CHEMISTRY ONLINE
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CHEMISTRY

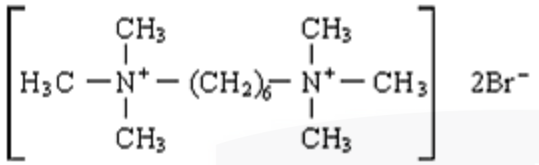
INORGANIC CHEMISTRY II

Level & Board	AQA (A-LEVEL)
TOPIC:	AMINES
PAPER TYPE:	SOLUTION - 3
TOTAL QUESTIONS	10
TOTAL MARKS	61

Amines - 3

1.

(a)

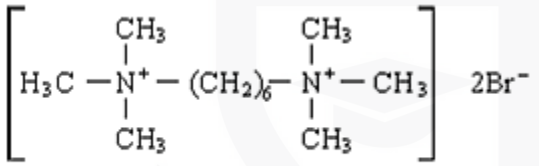


Compound **X**

The given compound belongs to quaternary ammonium bromide salt.

(1)

(b)



Compound **X**

To produce X comound from $H_2N(CH_2)_6NH_2$ following reagent and condition can be provided.

Reagent:

Bromomethane (CH_3Br) or methyl bromide.

Condition:

Excess bromomethane (CH_3Br).

(2)

(c)

Name of the mechanism involved:

Nucleophilic substitution

(2)

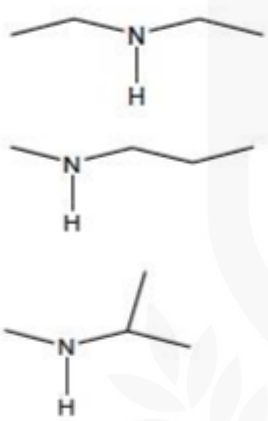
2. C

(1)

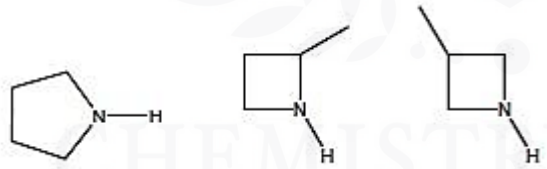
3.

(a)

Following are the skeletal formulas three secondary amines.



In cyclic form following can also be represented as three secondary amines



(2)

(b)

Using halogenoalkanes may lead to further reactions, generating impure product mixtures and lowering atom economy.

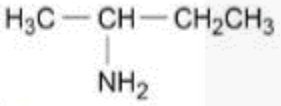
Nitrile reduction, however, yields primary amines without further reaction, ensuring a cleaner process and higher atom economy.

So, it is better to prepare primary amines from nitriles rather than from halogenoalkanes.

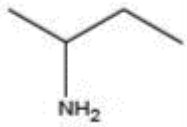
(2)

(c)

Following is the structure of a primary amine with four carbon atoms that cannot be formed from a nitrile.



Or



(1)

(d)

The reaction between propylamine ($CH_3CH_2CH_2NH_2$) and water (H_2O) can be represented as:

$CH_3CH_2CH_2NH_2\,(aq) + H_2O\,(aq) \rightleftharpoons CH_3CH_2CH_2NH_3^+\,(aq) + OH^-\,(aq)$

When Universal Indicator is added, the green color of the indicator turns blue.

This color change indicates that the solution has become more basic due to the presence of hydroxide ions (OH^-) generated from the reaction.

(2)

(e)

The reduction of nitrobenzene to form phenylamine can be represented as:

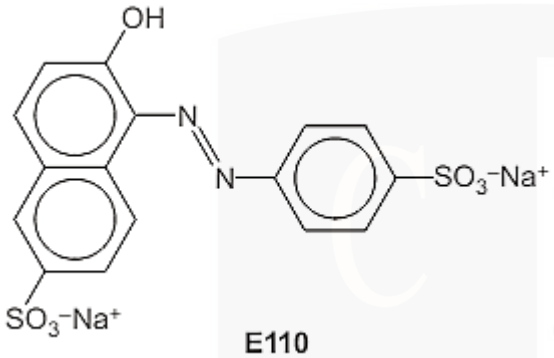
$C_6H_5NO_2 + 6[H] \rightarrow C_6H_5NH_2 + 2H_2O$

In this reaction, phenylamine ($C_6H_5NH_2$) is present as an ionic salt or ammonium chloride ($C_6H_5NH_3^+(Cl^-)$) rather than in its molecular form.

Therefore, the product is often referred to as phenylammonium chloride or phenyl ammonium chloride.

(2)

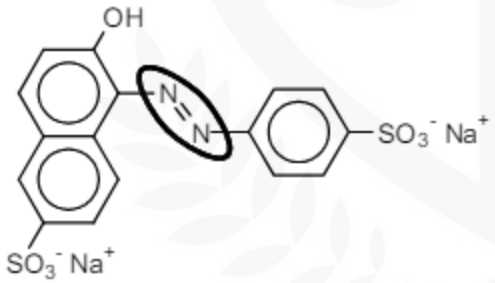
4. The structure of E110:



E110

(a)

Circle around the functional group identifies this molecule as an azo dye.



(1)

(b)

There are 16 carbon and 10 hydrogen atoms are in a molecule of E110.

(2)

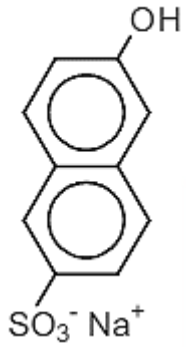
(c)

A suitable reagent that will convert the –OH group in E110 into an –O– group is: Na / NaOH / OH^-

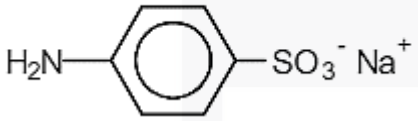
(1)

(d)

A phenol:

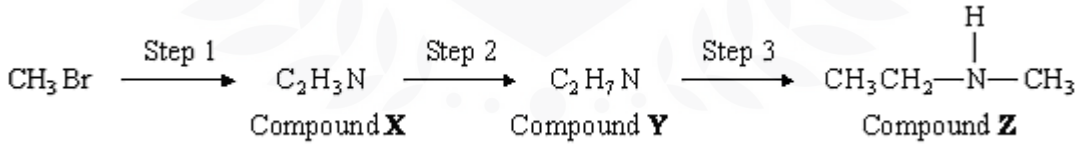


An amine:



(2)

5.



X is ethanenitrile / ethanonitrile / methyl cyanide / cyanomethane or ethyl nitrile

Y is $CH_3CH_2NH_2$ or ethylamine or aminoethane or ethanamine

Step 1:

Reagent:

Potassium cyanide (KCN), not hydrocyanic acid (HCN) or hydrogen chloride (HCl).

Conditions:
In aqueous solution (aq) or in an alcohol solvent.

Step 2:
Reagents:

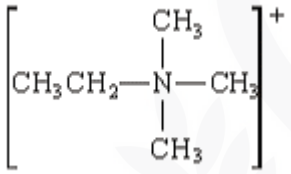
Hydrogen gas (H_2), lithium aluminum hydride ($LiAlH_4$), sodium (Na), zinc (Zn), iron (Fe), or tin (Sn), but not sodium borohydride ($NaBH_4$).

Conditions:

Using nickel (Ni), platinum (Pt), or palladium (Pd) catalysts in either ether or ethanol solvent with the presence of hydrogen chloride (HCl).

Z is an amine or aminoalkane i.e. N-Methylethanamine

The structure of the product is:



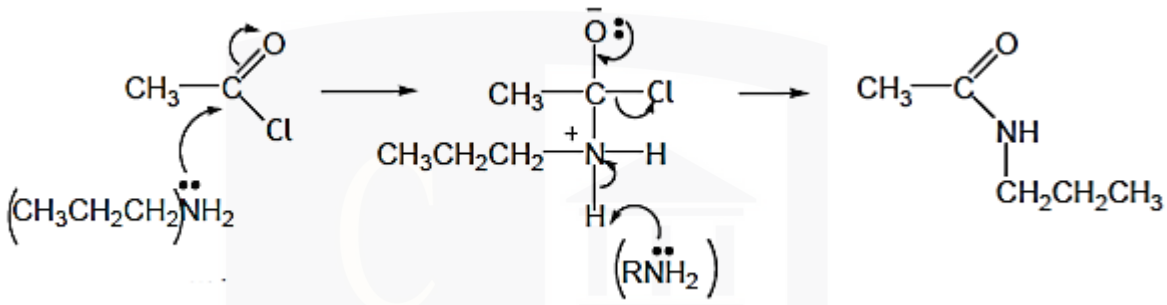
Type of mechanism: nucleophilic substitution

(9)

6.

Name: *Nucleophilic addition*

Mechanism:



Name of the amide formed:

N-propylethanamide

(6)

7.

- **Step 1**
  Reagent: Cl_2 Condition: UV or above 300 °C

- **Formation of CH_3CN :**

  React CH_4 with Cl_2 under UV light or above 300°C to form CH_3Cl.

  $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$

- **Step 2**
  Reagent: KCN Condition: aq and alcoholic

  React CH_3Cl with KCN in aqueous and alcoholic conditions under UV or sunlight to yield CH_3CN.

  $CH_3Cl+KCN \rightarrow CH_3CN+KCl$

  React CH_3CN with CH_3CH_2MgBr to produce CH_3CH_2CN.

  $CH_3CN+CH_3CH_2MgBr \rightarrow CH_3CH_2CN+MgBrCN$

- **Step 3**

  Reagent: H_2/Ni or $LiAlH_4$ or Na/C_2H_5OH

- **Formation of $CH_3CH_2NH_2$:**

  React CH_3CH_2CN with H_2/Ni or $LiAlH_4$ or Na/C_2H_5OH to generate $CH_3CH_2NH_2$.

  $CH_3CH_2CN+LiAlH_4 \rightarrow CH_3CH_2NH_2$

(6)

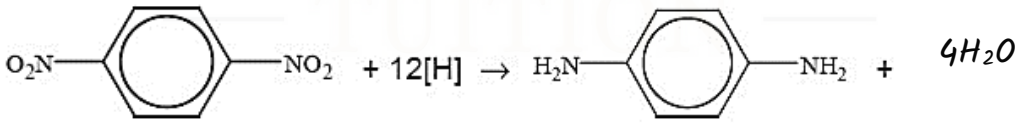
8.

(a)

Reagent or mixture of reagents:

H_2/Ni or Sn/HCl

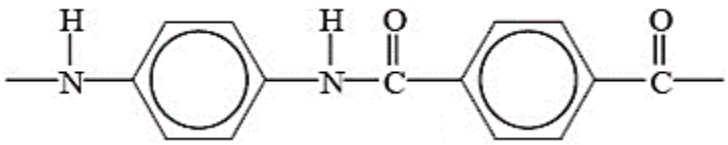
Equation for the reaction:



(2)

(b)

Following is the repeating unit of Kevlar.



(2)

(c)

Kevlar is more biodegradable compared to polyalkenes.

Kevlar's structure incorporates polar bonds, particularly amide (or peptide) linkages, giving rise to its characteristic hydrogen bonding between polymer chains.

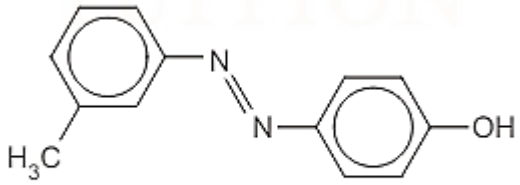
This structural feature makes Kevlar susceptible to hydrolysis and attack by nucleophiles, acids, bases, and enzymes, facilitating its degradation over time.

Polyalkenes, on the other hand, possess non-polar bonds within their structure, lacking the polar functionalities present in Kevlar.

While polyalkenes may have strong covalent bonds, their non-polar nature renders them less prone to interaction with hydrolyzing agents or biological catalysts, resulting in limited biodegradability.

(4)

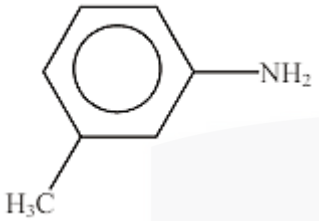
9. Compound A



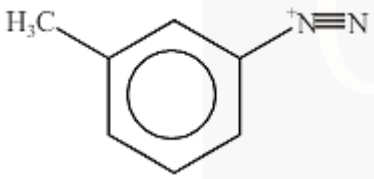
compound A

- Following are the displayed formula of the aromatic amine and of the diazonium ion.

  Aromatic amine:



  Diazonium ion:



- **Reagents :**

  HNO_2 + HCl

- **Conditions :**

  Temp < 10 °C

(5)

10.

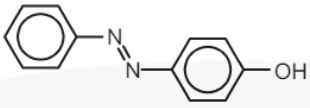
Phenylamine (aniline) is diazotized by treating it with sodium nitrite ($NaNO_2$) in the presence of hydrochloric acid (HCl) or nitrous acid (HNO_2) at temperatures below 10°C.

This reaction forms the diazonium salt intermediate.

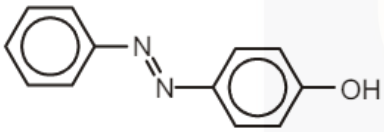
$C_6H_5NH_2+NaNO_2+HCl \rightarrow C_6H_5N_2Cl+NaCl+H_2O$

The diazonium salt is then coupled with an aromatic compound such as phenol under alkaline conditions (in the presence of OH^- ions).

This forms the azo dye.

$C_6H_5N_2Cl + C_6H_5OH \rightarrow$  $+ HCl$

An example of an azo dye that could be formed from phenylamine



This sequence represents the synthesis of an azo dye from phenylamine, involving diazotization followed by coupling with an aromatic compound under alkaline conditions.

(6)

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