Lab: Some Reactions of Toluene

1. **Halogenation**

a) *Substitution in the Ring*

Place 1 cm^3 of toluene in a boiling tube, add –4 drops of Br_2 in TTE, add 1 g of iron filings, boil very gently (CARE!) in the Fume Hood. Record observations. Test any gas evolved with aqueous pH paper. The product obtained is…

b) *Substitution in the Alkyl Chain*

Place 1 cm^3 of toluene in a boiling tube, add 2-3 drops of Br_2 in TTE, place in sunlight, and make observations.

2. **Nitration**

To 2 cm^3 of toluene, add a mixture of 1 cm^3 of conc, H_2SO_4 and 1 cm^3 of conc. HNO_3. Stir well, cool, the mixture in an ice bath if the reaction becomes too violent . After 2 minutes of shaking, pour the mixture into a beaker of water, the nitro- compounds will separate out as a yellow oil or solid.

3. **Sulphonation**

To 4 cm^3 of toluene add 10 drops of conc. H_2SO_4, shake until a homogenous solution is obtained. Warm,(CARE!!!), then pour the mixture with constant stirring into ~ 10 cm^3 of *cold saturated salt solution* (WHY?). What are the white crystals? Write a mechanistic equation for the reaction.

(This is used in the manufacture of saccharin).

4. **Oxidation**

a) *Combustion*

Ignite 4 drops on a watch glass, observe the sooty flame, why?

b) *Oxidising Agent*

To 2 cm^3 of toluene, add 5 drops of acidified $KMnO_{4(aq)}$, oxidation of toluene takes place resulting in the formation of benzoic acid, as observed by the decolourisation of the MnO_4^{-1} ion. Repeat this reaction using acidified $K_2Cr_2O_{7(aq)}$, instead of acidified $KMnO_{4(aq)}$.

Extension

1. What are the conditions required for each of the following reactions, and name (if any) product that may result ...

a) cyclohexene + $KMnO_{4(aq)}$ b) phenol + Br_2 c) benzene + conc. HNO_3

2. What deductions can you make from the following information?

a) Methylbenzene reacts with alkaline $KMnO_{4(aq)}$, but benzene does not.

b) Under the influence of ultra-violet light 1 mole of benzene reacts with 3 moles of chlorine gas without any production of hydrogen chloride fumes.

3. When benzene is treated with chlorine under the influence of ultra-violet light, a solid material is formed. Analysis gives an empirical formula of CHCl. Spectroscopic studies indicate a molar mass of ~ 292 g mol^{-1}.

a) What is the molecular formula of the product?

b) What is its possible structural formula?

c) What type of reaction has taken place?

d) Is the product of this reaction aromatic?

Actually, the product is a mixture of six isomers, one of which is an insecticide called Gammaxene.

e) How do these isomers differ from each other?