CHEMISTRY ONLINE
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CHEMISTRY

INORGANIC CHEMISTRY II

Level & Board	AQA (A-LEVEL)
TOPIC:	AMINES
PAPER TYPE:	SOLUTION - 2
TOTAL QUESTIONS	10
TOTAL MARKS	39

Amines - 2

1.

(a)

Reagent and a condition:

Stage 1:

- **Reagent:** KCN or NaCN
- **Condition:** Aqueous alcohol (ethanol or methanol)
  Explanation:
  The cyanide ion (CN^-) from KCN or NaCN will substitute one of the bromine atoms in 1,4-dibromobutane, forming the intermediate nitrile compound.

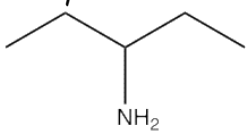
Stage 2:

- **Reagent:** Hydrogen gas (H_2) and a catalyst such as Ni or Pt or Pd
- **Condition:** High temperature and pressure.
  Explanation:
  The nitrile compound formed in Stage 1 is reduced by hydrogen gas in the presence of a catalyst like Ni or Pt or Pd to yield 1,6-diaminohexane.
  This step requires high temperature and pressure to proceed efficiently.

(3)

(b)

In 3-aminopentane, the lone pair on nitrogen is more available for donation compared to ammonia.



This increased availability is due to the presence of the alkyl group, which exerts an electron-donating or inductive effect.

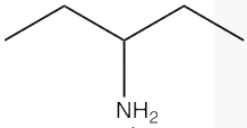
This effect pushes electron density towards the amino group, making the lone pair on nitrogen more nucleophilic and hence more likely to accept a proton (H^+).

So, the protonated form of 3-aminopentane is more stable than that of ammonia.

(2)

(c)

In 3-aminopentane, no carbon atom is bonded to four different groups, which is a prerequisite for chirality.



Hence, there are no chiral centers in 3-aminopentane.

(1)

2. D

(1)

3.

(a)

Butylamine is a stronger base than ammonia because the presence of the butyl group increases electron density around the nitrogen atom, making the lone pair on nitrogen more readily available for donation.

This is due to the positive inductive effect of the butyl group, which donates electrons and increases the basicity of butylamine compared to ammonia.

(1)

I am Sorry !!!!!

(b)

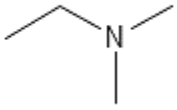
To produce a basic buffer solution with aqueous butylamine, add any weak acid or its salt, such as ammonium acetate or ammonium sulfate.

(1)

(c)

Following is a structure of a tertiary amine which is an isomer of butylamine.

$CH_3CH_2N(CH_3)_2$



(1)

4. D

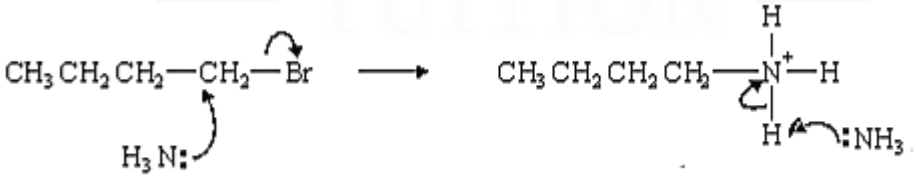
(1)

5.

(a)

Name of the mechanism: Nucleophilic substitution

Mechanism for the formation of butylamine, $CH_3CH_2CH_2CH_2NH_2$:



Product: $CH_3CH_2CH_2CH_2NH_2$

(5)

(b)

Equations for each of the two steps in the synthesis:

Step 1:

Reaction:
Nucleophilic substitution with potassium cyanide (KCN)

Equation:
$CH_3CH_2CH_2Br + KCN \rightarrow CH_3CH_2CH_2CN + KBr$

Step 2:

Reaction:
Reduction of the intermediate nitrile with hydrogen gas (H_2) using a suitable catalyst

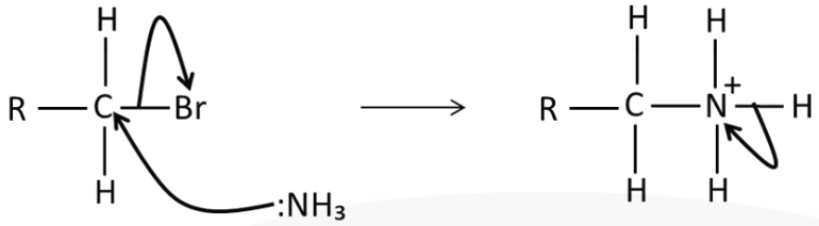
Equation:

$CH_3CH_2CH_2CN + 2H_2 \rightarrow CH_3CH_2CH_2CH_2NH_2$

(3)

6.

Mechanism:



Product:
RCH_2NH_2
Primary amine

(4)

7.

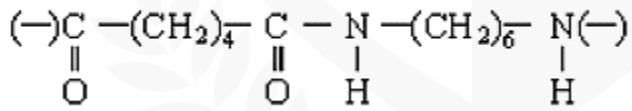
(a)

Name of the compound $H_2N(CH_2)_6NH_2$ is 1,6-diaminohexane.

(1)

(b)

Following is a repeating unit in the polyamide nylon 6,6.

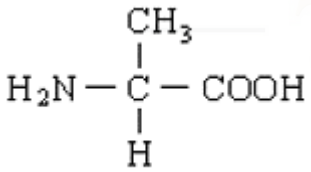


(1)

8.

(a)

Following is a structure of 2-aminopropanoic acid.

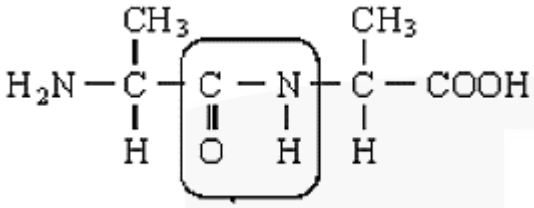


(2)

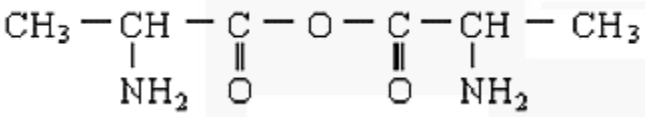
(b)

Following is organic product formed by the condensation of two molecules of 2-aminopropanoic acid.

i.e. peptidelink



Following product can also be formed as anhydride



(2)

9.

Compound Classification:

The compound $[CH_3(CH_2)_{15}N(CH_3)_3]^+Br^-$ is under the category of quaternary (alkyl) ammonium salts or quaternary alkyl ammonium bromides.

Reagents for Synthesis:

To produce cetrimide from $CH_3(CH_2)_{15}NH_2$, methyl bromide (CH_3Br) or bromomethane is added.
The presence of excess methyl bromide is necessary for the reaction.

Reaction Conditions:

The synthesis typically occurs under reflux conditions, where the reaction mixture is heated to boiling and the vapors are condensed and returned to the reaction vessel.

This ensures the reaction proceeds to completion.

Mechanism:

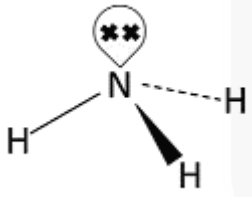
The reaction mechanism involved is nucleophilic substitution, specifically a quaternization reaction.

In this process, the nucleophile ($CH_3(CH_2)_{15}NH_2$) displaces the bromide ion from methyl bromide, leading to the formation of the quaternary ammonium salt, cetrimide.

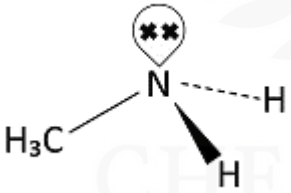
(4)

10.

0 carbon
Amonia



Primary amine:
1 carbon
Primary amine



Secondary amine:
2 carbon
Secondary amine

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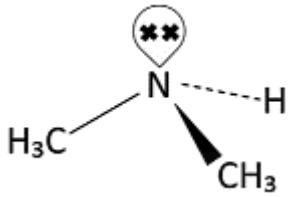
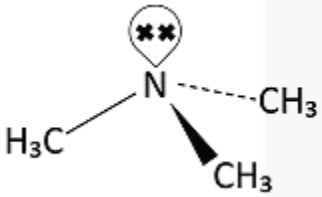


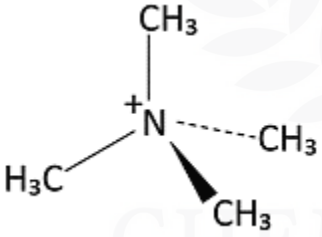
Tertiary amines:

3 carbon
Tertiary amines



Quaternary ammonium ion:

4 carbon
Quaternary ammonium ion



(4)

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