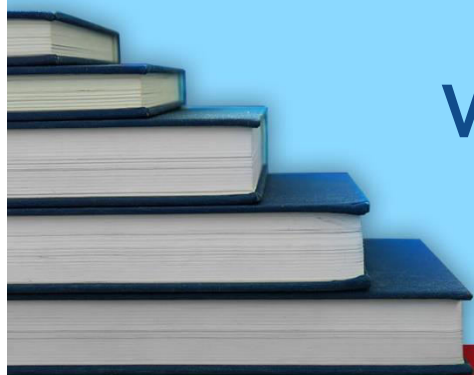


CHEMISTRY



WORKSHEET-5



STP

A PROJECT BY PUNJAB GROUP

Worksheet-05

(C. Organic Chemistry)

Carboxylic Acid and Amino Acids

- Q.1** Which of the following is the weakest acid?
 A) CH_3COOH C) Cl_2CHCOOH
 B) ClCH_2COOH D) Cl_3COOH
- Q.2** Which of the following acids cannot be prepared directly from carboxylic acid?
 A) Acid halide C) Ester
 B) Acid amide D) Acid anhydride
- Q.3** All of the following methods are used to prepare carboxylic acids EXCEPT:
 A) By the oxidation of alcohol
 B) By acid hydrolysis of alkane nitrile
 C) By the reaction R-Mg-Br with CO_2 followed by acid hydrolysis
 D) By the reduction of aldehydes
- Q.4** Which one of the following methods is used to prepare acid anhydride?
 A) Dehydration of carboxylic acid with P_2O_5
 B) Reaction of carboxylic acid with SOCl_2
 C) Reaction of carboxylic acid with NH_3
 D) Reaction of carboxylic acid with alcohol in the presence of conc. H_2SO_4
- Q.5** Which one of the following organic acids is the most reactive and the strongest acid?
 A) HCOOH C) $\text{CH}_3\text{CH}_2\text{COOH}$
 B) CH_3COOH D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$
- Q.6** Which of the following halosubstituted carboxylic acids is the strongest acid?
 A) FCH_2COOH C) BrCH_2COOH
 B) ClCH_2COOH D) ICH_2COOH
- Q.7** Organic compounds X and Y react together to form organic compound (Z). What type of compounds X, Y and Z be?

USE THIS SPACE FOR
SCRATCH WORK

Options	X	Y	Z
A)	Acid	Ester	Alcohol
B)	Alcohol	Ester	Acid
C)	Ester	Alcohol	Acid
D)	Alcohol	Acid	Ester

Q.13 Which of the followings has comparatively less acidic character?

- A) Ethanoic acid C) Phenol
B) Ethanol D) Water

Q.14 Which reaction does not produce benzoic acid?

- A) By hydrolysis of $C_6H_5CO_2C_2H_5$
B) By hydrolysis of C_6H_5CN
C) By oxidation of toluene
D) By oxidation of phenol

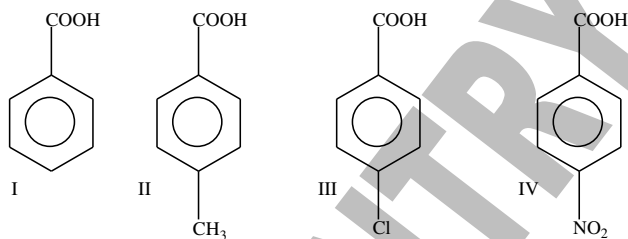
Q.15 Which class of organic compounds is used for artificial flavorings in jams?

- A) Ester C) Ketone
B) Carboxylic acid D) Aldehydes

Q.16 Which of the following compounds would react readily with NaOH?

- A) $R - NH_2$ C) $RCOOH$
B) $R - COCl$ D) $RCH_2 - OH$

Q.17 In the following carboxylic acids:



The decreasing order of acidic character is:

- A) III > IV > I > II C) I > IV > III > II
B) II > I > III > IV D) IV > III > I > II

Q.18 Amino acids have all of the following properties EXCEPT:

- A) They are colourless, crystalline solids
B) They have low melting points
C) They are soluble in water
D) They behave like salts rather than simple amides and carboxylic acid

Q.19 Which of the following carboxylic acids is prepared by acid hydrolysis of ethane nitrile?

- A) Methanoic acid C) Propanoic acid
B) Ethanoic acid D) Butanoic acid

USE THIS SPACE FOR
SCRATCH WORK

Q.20 Mark the incorrect statement about α -amino acids:

- A) They all have chiral carbon except glycine
- B) They are all L-amino acids
- C) 10 amino acids are called non-essential or dispensable amino acids
- D) Polypeptides act as acid only

Q.21 Which of the following methods is used to prepare amines (mixture of amines) on the commercial scale?

- A) Williamson's synthesis
- B) Strecker synthesis
- C) Wolf Kishner reduction reaction
- D) Hofmann's method

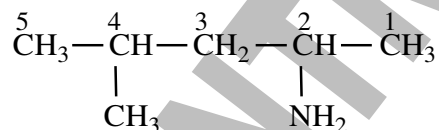
Q.22 Dehydration of an acid amide gives:

- A) Cyanide
- B) Isocyanide
- C) Amine
- D) Fatty acid

Q.23 Hoffmann's bromamide reaction is used to prepare _____ amine from amides.

- A) 1°
- B) 3°
- C) 2°
- D) 1° and 2°

Q.24 Consider the following structure of primary amine:



The correct name of the above structure according to IUPAC is:

- A) 4-Methyl pentan-2-amine
- B) 3-Methyl butan-2-amine
- C) 2-Methyl pentan-2-amine
- D) 4-Methyl pentan-3-amine

Q.25 For which of the following type of amines carbylamine test gives positive reaction:

- A) Prim. amine
- B) Sec. amine
- C) Tert. amines
- D) Both B and C

**USE THIS SPACE FOR
SCRATCH WORK**

Q.26 The correct order of basic nature of the following:

CH_3NH_2 , $(\text{CH}_3)_2\text{NH}$, $(\text{CH}_3)_3\text{N}$ and NH_3 is:

- A) $(\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_3\text{N} > \text{NH}_3$
- B) $\text{CH}_3\text{NH}_2 > (\text{CH}_3)_2\text{NH} > (\text{CH}_3)_3\text{N} > \text{NH}_3$
- C) $(\text{CH}_3)_2\text{NH} > (\text{CH}_3)_3\text{N} > \text{NH}_3 > \text{CH}_3\text{NH}_2$
- D) $\text{CH}_3\text{NH}_2 > (\text{CH}_3)_3\text{N} > \text{NH}_3 > (\text{CH}_3)_2\text{NH}$

Q.27 Reaction of ethanoic acid with ammonia gives:

- A) Ethane amide
- B) Ethane nitrile
- C) Ethyl amine
- D) Nitro methane

Q.28 Which of the following compounds is expected to be strongest base?

- A) Hydroxylamine
- B) Methylamine
- C) Aniline
- D) Ethylamine

Q.29 Which of the following types of isomerism is not shown by aliphatic amines?

- A) Chain isomerism
- B) Position isomerism
- C) Metamerism
- D) Tautomerism

Q.30 Electrophoresis is not used for the separation of:

- A) Nucleic acids
- B) Amino acids
- C) Proteins
- D) Lipids

Q.31 In gel electrophoresis, how do we make the DNA migrate through the gel?

- A) We place a negative electrode away from the walls
- B) Large fragments drift to the end of the gel
- C) We place a positive electrode away from the walls
- D) Gravity

Q.32 In electrophoresis, the electrophoretic mobility (μ) determines the characteristics of migration of different biomolecules. Which of the following is not having any influence in μ :

- A) Stereochemistry of molecule
- B) Molecular weight
- C) Size of molecule
- D) Net charge of molecule

Q.33 Which of the following derivatives of carboxylic acid is the most reactive?

- A) Acid amide
- B) Acid halide
- C) Ester
- D) Acid anhydride

**USE THIS SPACE FOR
SCRATCH WORK**

USE THIS SPACE FOR
SCRATCH WORK

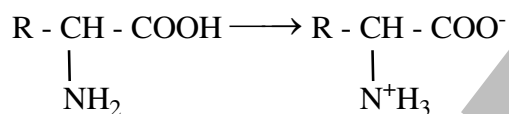
Q.34 In which of the following reactions acid chloride produces aldehyde?

- A) Reaction with H_2 C) Hydrolysis
B) Reaction with NH_3 D) Reaction with Alcohol

Q.35 Which of the following method is/are not used to prepare primary amines?

- A) By the reduction of acid amide
B) By reductive amination of aldehyde or ketones
C) By catalytic hydrogenation H_2/Pt
D) By the reaction of Grignard reagent with NH_3

Q.36 Each molecule of α -amino acid can interact within itself due to its basic $-NH_2$ group and its acidic $-COOH$ group. This is called zwitter ion:



Which of the following characteristics features is/are shown by zwitterion?

- A) In zwitterion the German zwei means two
B) It is amphoteric in nature
C) It is crystalline solid and soluble in water
D) All of these

Q.37 α -amino acid molecules can react with each other, the acid $-COOH$ group in one molecule reacts with the basic $-NH_2$ group in another molecule, when two α -amino acids react together, the resulting molecule is called:

- A) Peptide C) Polypeptide
B) Dipeptide D) Tripeptide

Q.38 On the acid hydrolysis of acid amide, which of the following product is obtained:

- A) Alkane nitrile
B) Sod. salt of carboxylic acid
C) Primary amine
D) Carboxylic acid

Q.39 Which of the following derivatives of carboxylic acid is least reactive?

- A) Acid halide C) Ester
B) Acid amide D) Acid anhydride

ANSWER KEY (Worksheet-05)

1	A	11	C	21	D	31	B
2	B	12	D	22	A	32	A
3	D	13	B	23	A	33	B
4	A	14	D	24	A	34	A
5	A	15	A	25	A	35	D
6	A	16	C	26	A	36	D
7	D	17	D	27	A	37	B
8	A	18	B	28	D	38	D
9	B	19	B	29	D	39	B
10	C	20	D	30	D	40	

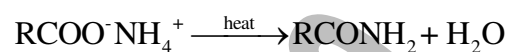
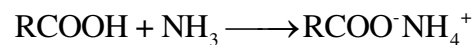
ANSWERS EXPLAINED

- Q.1 (A) Acid strength increases by increasing a number of electron-withdrawing substituents (e.g. Cl- group) on the carbon next to the **-COOH group**. Order of decreasing acidic strength is as follow $\text{Cl}_3\text{CCOOH} > \text{Cl}_2\text{CHCOOH} > \text{ClCH}_2\text{COOH} > \text{CH}_3\text{COOH}$

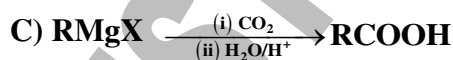
- Greater is K_a value (or less pK_a value) stronger is the acid

Carboxylic acid/Substituted carboxylic acid	K_a value	pK_a value
Cl_3CCOOH	23200×10^{-5}	0.60
Cl_2CHCOOH	5530×10^{-5}	1.26
ClCH_2COOH	136×10^{-5}	2.87
CH_3COOH	1.7×10^{-5}	4.76

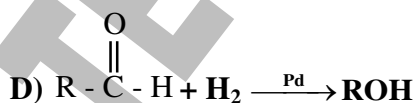
- Q.2 (B) Because when **carboxylic acid** is treated with **ammonia**, first of all ammonium salt of carboxylic acid is formed which on heating produces acid amide as **shown in the reaction**



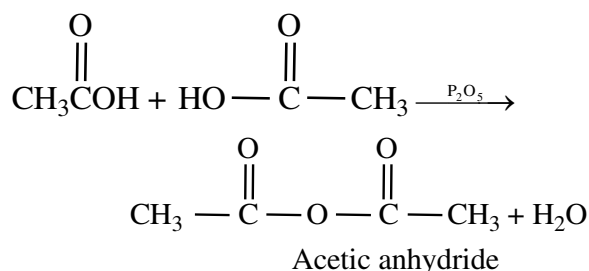
- Q.3 (D) In fact, by the reduction of **aldehydes, alcohols** are obtained instead of **carboxylic acids**. Detail of all preparatory methods of **carboxylic acids** are given below:



(Carbonation reaction)

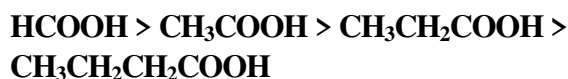


- Q.4 (A) Acid anhydride is prepared when carboxylic acids are dehydrated on heating strongly in the presence of phosphorus pentoxide as shown below in the reaction e.g.

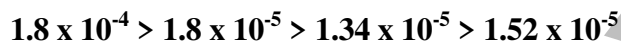


Q.5 (A) Methanoic acid is very reactive and stronger acid because with the increase of alkyl group polarity of carboxyl group decreases and strength of the acid also decreases.

- Because alkyl group is electron-donating group and it decreases polarity and thus deprotonation of carboxylic acid decreases with the increase of alkyl group.
- Order of reactivity and strength of acid is given below.



- Their K_a are given as respectively.



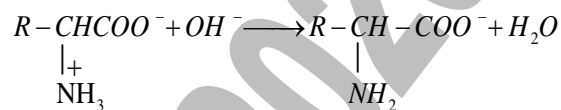
Q.6 (A) The electron-withdrawing tendency of a substituent depends upon its electronegativity. More electronegative substituent will have **greater electron-withdrawing** tendency.



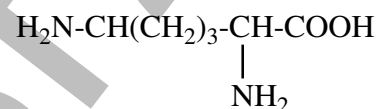
Q.7 (D) Compounds **X, Y and Z** stand for **Alcohol, carboxylic acid** and ester respectively. **X and Y** react with each other in the presence of **conc. H_2SO_4** to form **ester**. It is known as esterification or condensation reaction.

Q.8 (A) **Glycine** is not optically active compound because it **does not** contain asymmetric carbon atom (**Chiral carbon**).

Q.9 (B) When an **alkali** is added to an **α -amino acid**, (in the form of **zwitter ion**) **$-\text{NH}_3^+$** group releases the proton and therefore, the acidic character is due to this group.



Q.10 (C) The correct structure formula of **lysine** is

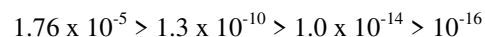


Q.11 (C) It is **incorrect** statement. The correct statement is as follow:

- **20 α -amino acids** can be sub-classified according to how the properties of other functional groups in the 'R' group influence the system.
- **Non—polar side chains** (e.g. alkyl groups)
- **Polar** (e.g. amides alcohols)
- **Acidic** (carboxylic acids, phenols)
- **Basic** (e.g. amines)

Q.12 (D) In fact it is used as local irritant but not as an antiseptic in nasal infection.

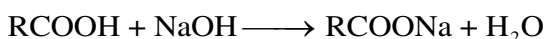
Q.13 (B) **Order of strength of acidic character** is given as follow:



Q.14 (D) Benzoic acid **cannot** be prepared by oxidation of **phenol**. Others **A, B, C methods** are used to **prepare Benzoic acid**.

Q.15 (A) **Ester (a class of organic compounds)** is used for artificial flavorings in **jams**.

Q.16 (C) **Carboxylic acid (RCOOH)** would react readily with **NaOH** as shown in the reaction:



Q.17 (D) Their **decreasing order** of acidic character is as follow **IV > III > I > II**

- **The electron releasing group –OH, –NH₂, –CH₃ etc. tend to decrease strength of benzoic acid.**
- **The electron withdrawing groups such as –NO₂, –Cl etc. tend to increase the strength of benzoic acid.**

Q.18 (B) In fact, **amino acid** have **high melting points**.

Q.19 (B) By acid hydrolysis of ethane nitrile ethanoic acid is obtained as shown in the reaction:



Q.20 (D) **Polypeptides** are amphoteric because of the presence of **free –NH₂ and –COOH** groups. Therefore they can be treated as **acids** and **bases**.

Q.21 (D) **Hofmann's method:**

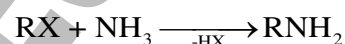
Haloalkanes when heated with an ethanolic solution of ammonia in a sealed tube at 100°C, a mixture of the three amines and some quaternary

ammonium salt are obtained. This reaction is called ammonylsis.

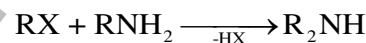
- This method is used for the industrial preparation of amines.
- The three amines so obtained can be separated from the quaternary ammonia salt by boiling with KOH, when the quaternary salt is left behind, and the three amines distil over.
- These can be separated from each other by fractional distillation:

Preparations of amines

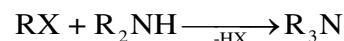
- **Primary amine:**



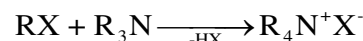
- **Secondary amine:**



- **Tertiary amine:**

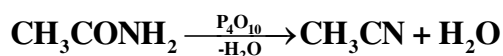


- **Quaternary salt:**



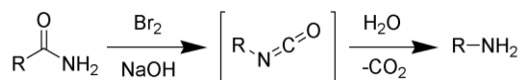
Q.22 (A) Amides are dehydrated by heating a solid mixture of the amide and phosphorus (V) oxide P₄O₁₀.

- **Water is removed from the amide group to leave a nitrile group, –CN. The liquid nitrile is collected by simple distillation.**
- **e.g. on the dehydration of ethanamide, in the presence of P₂O₅ ethane nitrile is obtained as shown in the reaction.**



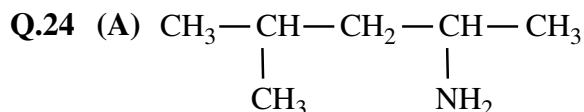
Q.23 (A) **Hoffmann's-bromide (or hypobromide) reaction:**

This reaction is also known as Hoffmann's rearrangement of amides. Treatment of acid amides with bromide and caustic potash gives primary amines having one carbon less than the amide.



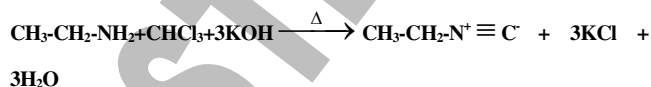
Isocyanate

The reaction is named after its discoverer - August Wilhelm von Hofmann. This reaction is also sometimes called the Hofmann degradation or the Harmon Process.



The correct name of the above structure according to IUPAC is 4-Methyl pentan-2-amine.

Q.25 (A) The carbylamine reaction, also known as Hoffmann's isocyanide test is a chemical test for detection of primary amines. In this reaction, the analyte is heated with alcoholic potassium hydroxide and chloroform. If a primary amine is present, the isocyanide (carbylamine) is formed which are foul smelling substances.



The carbylamine test does not give a positive reaction with secondary and tertiary amines.

Q.26 (A) The basicity of amines is often discussed indirectly in terms of the acidity of their respective conjugate acids.

- Recall that the conjugate acid of a weak base (e.g. like water) is a strong acid (like hydronium ion), while the conjugate acid of a strong base (like hydroxide ion) is a weak acid (like water).

- The concept of pKa has already been developed as a measure of the acidity of Bronsted acids, and we will also see that a corresponding concept, pKb can be used as a measure of the basicity of bases and that these two quantities are very closely related.

- Consider the acid dissociation, in dilute aqueous solution, of ammonia and a representative primary, secondary, and tertiary amine.

- The correct order of basic nature of the following CH_3NH_2 , $(\text{CH}_3)_2\text{NH}$, $(\text{CH}_3)_3\text{N}$ and NH_3 is $(\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_3\text{N} > \text{NH}_3$.

- The relative decreasing order of basic character can be justified on the basis of K_b and pK_b value as shown in the tabular form.

Type of amines and ammonia	K_b	pK_b
----------------------------	-------	--------

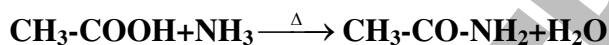
I. $(\text{CH}_3)_2\text{NH}$	5.4×10^{-4}	3.27
II. CH_3NH_2	4.5×10^{-4}	3.35
III. $(\text{CH}_3)_3\text{N}$	0.6×10^{-4}	4.22
IV. NH_3	1.8×10^{-5}	4.74

The observed order of basic strength of amines and ammonia is as follow:



- Thus the basic strength of aliphatic amines is governed by the following three factors:
- Electron-releasing tendency of the alkyl groups
- Solvation tendency of the protonated amine
- Steric effects of the alkyl groups

Q.27 (A) By the reaction of ethanoic acid with ammonia, ethane amide is obtained as shown in the reaction:



Q.28 (D) The strongest base among the following is ethylamine.

Q.29 (D) Tautomerism is not shown by aliphatic amines while chain isomerism, position isomerism and metamerism are shown by aliphatic amines.

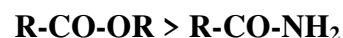
Q.30 (D) Electrophoresis is the motion of dispersed particles relative to a fluid under the influence of a spatially uniform electric field. It is used for the separation of proteins, amino acids, nucleic acids but not for lipids.

Q.31 (B) Gel electrophoresis is a laboratory method used to separate mixtures of

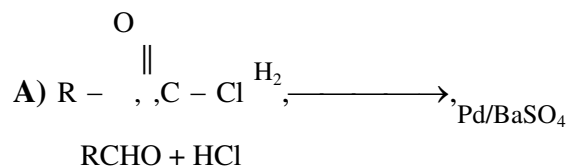
DNA, RNA, or proteins according to molecular size. In gel electrophoresis, the molecules to be separated are pushed by an electrical field through a gel that contains small pores.

Q.32 (A) In electrophoresis, the electrophoretic mobility (μ) determines the characteristics of migration of different biomolecules by the size of molecule, molecular weight and net charge on the molecule but stereochemistry of molecule is not involved in electrophoresis.

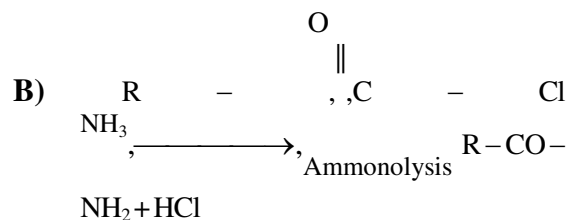
Q.33 (B) Among the derivative of carboxylic acid, acid halide is more reactive because halogen group is good leaving. Order of reactivity of derivative of carboxylic acid is given below:



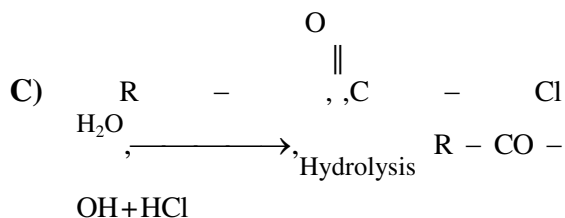
Q.34 (A) When acid chloride is treated with hydrogen, aldehyde is produced in the presence of Pd/BaSO₄. Detail of all the reactions is given below:



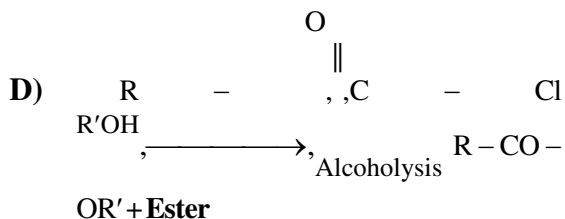
Aldehyde



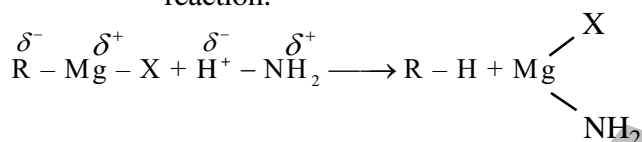
Acid amide



Carboxylic acid

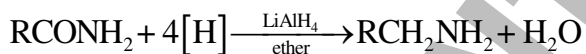


Q.35 (D) When Grignard reagent is treated with ammonia, alkane is produced along with side product as shown in the reaction:

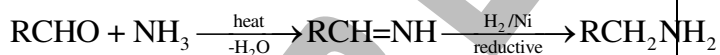


Methods which are used to prepare amine are as:

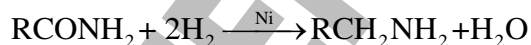
A) By the reduction of acid amide



B) Reductive amination of aldehyde or ketones



C) By catalytic hydrogenation H_2/Pt



Q.36 (D) All are the characteristics of zwitter ion.

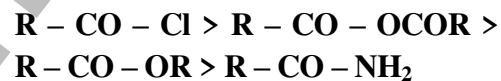
Q.37 (B) Amino acid molecules can react with each other, the acid $-\text{COOH}$ group in one molecule reacts with the basic $-\text{NH}_2$ group in another molecule. When two amino acids react

together, the resulting molecule is called dipeptide.

Q.38 (D) On the acidic hydrolysis of acid amide carboxylic acid is obtained along with side product as shown in the reaction:



Q.39 (B) The order of reactivity of derivatives of carboxylic acid is as follow:



This order clearly shows that acid amide is the least reactive.

STOP

A PROGRAM BY PUNJAB GROUP

