

(#7-1c)
PERCENT COMPOSITION I

Empirical Formula: Simplest ratio of Atoms
C = 80% H = 20%

Determining Empirical Formula

1. Convert % mass to mass.
 - o Given a 100 gram sample
 - 80g C & 20g H
2. Convert mass to number of particles (moles)
 - o 80g C * (1mol/12.01g) = 6.66 mol
 - o 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.
 - o C: 6.66/6.66 = 1 Empirical = CH₃
 - o 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.
 - o N: 1
 - o O = 2.5 or 2 ½ In this case you can't have a half an atom.
 - o Multiply by the reciprocal of the fraction, in this case that would be 2.
 - Empirical = N₂O₅

REVIEW:

1. Convert CO₂ to Percent Mass

$$\begin{array}{r} \text{CO}_2 \\ 12 \quad 16(2) = 32 \\ \hline 44 \end{array}$$

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

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

With results convert back to empirical formula.

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

$$\text{O: } 72.7\% \rightarrow 72.7\text{g} \cdot \frac{1 \text{ mol}}{16 \text{ g}} = 4.54 \text{ mol} / 2.26 = 2 \quad \boxed{\text{CO}_2}$$

2. Convert N₂O₅ to percent mass

$$\begin{array}{r} \text{N}_2\text{O}_5 \\ 14(2) = 28 \\ 16(5) = 80 \\ \hline 108 \end{array}$$

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

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

With results convert back to empirical formula.

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

$$\text{O } 74.0\% \rightarrow 74.0\text{g} \cdot \frac{1 \text{ mol}}{16 \text{ g}} = 4.62 \text{ mol} / 1.85 = 2.5 \times 2 = 5 \quad \boxed{\text{N}_2\text{O}_5}$$

1. Cl = 71.65% → 71.65g · $\frac{1 \text{ mol}}{35.45} = 2.02 / 2.02 = 1$
 C = 24.27% → 24.27g · $\frac{1 \text{ mol}}{12 \text{ g}} = 2.02 / 2.02 = 1$
 H = 4.07%

Determine Empirical Formula:

$$4.07\text{g} \cdot \frac{1 \text{ mol}}{1 \text{ g}} = 4.07 \text{ mol} = 2$$



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

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

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

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

Determine Empirical Formula:

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

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

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



SKID

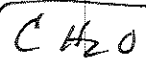
5. C = 40% H = 6.6% O = 53.3%

Determine Empirical Formula:

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

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

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



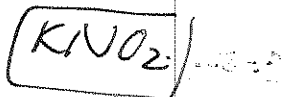
6. K = 45.9% N = 16.5% O = 37.6%

Determine Empirical Formula

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

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

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



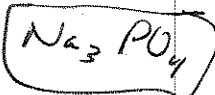
7. Na = 42.1% P = 18.9% O = 39.0%

Determine Empirical Formula

$$Na: 42.1g \cdot \frac{1 \text{ mol}}{23g} = 1.83 / 1.61 = 3$$

$$P: 18.9g \cdot \frac{1 \text{ mol}}{30.97g} = 0.61 / 1.61 = 1$$

$$O: 39.0g \cdot \frac{1 \text{ mol}}{16g} = 2.4 / 1.61 = 4$$



8. N = 11.6% Cl = 88.4%

Determine Empirical Formula

$$N = 11.6g \cdot \frac{1 \text{ mol}}{14g} \Rightarrow 0.82 / 0.82 = 1$$

$$Cl = 88.4g \cdot \frac{1 \text{ mol}}{35.45g} \Rightarrow 2.49 / 0.82 = 3$$

