(\frac{60\ \text{s}}{1\ \text{min}}\right) = \boxed{4.32 \times 10^5\ \text{s}}$$

Accidentally did 1.46b

b) 1454 ft → m

1 ft. = 12 in. 1 in. = 2.54 cm 1 m = 100 cm

$$1454\ \text{ft}\left(\frac{12\ \text{in}}{1\ \text{ft}}\right)\left(\frac{2.54\ \text{cm}}{1\ \text{in}}\right)\left(\frac{1\ \text{m}}{100\ \text{cm}}\right) = \boxed{443.2\ \text{m}}$$

1.47b 0.0550 mi → m

1 mi = 1.6093 km

1 km = 10^3 m

$$0.0550\ \text{mi}\left(\frac{1.6093\ \text{km}}{1\ \text{mi}}\right)\left(\frac{10^3\ \text{m}}{1\ \text{km}}\right) = \boxed{88.5\ \text{m}}$$

c) \$1.89/gal. → \$/L

1 gal. = 3.7854 L

$$1.89\ \$/\text{gal.}\left(\frac{1\ \text{gal}}{3.7854\ \text{L}}\right) = 0.500\ \$/\text{L} = \boxed{0.499\ \$/\text{L}}$$

d) 0.510 in./ms → km/hr

1 in. = 2.54 cm 100 cm = 1 m 1000 m = 1 km

1000 ms = s 60 s = 1 min 60 min. = 1 hr

$$0.510\ \frac{\text{in}}{\text{ms}}\left(\frac{2.54\ \text{cm}}{1\ \text{in.}}\right)\left(\frac{1\ \text{m}}{100\ \text{cm}}\right)\left(\frac{1\ \text{km}}{1000\ \text{m}}\right)\left(\frac{1000\ \text{ms}}{1\ \text{s}}\right)\left(\frac{60\ \text{s}}{1\ \text{min}}\right)\left(\frac{60\ \text{min.}}{1\ \text{hr.}}\right) = \boxed{46.6\ \text{km/hr}}$$

e) 22.5 gal/min → L/s

1 gal. = 3.7854 L 1 min = 60 s

$$22.5\ \frac{\text{gal}}{\text{min}}\left(\frac{3.7854\ \text{L}}{1\ \text{gal}}\right)\left(\frac{1\ \text{min}}{60\ \text{s}}\right) = \boxed{1.42\ \text{L/s}}$$

f) 0.02500 ft^3 → cm^3

1 ft = 12 in 1 in = 2.54 cm

$$0.02500\ \text{ft}^3\left[\left(\frac{12\ \text{in.}}{1\ \text{ft}}\right)\left(\frac{2.54\ \text{cm}}{1\ \text{in.}}\right)\right]^3 = 0.02500\ \text{ft}^3\left[\left(\frac{12^3\ \text{in.}^3}{1^3\ \text{ft}^3}\right)\left(\frac{2.54^3\ \text{cm}^3}{1^3\ \text{in.}^3}\right)\right]$$

$$= \boxed{707.9\ \text{cm}^3}$$

151) m = d·V 1000 g = 1 kg, 1 L = 10^3 cm^3 1 ft = 12 in 1 in = 2.54 cm

$$m = \left(1.19\ \text{g/L}\right)\left(12.5\ \text{ft} \cdot 15.5\ \text{ft} \cdot 8.0\ \text{ft}\right) = 1844.5\ \frac{\text{g}\cdot\text{ft}^3}{\text{L}}$$

cont.

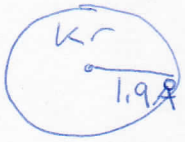
1.51) cont'd

$$1844.5\ \frac{g\cdot ft^3}{L}\left(\frac{1\ L}{10^3\ cm^3}\right)\left[\left(\frac{2.54\ cm}{1\ in}\right)\left(\frac{12\ in}{1\ ft}\right)\right]^3\left(\frac{1\ kg}{1000\ g}\right)=$$

$$1844.5\ \frac{g\cdot ft^3}{L}\left(\frac{1\ L}{10^3\ cm^3}\right)\left[\left(\frac{2.54^3\ cm^3}{1^3\ in^3}\right)\left(\frac{12^3\ in^3}{1^3\ ft^3}\right)\right]\left(\frac{1\ kg}{1000\ g}\right)=\boxed{52.2\ kg\ air}$$

Chapter 2

2.15

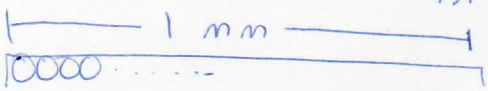


$1\text{Å} = 10^{-10}\ m \qquad 10^{-9}\ m = 1\ nm \qquad 10^{-12}\ m = 1\ pm$

$$1.9\text{Å}\left(\frac{10^{-10}\ m}{1\text{Å}}\right)\left(\frac{1\ nm}{10^{-9}\ m}\right)=\boxed{0.19\ nm}$$

$$1.9\text{Å}\left(\frac{10^{-10}\ m}{1\text{Å}}\right)\left(\frac{1\ pm}{10^{-12}\ m}\right)=\boxed{190\ pm}$$

b)



1.9Å x 2 = 3.8Å diameter

1 Kr atom is 3.8Å in diameter

$$\left(\frac{1\ \text{atom}}{3.8\text{Å}}\Big/\frac{1\text{Å}}{10^{-10}\ m}\right)\left(\frac{10^{-3}\ m}{1\ nm}\right)=\boxed{2.6\times10^{6}\ \frac{\text{Kr atoms}}{nm}}$$

c) $V=\frac{4}{3}\pi r^3$ ✱ $1\text{Å}=10^{-10}\ m$, $10^{-2}\ m = 1\ cm$

$$V=\frac{4\pi}{3}(1.9\text{Å})^3=\frac{4\pi}{3}(1.9\text{Å})^3\left[\left(\frac{10^{-10}\ m}{1\text{Å}}\right)\left(\frac{1\ cm}{10^{-2}\ m}\right)\right]^3=\frac{4\pi}{3}1.9^3\text{Å}^3\Big/\frac{(10^{-10})^3\ m^3}{1^3\text{Å}^3}\left(\frac{1^3\ cm^3}{(10^{-2})^3\ m^3}\right)$$

$$V=\frac{4\pi}{3}\cdot1.9^3\text{Å}^3\left(\frac{10^{-30}\ m^3}{1\text{Å}^3}\right)\left(\frac{1\ cm^3}{10^{-6}\ m^3}\right)=\boxed{2.9\times10^{-23}\ cm^3}$$

Chapter 3

3.21 a) $N_2O_5 = 2(14.0\ amu)+5(16.0\ amu)=\boxed{108.0\ amu}$

d) $Ca(HCO_3)_2 = (40.078\ amu)+2\cdot(1\ amu)+2\cdot(12\ amu)+6\cdot(16\ amu)=\boxed{162.1\ amu}$

3.23 a) % mass of O in SO_3

TOTAL ~~wt~~ molecular weight = $3\cdot16+32.1 = 80.1\ amu\ SO_3$

$$\%\ \text{mass O}=\frac{\text{weight O}}{\text{TOTAL weight}}=\frac{48}{80.1}\times100\%=\boxed{59.9\%\ O}$$

c) % mass of O in $Cr(NO_3)_3$, $Cr(NO_3)_3$ weighs: $52\ amu+3\cdot[(14+3\cdot16)]$

$= 238\ amu$

$$\%\ \text{mass O}=\frac{\text{weight}}{\text{TOTAL weight}}=\frac{144\ amu}{238\ amu}\times100\%=\boxed{60.5\%\ O}$$

3.33) a) $0.773 \text{ mol } CaH_2 \left(\frac{40.08 + 2.1 \text{ g}}{1 \text{ mol } CaH_2}\right) = \boxed{32.5 \text{ g } CaH_2}$

b) $5.35 \text{ g } Mg(NO_3)_2 \left(\frac{1 \text{ mole } Mg(NO_3)_2}{148.3 \text{ g}}\right) = \boxed{0.0361 \text{ mol } Mg(NO_3)_2}$

c) $0.0305 \text{ mol } CH_3OH \left(\frac{6.02 \times 10^{23} \text{ molecules}}{1 \text{ mol } CH_3OH}\right) = \boxed{1.84 \times 10^{22} \text{ molecules } CH_3OH}$

d) $0.585 \text{ mol } C_4H_{10} \left(\frac{6.02 \times 10^{23} \text{ molecules } C_4H_{10}}{1 \text{ mole } C_4H_{10}}\right)\left(\frac{4 \text{ C ATOMS}}{1 \text{ molecule } C_4H_{10}}\right) = \boxed{1.41 \times 10^{24} \text{ C ATOMS}}$

3.35) a) $2.5 \times 10^{-3} \text{ mol } (NH_4)_3PO_4 \left(\frac{148.97 \text{ g}}{1 \text{ mol } (NH_4)_3PO_4}\right) = \boxed{3.72 \times 10^{-1} \text{ g } (NH_4)_3PO_4}$

b) $0.2550 \text{ g } AlCl_3 \left(\frac{1 \text{ mol } AlCl_3}{133.33 \text{ g } AlCl_3}\right)\left(\frac{3 \text{ mol } Cl^-}{1 \text{ mol } AlCl_3}\right) = \boxed{5.738 \times 10^{-3} \text{ mol } Cl^-}$

c) $7.70 \times 10^{20} \text{ molecules } C_8H_{10}N_4O_2 \left(\frac{1 \text{ mol}}{6.02 \times 10^{23} \text{ molecules}}\right)\left(\frac{194 \text{ g}}{1 \text{ mol } C_8H_{10}N_4O_2}\right) = \boxed{0.248 \text{ g } C_8H_{10}N_4O_2}$

d) $\frac{0.406 \text{ g cholesterol}}{0.00105 \text{ mol}} = \boxed{386.67 \text{ g/mol cholesterol}}$

3.39) $1.250 \times 10^{21} \text{ C ATOMS} \left(\frac{C_6H_{12}O_6 \text{ molecule}}{6 \text{ C ATOMS}}\right)\left(\frac{12 \text{ H ATOMS}}{1 C_6H_{12}O_6 \text{ molecule}}\right) = \boxed{2.500 \times 10^{21} \text{ H ATOMS}}$

b) $1.250 \times 10^{21} \text{ C ATOMS} \left(\frac{1 C_6H_{12}O_6 \text{ molecule}}{6 \text{ C ATOMS}}\right) = \boxed{2.083 \times 10^{20} C_6H_{12}O_6 \text{ molecules}}$

c) $1.250 \times 10^{21} \text{ C ATOMS} \left(\frac{1 C_6H_{12}O_6 \text{ molecule}}{6 \text{ C ATOMS}}\right)\left(\frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ molecules}}\right) = \boxed{3.460 \times 10^{-4} \text{ mol } C_6H_{12}O_6}$

d) $1.250 \times 10^{21} \text{ C ATOM} \left(\frac{1 C_6H_{12}O_6 \text{ molecule}}{6 \text{ C ATOMS}}\right)\left(\frac{1 \text{ mole}}{6.02 \times 10^{23} \text{ molecules}}\right)\left(\frac{180 \text{ g } C_6H_{12}O_6}{1 \text{ mole}}\right) = \boxed{0.06227 \text{ g } C_6H_{12}O_6}$

3.43 a) 0.0130 mol C, 0.0390 mol H, $0.0065 \text{ mol O} \rightarrow \text{SMALLEST}$

$\frac{.0130 \text{ mol C}}{.0065 \text{ mol O}} = \frac{2 \text{ C}}{1 \text{ O}}$, $\frac{.0390 \text{ mol H}}{.0065 \text{ mol O}} = \frac{6 \text{ H}}{1 \text{ O}}$ → $\boxed{C_2H_6O}$

b) $11.66 \text{ g Fe} \left(\frac{1 \text{ mol Fe}}{55.845 \text{ g Fe}}\right) = 0.2088 \text{ mol Fe}$

$5.01 \text{ g O} \left(\frac{1 \text{ mol O}}{16 \text{ g O}}\right) = 0.313 \text{ mol O}$

$\frac{0.2088 \text{ mol Fe}}{0.313 \text{ mol O}} \approx \frac{2 \text{ mol Fe}}{3 \text{ mol O}}$ → $\boxed{Fe_2O_3}$

c) 40.0% C, 6.7% H, 53.3% O

Assume 100 g of sample, Then: 40 g C, 6.7 g H, 53.3 g O

$40 \text{ g C} \left(\frac{1 \text{ mol}}{12 \text{ g C}}\right) = 3.33 \text{ mol C}$ | $6.7 \text{ g H} \left(\frac{1 \text{ mol H}}{1 \text{ g H}}\right) = 6.7 \text{ mol H}$ | $53.3 \text{ g O} \left(\frac{1 \text{ mol O}}{16 \text{ g O}}\right) = 3.33 \text{ mol O}$

$\frac{3.33 \text{ mol C}}{6.7 \text{ mol H}} = \frac{1 \text{ C}}{2 \text{ H}}$, $\frac{3.33 \text{ mol O}}{6.7 \text{ mol H}} = \frac{1 \text{ O}}{2 \text{ H}}$ ∴ $\boxed{CH_2O}$

3.47 a) CH_2 → molar mass = $12 + 1\cdot2 = 14$ g/mol

molar mass of compound = 84 g/mol

$\frac{84}{14} = 6$, must be 6 units of CH_2 so the compound is C_6H_{12}

b) NH_2Cl → molar mass = 51.5 g/mol

molar mass of compound = 51.5 g/mol

∴ ~~NH_2Cl_2~~ NH_2Cl is the formula of the compound

3.57 $Na_2SiO_3(s) + 8\,HF_{(aq)} \longrightarrow H_2SiF_6(aq) + 2\,NaF_{(aq)} + 3\,H_2O_{(\ell)}$

a) how many moles of HF needed to react w/ 0.300 mol Na_2SiO_3?

$$0.300\text{ mol } Na_2SiO_3\left(\frac{8\text{ mol HF}}{1\text{ mol } Na_2SiO_3}\right) = 2.4\text{ mol HF}$$

b)

$$0.500\text{ mol HF}\left(\frac{2\text{ NaF}}{8\text{ HF}}\right)\left(\frac{42\text{ g NaF}}{1\text{ mol NaF}}\right) = 5.25\text{ g NaF}$$

c)

$$0.800\text{ g HF}\left(\frac{1\text{ mol HF}}{20\text{ g HF}}\right)\left(\frac{1\text{ } Na_2SiO_3}{8\text{ HF}}\right)\left(\frac{122.1\text{ g } Na_2SiO_3}{1\text{ mol } Na_2SiO_3}\right) = 0.610\text{ g } Na_2SiO_3$$

3.59 a) $Al(OH)_3 + 3HCl \longrightarrow AlCl_3 + 3H_2O$

b) $$0.500\text{ g } Al(OH)_3\left(\frac{1\text{ mol } Al(OH)_3}{78\text{ g } Al(OH)_3}\right)\left(\frac{3\text{ mol HCl}}{1\text{ mol } Al(OH)_3}\right)\left(\frac{36.5\text{ g HCl}}{1\text{ mol HCl}}\right) = 0.702\text{ g HCl}$$

c)

$$0.500\text{ g } Al(OH)_3\left(\frac{1\text{ mol}}{78\text{ g } Al(OH)_3}\right)\left(\frac{1\text{ mol } AlCl_3}{1\text{ mol } Al(OH)_3}\right)\left(\frac{133.5\text{ g } AlCl_3}{1\text{ mol } AlCl_3}\right) = 0.856\text{ g } AlCl_3$$

$$0.500\text{ g } Al(OH)_3\left(\frac{1\text{ mol}}{78\text{ g } Al(OH)_3}\right)\left(\frac{3\text{ mol } H_2O}{1\text{ mol } Al(OH)_3}\right)\left(\frac{18\text{ g } H_2O}{1\text{ mol } H_2O}\right) = 0.346\text{ g } H_2O$$

3.69 A) 4815 ~~bikes~~ wheels, 2305 frames, 2255 handle bars, 2255 bikes can be made, after that there are no more handle bars. They will be ~~[illegible]~~ 305 wheels left, and 50 frames.

3.71 $2\,NaOH + CO_2 \longrightarrow Na_2CO_3 + H_2O$

a) $$1.85\text{ mol } NaOH\left(\frac{1\text{ mol } CO_2}{2\text{ mol NaOH}}\right) = 0.925\text{ mol } CO_2$$ required. Since the question says we have 1 mol CO_2, we will be limited by CO_2 not CO_2

b) $$1.85\text{ mol } NaOH\left(\frac{1\text{ mol } Na_2CO_3}{2\text{ mol NaOH}}\right) = 0.925\text{ mol } Na_2CO_3$$

c) The NaOH will be used up completely. According to (a) we'll only use 0.925 mole CO_2 so there will be $1 - 0.925 = .075$ mol CO_2 remaining

3.77 $C_6H_6 + Br_2 \longrightarrow C_6H_5Br + HBr$

$$30\text{ g } C_6H_6\left(\frac{1\text{ mol}}{78\text{ g } C_6H_6}\right) = 0.385\text{ mol } C_6H_6 \text{ (limiting)}$$

$$65\text{ g } Br_2\left(\frac{1\text{ mol } Br_2}{159.8\text{ g } Br_2}\right) = 0.41\text{ mol } Br_2$$

$$.385\text{ mol } C_6H_6\left(\frac{1\text{ mol } C_6H_5Br}{1\text{ mol } C_6H_6}\right)\left(\frac{156.9\text{ g}}{1\text{ mol } C_6H_5Br}\right) =$$

60.3 g C_6H_5Br

$$\%\text{ yield} = \frac{\text{ACTUAL}}{\text{THEORETICAL}} \times 100\%$$

$$\%\text{ yield} = \frac{56.7\text{ g}}{60.3\text{ g}} \times 100\% = 94.0\%\text{ yield}$$