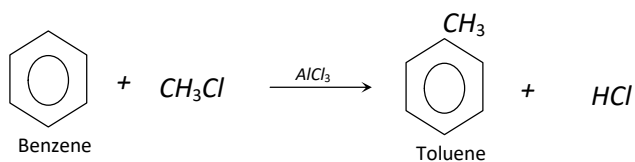


Toluene, methyl benzene or phenyl methane.

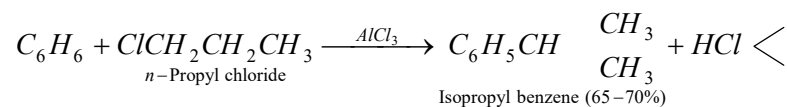
Toluene is the simplest homologue of benzene. It was first obtained by dry distillation of tolu balsam and hence named toluene. It is commercially known as tolual.

(1) Methods of preparation

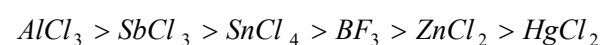
(i) **From benzene** [Friedel-craft's reaction] :



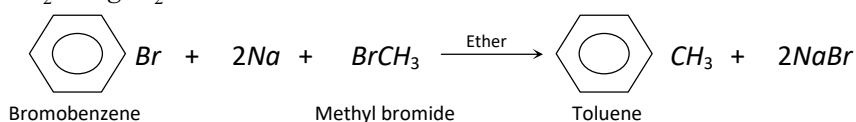
Note: Alkyl halide employed may undergo an isomeric change



Catalysts can be used in place of anhydrous $AlCl_3$ are,

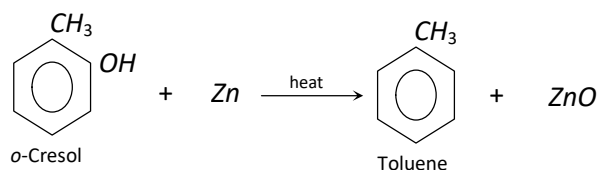


(ii) **Wurtz fitting reaction:**

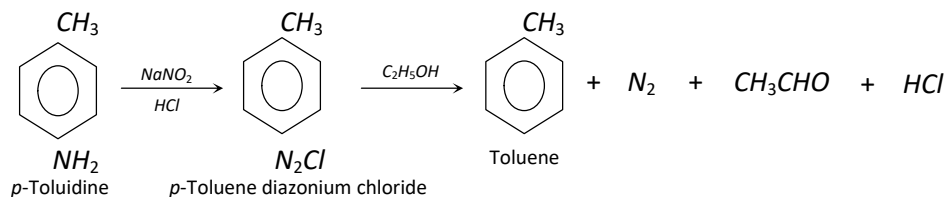
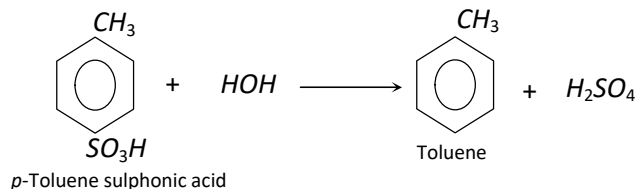

$$\text{(iii) Decarboxylation: } C_6H_5\text{COONa} \xrightarrow{\text{Soda lime}} C_6H_5CH_3 + Na_2CO_3$$

(o-, m- or p-) Sodium toluate Toluene

(iv) **Fromcresol:**

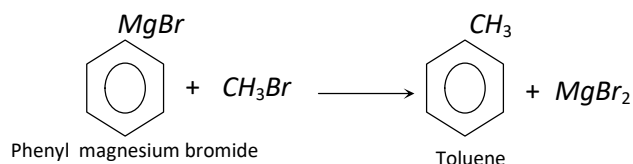


(v) **From toluene sulphonic acid:**



(vi) **Fromtoluidine:**

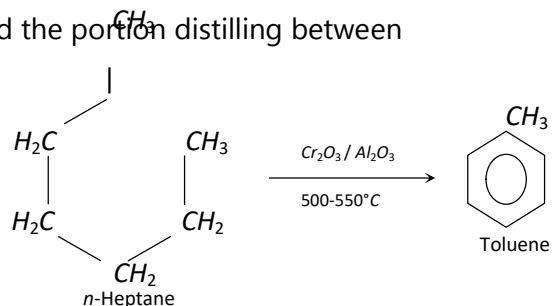
(vii) **From grignardreagent:**



(viii) **Commercial preparation**

From coal tar: The main source of commercial production of toluene is the light oil fraction of coal-tar. The light oil fraction is washed with conc. H_2SO_4 to remove the bases, then with $NaOH$ to remove acidic substances and finally with water. It is subjected to fractional distillation. The vapours collected between $80 - 110^\circ C$ is 90% benzol which contains 70 – 80% benzene and 14 – 24% toluene. 90% benzol is again distilled and the portion distilling between $108 - 110^\circ C$ is collected. It is toluene.

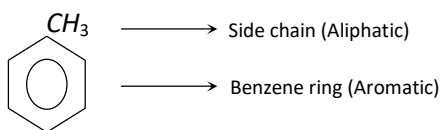
(ix) **From n- heptane and methyl cyclohexane**



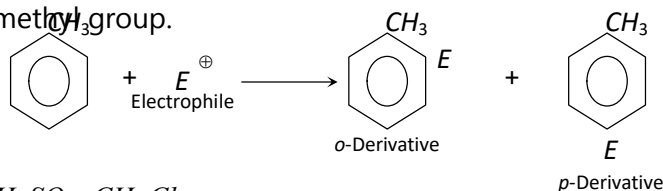
(2) **Physical properties**

- (i) It is a colourless mobile liquid having characteristic aromatic odour.
- (ii) It is lighter than water (sp. gr. 0.867 at $20^\circ C$).
- (iii) It is insoluble in water but miscible with alcohol and ether in all proportions.
- (iv) Its vapours are inflammable. It boils at $110^\circ C$ and freezes at $-96^\circ C$.
- (v) It is a good solvent for many organic compounds.
- (vi) It is a weak polar compound having dipole moment 0.4D.

(3) **Chemical properties:** Toluene shows the behavior of both



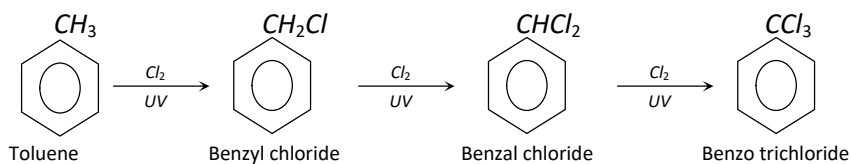
(i) **Electrophilic substitution reactions:** Aromatic character (More reactive than benzene) due to electron releasing nature of methyl group.



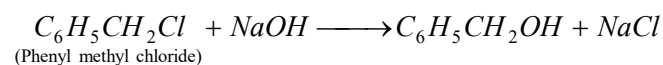
Note: E^+ may be chlorine, HNO_3 , H_2SO_4 , CH_3Cl .

(ii) **Reactions of side chain**

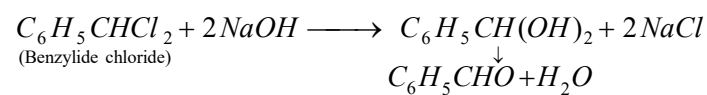
(a) Side chain halogenation :



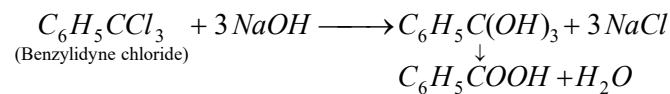
Note: Benzyl chloride on hydrolysis with aqueous caustic soda forms benzyl alcohol.



Benzal chloride on hydrolysis forms benzaldehyde.

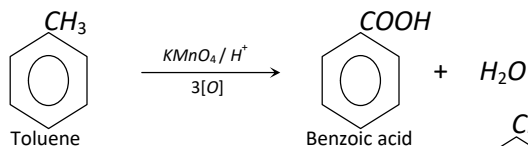


Benzotrichloride on hydrolysis forms benzoic acid.

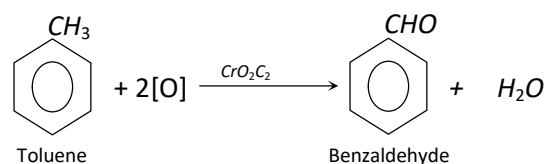


(b) Oxidation:

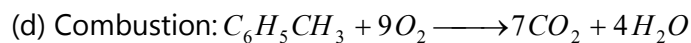
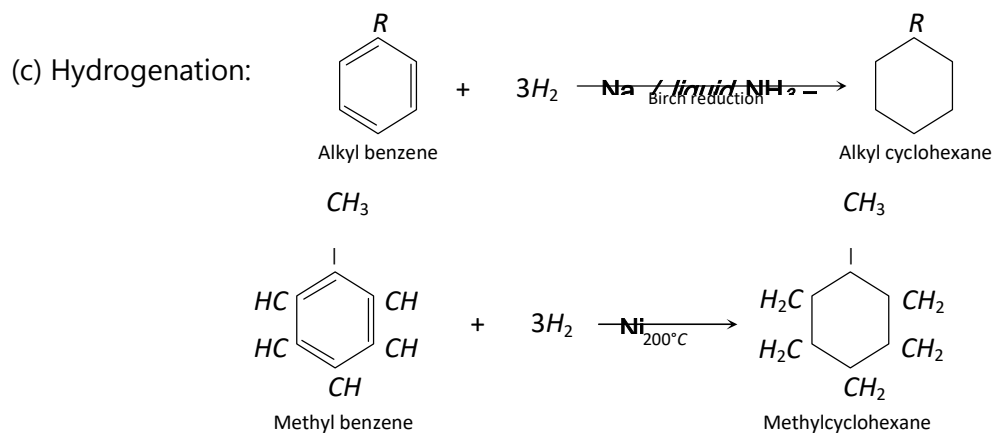
• With hot acidic KMnO_4 :



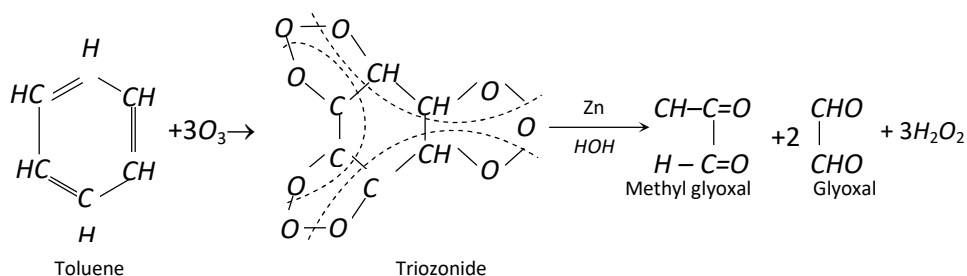
• With acidic manganese or chromyl chloride (Etards reaction) :



Note: All alkyl benzenes on oxidation with hot acidic $KMnO_4$ or $Na_2Cr_2O_7$ form benzoic acid. The length of the side chain does not matter.



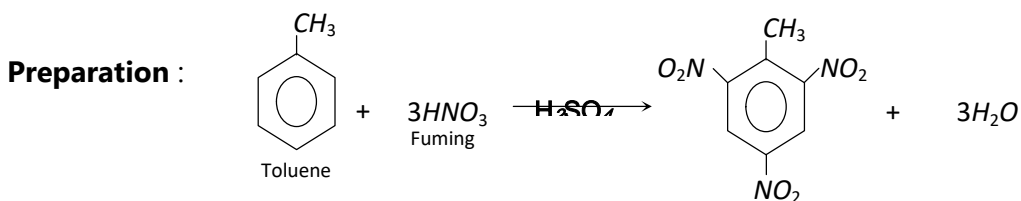
(e) Ozonolysis:



(4) Uses

- (i) In the manufacture of benzyl chloride, benzal chloride, benzyl alcohol, benzaldehyde, benzoic acid, saccharin, etc.
- (ii) In the manufacture of trinitrotoluene (TNT), a highly explosive substance.
- (iii) As an industrial solvent and in dry-cleaning.
- (iv) As a petrol substitute.
- (v) In the manufacture of certain dyes and drugs.

T.N.T. (Tri-nitro toluene)



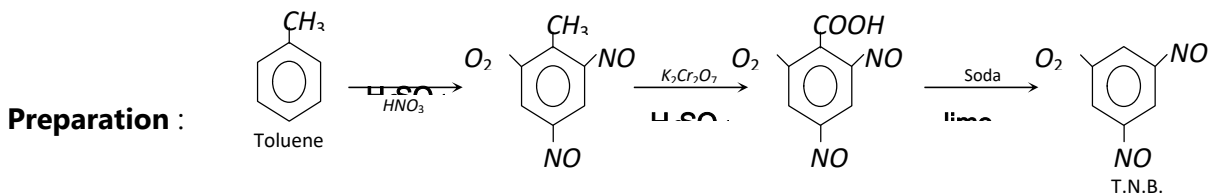
Properties : It is pale yellow crystalline solid (M.P. = 81°C).

Uses : • It is used as an explosive in shells, bombs and torpedoes under the name trotyl.

• When mixed with 80% ammonium nitrate it forms the explosive **amatol**.

• TNT is also used as a mixture of aluminium nitrate, alumina and charcoal under the name **ammonal**.

T.N.B. (Tri-nitro benzene)



Properties and uses: It is colorless solid (M.P. = 122°C). It is more explosive than T.N.T. and used for making explosive.