CHEMISTRY

WORKSHEET-6

STEP

A PROJECT BY PUNJAB GROUP

Worksheet-6

(C. Organic Chemistry)

Carboxylic Acid and Macromolecules

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) CH_3CH_2COOH

B) CH_3COOH D) $CH_3CH_2CH_2COOH$

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?

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

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Q.8 Vinegar has:

A) 4 to 5 % ethanoic acid C) 6 to 7 % ethanoic acid

B) 5 to 6 % ethanoic acid D) 7 to 8 % ethanoic acid

Q.9 Rancid butter has the smell due to:

A) Butanoic acid C) Ethanoic acid

B) Propanoic acid D) Methanoic acid

Q.10 Carboxylic acids have greater melting and boiling points than alcohols because they have stronger:

A) Hydrogen bonding C) Debye forces

B) Dipole-dipole forces D) van der Waals forces

Q.11 Mark the incorrect statement about structure of formic acid:

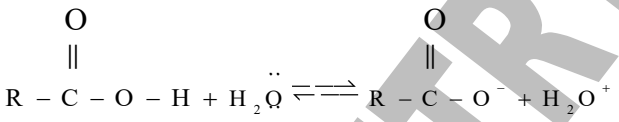
A) It has planar structure

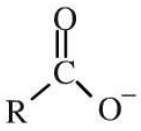
B) The bond length C = O is 120 pm

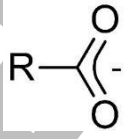
C) The bond angle of H – C = O is 124°

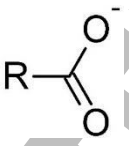
D) The bond angle of O – C = O is 120°

Q.12 The monocarboxylic acids are monobasic acids. Which of the following is resonance hybrid structure of carboxylate ion?



A) 

C) 

B) 

D) R-COO⁻

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

A) Ethanoic acid C) Phenol

B) Ethanol D) Water

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Q.14 Which of the following is not derivative of carboxylic acid?

A) Alkanoyl chloride C) Alkane amides

B) Alkyl alkanoate D) Alkanal

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

A) Ester C) Ketone

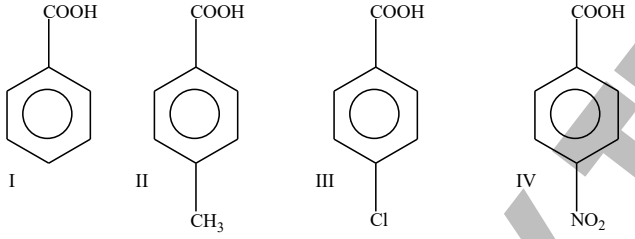
B) Carboxylic acid D) Aldehydes

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 The acid which is used as ink remover is

A) Oxalic acid C) Succinic acid

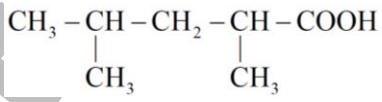
B) Adipic acid D) Acetic acid

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

Q.20 Consider the following structure of primary amine:



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

A) 2,4-Dimethylpentanoic acid

B) 4,2-Dimethylpentanoic acid

C) 2,3-Dimethylpentanoic acid

D) 4,3-Dimethylpentanoic acid

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Q.21 Reaction of ethanoic acid with ammonia gives:

A) Ethanamide C) Ethylamine

B) Ethanenitrile D) Nitromethane

Q.22 Which of the following derivatives of carboxylic acid is the most reactive?

A) Acid amide C) Ester

B) Acid halide D) Acid anhydride

Q.23 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.24 Which of the following derivatives of carboxylic acid is least reactive?

A) Acid halide C) Ester

B) Acid amide D) Acid anhydride

Q.25 When - COOH is attached directly to the benzene ring the acid is called

A) Aliphatic C) Alicyclic

B) Carboxylic D) Aromatic

Q.26 The common name of propane-1,3-dioic is:

A) Oxalic acid C) Aromatic acid

B) Malonic acid D) Fumaric acid

Q.27 The common thing in phthalic acid and oxalic acid is that both are

A) Aromatic C) Dicarboxylic

B) Hydrocarbons C) Strong acids

Q.28 The irritation caused by red ants bite is due to

A) Lactic acid C) Formic acid

B) Uric acid D) Acetic acid

Q.29 Consider the following sequence of conversion of X into Y and Y into Z. Identify which of the following is Z:

$$HC \equiv CH \xrightarrow[HgSO_2]{H_2O/H_2SO_4} (X) \xrightarrow{K_2Cr_2O_7/H^+} (Y) \xrightarrow{CH_3OH/H^+} (Z)$$

A) = CH_3COOCH_3 C) = $CH_3COOC_2H_5$

B) = $HCOOCH_3$ D) = CH_3COOH

Q.30 Which of the following is the strongest acid?

A) Water C) Formic acid

B) Acetic acid D) Propanoic acid

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Q.31 Which acid is the manufacture of synthetic rubber?

A) Acetic acid C) Formic acid

B) Carbonic acid D) Benzoic acid

Q.32 Which of the following reagents helps us to distinguish between methanoic acid and ethanoic acid?

A) Litmus solution C) Alcoholic $AgNO_3$

B) Tollen's reagent D) Sod. bicarbonate

Q.33 The sequence of the amino acids combined in a peptide chain is referred to as the _____ of protein:

A) Primary structure C) Tertiary structure

B) Secondary structure D) Quaternary structure

Q.34 The _____ structure of a protein is a regular coiling or zigzagging of polypeptide chains caused by hydrogen bonding between $\diagdown$ NH and C = O groups of amino acids $\diagup$ near each other in the chains.

A) Primary structure C) Tertiary structure

B) Secondary structure D) Quaternary structure

Q.35 All of the following co-factors correctly match with their respective enzyme EXCEPT:

Options	Co-factors	Enzymes
A)	Fe^{+2}	Chrome oxidase
B)	Zn^{+2}	Carbonic anhydrase
C)	Mg^{+2}	Glucose-6-phosphatase
D)	Vitamin B1	Thiamine glucose phosphatase

Q.36 Which of the following is an example of derived protein?

A) Collagen C) Lipoprotein

B) Oligopeptides D) Lactoglobulin

Q.37 The specific substance (metabolite) that fits on the enzyme surface and is converted to products is called:

A) Co-factor C) Isoenzyme

B) Prosthetic group D) Substrate

Q.38 Which one of the following is not called "food factor"?

A) Proteins C) Lipids

B) Carbohydrates D) Nucleic acids

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Q.39 The enzyme that catalyze the transfer of groups within molecules to yield isomeric forms is called:

A) Lyase
B) Ligase
C) Hydrolase
D) Isomerase

Q.40 Collagen proteins are present in _____ throughout the body.

A) Muscles
B) Red blood cells
C) Tendons
D) Blood plasma

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

ANSWERS EXPLAINED

Q.1 (A) Acidic strength of an acid 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 **Cl_3CCOOH > $Cl_2CHCOOH$ > $ClCH_2COOH$ > CH_3COOH**

- **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
$ClCH_2.COOH$	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**

$$RCOOH + NH_3 \longrightarrow RCOO^-NH_4^+$$

$$RCOO^-NH_4^+ \xrightarrow{heat} RCONH_2 + H_2O$$

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:**

A) $RCH_2OH \xrightarrow[\{O\}]{K_2Cr_2O_7/H^+} RCOOH$

B) $R-C\equiv N \xrightarrow{2H_2O/HCl} RCOOH + NH_4Cl$

C) $RMgX \xrightarrow[(ii)\ H_2O/H^+]{(i)\ CO_2} RCOOH$

(Carbonation reaction)

D) $R-\overset{O}{\overset{\|}{C}}-H + H_2 \xrightarrow{Pd} ROH$

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.

$$CH_3\overset{O}{\overset{\|}{C}}OH + HO-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow{P_2O_5} CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3 + H_2O$$

Acetic anhydride

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 de-protonation of carboxylic acid decreases with the increase of alkyl group.**
- **Order of reactivity and strength of acid is given below.**

$HCOOH > CH_3COOH > CH_3CH_2COOH > CH_3CH_2CH_2COOH$

- **Their Ka are given as respectively.**

$1.8 \times 10^{-4} > 1.8 \times 10^{-5} > 1.34 \times 10^{-5} > 1.52 \times 10^{-5}$

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

$FCH_2COOH > ClCH_2COOH > BrCH_2COOH > ICH_2COOH$

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) Vinegar has 4 to 5 % ethanoic acid.

Q.9 (A) Rancid butter has the smell due to butanoic acid.

Q.10 (A) **Carboxylic acids have greater melting and boiling points than alcohols because they have stronger hydrogen bonding.**

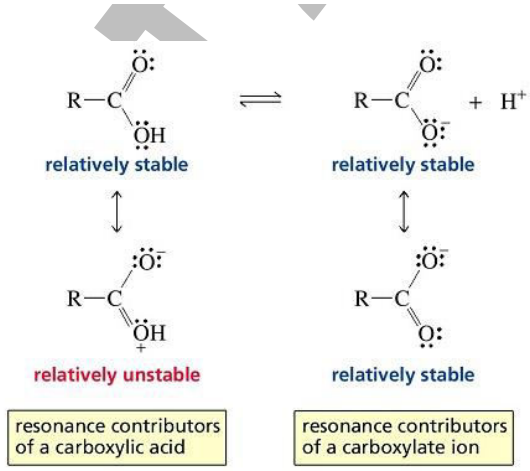
Q.11 (D) **It is incorrect statement. The correct statement is as follow:**

The bond angle of O – C = O is 125°.

Q.12 (C) It is resonance hybrid structure of carboxylate ion. It comparatively more stable.

At any rate, the subject of stability of carboxylic acids and carboxylate anions usually arises when discussing the level of acidity or in other words, the strength of the acid. It is pointed out in most organic chemistry books (where electron delocalization is explained) that electron delocalization or **resonance** is a concept that contributes to a certain structure's stability. That is to say, when a negative charge can be delocalized over several atoms (as is the case with a carboxylate group), instead of being localized on a single atom (as is the case with an alkoxide group), it is considered more stable energetically.

The relative stability of the carboxylate anion means that a carboxylic acid will favor (again, due to energetic considerations) the release of a proton **in a basic environment** (this is important, since in an acidic environment, the equilibrium will shift towards the acid, and much less carboxylate will exist in the solution), since the conjugate base (the carboxylate anion) is relatively stable, and therefore can exist in the solution in this form.



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

Ethanoic acid > Phenol > Water > Ethanol

$1.76 \times 10^{-5} > 1.3 \times 10^{-10} > 1.0 \times 10^{-14} > 10^{-16}$

Q.14 (D) **Alkanal is not derivative of carboxylic 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:

$RCOOH + NaOH \longrightarrow RCOONa + H_2O$

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

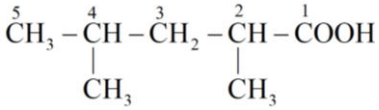
- **The electron releasing group –OH, -NH_2,-CH_3 etc. tend to decrease strength of benzoic acid.**
- **The electron withdrawing groups such as –NO_2, –Cl etc. tend to increase the strength of benzoic acid.**

Q.18 (A) The acid which is used as ink remover is oxalic acid.

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

$$CH_3\text{-}CN + 2HOH \xrightarrow{HCl} CH_3COOH + NH_4Cl$$

Q.20 (A)



The correct name of the above structure according to IUPAC is 2,4-Dimethylpentanoic acid.

Q.21 (A) By the reaction of ethanoic acid with ammonia, ethane amide is obtained as shown in the reaction:

$$CH_3\text{-}COOH + NH_3 \xrightarrow{\Delta} CH_3\text{-}CO\text{-}NH_2 + H_2O$$

Q.22 (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:**

R-CO-Cl > R-CO-OCOR >

R-CO-OR > R-CO-NH_2

Q.23 (A) When acid chloride is treated with hydrogen, aldehyde is produced in the presence of Pd/$BaSO_4$. Detail of all the reactions is given below:

A) $R-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow[Pd/BaSO_4]{H_2} RCHO + HCl$

Aldehyde

B) $R-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow[Ammonolysis]{NH_3} R-CO-NH_2+HCl$

Acid amide

C) $R-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow[Hydrolysis]{H_2O} R-CO-OH+HCl$

Carboxylic acid

D) $R-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow[Alcoholysis]{R'OH} R-CO-OR'+$

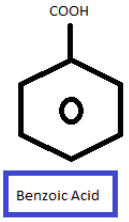
Ester

Q.24 (B) The order of reactivity of derivatives of carboxylic acid is as follow:

R – CO – Cl > R – CO – OCOR > R – CO – OR > R – CO – NH_2

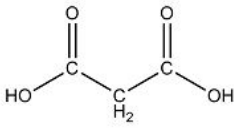
This order clearly shows that acid amide is the least reactive.

Q.25 (D) When - COOH is attached directly to the benzene ring the acid is called aromatic e.g. benzoic acid.



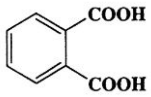
Benzoic Acid

Q.26 (B) The common name of propane 1 3-dioic is malonic acid. Structure of malonic acid is:



Malonic acid

Q.27 (C) The common thing in phthalic acid and oxalic acid is that both are dicarboxylic acid.



phthalic acid

Oxalic Acid, $H_2C_2O_4$

Q.28 (C) The irritation caused by red ants bite is due to formic acid (HCOOH).

Q.29 (A)

$$HC \equiv CH \xrightarrow[HgSO_4]{H_2O/H_2SO_4} CH_3CHO \xrightarrow{K_2Cr_2O_7/H^+} CH_3COOH \xrightarrow{CH_3OH/H^+} CH_3COOCH_3$$

- **CH_3CHO ; Ethanal**
- **CH_3COOH ; Ethanoic acid**
- **CH_3COOCH_3 ; Methyl ethanoate**

Q.30 (C) Formic acid is the strongest acid.

Q.31 (A) Acetic acid is used to manufacture synthetic rubber.

Q.32 (B) Tollen's reagent is reduced by methanoic acid, methanoic acid is the only carboxylic acid that can reduce Tollen's reagent.

Other acids do not.

$$HCOOH + [Ag(NH_3)_2]^{\oplus} + 2\overset{\ominus}{O}H \rightarrow 2Ag\downarrow + CO_2\uparrow + 2H_2O + 4NH_3$$

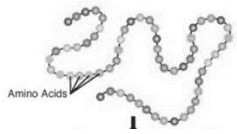
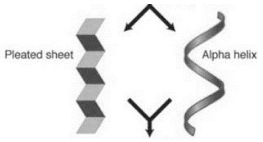
Silver mirror

Litmus indicator **solution** turns red in acidic **solutions** and blue in alkaline **solutions**. It turns purple in neutral **solutions**. **Litmus** paper is usually more reliable, and comes as red **litmus** paper and blue **litmus** paper.

Q.33 (A) The sequence of the amino acids combined in a peptide chain is referred to as the **primary structure.**

Q.34 (B) Difference between primary and secondary of proteins.

Primary Protein	Secondary Protein
• The sequence in which amino acids are arranged in a polypeptide chain of the protein is called its primary structure. • Proteins hydrolyze through a number of steps to form α-amino acid • **e.g. Proteins → Proteoses → Peptones → Polypeptides → Simple peptides → α-Amino acids**	• The conformation (or, shape) which the polypeptide chain of a protein molecule acquires due to the secondary bonding such as, hydrogen bonding between the carbonyl and amino groups, is called the secondary structure of the protein. • **e.g. The protein molecules gain addition structural strength by coiling up the polypeptide chains to form a helix. There are two types of helix** • **e.g.** • **I. α-Helix structure (coiled or spiral form)** • **II. β-Flat sheet (in horizontal position) and β-pleated sheet (in the folded form)**

Primary structure of proteins	Secondary structure of proteins
	

Q.35 (D) Also named Thiamine or Thiamine diphosphate (TPP), Vitamin B_1 is a cofactor for oxidative decarboxylation both in the Kreb's Cycle and in converting pyruvate to acetyl-CoA (an important molecule used in the citric acid cycle of metabolism). It is widely available in the human diet and particularly present in wheat germ and yeast. It's functionality results from a thiazole ring which stabilizes charge and electron transfer through resonance.

Q.36 (B)

(A) Collagen (Simple protein)
(B) Oligopeptides (Derived proteins)
(C) Lipoprotein (Compound or conjugated proteins)

Q.37 (D) The specific substance (metabolite) that fits on the enzyme surface and is converted to products is called substrate.

Q.38 (D) Nucleic acids is not called food factor while carbohydrates, fats and proteins are known as major food factors which are needed for human body.

Q.39 (D) The enzyme that catalyze the transfer of groups within molecules to yield isomeric forms is called **isomerase.**

Q.40 (C) Collagen proteins are present in **tendons** throughout the body.

STEP

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