

PERCENT COMPOSITION II

Notes

Determining the molecular formula from the empirical formula.

- What is the relationship between the empirical and molecular formula?
  - The molecular formula is some multiple of the empirical formula
    - CH<sub>4</sub> = empirical
    - Potential molecular formulas
      - CH<sub>4</sub>, C<sub>2</sub>H<sub>8</sub>, C<sub>3</sub>H<sub>12</sub> or C<sub>4</sub>H<sub>16</sub>....
  - Calculation
  - Molecular weight/Empirical weight = Multiple
    - CH<sub>4</sub> = 16g/mol and the molecular weight = 32g/mol
    - 32/16 = 2
    - C<sub>2</sub>H<sub>8</sub> = molecular formula

Determine empirical formula

1. N = 46.7% O = 53.3%
2. C = 92.3% H = 7.70%
3. C = 75.0% H = 25.0%

Determine empirical and molecular formula:

4. C = 80% H = 20% M.W. = 30.0

$C = 80g \cdot \frac{1 \text{ mol}}{12g} = 6.66 \text{ mol} / 6.66 = 1$       $C_1H_3 \rightarrow \begin{matrix} 1(12) \\ 3(1) \end{matrix} \left. \vphantom{\begin{matrix} 1(12) \\ 3(1) \end{matrix}} \right\} 15$   
 $H = 20g \cdot \frac{1 \text{ mol}}{1g} = 20 \text{ mol} / 6.66 = 3$   
 $30 / 15 = 2$       $C_2H_6$   
 $12(2) + 6 + 6 = 58 / 58 = 1$

5. C = 62% H = 10.4% O = 27.5% M.W. = 58.1

$C = 62\% \cdot \frac{1 \text{ mol}}{12g} = 5.16 \text{ mol} / 1.71 = 3.0$       $C_3H_6O$   
 $H = 10.4g \cdot \frac{1}{1} = 10.4 \text{ mol} / 1.71 = 6.08$   
 $O = 27.5g \cdot \frac{1 \text{ mol}}{16g} = 1.71 \text{ mol} / 1.71 = 1$

6. C = 40.0% H = 6.7% O = 53.3% M.W. = 60.0

$40g \cdot \frac{1 \text{ mol}}{12g} = 3.3 \text{ mol} / 3.3 = 1$       $C_1H_2O$  } 30g/mol      $\frac{60}{30} = 2$   
 $H = 6.7g \cdot \frac{1}{1} = 6.7 \text{ mol} / 3.3 = 2$   
 $O = 53.3g \cdot \frac{1 \text{ mol}}{16g} = 3.3 \text{ mol} / 3.3 = 1$       $C_2H_4O_2$

7. C = 40.92% H = 4.58% O = 54.51% M.W. = 176.1

$C = 40.92g \cdot \frac{1 \text{ mol}}{12g} = 3.41 / 3.4 = 1$  (x3) = 3  
 $H = 4.58g \cdot \frac{1}{1} = 4.58 \text{ mol} / 3.4 = 1.3 = 1\frac{1}{3}$  (x3) = 4  
 $O = 54.51g \cdot \frac{1 \text{ mol}}{16g} = 3.40 \text{ mol} / 3.4 = 1$  (x3) = 3  
 $C_3H_4O_3$

8. C = 46.3% H = 3.90% N = 27.0% O = 20.71% M.W. = 155

$C: 46.3g \rightarrow \frac{1}{12} = 3.85$  (x3) = 11.55  
 $H = 3.90g \rightarrow \frac{3.90 \text{ mol}}{1.29} = 3$  (x3) = 9  
 $N: 27.0 \rightarrow 1.92 \text{ mol} / 1.29 = 1.48 = 1.5$  (x2) = 3  
 $O = 20.71 \rightarrow \frac{1}{16} = 1.29 / 1.29 = 1$  (x2) = 2  
 $104$

Empirical  
 $C_6H_6N_3O_2$   
 Molecular