(#7-1c)
PERCENT COMPOSITION I

Empirical Formula: Simplest ratio of Atoms

C = 80% H = 20%

Determining Empirical Formula

1. Convert % mass to mass.
   - Given a 100 gram sample
     - 80g C & 20g H
2. Convert mass to number of particles (moles)
   - 80g C * (1mol/12.01g) = 6.66 mol
   - 20g H * (1mol/1g) = 20 mol
3. Divide out all the moles by the smallest value. This gives simplest ratio. Automatically sets the smallest value to 1.
   - C: 6.66/6.66 = 1 Empirical = CH_3
   - H: 20.0/6.66 = 3
4. What happens if the smallest value of the empirical value is not 1. You will get a fraction.
   - N: 1
   - O = 2.5 or 2 ½ In this case you can't have a half an atom.
   - Multiply by the reciprocal of the fraction, in this case that would be 2.
     - Empirical = N_2O_5

REVIEW:

1. Convert CO_2 to Percent Mass

CO_2

$12 + 16(2) = 32$

44

$\frac{12}{44} \times 100 = 27.2\%$

$\frac{32}{44} \times 100 = 72.7\%$

With results convert back to empirical formula.

C: $27.2\% \rightarrow 27.2\,g \cdot \frac{1\ mol}{12\ g} = 2.26\ mol / 2.26 = 1$

O: $72.7\% \rightarrow 72.7\,g \cdot \frac{1\ mol}{16\ g} = 4.54\ mol / 2.26 = 2$ (CO_2)

2. Convert N_2O_5 to percent mass

N_2O_5

$14(2) = 28$

$16(5) = 80$

108

$28/108 \times 100 = 25.92\%$

$80/108 \times 100 = 74.0\%$

With results convert back to empirical formula.

N $25.92\% \rightarrow 25.92\,g \cdot \frac{1\ mol}{14\ g} = 1.85\ mol / 1.85 = 1 \times 2 = 2$

O $74.0\% \rightarrow 74.0\,g \cdot \frac{1\ mol}{16\ g} = 4.62\ mol / 1.85 = 2\frac{1}{2} \times 2 = 5$

(N_2O_5)

1. Cl = 71.65% $\rightarrow 71.65\,g \cdot \frac{1\ mol}{35.45} = 2.02 / 2.02 = 1$
   C = 24.27% $\rightarrow 24.27\,g \cdot \frac{1\ mol}{12\ g} = 2.02 / 2.02 = 1$
   H = 4.07%

Determine Empirical Formula: $4.07\,g \cdot \frac{1\ mol}{1\ g} = 4.07\ mol = 2$

($ClCH_2$)

2. P = 43.64% O= 56.36%
Determine the empirical formula

$P: 43.64\,g \cdot \frac{1\ mol}{30.97\,g} = 1.40 / 1.4 = 1 \times 2 = 2$

$O: 56.36\,g \cdot \frac{1\ mol}{16\,g} \quad 3.52 / 1.4 = 2.51 \times 2 = 5$

$(2\frac{1}{2})$

P_2O_5

3. C = 26.4 H = 5.6% N= 67.9%

Determine Empirical Formula:

$C: 26.4\,g \cdot \frac{1\ mol}{12\,g} = 2.2/2.2 = 1$

$H = 5.6\,g \cdot \frac{1\ mol}{1\,g} = 5.6\,g/2.2 = 2.5$

$N = 67.9\,g \cdot \frac{1\ mol}{14\,g} = 4.85/2.2$

SKID

5. C = 40% H = 6.6% O = 53.3%

Determine Empirical Formula:

$C = 40\,g \cdot \frac{1\ mol}{12\,g} = 3.3\ mol / 3.3 = 1$

$H = 6.6\,g \cdot \frac{1}{1} = 6.6\ mol / 3.3 = 2$

$O = 53.3\,g \cdot \frac{1\ mol}{16\,g} = 3.33\ mol / 3.3 = 1$

CH_2O

6. K = 45.9% N = 16.5% O = 37.6%

Determine Empirical Formula

$K = 45.9\,g \cdot \frac{1\ mol}{39\,g} = 1.17/1.17 = 1$

$N = 16.5\,g \cdot \frac{1}{14} = 1.17/1.17 = 1$

$O = 37.6\,g \cdot \frac{1}{16\,g} = 2.35/1.17 = 2$

KNO_2

7. Na = 42.1% P= 18.9% O = 39.0%

Determine Empirical Formula

$Na\ 42.1\,g \cdot \frac{1\ mol}{23\,g} = 1.83/.61 = 3$

$P = 18.9\,g \cdot \frac{1\ mol}{30.97\,g} = 0.61/.61 = 1$

$O = 39.0\,g \cdot \frac{1\ mol}{16\,g} = 2.4/.61 = 4$

Na_3PO_4

8. Pb = 68.3% S = 10.6% O = 21.1%

Determine Empirical Formula

$N = 11.6\,g \cdot \frac{1\ mol}{14\,g} \cdot \Rightarrow .82/.82 = 1$

8. N = 11.6% Cl = 88.4%
Determine Empirical Formula

$Cl = 88.4\,g \cdot \frac{1\ mol}{35.45\,g} \Rightarrow 2.49/.82 = 3$

NCl_3