

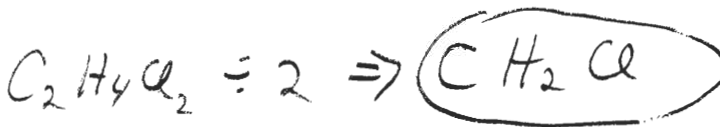
1. (6 Pts) A dry cleaning solvent is found to contain 24.3% carbon, 4.1% hydrogen, with the remainder being chlorine.

a) Determine the compound's empirical formula. *Assume 100g (100%)*

$$C: \frac{24.3g}{12.01g/mol} = 2.02$$

$$H: \frac{4.1g}{1.01g/mol} = 4.06$$

$$Cl: \frac{71.6g}{35.45g/mol} = 2.02$$



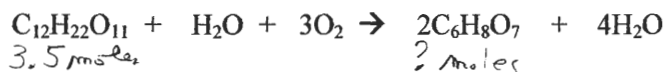
All even #s

b) If the above compound has a molecular mass of 99 amu, determine its molecular formula

99 is twice the empirical mass (49.48) so $C_2H_4Cl_2$

2. Citric acid, $C_6H_8O_7$, is prepared industrially by the fermentation of sucrose, $C_{12}H_{22}O_{11}$, by the mold *Aspergillus niger*.

a) (5 Pts) How many moles of citric acid can be prepared from 3.5 moles of sucrose?



$$\frac{3.5 \text{ mol sucrose}}{1 \text{ mol sucrose}} \times \frac{2 \text{ mol cit. Ac}}{1 \text{ mol sucrose}} = 7.0 \text{ mol cit. Ac.}$$

b) (6 Pts) How many moles of citric acid can be prepared from 357 grams of sucrose?

$$\frac{357g \text{ sucrose}}{342.2g \text{ sucrose}} \times \frac{2 \text{ mol cit. acid}}{1 \text{ mol sucrose}} = 2.086 \text{ mol cit. Ac.}$$

c) (6 Pts) How many moles of citric acid can be prepared from 357 grams of sucrose and 15.5 grams of water?

Based on sucrose: $\frac{357g \text{ sucrose}}{342.2g \text{ sucrose}} \times \frac{2 \text{ mol cit. Ac.}}{1 \text{ mol sucrose}} = 2.086 \text{ mol cit. Ac.}$

Based on H_2O : $\frac{15.5g H_2O}{18.02g H_2O} \times \frac{2 \text{ mol cit. Ac.}}{1 \text{ mol } H_2O} = 1.72 \text{ mol cit. Ac.}$

4. (2 Pts) What is the percent sulfur in H_2SO_4 ?

$$\begin{array}{r} 4 \times 16.0 \\ 1 \times 32.06 \\ 2 \times 1.008 \\ \hline 98.076 \end{array}$$

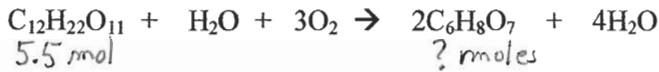
$$\% S = \frac{32.06}{98.076} \times 100 = 32.7\%$$

1. (2 Pts) What is the percent sulfur in H_2SO_3 ?

$$\begin{array}{l} \begin{array}{l} 3 \times 16.00 = 48.00 \\ 1 \times 32.06 = 32.06 \\ 2 \times 1.008 = 2.02 \\ \hline 82.08 \end{array} \quad \%S = \frac{32.06}{82.08} \times 100 \\ \hline \quad \quad \quad \%S = \boxed{39.06\%} \end{array}$$

2. Citric acid, $C_6H_8O_7$, is prepared industrially by the fermentation of sucrose, $C_{12}H_{22}O_{11}$, by the mold *Aspergillus niger*.

a) (5 Pts) How many moles of citric acid can be prepared from 5.5 moles of sucrose?



$$\frac{5.5 \text{ mole sucrose}}{1 \text{ mol sucrose}} \times \frac{2 \text{ mol cit. ac.}}{1 \text{ mol sucrose}} = 11 \text{ moles cit. ac.}$$

b) (6 Pts) How many moles of citric acid can be prepared from 457 grams of sucrose?

$$\frac{457 \text{ g sucrose}}{342.2 \text{ g sucrose}} \times \frac{1 \text{ mol sucrose}}{1 \text{ mol sucrose}} \times \frac{2 \text{ mol cit. ac.}}{1 \text{ mol sucrose}} = 2.67 \text{ mol cit. ac.}$$

c) (6 Pts) How many moles of citric acid can be prepared from 357 grams of sucrose and 12.5 grams of water?

Based on sucrose:

$$\frac{357 \text{ g sucrose}}{342.2 \text{ g sucrose}} \times \frac{1 \text{ mol sucrose}}{1 \text{ mol sucrose}} \times \frac{2 \text{ mol cit. ac.}}{1 \text{ mol sucrose}} = 2.086 \text{ mol cit. acid}$$

Based on H_2O :

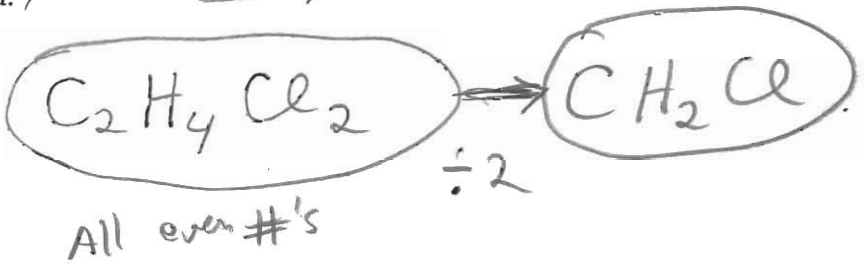
$$\frac{12.5 \text{ g } H_2O}{18.02 \text{ g } H_2O} \times \frac{1 \text{ mol } H_2O}{1 \text{ mol } H_2O} \times \frac{2 \text{ mol cit. ac.}}{1 \text{ mol } H_2O} = 1.387 \text{ mol cit. acid}$$

Limiting Reactant.

4. (6 Pts) A dry cleaning solvent is found to contain 24.3% carbon, 4.1% hydrogen, with the remainder being chlorine.

a) Determine the compound's empirical formula. Assume 100 g (100%)

$$\begin{array}{l} C: \frac{24.3 \text{ g}}{12.01 \text{ g/mol}} = 2.02 \\ H: \frac{4.1 \text{ g}}{1.01 \text{ g/mol}} = 4.06 \\ Cl: \frac{71.6 \text{ g}}{35.45 \text{ g/mol}} = 2.02 \end{array}$$



b) If the above compound has a molecular mass of 99 amu, determine its molecular formula.

empirical mass of above is 99 so $99 \div 49.48 = 2$

$$\text{C}_2\text{H}_4\text{Cl}_2$$