Ncert problem and solutions

1.How will you convert benzene into:

(i) p – nitrobromobenzene

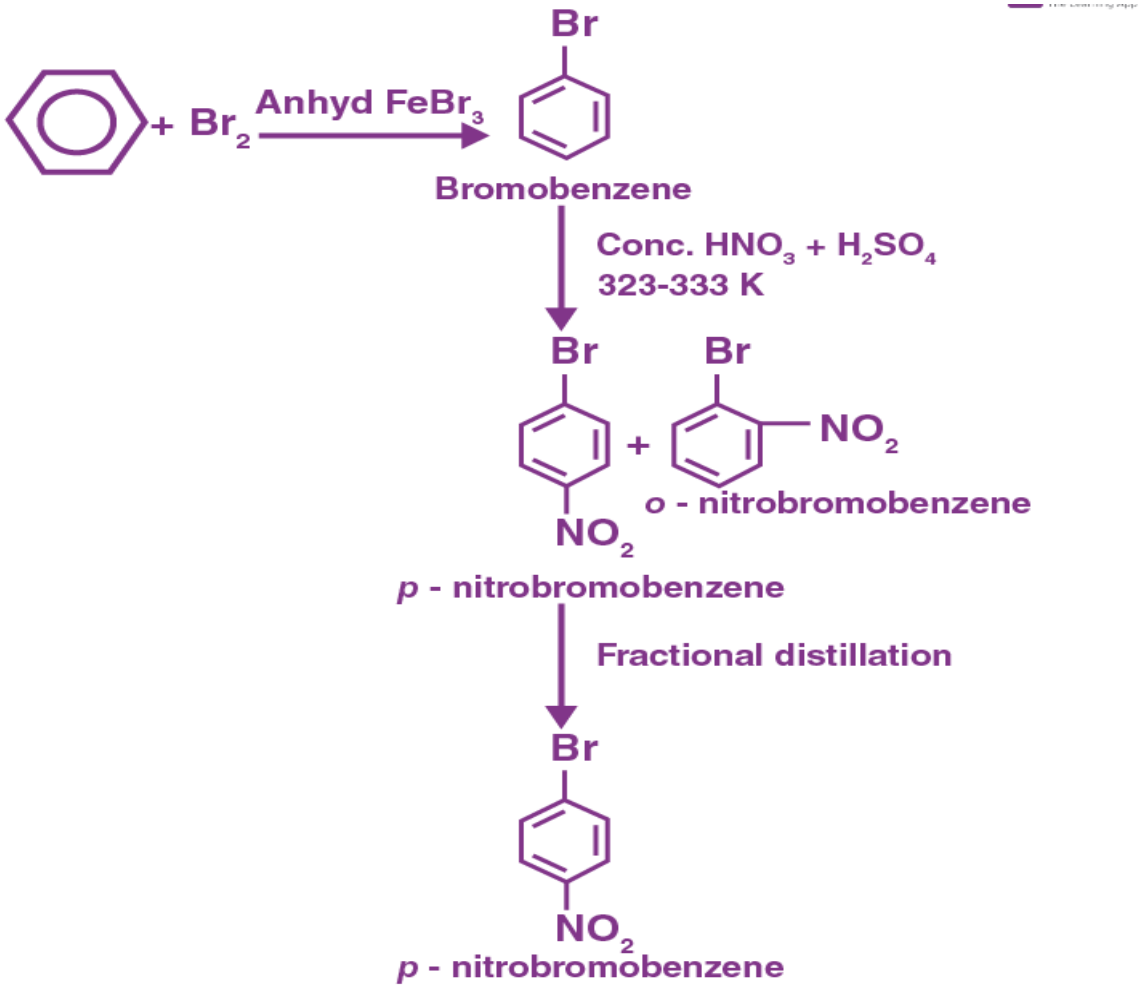
(ii) m-nitrochlorobenzene

(iii) p -nitrotoluene

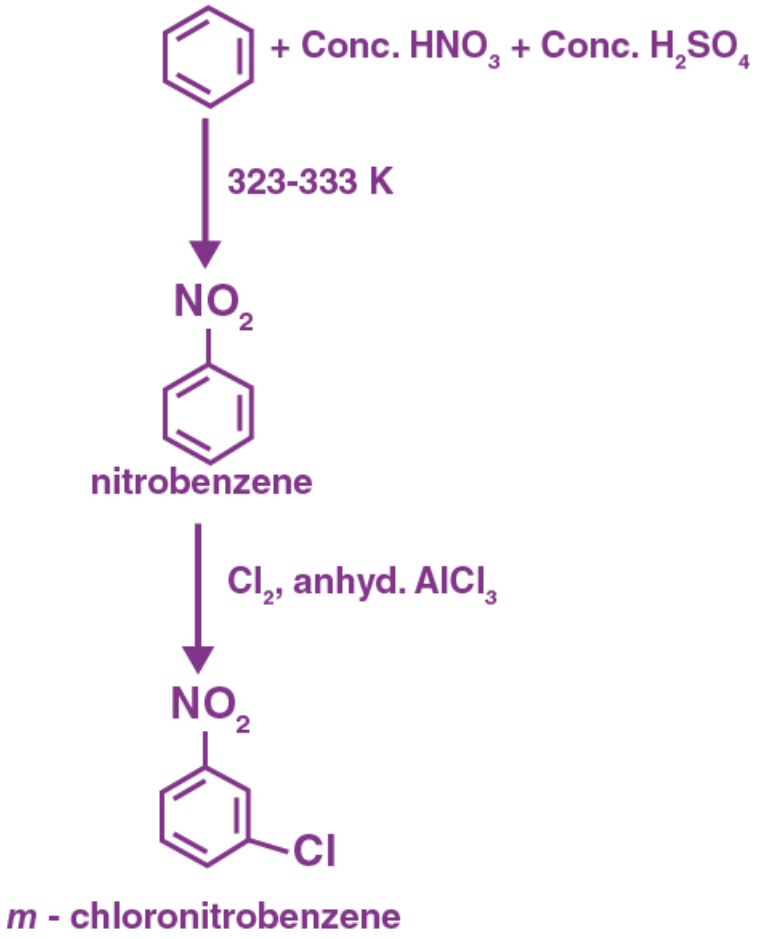
(iv) acetophenone

Answer 13.13:

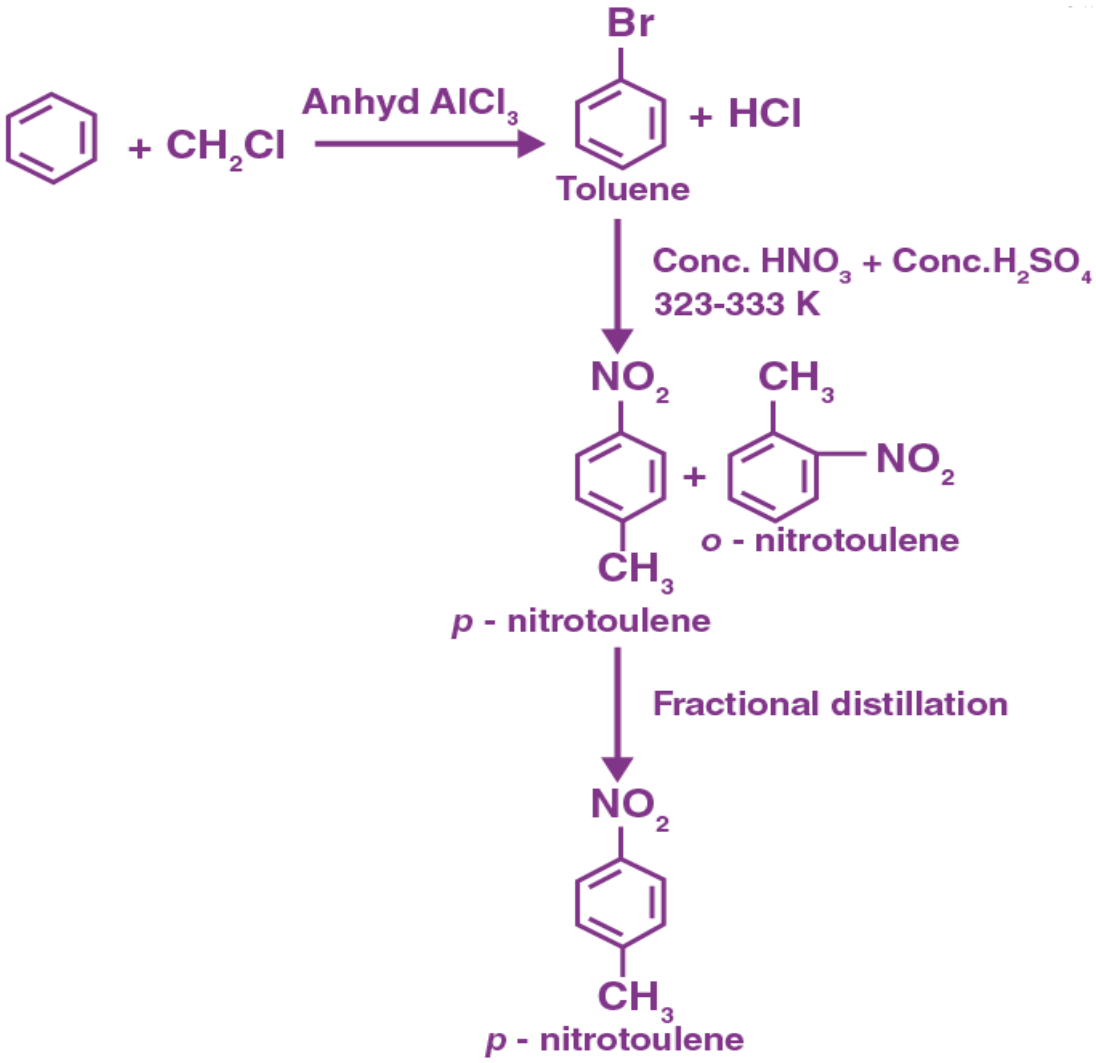
(i) Benzene converted to p – nitrobromobenzene



(ii) Benzene converted to m-nitrochlorobenzene



(iii) Benzene converted to p –nitrotoluene



(iv) Benzene converted to acetophenone

2.Why does benzene undergo electrophilic substitution reactions easily and nucleophilic substitutions with difficulty?

Answer

Benzene is a planar molecule with electrons delocalized under and above the ring plane. Hence, it is a material rich in electrons. As a consequence, electron-deficient species, i.e., electrophiles, are extremely attractive.

Benzene therefore very easily undergoes electrophilic substitution reactions. Nucleophiles, on the other hand, are also species that are rich in electron. Therefore, benzene is repelled as compared to electrophiles. Thus, benzene suffers from difficulty from nucleophilic substitutions.

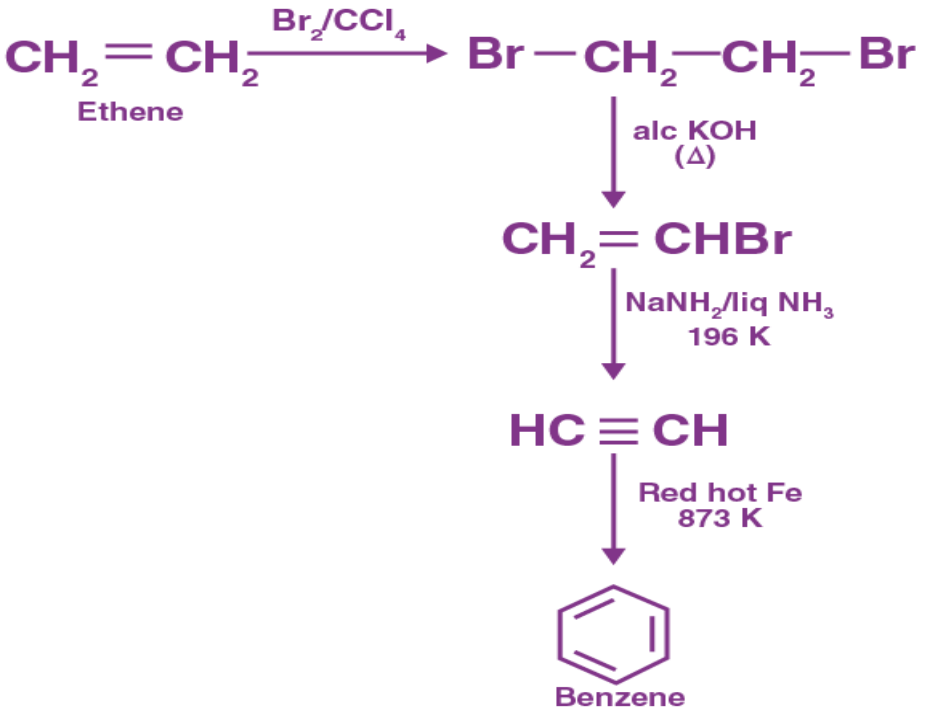
3.How would you convert the following compounds into benzene?

(i) Ethyne (ii) Ethene (iii) Hexane

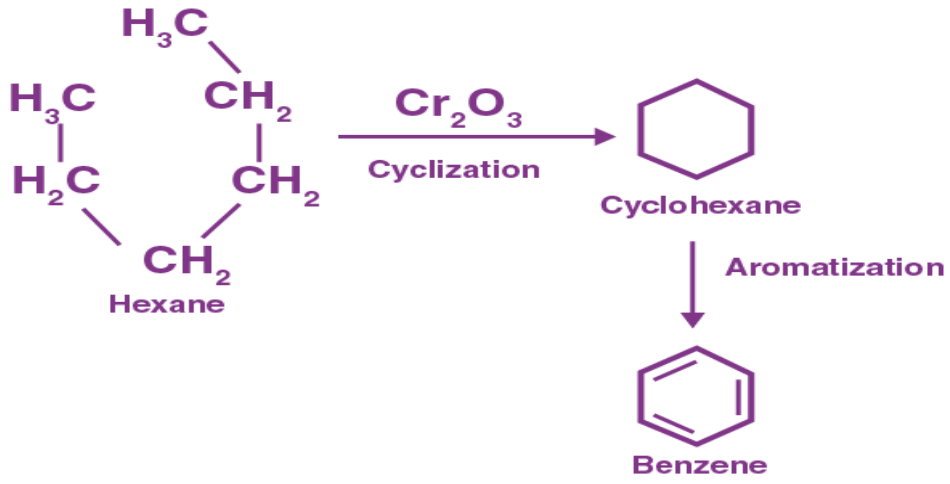
Answer

(i)Benzene from Ethyne:

(ii)Benzene from Ethene:



(iii) Hexane to Benzene



4.Arrange the following set of compounds in order of their increasing relative reactivity with an electrophile, E^+

(a) *p*-nitrochlorobenzene, Chlorobenzene, 2,4-dinitrochlorobenzene,

(b) *p* – H_3C – C_6H_4 – NO_2, Toluene, *p*-O_2N – C_6H_4 – NO_2.

Answer 13.22:

Electrophiles are reagents that participate in a reaction by accepting a pair of electrons to bind to nucleophiles.

The higher the density of electrons on a benzene ring, the more reactive the compound is to an electrophile, E^+ (Electrophilic reaction).

(a) The electron density of the aromatic ring decreases due to the presence of an electron-withdrawing group (i.e., NO_2 – and Cl –) which deactivates the aromatic ring.

Since, Cl – group is less electron-withdrawing (due to the inductive effect) than NO_2 – group (due to resonance effect), the increasing order of reactivity is as follows:

2, 4 – dinitrochlorobenzene < *p* – nitrochlorobenzene < Chlorobenzene

(b) While NO_2– group is electron-withdrawing, CH_3– is an electron-donating group.

Toluene, therefore, has the maximum density of electrons and is most easily attacked by E_+. Since NO_2– is an electron-removing group. Therefore, when the number of NO_2 substitutes is higher, the order is the following.:

p-O_2N – C_6H_4 – NO_2 < *p* – H_3C – C_6H_4 – NO_2 < Toluene.

5.Out of benzene, *m*–dinitrobenzene and toluene, state the increasing order of nitration. Justify your answer?

Answer 13.23:

The ease of nitration depends on the presence of electron density on the compound to form nitrates. Nitration reactions are examples of electrophilic substitution reactions where a nitronium ion (NO_2–) attacks an electron-rich species.

Now NO_2– is electron withdrawing and CH_3– group is electron donating. Since, m–Dinitrobenzene will have the least electron density. Hence, it will undergo nitration with difficulty.

Therefore, toluene will have the maximum electron density among the three compounds followed by benzene. Hence, the increasing order of nitration is as follows: