Chapter 8

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41. a) $1.271\ g\ C_2H_5OH \times \frac{1\ mol\ C_2H_5OH}{46.0694\ g\ C_2H_5OH} \times \frac{2\ mol\ C}{1\ mol\ C_2H_5OH} = \boxed{0.05518\ mol\ C}$

b) $3.982\ g\ C_6H_4Cl_2 \times \frac{1\ mol\ C_6H_4Cl_2}{147.0036\ g\ C_6H_4Cl_2} \times \frac{6\ mol\ C}{1\ mol\ C_6H_4Cl_2} = \boxed{0.1625\ mol\ C}$

c) $0.4438\ g\ C_3O_2 \times \frac{1\ mol\ C_3O_2}{68.033\ g\ C_3O_2} \times \frac{3\ mol\ C}{1\ mol\ C_3O_2} = \boxed{0.01957\ mol\ C}$

d) $2.910\ g\ CH_2Cl_2 \times \frac{1\ mol\ CH_2Cl_2}{84.9328\ g\ CH_2Cl_2} \times \frac{1\ mol\ C}{1\ mol\ CH_2Cl_2} = \boxed{0.03426\ mol\ C}$

45. a) $\%(H)\text{ in }HClO_3 = \frac{1\ mol\ H}{1\ mol\ HClO_3} \times \frac{1.0079\ g\ H}{1\ mol\ H} \times \frac{1\ mol\ HClO_3}{84.4609\ g\ HClO_3} = 0.01193 \approx \boxed{1.193\%\ H}$

$\%(Cl)\text{ in }HClO_3 = \frac{35.453\ g\ Cl\text{ in }HClO_3}{84.4609\ g\ HClO_3} = 0.4198 \approx \boxed{41.98\%\ Cl}$

$\%(O)\text{ in }HClO_3 = 1 - (.01193 + 0.4198) = 0.5683 \approx \boxed{56.83\%\ O}$

b) $\%(U)\text{ in }UF_4 = \frac{238.03\ g\ U/mol\ UF_4}{314.03\ g\ UF_4/mol\ F_4} = \frac{0.7580\ g\ U}{1\ g\ UF_4} \approx \boxed{75.80\%\ U}$

$\%(F)\text{ in }UF_4 = 1 - (0.7580) = 0.2420 \approx \boxed{24.20\%\ F}$

c) $\%(Ca)\text{ in }CaH_2 = \frac{40.08\ g\ Ca/mol\ CaH_2}{42.0958\ g\ CaH_2/mol\ CaH_2} = \frac{0.9521\ g\ Ca}{1\ g\ CaH_2} \approx \boxed{95.21\%\ Ca}$

$\%(H)\text{ in }CaH_2 = 1 - (0.9521) = 0.0479 \approx \boxed{4.79\%\ H}$

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	Molecular Formula	Empirical Formula
55. a)	Na_2O_2	NaO
b)	$C_8H_6O_4$	$C_4H_3O_2$
c)	$C_{12}H_{12}N_2O_3$	$C_{12}H_{12}N_2O_3$
d)	$C_4H_6Cl_2$	C_2H_3Cl

57. Assume you have 100g of compound Li_xO_y.

$$100\,g\ Li_xO_y \times 46.46\% = 46.46\,g\ Li \times \frac{1\ mol\ Li}{6.941\ g\ Li} = 6.6935\ mol\ Li$$

$$100\,g\ Li_xO_y \times 53.54\% = 53.54\,g\ O \times \frac{1\ mol\ O}{16\ g\ O} = 3.34625\ mol\ O$$

$$Li_{6.6935}O_{3.34625} \longrightarrow Li_{\frac{6.6935}{3.34625}}O_{\frac{3.34625}{3.34625}} \longrightarrow \boxed{Li_2O} \quad (x=2,\ y=1)$$

59. First, check that total mass of new compound (0.5998 g) is accounted for by masses of carbon, hydrogen, and oxygen:

mass (C) + mass (H) + mass (O) = 0.2322g + 0.05848g + 0.3091g = 0.59978g

So, only C, H, and O is in new compound. It is a hydrocarbon $C_xH_yO_z$.

$$0.2322\,g\ C \times \frac{1\ mol\ C}{12.011\ g\ C} = 0.01933\ mol\ C$$

$$0.05848\,g\ H \times \frac{1\ mol\ H}{1.0079\ g\ H} = 0.05802\ mol\ H$$

$$0.3091\,g\ O \times \frac{1\ mol\ O}{16\ g\ O} = 0.01932\ mol\ O$$

$C_{0.01933}H_{0.05802}O_{0.01932}$

$\downarrow$

$C_{0.01933/0.01932}H_{0.05802/0.01932}O_{0.01932/0.01932}$

$\downarrow$

$\boxed{CH_3O}$

$x=1,\ y=3,\ z=1$

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71. Assume you have 100g of compound $Cu_xP_yO_z$.

$$100\,g\ Cu_xP_yO_z \times 66.75\% = 66.75\,g\ Cu \times \frac{1\ mol\ Cu}{63.55\,g\ Cu} = 1.0504\ mol\ Cu$$

$$100\,g\ Cu_xP_yO_z \times 10.84\% = 10.84\,g\ P \times \frac{1\ mol\ P}{30.974\,g\ P} = 0.34997\ mol\ P$$

$$100\,g\ Cu_xP_yO_z \times 22.41\% = 22.41\,g\ O \times \frac{1\ mol\ O}{16\,g\ O} = 1.4006\ mol\ O$$

$$Cu_{1.0504}P_{0.34997}O_{1.4006} \rightarrow Cu_{\frac{1.0504}{0.34997}}P_{\frac{0.34997}{0.34997}}O_{\frac{1.4006}{0.34997}} \rightarrow \boxed{Cu_3PO_4}$$

81. Assume you have 100g of compound $C_xH_yO_zN_q$.

$$100\,g\ unknown \times 42.87\% = 42.87\,g\ C \times \frac{1\ mol\ C}{12.011\,g\ C} = 3.5692\ mol\ C$$

$$100\,g\ unknown \times 3.598\% = 3.598\,g\ H \times \frac{1\ mol\ H}{1.0079\,g\ H} = 3.5698\ mol\ H$$

$$100\,g\ unknown \times 28.55\% = 28.55\,g\ O \times \frac{1\ mol\ O}{16.00\,g\ O} = 1.7844\ mol\ O$$

$$100\,g\ unknown \times 25.00\% = 25.00\,g\ N \times \frac{1\ mol\ N}{14.007\,g\ N} = 1.7848\ mol\ N$$

$$C_{3.5692}H_{3.5698}O_{1.7844}N_{1.7848} \rightarrow C_{\frac{3.5692}{1.7844}}H_{\frac{3.5698}{1.7844}}O_{\frac{1.7844}{1.7844}}N_{\frac{1.7848}{1.7844}} \rightarrow C_2H_2ON$$

Empirical formula: C_2H_2ON (empirical molar mass = $2(12.011) + 2(1.0079) + 16 + 14.007 = 56.045\,g/$

$$\frac{\text{molecular molar mass}}{\text{empirical molar mass}} = \frac{(165\,g \text{ to } 170\,g)/mol}{56.045\,g/mol} = 2.94407 \text{ to } 3.0333 \approx 3$$

Molecular formula: $\boxed{C_6H_6O_3N_3}$ $(C_{2\times3}H_{2\times3}O_{1\times3}N_{1\times3})$