

Name: \_\_\_\_\_

### SCH 3U Formula Quiz

1. Given that a compound is 48.64 % carbon, 8.16 % hydrogen and 43.20 % oxygen by mass and that the mass of one mole of this compound is 296.32 g/mol, show a complete calculation for the molecular formula of this compound.

In a 100 g sample:

$$\text{C: } 48.64 \text{ g} \times \frac{1 \text{ mol}}{12.01 \text{ g}} = 4.050 \text{ mol} \div 2.700 \text{ mol} = 1.500 \times 2 = 3.000 \approx 3$$

$$\text{H: } 8.17 \text{ g} \times \frac{1 \text{ mol}}{1.01 \text{ g}} = 8.089 \text{ mol} \div 2.700 \text{ mol} = 2.996 \times 2 = 5.992 \approx 6$$

$$\text{O: } 43.20 \text{ g} \times \frac{1 \text{ mol}}{16.00 \text{ g}} = 2.700 \text{ mol} \div 2.700 \text{ mol} = 1.000 \times 2 = 2.000 \approx 2$$

Therefore the empirical formula is  $\text{C}_3\text{H}_6\text{O}_2$

The empirical mass is:

$$\text{C: } 3 \times 12.01 \text{ g} = 36.03 \text{ g}$$

$$\text{H: } 6 \times 1.01 \text{ g} = 6.06 \text{ g}$$

$$\text{O: } 2 \times 16.00 \text{ g} = 32.00 \text{ g}$$

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$$74.09 \text{ g}$$

Number of Empirical Units are:

$$\frac{\text{molecular mass}}{\text{empirical mass}} = \frac{296.32 \text{ g}}{74.09 \text{ g}} \approx 4$$

$\therefore 4 \times \text{C}_3\text{H}_6\text{O}_2 = \text{C}_{12}\text{H}_{24}\text{O}_8$  is the molecular formula

2. Perform a complete percentage by mass calculation for ammonium phosphate →  $(\text{NH}_4)_3\text{PO}_4$

$$\text{N: } 3 \times 14.01 = 42.03 \text{ g}$$

$$\text{H: } 12 \times 1.01 = 12.12 \text{ g}$$

$$\text{P: } 1 \times 30.97 = 30.97 \text{ g}$$

$$\text{O: } 4 \times 16.00 = 64.00 \text{ g}$$

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$$149.12 \text{ g}$$

$$\% \text{ N} = \frac{\text{mass N}}{\text{mass } (\text{NH}_4)_3\text{PO}_4} \times 100\%$$

$$\% \text{ N} = \frac{42.03 \text{ g}}{149.12 \text{ g}} \times 100\%$$

$$\% \text{ N} = 28.19 \% \text{ N}$$

$$\% \text{ H} = \frac{\text{mass H}}{\text{mass } (\text{NH}_4)_3\text{PO}_4} \times 100\%$$

$$\% \text{ H} = \frac{12.12 \text{ g}}{149.12 \text{ g}} \times 100\%$$

$$\% \text{ H} = 8.13\% \text{ H}$$

$$\% \text{ P} = \frac{\text{mass P}}{\text{mass } (\text{NH}_4)_3\text{PO}_4} \times 100\%$$

$$\% \text{ P} = \frac{30.97 \text{ g}}{149.12 \text{ g}} \times 100\%$$

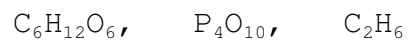
$$\% \text{ P} = 20.77 \% \text{ P}$$

$$\% \text{ O} = \frac{\text{mass O}}{\text{mass } (\text{NH}_4)_3\text{PO}_4} \times 100\%$$

$$\% \text{ O} = \frac{64.00 \text{ g}}{149.12 \text{ g}} \times 100\%$$

$$\% \text{ O} = 42.92 \% \text{ O}$$

3. Give an example of a chemical formula that is clearly a molecular formula and not an empirical formula. What is it about this formula that makes it impossible for it to represent a empirical formula.



All of these formula can be reduced ( $CH_2O$ ,  $PO_5$ ,  $CH_3$ )