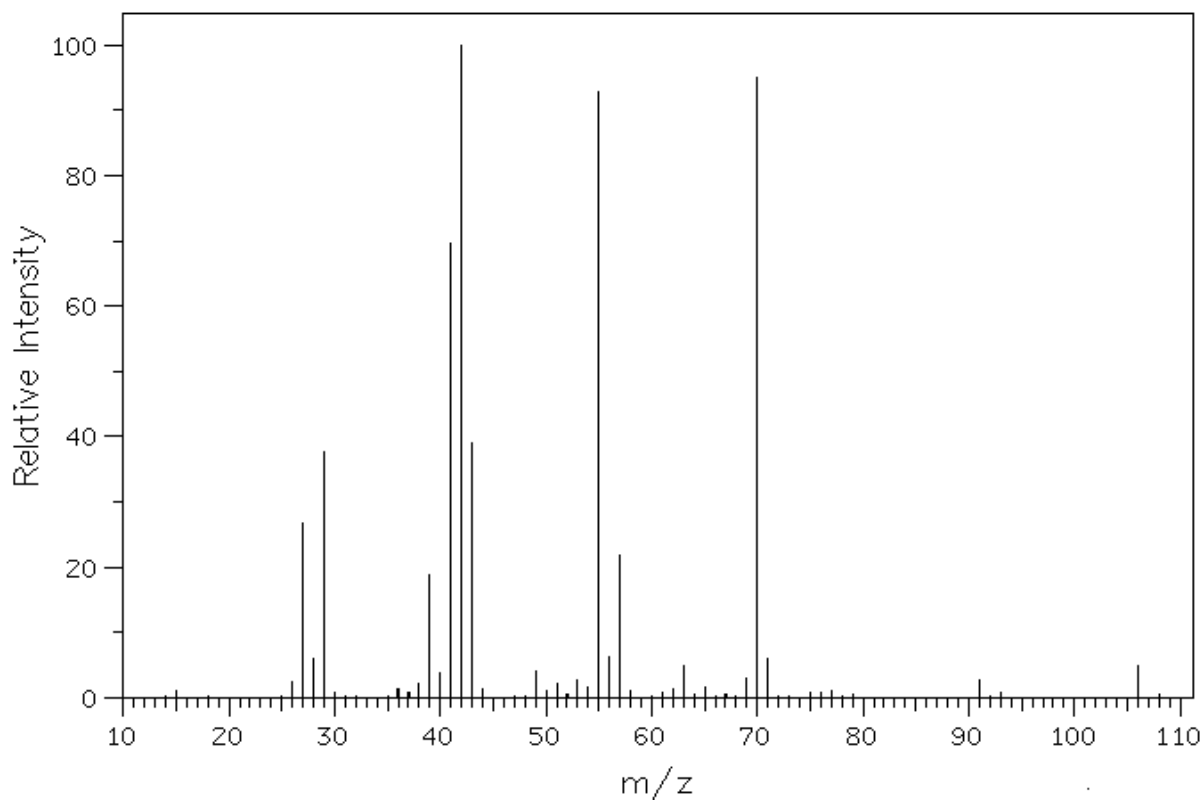


Friday Worksheet

Name:

Organic worksheet 5

- 1) The products of a reaction pathway consisted of two compounds. The compounds were analysed and both found to contain 56.34% carbon, 10.33% hydrogen and 33.33% chlorine by mass. The mass spectrum of one of the compounds is shown below.



- a) Find the empirical formula of the compound?

$$\Rightarrow 56.34/12.0 \text{ C} : 10.33 / 1.00 \text{ H} : 33.33 / 36.5 \text{ Cl}$$

$$\Rightarrow 4.70 \text{ C} : 10.33 \text{ H} : 0.913 \text{ Cl}$$

$$\Rightarrow 4.70/0.913 : 10.33 / 0.933 : 0.933/0.933$$

$$\Rightarrow 5.14 : 11.1 : 1.00$$

$$\Rightarrow \text{C}_5\text{H}_{11}\text{Cl}$$

- b) What is the molecular formula of the compound?

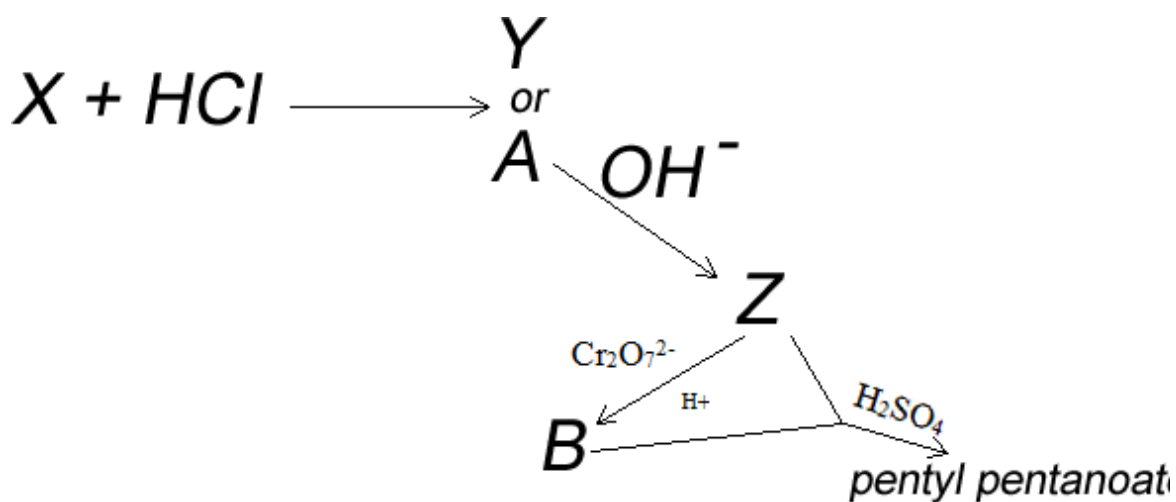
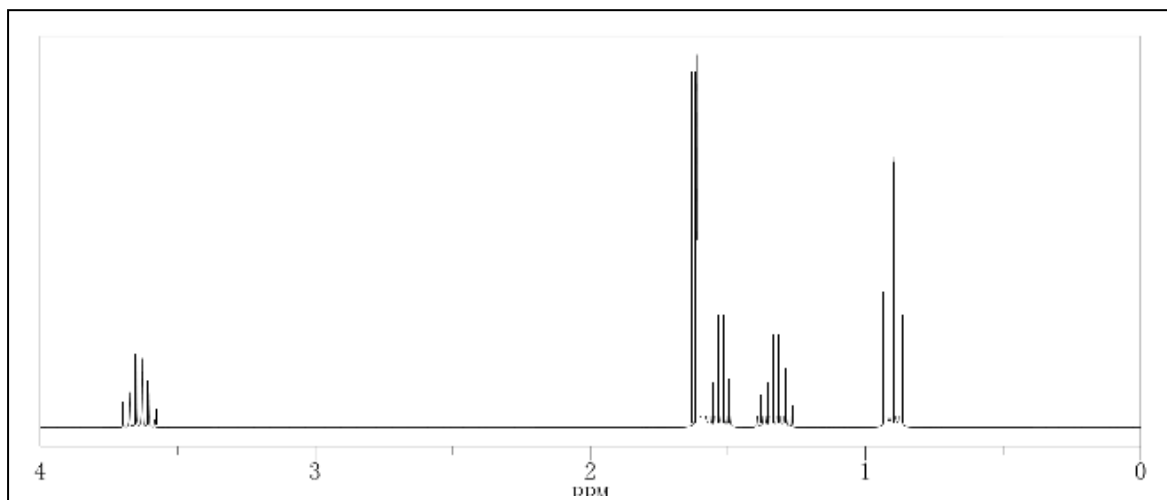
$$\text{Molecular formula} = \text{empirical formula} \times (\text{formula mass} / \text{empirical mass})$$

The formula mass can be derived from the mass spectrum. It is the fragment with the highest m/z value.

$$\Rightarrow (\text{C}_5\text{H}_{11}\text{Cl}) \times 106 / 106.5$$

$$\Rightarrow \text{C}_5\text{H}_{11}\text{Cl}$$

- c) The $^1\text{H NMR}$ spectrum of one of the isomers of the compound is given below. Give its systematic name.



- 2) Identify the following

X pent-1-ene
 Y 2-chloropentane
 Z pentan-1-ol
 A 1-chloropentane
 B pentanoic acid

- 3) i) What type of reaction forms pentyl pentanoate from B and Z?

condensation

ii) What type of reaction forms A or Y?

addition

iii) What type of reaction forms B?

oxidation

- 4) A compound was analysed and found to contain 90% carbon and 10% hydrogen by mass. A 1.60 gram sample of this compound was titrated with a 2.00 M Br₂ solution. An average titre of 30.00 mL was obtained before the brown colour persisted.

a) If the compound has three double bonds find the molecular formula of the compound.

First find the empirical formula of the compound.

$$\Rightarrow 90/12 \text{ C} : 10/1 \text{ H}$$

$$\Rightarrow 7.5 \text{ C} : 10$$

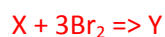
$$\Rightarrow 7.5/7.5 \text{ C} : 10 / 7.5$$

$$\Rightarrow 1\text{C} : 1.33\text{H}$$

$$\Rightarrow (1\text{C} : 1.33\text{H}) \times 3$$

$$\Rightarrow \text{C}_3\text{H}_4$$

Each molecule of Br₂ reacts with one double bond on the alkene molecule. Knowing that the compound has three double bonds we can write the following equation where X is the compound.



Step 1 find the number of moles of Br₂ that reacted

$$\Rightarrow n = C \times V$$

$$\Rightarrow n_{\text{bromine}} = 2.00 \times 0.030 = 0.0600$$

$$\Rightarrow n_{\text{alkene}} = 1/3 n_{\text{bromine}}$$

$$\Rightarrow n_{\text{alkene}} = 0.0200$$

Step 2 find the formula mass

$$\Rightarrow M_{\text{alkene}} = \text{mass} / n = 1.60 / 0.0200 = 80 \text{ g/mol}$$

Step 2 Find the molecular formula

Molecular formula = empirical formula X (formula mass/empirical mass)

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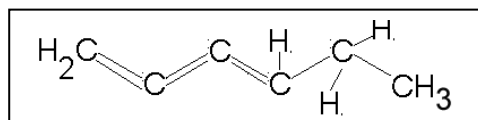
$$\Rightarrow (\text{C}_3\text{H}_4) \times 80/40$$

$$\Rightarrow \text{C}_6\text{H}_8$$

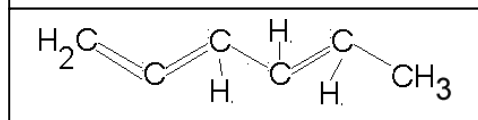
b) The ^1H NMR spectrum shows four signals. Give the systematic name of the hydrocarbon.

Four possible isomers exist

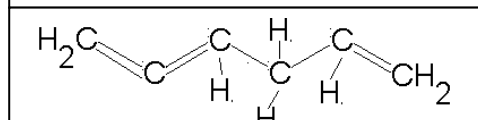
hex-1,2,3-triene



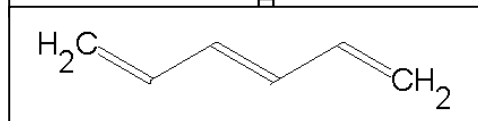
hex-1,2,4-triene



hex-1,2,5-triene



hex-1,3,5-triene



Hex-1,2,3-triene has four different hydrogen chemical environments.