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CHEM · CHEMISTRY

18. Carboxylic Acids

Official PMDC Solved Past Paper Topical Booklet · High-Yield Examination Series

94 Solved Questions

2010 to 2024 Archive

Boards: BUMHS, DUHS, KMU, MDCAT, NUMS, PMDC

Weightage: 27% of MDCAT (54 MCQs)

Curated by Ibrahim for fellow bees. Every question in this chapter has been verified against official UHS, NUMS, SZABMU, DUHS, and KMU answer keys. Propolis cognitive autopsies are provided at the end of this booklet to explain core concepts and break down common distractor traps.

OFFICIAL SOLVED EDITION**Q1.**

UHS 2024

Common name of 2-Hydroxy propanoic acid is:

- (A) Tartaric acid
- (B) Phthalic acid
- (C) Lactic acid
- (D) Formic acid

Q2.

UHS 2024

Which of the following is not an amino acid?

- (A) Folic acid
- (B) Glycine
- (C) Glutamic acid
- (D) Lysine

Q3.

SZABMU 2024

The oxidation of Methanal results in the formation of _____.

- (A) Acetic acid
- (B) Methanol
- (C) Formic acid
- (D) Propanoic acid

Q4.

SZABMU 2024

The IUPAC name of Malonic acid $\text{CH}_2(\text{COOH})_2$ is _____.

- (A) 1,2-Ethanedioic
- (B) 1,4-Butanedioic acid
- (C) 1,3-Propanedioic acid
- (D) 1,6-Hexadecanoic acid

Q5.

SZABMU 2024

Oxidation of Propanal in the presence of $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4$ produces

- (A) Propanol
- (B) Propanoic acid
- (C) Propanone
- (D) Propene

Q6.

SZABMU 2024

Decarboxylation of carboxylic acid occurs in the presence of

- (A) Baking soda
- (B) Lime
- (C) Soda lime
- (D) Caustic soda

Q7.

SZABMU 2024

The common name of pentanedioic acid

- (A) Glutaric acid
- (B) Oxalic acid
- (C) Succinic acid
- (D) Maleic acid

Q8.

SZABMU 2024

On reacting acetic acid with baking soda a gas is evolved which turns lime water milky. Gas evolved is

- (A) Cl_2
- (B) NO_2
- (C) H_2
- (D) CO_2

Q9.

SZABMU 2024

Hydrolysis of Nitrile will produce

- (A) Ketones
- (B) Ester
- (C) Carboxylic acid
- (D) Aldehydes

Q10.

SZABMU 2024

Ethyl acetate is an

- (A) Amide
- (B) Ester
- (C) Acid halide
- (D) Carboxylic acid

Q11.

SZABMU 2024

The two functional groups present in all amino acids are

- (A) Carboxylic acid and amine
- (B) Ether and carboxylic acid
- (C) Ester and amine
- (D) Aldehyde and carboxylic acid

Q12.

KMU 2024

Acetic acid can be prepared by the hydrolysis of

- (A) Ethanal
- (B) Methanoic acid
- (C) Ethanol
- (D) Methyl cyanide

Q13.

DUHS 2024

It is used as a preservative and antibacterial agent in livestock feed

- (A) Butyric acid
- (B) Caproic acid
- (C) Formic acid
- (D) Propionic acid

Q14.

DUHS 2024

The carboxylic acid is stronger than:

(Note: This question refers to acidic strength compared to other given substances, despite flawed original phrasing).

- (A) PCl_5
- (B) HNO_3
- (C) H_2SO_4
- (D) HCl

Q15.

DUHS 2024

Total number of alpha amino acids are:

- (A) 20
- (B) 22
- (C) 27
- (D) 25

Q16.

BUMHS 2024

On heating acetic acid in the presence of P_2O_5 , dehydration occurs with the formation of

- (A) Acetamide
- (B) Octyl acetate
- (C) Methyl acetate
- (D) Acetic anhydride

Q17.

NUMS 2024

Select the carboxylic acid with highest melting point:

- (A) Ethanoic acid
- (B) Butanoic acid
- (C) Propanoic acid
- (D) Pentanoic acid

Q18.

NUMS 2024

Identify the following compound having shortest bond length:

- (A) Methyl amine
- (B) Formic acid
- (C) Formamide
- (D) Ethanol

Q19.

NUMS 2024

Compound $\text{X} + \text{Na}_2\text{CO}_3 \rightarrow \text{compound Y} + \text{CO}_2 + \text{H}_2\text{O}$. The compound Y is:

(Note: The official key selects the acid (X). The actual compound Y is the resulting salt).

- (A) $\text{CH}_2=\text{CH}-\text{CH}_2-\text{CH}_3$
- (B) $\text{CH}_3\text{COOCH}_3$
- (C) $\text{CH}_3\text{CH}_2\text{CHO}$
- (D) $\text{CH}_3\text{CH}_2\text{COOH}$

Q20.

UHS 2023

If carboxylic acid and ketone groups $\text{C}=\text{O}$ are present in a chain, then final name will be given as

- (A) oxo, oic acid
- (B) one, oic acid
- (C) Both 1 and 2
- (D) None of these

Q21.

UHS 2023

Acetic acid is weak acid than sulphuric acid because of which of the following reasons?

- (A) It decomposes on increasing temperature
- (B) It has less degree of ionization
- (C) It has $-\text{COOH}$ group
- (D) It has more inductive effect

Q22.

UHS 2023

Mr. Khan mix acetic acid with thionyl chloride. Which product is obtained?

- (A) $\text{CH}_3\text{COCl} + \text{SO}_2 + \text{HCl}$
- (B) $\text{CH}_3\text{Cl} + \text{CH}_3\text{COCl}$
- (C) $\text{CH}_3\text{COOCH}_3 + \text{SO}_2$
- (D) $\text{CH}_3\text{Cl} + \text{SO}_2 + \text{HCl}$

Q23.

UHS 2023

Complete oxidation of alcohol gives which of the following?

- (A) Aldehyde
- (B) Alkane
- (C) Carboxylic acid
- (D) Ketone

Q24.

SZABMU 2023

The relative acidic strength of phenol, water, alcohol & carboxylic acid is:

- (A) $-\text{COOH} > \text{H}_2\text{O} > \text{C}_6\text{H}_5\text{OH} > -\text{OH}$
- (B) $-\text{COOH} > \text{C}_6\text{H}_5\text{OH} > \text{H}_2\text{O} > -\text{OH}$
- (C) $-\text{COOH} > -\text{OH} > \text{C}_6\text{H}_5\text{OH} > \text{H}_2\text{O}$
- (D) $-\text{COOH} > \text{H}_2\text{O} > -\text{OH} > \text{C}_6\text{H}_5\text{OH}$

Q25.

SZABMU 2023

When carboxylic acids are heated with alcohol in the presence of concentration H_2SO_4 , the conversion of functional group takes place from:

- (A) Carboxyl to carbonyl group
- (B) Carboxyl group to an ester group
- (C) Carbonyl to carboxyl group
- (D) Carboxyl to hydroxyl group

Q26.

SZABMU 2023

Thionyl chloride reacts with acetic acid resulting in transformation of Carboxylic group to:

- (A) Acetamide
- (B) Acid halide
- (C) Alcohol
- (D) Ester

Q27.

SZABMU 2023

Reactivity of carboxyl group is due to presence of:

- (A) Hydroxyl group
- (B) Terminal hydrogen
- (C) Carbonyl group
- (D) Alkyl group

Q28.

KMU 2023

In conversion of acid halides to ester, pyridine is used to:

- (A) Stabilize acid halides
- (B) Consume HCl formed in the reaction
- (C) Dehydrate alcohol
- (D) Dehydrogenate acid halides

Q29.

KMU 2023

Number of carbon atoms in Valeric acid is:

- (A) 4
- (B) 5
- (C) 6
- (D) 7

Q30.

KMU 2023

The IUPAC name of formyl chloride is:

- (A) Chloro methanoic acid
- (B) Chloro methane
- (C) Methanoyl chloride
- (D) Chloromethanoate

Q31.

DUHS 2023

Which of the following is formed when formaldehyde is treated with oxidizing mixture? ($\text{H}_2\text{SO}_4 + \text{K}_2\text{Cr}_2\text{O}_7$)?

- (A) Methanol
- (B) Methanoic acid
- (C) Acetone
- (D) Acetaldehyde

Q32.

DUHS 2023

What is the IUPAC name of stearic acid?

- (A) Hexanoic acid
- (B) Octadecanoic acid
- (C) Octanoic acid
- (D) Hexadecanoic acid

Q33.

DUHS 2023

Which of the following is formed when acetone is oxidized?

- (A) Formic acid
- (B) Ethanoic acid
- (C) Propanoic acid
- (D) Butyric acid

Q34.

DUHS 2023

What's the IUPAC name of α, β -dimethyl valeric acid?

- (A) 2,3-dimethyl hexanoic acid
- (B) 3,4-dimethyl hexanoic acid
- (C) 3,4-dimethyl pentanoic acid
- (D) 2,3-dimethyl pentanoic acid

Q35.

NUMS 2023

Which of the following reacts with Carboxylic Acid to form Ester?

- (A) Aldehyde
- (B) Alkyl Halide
- (C) Ketones
- (D) Alcohol

Q36.

NUMS 2023

Hydrolysis of Nitriles produces:

- (A) Carboxylic acid
- (B) Aldehydes
- (C) Ketones
- (D) Esters

Q37.

BUMHS 2023

Acetic acid is weak acid than sulphuric acid because of which of the following reasons?

- (A) It decomposes on increasing temperature
- (B) It has less degree of ionization
- (C) It has -COOH group
- (D) It has more inductive effect

Q38.

BUMHS 2023

The solubility of carboxylic acid in water gradually decreases with:

- (A) Decreases in molecular mass
- (B) Increases in molecular mass
- (C) Increases the amount of acid
- (D) Decreases the amount of water

Q39.

BUMHS 2023

Which of the following acids has the smallest dissociation constant?

- (A) $\text{CH}_3\text{CHFCOOH}$
- (B) $\text{FCH}_2\text{CH}_2\text{COOH}$
- (C) $\text{BrCH}_2\text{CH}_2\text{COOH}$
- (D) $\text{CH}_3\text{CHBrCOOH}$

Q40.

BUMHS 2023

Which product is formed when RMgX reacts with CO_2 ?

- (A) Aldehyde
- (B) Ketone
- (C) Carboxylic acid
- (D) Ethers

Q41.

UHS 2022

Which among the following have least pH?

- (A) $\text{CH}_3\text{CH}_2\text{COOH}$
- (B) $\text{CH}_3\text{CCl}_2\text{COOH}$
- (C) $\text{CH}_2\text{ClCH}_2\text{COOH}$
- (D) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH}$

Q42.

UHS 2022

If carboxylic acid and ketone groups $> \text{C}=\text{O}$ are present in a chain then final name will be given as:

- (A) Oxo, oic acid
- (B) One, oic acid
- (C) Both A and B
- (D) None of these

Q43.

UHS 2022

When carboxylic acids and dicarboxylic acids have similar molecular weights, how do their m.p compare?

- (A) Carboxylic acids have greater m.p
- (B) Dicarboxylic acids have greater m.p
- (C) Both have similar m.p
- (D) No any consistent trends exists

Q44.

SZABMU 2022

Select the correct order of relative acidic strength of phenol, alcohol, water and carboxylic acid:

- (A) Carboxylic acid > water > phenol > alcohol
- (B) Carboxylic acid > phenol > water > alcohol
- (C) Carboxylic acid > alcohol > phenol > water
- (D) Carboxylic acid > water > alcohol > phenol

Q45.

SZABMU 2022

Carboxylic acid reacts with alcohol to form:

- (A) Ester
- (B) Aldehyde
- (C) Ketones
- (D) Alkyl Halide

Q46.

KMU 2022

Which of the following statements is false about the acid-strength of acetic acid?

- (A) Acetic acid is a stronger acid than monochloroacetic acid
- (B) Acetic acid is a stronger acid than Propionic acid.
- (C) Acetic acid is a weaker acid than trichloroacetic acid
- (D) Acetic acid is a weaker acid than formic acid

Q47.

DUHS 2022

HOOC – COOH has IUPAC name

- (A) Acetic acid
- (B) Oxalic acid
- (C) Diethanoic acid
- (D) Ethandioic acid

Q48.

DUHS 2022

Hexanoic acid is IUPAC name:

- (A) Adipic acid
- (B) Propionic acid
- (C) Formic acid
- (D) Caproic acid

Q49.

BUMHS 2022

Which of the functional group are present in ethyl acetate?

- (A) Aldehyde group
- (B) Carboxyl group
- (C) Ester group
- (D) Ether group

Q50.

NUMS 2022

Carboxylic acids are water soluble because they:

- (A) Are more reactive
- (B) Have low melting point
- (C) Have hydrogen bonding
- (D) Have high density

Q51.

PMDC 2021

Number of oxygen in cyclic ring of dimer of carboxylic acid are:

- (A) 2
- (B) 4
- (C) 5
- (D) 6

Q52.

PMDC 2021

Which of the following catalyst is used for the preparation of acidic anhydrides?

- (A) $K_2Cr_2O_7$
- (B) P_2O_5
- (C) H^+/H_2O
- (D) H_2SO_4

Q53.

PMDC 2021

Which of the following is a carboxylic acid derivative?

- (A) Alcohol
- (B) Acetic acid
- (C) Acyl halide
- (D) Methyl halide

Q54.

PMDC 2021

Which one is weak acid?

- (A) Acetic acid
- (B) Formic acid
- (C) Propanoic acid
- (D) Butanoic acid

Q55.

PMDC 2020

Which of the following is the strongest acid?

- (A) Propanoic acid
- (B) Fluoroethanoic acid
- (C) Trichloroethanoic acid
- (D) Nitroethanoic acid

Q56.

PMDC 2020

Hydrolysis of acyl chloride results in the formation of:

- (A) Acid anhydride
- (B) Carboxylic acid
- (C) Amides
- (D) Esters

Q57.

PMDC 2020

The exact reactivity order for carboxylic acid derivatives is:

- (A) Anhydride > Acyl chloride > Ester
- (B) Ester > Anhydride > Acyl chloride
- (C) Amide > Acyl chloride > Ester
- (D) Acyl chloride > Anhydride > Ester

Q58.

SET 2019

Acetyl chloride (Ethanoyl chloride) is used in the synthesis of organic compounds. It is prepared by treating acetic acid with:

- (A) SOCl_2
- (B) HCl
- (C) CH_3Cl
- (D) ClNH_2

Q59.

SET 2019

What will be the outcome of reaction of methanol with ethanoic acid in the presence of concentrated sulphuric acid?

- (A) Propanone is formed
- (B) Propanoic acid formed
- (C) Methyl ethanoate is formed
- (D) Propanol is formed

Q60.

SET 2019

Which one of the following compounds can exist in the form of cyclic dimers?

- (A) Benzene
- (B) Acetals
- (C) Ozonide
- (D) A carboxylic acid

Q61.

NUMS 2019

Reagent used to reduce a carboxylic acid to an alkane is:

- (A) Ni/H_2
- (B) NaBH_4
- (C) P/HI
- (D) LiAlH_4

Q62.

NUMS 2019

Which of the following is not a fatty acid?

- (A) Phenyl acetic acid
- (B) Stearic acid
- (C) Palmitic acid
- (D) Oleic acid

Q63.

KMU 2019

Which compound shows the highest boiling point?

- (A) CH_3COOH
- (B) $\text{C}_2\text{H}_5\text{OH}$
- (C) $\text{C}_2\text{H}_5\text{-O-C}_2\text{H}_5$
- (D) $(\text{CH}_3\text{CH}_2)_3\text{N}$

Q64.

KMU 2019

Which one is more reactive?

- (A) Ester
- (B) Acid halide
- (C) Amide
- (D) Acid anhydride

Q65.

MDCAT 2019

Nitriles (RCN) on hydrolysis in the presence of a mineral acid yield:

- (A) Ethers
- (B) Aldehydes
- (C) Alcohols
- (D) Carboxylic acids

Q66.

MDCAT 2019

Carboxylic acids can be reduced into corresponding alcohols. Which of the following reagent can be used for this purpose?

- (A) $\text{K}_2\text{Cr}_2\text{O}_7$
- (B) LiAlH_4
- (C) H_2SO_4
- (D) KMnO_4

Q67.

MDCAT 2019

Which of the following reagent is required for preparation of acyl chloride (CH_3COCl) from ethanoic acid?

- (A) HCl
- (B) PCl_5
- (C) CH_3Cl
- (D) POCl_3

Q68.

MDCAT 2019

Which balance chemical equation show the formation of ethanoyl chloride using thionyl chloride?

- (A) $\text{CH}_3\text{CH}_2\text{COOH} + 2\text{SOCl}_2 \rightarrow \text{CH}_3\text{CH}_2\text{COCl} + \text{SO}_2 + \text{HCl}$
- (B) $\text{CH}_3\text{COOH} + \text{SOCl}_2 \rightarrow \text{CH}_3\text{COCl} + \text{SO}_2 + \text{HCl}$
- (C) $\text{HCOOH} + \text{SOCl}_2 \rightarrow \text{HCOCl} + \text{SO}_2 + \text{HCl}$
- (D) $\text{CH}_3\text{CH}_2\text{COOH} + 2\text{SOCl}_2 \rightarrow \text{CH}_3\text{CH}_2\text{COCl} + \text{SO}_3 + \text{HCl}$

Q69.

MDCAT 2018



Which of the following catalyst is used in the above reaction?

- (A) Pt
- (B) Ni
- (C) Pumice stone
- (D) Conc. H_2SO_4

Q70.

MDCAT 2018

Which product is formed by the reaction of carboxylic acid with alcohol?

- (A) Ester
- (B) Aldehyde
- (C) Alkane
- (D) Ether

Q71.

MDCAT 2018

Which one will be act as a strong acid?

- (A) Dichloroethanoic acid
- (B) Ethanoic acid
- (C) Trichloroethanoic acid
- (D) Chloroethanoic acid

Q72.

MDCAT 2017

Compounds having $-\text{C} \equiv \text{N}$ group are called:

- (A) Cyano compounds
- (B) Nitro compounds
- (C) Carbon nitrogen molecules
- (D) Nitriles

Q73.

MDCAT 2017

Final product of hydrolysis of nitrile yield:

- (A) Ketone
- (B) Alcohol
- (C) Aldehyde
- (D) Carboxylic acid

Q74.

MDCAT 2017

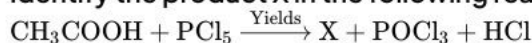
During esterification, the bond from alcohol that breaks is between:

- (A) Carbon and Oxygen
- (B) Carbon and carbon
- (C) Oxygen and hydrogen
- (D) None of these

Q75.

MDCAT 2017

Identify the product X in the following reaction:



- (A) CH_3COCl
- (B) $\text{CH}_3\text{COCH}_2\text{Cl}_2$
- (C) CH_3COCl_2
- (D) CH_2COCl_2

Q76.

MDCAT 2016



Which one of the following will act as a catalyst in above reaction?

- (A) HNO_3
- (B) Acidified potassium dichromate
- (C) H_2SO_4
- (D) SOCl_2

Q77.

MDCAT 2016

Which one of the following reaction of carboxylic acid is reversible?

- (A) Esterification
- (B) Reaction with PCl_5
- (C) Salt formation
- (D) Reaction with SOCl_2

Q78.

MDCAT 2016

'Ka' values of few organic acids are given.

$$\text{CH}_3\text{COOH} = 1.85 \times 10^{-5}$$

$$\text{CCl}_3\text{COOH} = 2.3 \times 10^{-2}$$

$$\text{CHCl}_2\text{COOH} = 5.0 \times 10^{-3}$$

$$\text{CH}_2\text{ClCOOH} = 1.3 \times 10^{-3}$$

The order of the acid strength is:

- (A) $\text{CCl}_3\text{COOH} > \text{CHCl}_2\text{COOH} > \text{CH}_2\text{ClCOOH} > \text{CH}_3\text{COOH}$
- (B) $\text{CH}_3\text{COOH} > \text{CHCl}_2\text{COOH} > \text{CCl}_3\text{COOH} > \text{CH}_2\text{ClCOOH}$
- (C) $\text{CHCl}_2\text{COOH} > \text{CH}_3\text{COOH} > \text{CCl}_3\text{COOH} > \text{CH}_2\text{ClCOOH}$
- (D) $\text{CCl}_3\text{COOH} > \text{CH}_3\text{COOH} > \text{CHCl}_2\text{COOH} > \text{CH}_2\text{ClCOOH}$

Q79.

KMU 2016

Select the correct order of the acids strength?

- (A) $\text{CH}_3\text{COOH} > \text{CHCl}_2\text{COOH} > \text{CH}_2\text{ClCOOH}$
- (B) $\text{CHCl}_2\text{COOH} > \text{CH}_2\text{ClCOOH} > \text{CH}_3\text{COOH}$
- (C) $\text{CH}_2\text{ClCOOH} > \text{CHCl}_2\text{COOH} > \text{CH}_3\text{COOH}$
- (D) $\text{CHCl}_2\text{COOH} > \text{CH}_2\text{COOH} > \text{CH}_2\text{ClCOOH}$

Q80.

MDCAT 2015

An organic acid 'z' reacts separately with sodium bicarbonate, sodium hydroxide and sodium carbonate. Which one of the following represent the structure of 'z'?

- (A) HCOOC_2H_5
- (B) $\text{CH}_3\text{CH}_2\text{OH}$
- (C) $\text{CH}_3\text{-CH=CH}_2$
- (D) $\text{H}_3\text{C-CH}_2\text{-COOH}$

Q81.

MDCAT 2014

Ethyl butyrate and butyl butanoate are esters with the flavor of

- (A) Pear
- (B) Pineapple
- (C) Banana
- (D) Apple

Q82.

MDCAT 2014

Organic compound 'X' and 'Y' both can react with Na-metal to evolve hydrogen gas. 'X' and 'Y' if react with each other form an organic compound 'Z' which gives fruity smell. What types of compounds 'X', 'Y' and 'Z' are?

- (A) X = Alcohol, Y = Ester, Z = Acetic Acid
- (B) X = Alcohol, Y = Ester, Z = Mineral Acid
- (C) X = Alcohol, Y = Acetic Acid, Z = Ester
- (D) X = Alcohol, Y = Mineral Acid, Z = Ester

Q83.

MDCAT 2013

Methyl cyanides, on boiling with mineral acids or alkalies, yield:

- (A) Butanoic acid
- (B) Formic acid
- (C) Acetic acid
- (D) Propanoic acid

Q84.

MDCAT 2013

The formation of ester from acetic acid in presence of acid and ethanol is a:

- (A) Nucleophilic addition reaction
- (B) Nucleophilic substitution reaction
- (C) Electrophilic substitution reaction
- (D) Electrophilic addition reaction

Q85.

MDCAT 2013



The final products formed are:

- (A) $\text{CH}_3\text{-C(=O)-NH}_2 + \text{CO}_2$
- (B) $\text{CH}_3\text{-C(=O)-NH}_2 + \text{H}_2\text{O}$
- (C) $\text{CH}_3\text{-C(=O)-NH}_2 + \text{H}_2$
- (D) $\text{CH}_3\text{-C(=O)-NH}_2 + \text{HCl}$

Q86.

MDCAT 2012

When $\text{CH}_3\text{-CH}_2\text{-OH}$ is oxidized in the presence of $\text{K}_2\text{Cr}_2\text{O}_7$ and H_2SO_4 , the product formed is:

- (A) $\text{CH}_3\text{-C(=O)-OH}$
- (B) $\text{CH}_3\text{-C(=O)-CH}_3$
- (C) H-C(=O)-OH
- (D) $\text{CH}_3\text{-C(=O)-OCH}_3$

Q87.

MDCAT 2012

When ethanoyl chloride reacts with methylamine an amide is formed. What is the structure of the amide formed?

- (A) $\text{CH}_3\text{-CH}_2\text{-C(=O)-NH}_2$
- (B) $\text{CH}_3\text{-C(=O)-NH}_2$
- (C) $\text{CH}_3\text{-CH}_2\text{-C(=O)-NHCH}_3$
- (D) $\text{CH}_3\text{-C(=O)-NHCH}_3$

Q88.

MDCAT 2011

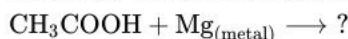
$\text{CH}_3\text{CN} + \text{HCl} \rightarrow \text{A} + \text{B}$ in presence of water in the above reaction A and B are:

- (A) Acetic acid and acid amide
- (B) Acetic acid and methyl chloride
- (C) Acetic acid and ammonia
- (D) Acetic acid and ammonium chloride

Q89.

MDCAT 2011

Consider the following reaction:



What product will form?

- (A) Magnesium formate
- (B) Magnesium ion
- (C) Magnesium acetate
- (D) Carboxylate ion

Q90.

MDCAT 2011

$\text{CH}_3\text{COOH} + \text{PCl}_5 \longrightarrow$ the products of the above reaction are:

- (A) $\text{CH}_3\text{COCl} + \text{POCl}_2 + \text{HCl}$
- (B) $\text{CH}_3\text{Cl} + \text{POCl}_3 + \text{HCl}$
- (C) $\text{CH}_3\text{COCl} + \text{POCl}_3 + \text{HCl}$
- (D) $\text{CH}_3\text{COCl} + \text{POCl}_3 + \text{H}_2$

Q91.

MDCAT 2011

The $-\text{CONH}_2$ group is called:

- (A) Amide group
- (B) Amino group
- (C) Protein linkage
- (D) Peptide linkage

Q92.

MDCAT 2011

Relative acidic strength of alcohol, phenol, water and carboxylic acids is:

- (A) Carboxylic acid > Alcohol > Phenol > Water
- (B) Carboxylic acid > Phenol > Water > Alcohol
- (C) Phenol > Carboxylic acid > Alcohol > Water
- (D) Water > Phenol > Alcohol > Carboxylic acid

Q93.

MDCAT 2010

Hydrolysis of cyano group by an aqueous acid results into:

- (A) Acid amide
- (B) Cyano hydride
- (C) Carboxylic acid
- (D) Formaldehyde

Q94.

MDCAT 2010

Which of the following compounds in the form of aqueous solution will produce CO_2 on reaction with sodium carbonate?

- (A) $\text{CH}_3\text{COOC}_2\text{H}_5$
- (B) $\text{C}_2\text{H}_5\text{COOC}_2\text{H}_5$
- (C) $\text{C}_2\text{H}_5\text{COOCH}_3$
- (D) $\text{C}_2\text{H}_5\text{COOH}$

RAPID 5–COLUMN ANSWER KEY

Official PMDC verified answer keys for 18. Carboxylic Acids.

beambeprep.com

Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD
1	C	UHS 2024	20	A	UHS 2023	39	C	BUMHS 2023	58	A	SET 2019	77	A	MDCAT 2016
2	A	UHS 2024	21	B	UHS 2023	40	C	BUMHS 2023	59	C	SET 2019	78	A	MDCAT 2016
3	C	SZABMU 2024	22	A	UHS 2023	41	B	UHS 2022	60	D	SET 2019	79	B	KMU 2016
4	C	SZABMU 2024	23	C	UHS 2023	42	A	UHS 2022	61	C	NUMS 2019	80	D	MDCAT 2015
5	B	SZABMU 2024	24	B	SZABMU 2023	43	B	UHS 2022	62	A	NUMS 2019	81	B	MDCAT 2014
6	C	SZABMU 2024	25	B	SZABMU 2023	44	B	SZABMU 2022	63	A	KMU 2019	82	C	MDCAT 2014
7	A	SZABMU 2024	26	B	SZABMU 2023	45	A	SZABMU 2022	64	B	KMU 2019	83	C	MDCAT 2013
8	D	SZABMU 2024	27	C	SZABMU 2023	46	A	KMU 2022	65	D	MDCAT 2019	84	B	MDCAT 2013
9	C	SZABMU 2024	28	B	KMU 2023	47	D	DUHS 2022	66	B	MDCAT 2019	85	B	MDCAT 2013
10	B	SZABMU 2024	29	B	KMU 2023	48	D	DUHS 2022	67	B	MDCAT 2019	86	A	MDCAT 2012
11	A	SZABMU 2024	30	C	KMU 2023	49	C	BUMHS 2022	68	B	MDCAT 2019	87	D	MDCAT 2012
12	D	KMU 2024	31	B	DUHS 2023	50	C	NUMS 2022	69	D	MDCAT 2018	88	D	MDCAT 2011
13	C	DUHS 2024	32	B	DUHS 2023	51	B	PMDC 2021	70	A	MDCAT 2018	89	C	MDCAT 2011
14	A	DUHS 2024	33	B	DUHS 2023	52	B	PMDC 2021	71	C	MDCAT 2018	90	C	MDCAT 2011
15	A	DUHS 2024	34	D	DUHS 2023	53	C	PMDC 2021	72	D	MDCAT 2017	91	A	MDCAT 2011
16	D	BUMHS 2024	35	D	NUMS 2023	54	D	PMDC 2021	73	D	MDCAT 2017	92	B	MDCAT 2011
17	A	NUMS 2024	36	A	NUMS 2023	55	C	PMDC 2020	74	C	MDCAT 2017	93	C	MDCAT 2010
18	B	NUMS 2024	37	B	BUMHS 2023	56	B	PMDC 2020	75	A	MDCAT 2017	94	D	MDCAT 2010
19	D	NUMS 2024	38	B	BUMHS 2023	57	D	PMDC 2020	76	C	MDCAT 2016			

TOTAL
MCQS

94

CORRECT

INCORRECT

BLANK

ACCURACY

%

Scan the booklet QR code to enter answers in
BeambePrep Grind Mode for automated error
 autopsies.

PROPOLIS COGNITIVE ERROR AUTOPSIES

Step-by-step conceptual derivations, formula working, and distractor autopsies for every question.

Question #1 Key: (C)

UHS 2024

Common name of 2-Hydroxy propanoic acid is:

CORE CONCEPT AND DERIVATION

2-Hydroxypropanoic acid consists of a 3-carbon chain with a carboxylic acid group at C1 and a hydroxyl (–OH) group at C2.

Formula:



Solution:

- This specific structure is famously known as **lactic acid**, the primary acid found in sour milk and produced in muscles during anaerobic respiration.

Why other options are incorrect:

Tartaric acid is 2,3-dihydroxybutanedioic acid. Phthalic acid is an aromatic dicarboxylic acid. Formic acid is the simplest 1-carbon acid.

Question #2 Key: (A)

UHS 2024

Which of the following is not an amino acid?

CORE CONCEPT AND DERIVATION

Alpha-amino acids are the building blocks of proteins, characterized by having an amino group (–NH₂) and a carboxyl group (–COOH) attached to the same alpha-carbon.

Solution:

- Glycine, Glutamic acid, and Lysine are all standard, proteinogenic α-amino acids.
- Folic acid** (Vitamin B9) is a complex water-soluble vitamin consisting of a pteridine ring, p-aminobenzoic acid, and glutamic acid moieties. While it contains an amino acid moiety, the molecule as a whole is classified as a vitamin, not a fundamental monomeric amino acid.

Why other options are incorrect:

Glycine, Glutamic acid, and Lysine perfectly fit the strict biochemical definition of alpha-amino acids.

Question #3 Key: (C)

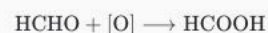
SZABMU 2024

The oxidation of Methanal results in the formation of ———.

CORE CONCEPT AND DERIVATION

Oxidation of an aldehyde yields a carboxylic acid with the exact same number of carbon atoms.

Formula:



Solution:

- Methanal (formaldehyde) is a 1-carbon aldehyde.
- Upon oxidation, the C-H bond of the aldehyde group converts to a C-OH bond.
- The resulting 1-carbon carboxylic acid is methanoic acid, commonly known as **formic acid**.

Why other options are incorrect:

Methanol is a reduction product. Acetic acid and propanoic acid contain 2 and 3 carbons, respectively, and cannot be formed without chain elongation.

Question #4 Key: (C)

SZABMU 2024

The IUPAC name of Malonic acid [Formula] is -----.

CORE CONCEPT AND DERIVATION

Dicarboxylic acids are named in IUPAC by identifying the longest continuous carbon chain containing both carboxyl groups and appending "-dioic acid".

Formula:



Solution:

- Count the carbon atoms in the chain: one central CH_2 plus two COOH carbons gives a total of **3 carbon atoms**.
- The 3-carbon parent alkane is propane.
- Appending the suffix for two acid groups gives propanedioic acid. Using locants (though technically redundant for this molecule), it is **1,3-propanedioic acid**.

Why other options are incorrect:

Ethanedioic is oxalic acid (2 carbons). Butanedioic is succinic acid (4 carbons).

Question #5 Key: (B)

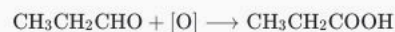
SZABMU 2024

Oxidation of Propanal in the presence of [Formula] produces

CORE CONCEPT AND DERIVATION

Aldehydes are effortlessly oxidized to carboxylic acids under acidic dichromate conditions, preserving the carbon chain length.

Formula:



Solution:

- Propanal is a 3-carbon aldehyde.
- The strong oxidizing agent ($\text{K}_2\text{Cr}_2\text{O}_7$) converts the terminal $-\text{CHO}$ group directly into a $-\text{COOH}$ group.
- The resultant 3-carbon acid is **propanoic acid**.

Why other options are incorrect:

Propanol requires reduction. Propanone is a ketone (requiring a secondary alcohol backbone). Propene requires dehydration/elimination.

Question #6 Key: (C)

SZABMU 2024

Decarboxylation of carboxylic acid occurs in the presence of

CORE CONCEPT AND DERIVATION

Decarboxylation is the chemical removal of a carboxyl group, releasing carbon dioxide. For simple aliphatic carboxylic acids (usually as their sodium salts), this requires extreme heat and a specialized fluxing agent.

Formula:



Solution:

- **Soda lime** is a solid mixture of sodium hydroxide (NaOH) and calcium oxide (CaO).
- The NaOH acts as the active decarboxylating agent, while the CaO keeps the mixture porous, prevents it from melting, and mitigates the aggressive nature of molten NaOH.

Why other options are incorrect:

Baking soda (NaHCO_3) only forms a salt; it cannot strip the carbon off the chain. Caustic soda (NaOH) alone will melt and damage glassware without the stabilizing lime.

Question #7 Key: (A)

SZABMU 2024

The common name of pentanedioic acid

CORE CONCEPT AND DERIVATION

Common names of aliphatic dicarboxylic acids follow a standard mnemonic based on the number of carbon atoms: "Oh My Such Good Apple Pie" (Oxalic, Malonic, Succinic, Glutaric, Adipic, Pimelic for C2 to C7).

Solution:

- Pentanedioic acid contains 5 carbon atoms.
- Following the sequence: C2=Oxalic, C3=Malonic, C4=Succinic, C5=**Glutaric**.
- Therefore, the common name is glutaric acid.

Why other options are incorrect:

Oxalic is C2. Succinic is C4. Maleic is an unsaturated C4 dicarboxylic acid (cis-butenedioic acid).

Question #8 Key: (D)

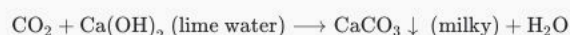
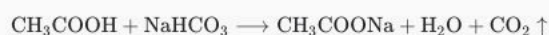
SZABMU 2024

On reacting acetic acid with baking soda a gas is evolved which turns lime water milky. Gas evolved is

CORE CONCEPT AND DERIVATION

Carboxylic acids are sufficiently acidic to decompose carbonates and bicarbonates, liberating carbon dioxide gas in the process.

Formula:



Solution:

- Acetic acid reacts with baking soda (NaHCO_3) via a standard acid-base neutralization.
- The breakdown of the resulting carbonic acid rapidly evolves **carbon dioxide** (CO_2) gas.
- When CO_2 is bubbled through lime water (calcium hydroxide), it forms insoluble calcium carbonate, turning the solution milky.

Why other options are incorrect:

Hydrogen (H_2) is evolved with active metals, not carbonates, and does not turn lime water milky. Cl_2 and NO_2 are entirely unrelated to this acid-base reaction.

Question #9 Key: (C)

SZABMU 2024

*Hydrolysis of Nitrile will produce***CORE CONCEPT AND DERIVATION**

The functional group interconversion of a nitrile (cyano group, $-C \equiv N$) via hydrolysis is a classic method for synthesizing carboxylic acids.

Formula:**Solution:**

- Heating a nitrile in aqueous acidic or basic conditions breaks the carbon-nitrogen triple bond.
- The nitrogen is eliminated as ammonia (or an ammonium salt).
- The carbon atom is fully oxidized by water to become a **carboxylic acid**.

Why other options are incorrect:

Aldehydes and ketones require specialized organometallic or reducing agents to form from nitriles. Esters are formed by reacting the resulting acid with an alcohol.

Question #11 Key: (A)

SZABMU 2024

*The two functional groups present in all amino acids are***CORE CONCEPT AND DERIVATION**

The very name "amino acid" directly reveals its biochemical architecture.

Solution:

- Every standard amino acid contains a central alpha-carbon.
- Attached to this carbon are two primary functional groups:
 1. A basic **amine** group ($-NH_2$).
 2. An acidic **carboxylic acid** group ($-COOH$).
- (They also contain a hydrogen atom and a variable 'R' side chain).

Why other options are incorrect:

Ethers and aldehydes are not foundational backbone components of amino acids.

Question #10 Key: (B)

SZABMU 2024

*Ethyl acetate is an***CORE CONCEPT AND DERIVATION**

Organic compounds ending in the suffix "-ate" denote a derivative of a carboxylic acid where the acidic hydrogen has been replaced by an alkyl group (in covalent molecules) or a metal (in ionic salts).

Formula:**Solution:**

- The structure features an acyl group (CH_3CO-) bonded to an alkoxy group ($-OCH_2CH_3$).
- This specific $R-CO-O-R'$ functional group defines an **ester**.

Why other options are incorrect:

Amides have an N bonded to the carbonyl. Acid halides have a halogen. Carboxylic acids have a free $-OH$.

Question #12 Key: (D)

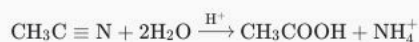
KMU 2024

Acetic acid can be prepared by the hydrolysis of

CORE CONCEPT AND DERIVATION

Hydrolysis of a nitrile yields a carboxylic acid with the exact same number of carbon atoms.

Formula:



Solution:

- Acetic acid (CH_3COOH) contains exactly 2 carbon atoms.
- To prepare it via hydrolysis, we must start with a 2-carbon nitrile.
- **Methyl cyanide** (CH_3CN), also known as ethanenitrile, contains 2 carbon atoms.
- Hydrolyzing the $-\text{CN}$ group converts it into the $-\text{COOH}$ group of acetic acid.

Why other options are incorrect:

Ethanal and ethanol require oxidation, not hydrolysis, to become acetic acid. Methanoic acid is already an acid and has only 1 carbon.

Question #13 Key: (C)

DUHS 2024

It is used as a preservative and antibacterial agent in livestock feed

CORE CONCEPT AND DERIVATION

Short-chain organic acids are widely used in agriculture due to their powerful antimicrobial properties, preventing the spoilage of animal feed.

Solution:

- **Formic acid** (HCOOH) is highly efficacious against bacteria (especially Salmonella) and fungi.
- It is industrially sprayed onto livestock feed and silage. It rapidly lowers the pH, inhibiting microbial growth and preserving the nutritional value of the feed over long winter months.

Why other options are incorrect:

While propionic acid is also used as a mold inhibitor, formic acid is heavily tested in textbooks as the primary antibacterial preservative for livestock feed.

Question #14 Key: (A)

DUHS 2024

The carboxylic acid is stronger than: (Note: This question refers to acidic strength compared to other given s...

CORE CONCEPT AND DERIVATION

Carboxylic acids are weak organic acids. They are completely outclassed in proton-donating ability by strong inorganic mineral acids.

Solution:

- HNO_3 , H_2SO_4 , and HCl are all strong mineral acids that ionize completely in water. Carboxylic acids are decidedly **weaker** than all of these.
- PCl_5 is not a Brønsted-Lowry acid at all (it is an electrophilic chlorinating agent).
- By elimination, carboxylic acid possesses more acidic character (proton donation) than a non-acid like PCl_5 .

Why other options are incorrect:

Options B, C, and D are classical strong mineral acids with negative pK_a values, far stronger than any typical carboxylic acid.

Question #15 Key: (A)

DUHS 2024

Total number of alpha amino acids are:

CORE CONCEPT AND DERIVATION

While hundreds of amino acids exist in nature, only a specific subset is coded directly by the universal genetic code to build proteins.

Solution:

- In standard biochemistry taught at this level, there are exactly **20** standard alpha-amino acids that make up human proteins (proteinogenic amino acids).

Why other options are incorrect:

While discoveries of selenocysteine (21st) and pyrrolysine (22nd) exist in advanced molecular biology, 20 is the definitive textbook standard for this academic level.

Question #16 Key: (D)

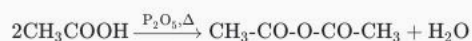
BUMHS 2024

On heating acetic acid in the presence of [Formula], dehydration occurs with the formation of

CORE CONCEPT AND DERIVATION

Phosphorus pentoxide (P_2O_5) is a hyper-aggressive dehydrating agent capable of ripping a water molecule out from between two carboxylic acid molecules.

Formula:



Solution:

- Two molecules of acetic acid are brought together.
- P_2O_5 removes an $-OH$ from one and an $-H$ from the other.
- The resulting bond fuses the two acyl groups through a central oxygen, forming **acetic anhydride**.

Why other options are incorrect:

Acetamide requires ammonia. Methyl and octyl acetates are esters, requiring the presence of an alcohol.

Question #17 Key: (A)

NUMS 2024

Select the carboxylic acid with highest melting point:

CORE CONCEPT AND DERIVATION

Melting points of carboxylic acids do not uniformly increase with chain length; they exhibit an alternating (sawtooth) effect. Furthermore, smaller molecules often pack exceptionally well into crystal lattices.

Solution:

- Ethanoic acid** (acetic acid) has a relatively high melting point ($16.6^\circ C$) due to its small, symmetrical size allowing incredibly tight and efficient packing in the solid state, alongside strong dimeric hydrogen bonding.
- In contrast, propanoic acid ($-20.8^\circ C$), butanoic acid ($-5^\circ C$), and pentanoic acid ($-34.5^\circ C$) have significantly lower melting points because their longer, flexible alkyl chains disrupt efficient crystal packing.

Why other options are incorrect:

Because of the packing efficiency of the tiny methyl group, ethanoic acid dominates the melting points of the immediate lower aliphatic series.

Question #18 Key: (B)

NUMS 2024

Identify the following compound having shortest bond length:

CORE CONCEPT AND DERIVATION

Bond length correlates with bond order; double bonds ($C=O$) are substantially shorter than single bonds ($C-O$, $C-N$). Resonance can lengthen a double bond by giving it partial single-bond character.

Solution:

- Methyl amine ($C-N$) and Ethanol ($C-O$) possess only single bonds, which are long.
- Formamide ($H-CO-NH_2$) contains a $C=O$ bond, but the nitrogen's lone pair donates heavily into the carbonyl via resonance, significantly lengthening the $C=O$ bond.
- Formic acid** ($H-COOH$) also has a $C=O$ bond, but oxygen is much less willing to donate its lone pair via resonance than nitrogen. Therefore, the $C=O$ retains more pure double-bond character, making it the **shortest** bond among the choices.

Why other options are incorrect:

Single bonds are inherently longer than double bonds. Nitrogen resonance in amides lengthens the carbonyl bond more than oxygen resonance in acids.

Question #19 Key: (D)

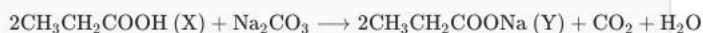
NUMS 2024

Compound X + [Formula] compound Y + [Formula] + [Formula]. The compound Y is: (Note: The official key selects...

CORE CONCEPT AND DERIVATION

Carboxylic acids react with sodium carbonate to form a sodium carboxylate salt, carbon dioxide, and water.

Formula:



Solution:

- The question stem technically asks for "Compound Y", which should be sodium propanoate ($\text{CH}_3\text{CH}_2\text{COONa}$).
- However, none of the options list a salt. The official past-paper key assigns Option D.
- Therefore, Option D (**Propanoic acid**) represents "Compound X" (the reactant acid), which is the only molecule among the choices logically capable of reacting with a carbonate to release CO_2 .

Why other options are incorrect:

Alkenes, esters, and aldehydes do not undergo acid-base neutralization with sodium carbonate to evolve carbon dioxide.

Question #20 Key: (A)

UHS 2023

If carboxylic acid and ketone groups [Formula] are present in a chain, then final name will be given as

CORE CONCEPT AND DERIVATION

When multiple functional groups are present, IUPAC nomenclature dictates a strict priority order to determine the parent suffix. The carboxylic acid group is at the very top of this priority list.

Solution:

- Because the carboxylic acid takes highest priority, the parent chain must end with the suffix "**-oic acid**".
- All other groups, including the ketone, are relegated to being substituents.
- As a substituent, the ketone group is designated by the prefix "**oxo-**".
- Thus, the final naming pattern is "oxo...oic acid".

Why other options are incorrect:

The suffix "-one" can only be used if the ketone is the highest priority group in the entire molecule, which is impossible if an acid is present.

Question #21 Key: (B)

UHS 2023

Acetic acid is weak acid than sulphuric acid because of which of the following reasons?

CORE CONCEPT AND DERIVATION

The strength of an acid is defined strictly by its ability to dissociate (ionize) and donate protons (H^+) in an aqueous solution.

Solution:

- Sulfuric acid (H_2SO_4) is a strong mineral acid that ionizes nearly 100% in water, yielding a high concentration of protons.
- Acetic acid (CH_3COOH) is an organic acid with a very low acid dissociation constant ($K_a \approx 1.8 \times 10^{-5}$).
- This means it only partially dissociates (has a **less degree of ionization**), making it a much weaker acid.

Why other options are incorrect:

Having a $-COOH$ group defines its class but does not scientifically define why it's weaker than a mineral acid. Thermal decomposition and inductive effects are irrelevant to the core definition of its weak electrolytic nature compared to H_2SO_4 .

Question #22 Key: (A)

UHS 2023

Mr. Khan mix acetic acid with thionyl chloride. Which product is obtained?

CORE CONCEPT AND DERIVATION

Thionyl chloride ($SOCl_2$) is the most efficient reagent for converting a carboxylic acid into an acyl chloride (acid chloride).

Formula:



Solution:

- The hydroxyl group ($-OH$) of the acetic acid is nucleophilically substituted by a chlorine atom.
- This forms acetyl chloride (CH_3COCl).
- The byproducts are sulfur dioxide (SO_2) and hydrogen chloride (HCl), both of which escape as gases, driving the reaction to completion.

Why other options are incorrect:

Options B and D incorrectly suggest the cleavage of the C-C bond to form methyl chloride (CH_3Cl). Option C incorrectly depicts an ester.

Question #23 Key: (C)

UHS 2023

Complete oxidation of alcohol gives which of the following?

CORE CONCEPT AND DERIVATION

The oxidation state of the central carbon in a primary alcohol can be sequentially increased by removing hydrogen and adding oxygen bonds.

Formula:



Solution:

- Mild oxidation of a primary alcohol yields an aldehyde (partial oxidation).
- Complete** (exhaustive) oxidation using strong agents like acidified $\text{K}_2\text{Cr}_2\text{O}_7$ or KMnO_4 pushes the reaction all the way to a **carboxylic acid**.

Why other options are incorrect:

Aldehydes are intermediate (incomplete) products. Alkanes require reduction, not oxidation. Ketones are formed from secondary alcohols, which cannot be further oxidized without breaking carbon-carbon bonds.

Question #24 Key: (B)

SZABMU 2023

The relative acidic strength of phenol, water, alcohol & carboxylic acid is:

CORE CONCEPT AND DERIVATION

Acid strength correlates directly with the stability of the conjugate base. Resonance stabilization heavily favors stronger acidity.

Solution:

- Carboxylic acid ($-\text{COOH}$):** The carboxylate ion is immensely stabilized by equivalent resonance over two oxygen atoms. (Strongest)
- Phenol ($\text{C}_6\text{H}_5\text{OH}$):** The phenoxide ion is stabilized by resonance into the aromatic ring, making it fairly acidic.
- Water (H_2O):** The hydroxide ion lacks resonance but has no destabilizing alkyl groups.
- Aliphatic Alcohol ($-\text{OH}$):** The alkoxide ion is destabilized by the electron-donating inductive effect ($+I$) of the alkyl chain. (Weakest)

Why other options are incorrect:

Option B is the universally accepted chemical order of acidity for these standard functional classes.

Question #25 Key: (B)

SZABMU 2023

When carboxylic acids are heated with alcohol in the presence of concentration [Formula], the conversion of f...

CORE CONCEPT AND DERIVATION

The reaction described is Fischer esterification, where a carboxylic acid and an alcohol condense to form an ester and water.

Formula:



Solution:

- The reactant functional group is the **carboxyl group** (–COOH).
- During the reaction, the –OH portion of the acid is replaced by the –OR' alkoxy group from the alcohol.
- The resulting product functional group is an **ester group** (–COOR').

Why other options are incorrect:

The acid is not converted into a pure carbonyl (aldehyde/ketone) or a hydroxyl (alcohol). The explicit transformation is Acid → Ester.

Question #26 Key: (B)

SZABMU 2023

Thionyl chloride reacts with acetic acid resulting in transformation of Carboxylic group to:

CORE CONCEPT AND DERIVATION

Thionyl chloride (SOCl₂) acts as a chlorinating agent, specifically targeting the hydroxyl component of the carboxyl group.

Formula:



Solution:

- The –OH group of the carboxylic acid is substituted by a halogen (chlorine).
- This transforms the carboxylic functional group (–COOH) into an **acid halide** functional group (–COCl).

Why other options are incorrect:

Acetamides require reaction with ammonia. Alcohols require strong reducing agents. Esters require reaction with an alcohol.

Question #27 Key: (C)

SZABMU 2023

Reactivity of carboxyl group is due to presence of:

CORE CONCEPT AND DERIVATION

The carboxyl group (–COOH) consists of a carbonyl group (C=O) directly bonded to a hydroxyl group (–OH). The principal site of nucleophilic attack and reactivity is dictated by the polarization of the carbonyl bond.

Solution:

- The highly electronegative oxygen in the **carbonyl group** pulls electron density away from the carbon atom.
- This renders the carbonyl carbon highly electrophilic (δ⁺), making it the primary target for nucleophilic acyl substitution reactions (such as esterification, amide formation, etc.).

Why other options are incorrect:

While the hydroxyl group provides the acidic proton and acts as a leaving group, the initial driving force and central hub for the most characteristic substitution reactions is the electron-deficient carbonyl carbon.

Question #28 Key: (B)

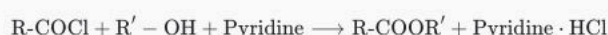
KMU 2023

In conversion of acid halides to ester, pyridine is used to:

CORE CONCEPT AND DERIVATION

When synthesizing an ester from an acid chloride and an alcohol, hydrogen chloride (HCl) gas is produced as a byproduct. Pyridine acts as a mild base/scavenger.

Formula:



Solution:

- Acid chlorides are incredibly reactive, and their reaction with alcohols yields HCl.
- If left unchecked, HCl can cause unwanted side reactions or reverse equilibria in complex syntheses.
- Pyridine (a weak organic base) is added specifically to neutralize and **consume the** HCl, forming a harmless pyridinium chloride precipitate.

Why other options are incorrect:

Pyridine does not act as a dehydrating or dehydrogenating agent, nor does it stabilize the already hyper-reactive acid halide.

Question #29 **Key: (B)**

KMU 2023

Number of carbon atoms in Valeric acid is:

CORE CONCEPT AND DERIVATION

Common nomenclature of straight-chain carboxylic acids relies on historically established names linked to carbon count.

Solution:

- 1 Carbon: Formic acid
- 2 Carbons: Acetic acid
- 3 Carbons: Propionic acid
- 4 Carbons: Butyric acid
- **5 Carbons: Valeric acid** (IUPAC: Pentanoic acid)

Why other options are incorrect:

4 carbons is butyric, 6 is caproic, and 7 is enanthic acid.

Question #30 **Key: (C)**

KMU 2023

The IUPAC name of formyl chloride is:

CORE CONCEPT AND DERIVATION

Formyl chloride is the simplest possible acid chloride, derived from formic acid. IUPAC rules dictate naming acid chlorides by replacing the "-ic acid" suffix of the parent acid with "-oyl chloride".

Formula:**Solution:**

- The parent carboxylic acid with 1 carbon atom is methanoic acid.
- Following the IUPAC rule, drop the "-ic acid" and add "-oyl chloride".
- This yields the correct IUPAC name: **methanoyl chloride**.

Why other options are incorrect:

Chloro methanoic acid incorrectly implies it's still an acid. Chloro methane is CH_3Cl . Chloromethanoate implies an ester.

Question #31 **Key: (B)**

DUHS 2023

Which of the following is formed when formaldehyde is treated with oxidizing mixture? ([Formula])?

CORE CONCEPT AND DERIVATION

Aldehydes are highly susceptible to oxidation and are readily converted into their corresponding carboxylic acids (maintaining the same number of carbon atoms) when treated with strong oxidizing agents.

Formula:**Solution:**

- Formaldehyde (HCHO) contains exactly one carbon atom.
- Acidified potassium dichromate is a strong oxidizing agent.
- It inserts an oxygen atom into the aldehydic C-H bond, creating a carboxyl group ($-\text{COOH}$).
- The 1-carbon carboxylic acid formed is **methanoic acid** (formic acid).

Why other options are incorrect:

Methanol would require reduction. Acetone (3 carbons) and Acetaldehyde (2 carbons) are impossible to form without adding carbon atoms to the framework.

Question #32 Key: (B)

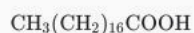
DUHS 2023

What is the IUPAC name of stearic acid?

CORE CONCEPT AND DERIVATION

Stearic acid is one of the most common long-chain saturated fatty acids found in animal and vegetable fats.

Formula:



Solution:

- Stearic acid has a continuous straight carbon chain consisting of exactly 18 carbon atoms.
- In IUPAC nomenclature, the 18-carbon alkane is octadecane.
- Adding the standard acid suffix gives **octadecanoic acid**.

Why other options are incorrect:

Hexanoic acid has 6 carbons. Octanoic acid has 8 carbons. Hexadecanoic acid has 16 carbons (known commonly as palmitic acid).

Question #33 Key: (B)

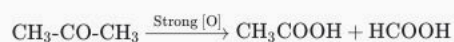
DUHS 2023

Which of the following is formed when acetone is oxidized?

CORE CONCEPT AND DERIVATION

Ketones strongly resist oxidation. However, under drastic conditions with strong oxidizing agents, the carbon-carbon bond adjacent to the carbonyl group ruptures, producing a mixture of smaller carboxylic acids.

Formula:



Solution:

- Acetone (propanone) has 3 carbon atoms.
- Vigorous oxidation cleaves the molecule into a 2-carbon fragment and a 1-carbon fragment.
- The 2-carbon fragment forms **ethanoic acid** (acetic acid).
- The 1-carbon fragment forms formic acid, which under strong oxidative conditions frequently further degrades to CO_2 and H_2O . Thus, ethanoic acid is the primary stable product.

Why other options are incorrect:

Propanoic acid (3 carbons) cannot be formed because oxidation of a ketone inherently demands carbon-carbon bond cleavage, reducing the chain length.

Question #34 Key: (D)

DUHS 2023

What's the IUPAC name of [Formula], [Formula] -dimethyl valeric acid?

CORE CONCEPT AND DERIVATION

Translating common Greek-letter nomenclature to IUPAC requires knowing the parent chain length and how alpha/beta positions map to numeric locants.

Solution:

- **Parent Chain:** Valeric acid has 5 carbon atoms. In IUPAC, a 5-carbon acid is pentanoic acid.
- **Numbering:** In IUPAC, the carbonyl carbon is C1. Therefore, the adjacent α -carbon is C2, and the β -carbon is C3.
- **Substituents:** There are methyl groups at the α (C2) and β (C3) positions.
- Combining these gives: **2,3-dimethylpentanoic acid**.

Why other options are incorrect:

Hexanoic acid indicates a 6-carbon parent chain (caproic acid, not valeric). Option C uses incorrect locants (3,4 instead of 2,3).

Question #35 Key: (D)

NUMS 2023

Which of the following reacts with Carboxylic Acid to form Ester?

CORE CONCEPT AND DERIVATION

Esterification is the classic condensation reaction synthesizing an ester from a carboxylic acid.

Formula:**Solution:**

- The necessary counterpart to a carboxylic acid to create the R-CO-O-R' ester linkage is a molecule providing an alkoxy (–OR') group.
- **Alcohols** (R' – OH) perfectly serve this role, attacking the acid via nucleophilic acyl substitution.

Why other options are incorrect:

Aldehydes, alkyl halides, and ketones lack the nucleophilic hydroxyl group required to undergo Fischer esterification directly with an acid.

Question #36 Key: (A)

NUMS 2023

Hydrolysis of Nitriles produces:

CORE CONCEPT AND DERIVATION

Nitriles possess a carbon triple-bonded to a nitrogen ($-\text{C} \equiv \text{N}$). The hydrolysis of this highly oxidized carbon yields a molecule in a similarly high oxidation state.

Formula:**Solution:**

- When boiled with aqueous acids or bases, the triple bond is entirely broken.
- The nitrogen is expelled as ammonia/ammonium.
- The remaining carbon fragment bonds with oxygen from the water to yield a **carboxylic acid**.

Why other options are incorrect:

Aldehydes and ketones require specialized partial reductions (like DIBAL-H or Grignard additions) to form from nitriles, not simple hydrolysis. Esters require the presence of an alcohol.

Question #37 Key: (B)

BUMHS 2023

Acetic acid is weak acid than sulphuric acid because of which of the following reasons?

CORE CONCEPT AND DERIVATION

Acid strength is fundamentally defined by the extent to which an acid dissociates into protons (H^+) in aqueous solution.

Solution:

- Sulfuric acid (a mineral acid) ionizes almost completely in water, releasing massive amounts of H^+ .
- Acetic acid (an organic acid) exists in a tight equilibrium where only a tiny fraction (less than 1%) of the molecules dissociate.
- Because it has a much **less degree of ionization**, it provides far fewer protons, categorizing it scientifically as a weak acid.

Why other options are incorrect:

Thermal stability and inductive effects do not serve as the fundamental thermodynamic definition of acid strength in solvent, whereas the degree of ionization (α) directly does.

Question #38 Key: (B)

BUMHS 2023

The solubility of carboxylic acid in water gradually decreases with:

CORE CONCEPT AND DERIVATION

The solubility of organic compounds in water is a battle between the hydrophilic (water-loving) polar head and the hydrophobic (water-fearing) non-polar hydrocarbon tail.

Solution:

- The carboxyl group ($-\text{COOH}$) is hydrophilic and promotes solubility via hydrogen bonding.
- As the molecular mass increases (by adding more $-\text{CH}_2-$ units to the alkyl chain), the hydrophobic non-polar tail grows larger and more dominant.
- This bulky hydrocarbon tail disrupts the water's hydrogen bond network, rendering the overall molecule increasingly insoluble.

Why other options are incorrect:

Decreasing molecular mass actually *increases* solubility (e.g., acetic acid is infinitely soluble). The other options describe concentrations, not inherent molecular solubility traits.

Question #39 Key: (C)

BUMHS 2023

Which of the following acids has the smallest dissociation constant?

CORE CONCEPT AND DERIVATION

The acid dissociation constant (K_a) is a measure of acid strength. The "smallest dissociation constant" implies the **weakest acid**. Acidity increases with highly electronegative substituents (Fluorine > Bromine) and their proximity to the carboxyl group (α -position > β -position).

Solution:

- To find the weakest acid, we want the weakest halogen placed furthest away from the $-\text{COOH}$ group to minimize the electron-withdrawing inductive ($-I$) effect.
- Option A: Fluorine on the α -carbon (Very Strong).
- Option D: Bromine on the α -carbon (Strong).
- Option B: Fluorine on the β -carbon (Moderate).
- Option C: Bromine on the β -carbon. Bromine is less electronegative than Fluorine, and it is located far away on the β -carbon. This exerts the weakest $-I$ effect, yielding the least stable anion and thus the smallest K_a .

Why other options are incorrect:

All other options feature either a more electronegative halogen (F) or a closer proximity (α -position), both of which result in a larger dissociation constant.

Question #40 Key: (C)

BUMHS 2023

Which product is formed when RMgX reacts with [Formula] ?

CORE CONCEPT AND DERIVATION

Grignard reagents (RMgX) are potent nucleophiles that attack the electrophilic carbon atom in carbon dioxide ($\text{O}=\text{C}=\text{O}$).

Formula:



Solution:

- The nucleophilic alkyl group (R^-) from the Grignard reagent attacks the partially positive central carbon of CO_2 .
- This pushes electrons onto one of the oxygens, forming a carboxylate magnesium salt intermediate.
- Upon acidic workup (hydrolysis), the salt is protonated to yield a **carboxylic acid** with one more carbon atom than the original Grignard reagent.

Why other options are incorrect:

Aldehydes and ketones are formed by reacting Grignard reagents with formates or nitriles, respectively. Ethers are often the solvent, not the product.

Question #41 Key: (B)

UHS 2022

Which among the following have least pH?

CORE CONCEPT AND DERIVATION

The term "least pH" designates the strongest acid (highest $[\text{H}^+]$). The strength of halogenated acids depends on both the number of halogen atoms and their proximity to the carboxyl group.

Solution:

- Options A and D are unsubstituted, weak aliphatic acids.
- Option C (3-chloropropanoic acid) has one chlorine atom on the far β -carbon. The inductive effect diminishes rapidly with distance.
- Option B (2,2-dichloropropanoic acid) has **two** highly electronegative chlorine atoms, and they are located on the α -carbon, directly adjacent to the carboxyl group.
- This creates massive stabilization for the resulting anion, making Option B undeniably the strongest acid, hence producing the lowest (least) pH.

Why other options are incorrect:

They either lack halogens entirely or the halogens are too few and too distant to compete with 2,2-dichloropropanoic acid.

Question #42 Key: (A)

UHS 2022

If carboxylic acid and ketone groups [Formula] are present in a chain then final name will be given as:

CORE CONCEPT AND DERIVATION

According to IUPAC priority rules, the carboxylic acid group ($-\text{COOH}$) holds the highest priority among common functional groups, thereby commanding the suffix of the molecule.

Solution:

- Because the carboxylic acid governs the parent name, the molecule will end in the suffix "**-oic acid**".
- The ketone group ($> \text{C}=\text{O}$) is consequently downgraded to a mere substituent.
- As a prefix substituent, the ketone oxygen is denoted by the term "**oxo-**".
- Therefore, the naming format is "...oxo...oic acid".

Why other options are incorrect:

The suffix "-one" is strictly reserved for when a ketone is the highest priority group in the molecule, which is never the case when an acid is present.

Question #43 Key: (B)

UHS 2022

When carboxylic acids and dicarboxylic acids have similar molecular weights, how do their m.p compare?

CORE CONCEPT AND DERIVATION

Melting point (m.p) is determined by the ability of molecules to pack efficiently in a solid crystal lattice and the extent of intermolecular hydrogen bonding.

Solution:

- Monocarboxylic acids possess only one carboxyl ($-\text{COOH}$) group, allowing for hydrogen bonding on only one end of the molecule.
- **Dicarboxylic acids** contain two $-\text{COOH}$ groups (one at each end of the carbon chain).
- This allows them to form an extensive, continuous, cross-linked network of hydrogen bonds throughout the entire solid crystal lattice.
- Due to these drastically stronger intermolecular forces, dicarboxylic acids require vastly more energy to melt, giving them a much higher melting point.

Why other options are incorrect:

It is not similar or random; the structural doubling of hydrogen-bonding sites guarantees a higher melting point for the dicarboxylic variant.

Question #44 Key: (B)

SZABMU 2022

Select the correct order of relative acidic strength of phenol, alcohol, water and carboxylic acid:

CORE CONCEPT AND DERIVATION

Acidic strength is dictated by the stability of the conjugate base. Greater resonance or lack of destabilizing electron-donating groups leads to higher acidity.

Solution:

- **Carboxylic Acids:** Extremely stable carboxylate ion via identical resonance structures. (Strongest)
- **Phenol:** Phenoxide ion stabilized by resonance into the aromatic ring, but less stable than carboxylate.
- **Water:** Forms hydroxide ion. No resonance, but no destabilizing alkyl groups either.
- **Alcohol:** Forms alkoxide ion. The alkyl group pushes electrons (+I effect) onto the already negative oxygen, heavily destabilizing it. (Weakest)

Why other options are incorrect:

Option B is the only chemically accurate sequence recognizing water as a stronger acid than unsubstituted aliphatic alcohols.

Question #45 Key: (A)

SZABMU 2022

Carboxylic acid reacts with alcohol to form:

CORE CONCEPT AND DERIVATION

The direct reaction between a carboxylic acid and an alcohol under acidic catalysis is a classic condensation reaction called Fischer esterification.

Formula:



Solution:

- The nucleophilic oxygen of the alcohol attacks the electrophilic carbonyl carbon of the carboxylic acid.
- A water molecule is expelled, and the two organic fragments link via an oxygen atom to form an **ester**.

Why other options are incorrect:

Aldehydes, ketones, and alkyl halides cannot be synthesized by merely mixing an acid and an alcohol; those require redox or halogenation chemistry.

Question #46 Key: (A)

KMU 2022

Which of the following statements is false about the acid-strength of acetic acid?

CORE CONCEPT AND DERIVATION

Adding an electron-withdrawing halogen (like chlorine) to a carboxylic acid dramatically increases its acidity via the inductive (–I) effect. Conversely, adding electron-donating alkyl groups decreases acidity.

Solution:

- Let's evaluate the truth of each statement.
- Option B: True. Acetic acid is stronger than propionic acid (ethyl group has stronger +I than methyl).
- Option C: True. Trichloroacetic acid is vastly stronger due to 3 chlorines.
- Option D: True. Formic acid has no methyl group destabilizing its anion, so it is stronger than acetic acid.
- Option A: **False**. Monochloroacetic acid has a chlorine atom pulling electron density, making it **stronger** than unsubstituted acetic acid. The statement claims acetic is stronger, which is a lie.

Why other options are incorrect:

Options B, C, and D state experimentally verifiable facts. The question specifically asks for the false statement.

Question #47 Key: (D)

DUHS 2022

*[Formula] has IUPAC name***CORE CONCEPT AND DERIVATION**

The IUPAC nomenclature for dicarboxylic acids dictates finding the longest continuous carbon chain containing both carboxyl groups and appending the suffix "-dioic acid" to the parent alkane name.

Formula:



Solution:

- The structure consists of exactly 2 carbon atoms bonded together.
- The 2-carbon parent alkane is ethane.
- Because there are two carboxylic acid groups, the suffix is "-dioic acid".
- Therefore, the official IUPAC name is **ethanedioic acid**.

Why other options are incorrect:

"Oxalic acid" is the common (trivial) name, not the IUPAC name.
Acetic acid (ethanoic acid) is a monocarboxylic acid.
"Diethanoic acid" is not valid nomenclature.

Question #48 Key: (D)

DUHS 2022

*Hexanoic acid is IUPAC name:***CORE CONCEPT AND DERIVATION**

Many straight-chain carboxylic acids are better known by their historical common names, which are often derived from their natural sources.

Solution:

- Hexanoic acid is a 6-carbon straight-chain monocarboxylic acid ($\text{C}_6\text{H}_{11}\text{COOH}$).
- Its common name is **caproic acid**, derived from the Latin word *caper* (goat), as it is one of the fatty acids responsible for the distinct odor of goats and goat milk.

Why other options are incorrect:

Adipic acid is hexanedioic acid (a dicarboxylic acid). Propionic acid is the 3-carbon acid. Formic acid is the 1-carbon acid.

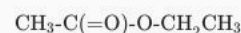
Question #49 Key: (C)

BUMHS 2022

*Which of the functional group are present in ethyl acetate?***CORE CONCEPT AND DERIVATION**

The suffix "-ate" in organic nomenclature is specifically designated for the salts and esters of carboxylic acids.

Formula:



Solution:

- Ethyl acetate is formed from the condensation of acetic acid and ethanol.
- The defining linkage is R-C(=O)-O-R' , which is the **ester** functional group.

Why other options are incorrect:

Aldehydes have a -CHO group. Carboxyl groups (-COOH) indicate a free acid. Ethers have an R-O-R' group lacking the carbonyl (C=O).

Question #50 Key: (C)

NUMS 2022

*Carboxylic acids are water soluble because they:***CORE CONCEPT AND DERIVATION**

Solubility of organic compounds in water heavily depends on their ability to interact with water molecules via strong intermolecular forces, specifically hydrogen bonds.

Solution:

- Carboxylic acids contain a highly polar carboxyl group ($-\text{COOH}$).
- The carbonyl oxygen (C=O) acts as a hydrogen bond acceptor, while the hydroxyl group ($-\text{OH}$) acts as a strong hydrogen bond donor.
- This allows them to form extensive **hydrogen bonding** networks with water molecules, making lower-chain carboxylic acids highly soluble.

Why other options are incorrect:

Reactivity, melting point, and density do not fundamentally explain the thermodynamic favorability of dissolving in a highly polar solvent like water.

Question #51 Key: (B)

PMDC 2021

Number of oxygen in cyclic ring of dimer of carboxylic acid are:

CORE CONCEPT AND DERIVATION

Carboxylic acids ($R\text{-COOH}$) readily form dimers through intermolecular hydrogen bonding in the vapor phase and in non-polar solvents.

Solution:

- A single molecule of a monocarboxylic acid contains 2 oxygen atoms.
- A dimer is formed by the hydrogen-bonding association of exactly **two** such acid molecules.
- Therefore, $2 \text{ molecules} \times 2 \text{ oxygen atoms/molecule} = 4 \text{ oxygen atoms}$ in the resulting cyclic dimer structure.

Why other options are incorrect:

The math directly totals to 4. Options A, C, and D are mathematically impossible for a dimer of a standard monocarboxylic acid.

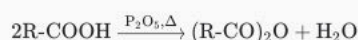
Question #52 Key: (B)

PMDC 2021

Which of the following catalyst is used for the preparation of acidic anhydrides?

CORE CONCEPT AND DERIVATION

Acid anhydrides are literally formed by removing a water molecule (dehydration) from two molecules of a carboxylic acid. This requires a powerful, specialized dehydrating agent.

Formula:**Solution:**

- Phosphorus pentoxide (P_2O_5) is one of the strongest dehydrating agents known in chemistry.
- When heated with a carboxylic acid, it forcefully extracts H_2O , chemically locking the two acid remnants into an anhydride linkage.

Why other options are incorrect:

H_2SO_4 is a dehydrating agent, but it is typically used for esterification or dehydrating alcohols to alkenes. P_2O_5 is required for the much more difficult dehydration of acids to anhydrides.

Question #53 Key: (C)

PMDC 2021

Which of the following is a carboxylic acid derivative?

CORE CONCEPT AND DERIVATION

A carboxylic acid derivative is a compound that yields a carboxylic acid upon hydrolysis. The defining structural trait is an acyl group ($R\text{-C=O}$) attached to an electronegative atom that can act as a leaving group.

Solution:

- **Acyl halides** (like acetyl chloride, CH_3COCl) fit this definition perfectly. The $-OH$ of the acid is replaced by a halogen ($-X$).
- Other standard derivatives include esters, amides, and acid anhydrides.

Why other options are incorrect:

Acetic acid is the parent acid, not a derivative. Alcohols and methyl halides do not contain the acyl ($C=O$) group required to be an acid derivative.

Question #54 Key: (D)

PMDC 2021

Which one is weak acid?

CORE CONCEPT AND DERIVATION

The acidic strength of unsubstituted aliphatic carboxylic acids decreases as the length of the alkyl chain increases due to the electron-donating inductive effect ($+I$) of alkyl groups, which destabilizes the conjugate base.

Formula:

Longer Alkyl Chain $\rightarrow$ Greater $+I$ Effect $\rightarrow$ Weaker Acid

Solution:

- Formic acid (1 carbon) has no alkyl group $\rightarrow$ strongest.
- Acetic acid (2 carbons) has a methyl group.
- Propanoic acid (3 carbons) has an ethyl group.
- **Butanoic acid** (4 carbons) has a propyl group. The larger propyl group exerts the strongest $+I$ effect, destabilizing the carboxylate anion the most, rendering it the weakest acid of the bunch.

Why other options are incorrect:

They all possess shorter carbon chains and therefore inherently less electron-donating interference than butanoic acid.

Question #55 Key: (C)

PMDC 2020

Which of the following is the strongest acid?

CORE CONCEPT AND DERIVATION

Acid strength is magnified by electron-withdrawing groups (EWG). While the nitro group and fluorine are stronger individual EWGs than chlorine, the sheer cumulative effect of **three** chlorine atoms on one carbon outweighs a single stronger group.

Solution:

- Fluoroethanoic acid has 1 fluorine atom (strong single pull).
- Nitroethanoic acid has 1 nitro group (very strong single pull).
- **Trichloroethanoic acid** features 3 chlorine atoms. Their combined, additive inductive effect ($-I$) severely depletes electron density from the carboxylate group.
- Consequently, the trichloroacetate anion is the most stabilized, making the parent acid the strongest (lowest pKa).

Why other options are incorrect:

Propanoic acid has electron-donating alkyl groups (weakest acid). Single substituents (Fluoro, Nitro) do not surpass the collective pull of three chlorines.

Question #56 Key: (B)

PMDC 2020

Hydrolysis of acyl chloride results in the formation of:

CORE CONCEPT AND DERIVATION

Acyl chlorides are the most reactive of all carboxylic acid derivatives. They react vigorously with water via nucleophilic acyl substitution.

Formula:



Solution:

- Water acts as a nucleophile, attacking the highly electrophilic carbonyl carbon.
- The superior leaving group, chloride (Cl^-), is rapidly expelled.
- The final product is the corresponding carboxylic acid alongside hydrogen chloride gas.

Why other options are incorrect:

Forming anhydrides requires reacting with a carboxylate salt. Forming esters requires an alcohol. Forming amides requires ammonia or an amine.

Question #57 Key: (D)

PMDC 2020

The exact reactivity order for carboxylic acid derivatives is:

CORE CONCEPT AND DERIVATION

The reactivity of acyl derivatives is governed by how well the substituent can act as a leaving group. Weaker bases constitute better leaving groups.

Solution:

- **Acyl chlorides:** Cl^- is a very weak base (conjugate of strong HCl), making it the best leaving group. (Most reactive).
- **Acid anhydrides:** The carboxylate ion (RCOO^-) is a moderate leaving group.
- **Esters:** The alkoxide ion (RO^-) is a strong base and poor leaving group.
- **Amides:** The amide ion (NH_2^-) is a very strong base and terrible leaving group. (Least reactive).

Why other options are incorrect:

Only Option D perfectly maps the sequence from weakest base leaving group to stronger base leaving group.

Question #58 Key: (A)

SET 2019

Acetyl chloride (Ethanoyl chloride) is used in the synthesis of organic compounds. It is prepared by treating ...

CORE CONCEPT AND DERIVATION

Thionyl chloride (SOCl_2) is the premier, preferred reagent for converting carboxylic acids into acid chlorides because the byproducts are gaseous and immediately leave the reaction mixture, driving it to completion.

Formula:**Solution:**

- Acetic acid reacts with SOCl_2 to form acetyl chloride.
- The gas evolution (SO_2 and HCl) makes the product incredibly easy to purify without complex distillation.

Why other options are incorrect:

Aqueous HCl does not readily substitute the $-\text{OH}$ of a carboxylic acid because the leaving group (OH^-) is poor. Options C and D are not halogenating agents.

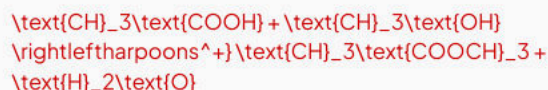
Question #59 Key: (C)

SET 2019

What will be the outcome of reaction of methanol with ethanoic acid in the presence of concentrated sulphuric ...

CORE CONCEPT AND DERIVATION

The acid-catalyzed condensation of an alcohol and a carboxylic acid produces an ester (Esterification).

Formula:**Solution:**

- The alcohol is methanol (providing the methyl group).
- The acid is ethanoic acid (providing the ethanoate backbone).
- Combining them forms the ester named **methyl ethanoate**.

Why other options are incorrect:

Propanone (a ketone), propanoic acid, and propanol require completely different reactants and non-esterification reaction pathways.

Question #60 Key: (D)

SET 2019

Which one of the following compounds can exist in the form of cyclic dimers?

CORE CONCEPT AND DERIVATION

Carboxylic acids exhibit extraordinarily strong intermolecular hydrogen bonding, causing them to pair up tightly into cyclic dimers, particularly in the vapor phase or in non-polar solvents.

Formula:



Solution:

- The highly polarized O-H bond of one acid molecule donates a hydrogen bond to the carbonyl oxygen (C=O) of a second molecule, and vice-versa.
- This forms an extremely stable 8-membered cyclic ring structure known as a dimer, doubling their effective molecular weight in certain environments.

Why other options are incorrect:

Benzene is non-polar. Acetals lack hydrogen-bond donors. Ozonides are unstable cyclic intermediates of ozonolysis, not stable hydrogen-bonded dimers.

Question #61 Key: (C)

NUMS 2019

Reagent used to reduce a carboxylic acid to an alkane is:

CORE CONCEPT AND DERIVATION

Reducing a highly oxidized functional group like a carboxylic acid all the way down to a fully saturated alkane requires a tremendously aggressive reducing environment.

Formula:



Solution:

- Hydrogen iodide (HI) in the presence of red phosphorus (P) is a powerful classical reagent system capable of completely stripping all oxygen atoms from a carboxylic acid, replacing them with hydrogens to form an alkane.

Why other options are incorrect:

$LiAlH_4$ stops at the primary alcohol stage. $NaBH_4$ is too weak to reduce carboxylic acids. Catalytic hydrogenation (Ni/H_2) is generally ineffective against the stable carboxyl group.

Question #62 Key: (A)

NUMS 2019

Which of the following is not a fatty acid?

CORE CONCEPT AND DERIVATION

By definition, true fatty acids are long-chain aliphatic (straight-chain, non-aromatic) carboxylic acids found in fats and oils.

Solution:

- Stearic acid** (C18), **Palmitic acid** (C16), and **Oleic acid** (C18, unsaturated) are classic aliphatic fatty acids derived from biological lipids.
- Phenyl acetic acid** contains an aromatic benzene ring ($C_6H_5CH_2COOH$). Aromatic acids are structurally distinct and are excluded from the biochemical definition of fatty acids.

Why other options are incorrect:

Options B, C, and D accurately represent biological fatty acids.

Question #63 Key: (A)

KMU 2019

Which compound shows the highest boiling point?

CORE CONCEPT AND DERIVATION

Boiling point is heavily dependent on the strength of intermolecular forces. Hydrogen bonding is exceptionally strong in carboxylic acids because they form dimers.

Solution:

- Ethers (Option C) and tertiary amines (Option D) lack O-H or N-H bonds and cannot act as hydrogen bond donors; their boiling points are low.
- Alcohols like ethanol (Option B) can hydrogen bond, but only single strands.
- Carboxylic acids like acetic acid (Option A) form tightly bound cyclic dimers via double hydrogen bonds, drastically increasing the energy required to vaporize them.

Why other options are incorrect:

None of the other functional groups can form the uniquely stable cyclic dimer geometry characteristic of carboxylic acids.

Question #64 Key: (B)

KMU 2019

*Which one is more reactive?***CORE CONCEPT AND DERIVATION**

The reactivity of carboxylic acid derivatives toward nucleophilic acyl substitution depends inversely on the basicity (and directly on the leaving group ability) of the substituted group.

Formula:

Reactivity Order: Acid Chloride > Anhydride > Ester > Amide

Solution:

- The chloride ion (Cl^-) in acid halides is an extremely weak base and a fantastic leaving group.
- Furthermore, chlorine's high electronegativity renders the carbonyl carbon highly electrophilic and susceptible to attack.

Why other options are incorrect:

Amides are the least reactive because the NH_2^- ion is a terrible leaving group and strongly donates electrons via resonance. Esters and anhydrides fall in the middle.

Question #65 Key: (D)

MDCAT 2019

*Nitriles (RCN) on hydrolysis in the presence of a mineral acid yield:***CORE CONCEPT AND DERIVATION**

The complete hydrolysis of a nitrile ($\text{R}-\text{C} \equiv \text{N}$) under acidic conditions universally yields a carboxylic acid.

Formula:**Solution:**

- Water molecules progressively add across the carbon-nitrogen triple bond.
- An unstable intermediate tautomerizes into an amide, which then fully hydrolyzes, kicking out ammonia (captured as an ammonium ion by the acid) and generating a carboxylic acid.

Why other options are incorrect:

Hydrolysis of nitriles inherently retains the highly oxidized state of the central carbon, making it impossible to yield lower oxidation states like alcohols or ethers.

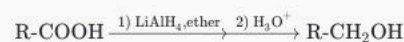
Question #66 Key: (B)

MDCAT 2019

Carboxylic acids can be reduced into corresponding alcohols. Which of the following reagent can be used for th...

CORE CONCEPT AND DERIVATION

Carboxylic acids are highly oxidized and strongly resist mild reduction. Only very powerful hydride donors can reduce them to primary alcohols.

Formula:**Solution:**

- Lithium aluminum hydride (LiAlH_4) is a potent source of hydride (H^-) ions.
- It successfully attacks the stubborn carboxylate intermediate, forcing the reduction completely down to a primary alcohol.

Why other options are incorrect:

$\text{K}_2\text{Cr}_2\text{O}_7$ and KMnO_4 are strong oxidizing agents, not reducers. H_2SO_4 is merely an acid/dehydrating agent.

Question #67 Key: (B)

MDCAT 2019

Which of the following reagent is required for preparation of acyl chloride ([Formula]) from ethanoic acid?

CORE CONCEPT AND DERIVATION

To convert a carboxylic acid into an acyl chloride (acid chloride), specialized inorganic chlorinating agents are required to substitute the $-\text{OH}$ group with a $-\text{Cl}$.

Formula:**Solution:**

- Phosphorus pentachloride (PCl_5) acts effectively, ripping the oxygen atom away and replacing it with chlorine.
- Other standard reagents for this include PCl_3 and SOCl_2 .

Why other options are incorrect:

HCl does not react this way because OH^- is a terrible leaving group in acid. POCl_3 is actually a byproduct of the PCl_5 reaction, not the primary reactant.

Question #68 Key: (B)

MDCAT 2019

Which balance chemical equation show the formation of ethanoyl chloride using thionyl chloride?

CORE CONCEPT AND DERIVATION

Thionyl chloride (SOCl_2) reacts with carboxylic acids in a 1:1 molar ratio, creating an acyl chloride, sulfur dioxide gas, and hydrogen chloride gas.

Solution:

- We must identify the correct acid: Ethanoyl chloride implies the starting material must be ethanoic acid (acetic acid, CH_3COOH).
- Check the balancing: 1 mole of CH_3COOH + 1 mole of SOCl_2 correctly balances to yield 1 mole of CH_3COCl + 1 mole of SO_2 + 1 mole of HCl .

Why other options are incorrect:

Option A and D use propanoic acid ($\text{CH}_3\text{CH}_2\text{COOH}$) and incorrectly list the reagent as " SOCl ". Option C utilizes methanoic (formic) acid, which yields formyl chloride.

Question #69 Key: (D)

MDCAT 2018

[Formula] Which of the following catalyst is used in the above reaction?

CORE CONCEPT AND DERIVATION

The esterification of a carboxylic acid with an alcohol requires an acid catalyst to proceed at a functional rate and to drive the equilibrium forward by sequestering the formed water.

Formula:**Solution:**

- Concentrated sulfuric acid (H_2SO_4) acts as both a catalyst (providing protons) and a dehydrating agent.
- By absorbing H_2O , it shifts the reaction equilibrium toward the right, maximizing ester yield.

Why other options are incorrect:

Platinum (Pt) and Nickel (Ni) are hydrogenation/reduction catalysts. Pumice stone prevents bumping during boiling but possesses no catalytic properties for esterification.

Question #70 Key: (A)

MDCAT 2018

Which product is formed by the reaction of carboxylic acid with alcohol?

CORE CONCEPT AND DERIVATION

The condensation reaction between a carboxylic acid and an alcohol forms an ester and water. This is universally known as Fischer esterification.

Formula:**Solution:**

- The $-\text{OH}$ from the acid and the $-\text{H}$ from the alcohol combine to exit as water.
- The remaining fragments bond via an oxygen atom to form the ester linkage ($-\text{COO}-$).

Why other options are incorrect:

Aldehydes, alkanes, and ethers require entirely different synthetic pathways (oxidation, reduction, or Williamson ether synthesis, respectively).

Question #71 Key: (C)

MDCAT 2018

Which one will be act as a strong acid?

CORE CONCEPT AND DERIVATION

The acidity of halogenated carboxylic acids is highly dependent on the Inductive Effect ($-I$). Strongly electronegative halogens pull electron density away from the O-H bond, weakening it, and simultaneously stabilize the resulting carboxylate anion.

Formula:

$$\text{Acidity} \propto \text{Number of Electron-Withdrawing Groups (EWG)}$$

Solution:

- Ethanoic acid has no EWG halogens.
- Chloroethanoic acid has 1 Chlorine atom.
- Dichloroethanoic acid has 2 Chlorine atoms.
- Trichloroethanoic acid** possesses 3 Chlorine atoms pulling electron density, generating massive stabilization of the anion, rendering it the strongest acid listed.

Why other options are incorrect:

The strength increases strictly sequentially: Unsubstituted < Monochloro < Dichloro < Trichloro.

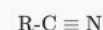
Question #72 Key: (D)

MDCAT 2017

Compounds having [Formula] group are called:

CORE CONCEPT AND DERIVATION

Organic compounds containing a cyano group ($-\text{C} \equiv \text{N}$) attached to an alkyl or aryl group are classified officially under IUPAC nomenclature as nitriles.

Formula:**Solution:**

- The functional group is termed a cyano group, but the entire class of organic molecules containing it as the principal functional group is officially named **nitriles**.
- For example, CH_3CN is called ethanenitrile (or commonly methyl cyanide).

Why other options are incorrect:

While "cyano compounds" is a descriptive term, "nitriles" is the accepted organic family name. Nitro compounds contain the $-\text{NO}_2$ group.

Question #73 Key: (D)

MDCAT 2017

Final product of hydrolysis of nitrile yield:

CORE CONCEPT AND DERIVATION

The complete hydrolysis (acidic or basic) of a nitrile cleaves the carbon-nitrogen triple bond and converts the functional group entirely into a carboxyl group.

Formula:**Solution:**

- Hydrolysis of a nitrile proceeds in two stages: partial hydrolysis yields an amide ($\text{R}-\text{CONH}_2$).
- Further, complete hydrolysis breaks the amide bond, replacing nitrogen with oxygen, generating a **carboxylic acid**.

Why other options are incorrect:

Alcohols, aldehydes, and ketones have different oxidation states or skeletons and are not products of nitrile hydrolysis without subsequent redox reactions.

Question #74 Key: (C)

MDCAT 2017

During esterification, the bond from alcohol that breaks is between:

CORE CONCEPT AND DERIVATION

Through isotopic labeling experiments (using Oxygen-18), it is proven that during the Fischer esterification process, the carboxylic acid contributes the -OH group, while the alcohol contributes only the -H atom to form water.

Formula:



Solution:

- The nucleophilic oxygen of the alcohol attacks the electrophilic carbonyl carbon of the carboxylic acid.
- To stabilize the resulting intermediate, the alcohol loses its proton (H^+).
- Therefore, the bond that breaks in the alcohol molecule is exclusively the **O-H** bond (Oxygen and Hydrogen).

Why other options are incorrect:

Breaking the C-O bond in alcohol would imply the alcohol provides the -OH group, which is factually incorrect for standard carboxylic acid esterification.

Question #75 Key: (A)

MDCAT 2017

Identify the product X in the following reaction: [Formula]

CORE CONCEPT AND DERIVATION

Reacting a carboxylic acid with phosphorus pentachloride (PCl_5) replaces the hydroxyl group with a single chlorine atom, generating an acyl chloride.

Formula:



Solution:

- The reactant is acetic acid (CH_3COOH).
- The substitution yields acetyl chloride, which has the formula CH_3COCl .

Why other options are incorrect:

Options B, C, and D depict chemically impossible or structurally flawed hypervalent carbon compounds or incorrect halogen substitutions.

Question #76 Key: (C)

MDCAT 2016

[Formula] Which one of the following will act as a catalyst in above reaction?

CORE CONCEPT AND DERIVATION

Esterification (the reaction between a carboxylic acid and an alcohol) requires a strong acid catalyst to protonate the carbonyl oxygen and act as a dehydrating agent.

Formula:



Solution:

- Concentrated sulfuric acid (H_2SO_4) acts as a catalyst by providing H^+ ions, which makes the carbonyl carbon more electrophilic.
- Furthermore, concentrated H_2SO_4 absorbs the water produced in the reaction, driving the equilibrium forward according to Le Chatelier's Principle.

Why other options are incorrect:

Nitric acid (HNO_3) is a strong oxidizing agent and would likely oxidize the alcohol rather than catalyze esterification.

Potassium dichromate is also an oxidizer. Thionyl chloride (SOCl_2) converts acids into acid chlorides.

Question #77 Key: (A)

MDCAT 2016

Which one of the following reaction of carboxylic acid is reversible?

CORE CONCEPT AND DERIVATION

Fischer esterification is an equilibrium-controlled, reversible reaction, whereas most other carboxylic acid conversions are thermodynamically driven to completion.

Formula:**Solution:**

- Esterification constantly establishes an equilibrium between the acid/alcohol and the ester/water. The reverse process is known as ester hydrolysis.
- The synthesis of acid chlorides using PCl_5 or SOCl_2 releases gases (like SO_2 and HCl) that escape the system, rendering the reaction highly irreversible.
- Acid-base salt formation is practically irreversible under standard conditions due to massive energy release.

Why other options are incorrect:

Reactions emitting gaseous byproducts or resulting in deep energy wells (salts) are strictly forward-driven.

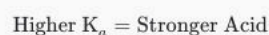
Question #78 Key: (A)

MDCAT 2016

'K_a' values of few organic acids are given. [Formula] [Formula] [Formula] [Formula] The order of the acid stre...

CORE CONCEPT AND DERIVATION

Acid strength is directly proportional to the acid dissociation constant (K_a). A larger K_a implies a stronger acid. Furthermore, electron-withdrawing groups (like chlorine) stabilize the conjugate base via the inductive effect ($-I$), increasing acid strength.

Formula:**Solution:**

- Compare the given K_a values directly:
- CCl_3COOH : 2.3×10^{-2} (Largest, strongest)
- CHCl_2COOH : 5.0×10^{-3}
- CH_2ClCOOH : 1.3×10^{-3}
- CH_3COOH : 1.85×10^{-5} (Smallest, weakest)

Why other options are incorrect:

The other options arrange the acids contradicting their experimental K_a values and the fundamental inductive effect (more halogens = stronger acid).

Question #79 Key: (B)

KMU 2016

Select the correct order of the acids strength?

CORE CONCEPT AND DERIVATION

Acidic strength is magnified by the presence of electron-withdrawing groups (EWG), which operate via the Inductive ($-I$) effect to disperse the negative charge of the conjugate base.

Solution:

- Acetic acid (CH_3COOH) has zero electron-withdrawing halogens.
- Chloroacetic acid (CH_2ClCOOH) has 1 chlorine atom pulling electron density.
- Dichloroacetic acid (CHCl_2COOH) has 2 chlorine atoms, exerting a double $-I$ pull, making it the strongest.
- The correct decreasing order is therefore: Dichloroacetic > Chloroacetic > Acetic.

Why other options are incorrect:

Options A and C incorrectly list acetic acid as the strongest. Option D has typos (CH_2COOH is not a complete molecule) and incorrect ordering.

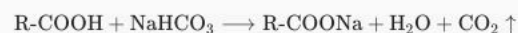
Question #80 Key: (D)

MDCAT 2015

An organic acid 'z' reacts separately with sodium bicarbonate, sodium hydroxide and sodium carbonate. Which on...

CORE CONCEPT AND DERIVATION

Only carboxylic acids possess sufficient acidity to react with weak bases like sodium bicarbonate and sodium carbonate to release CO_2 gas.

Formula:**Solution:**

- Option A is an ester (ethyl formate); it is neutral and unreactive with bases under normal conditions.
- Option B is an alcohol (ethanol); it can react with strong metals but not weak bases like NaHCO_3 .
- Option C is an alkene (propene); it does not undergo acid-base reactions.
- Option D is propanoic acid ($\text{CH}_3\text{CH}_2\text{COOH}$), a carboxylic acid that readily neutralizes NaOH , NaHCO_3 , and Na_2CO_3 .

Why other options are incorrect:

Only the molecule containing the carboxyl group ($-\text{COOH}$) possesses the necessary acid strength.

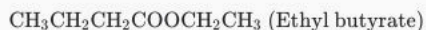
Question #81 Key: (B)

MDCAT 2014

Ethyl butyrate and butyl butanoate are esters with the flavor of

CORE CONCEPT AND DERIVATION

Low molecular weight esters possess characteristic fruity odors and are heavily used in artificial flavoring.

Formula:**Solution:**

- Esters derived from butyric (butanoic) acid are well known for their fruity, tropical profiles.
- Specifically, ethyl butyrate and butyl butanoate both predominantly carry a distinct **pineapple** flavor and scent profile.

Why other options are incorrect:

Amyl acetate smells like bananas. Isoamyl acetate smells like pear/banana. Ethyl isovalerate smells like apple. The specific butyrate esters listed give a pineapple flavor.

Question #82 Key: (C)

MDCAT 2014

Organic compound 'X' and 'Y' both can react with Na-metal to evolve hydrogen gas. 'X' and 'Y' if react with ea...

CORE CONCEPT AND DERIVATION

Both alcohols and carboxylic acids possess active acidic hydrogen attached to oxygen, reacting with active alkali metals like sodium (Na) to evolve H_2 gas. When an alcohol and a carboxylic acid react together in the presence of an acid catalyst, they undergo esterification to form an ester, characterized by a distinct sweet fruity fragrance.

Reactions:**Solution:**

- Because both X and Y liberate H_2 gas with metallic sodium, they must be an **alcohol** and a **carboxylic acid**.
- When X and Y react together, the resultant compound Z gives a pleasant fruity aroma, identifying Z unequivocally as an **ester**.
- Matching the choices: X = Alcohol, Y = Acetic Acid (a carboxylic acid), and Z = Ester, which corresponds to **Option C**.

Why other options are incorrect:

- Option A & Option B:** Esters cannot react with sodium metal to evolve hydrogen gas, so Y cannot be an ester. Mineral acids are inorganic compounds.
- Option D:** Mineral acids are inorganic and do not form organic esters with fruity smell when classified as Y in this organic context.

Question #83 Key: (C)

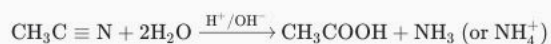
MDCAT 2013

Methyl cyanides, on boiling with mineral acids or alkalies, yield:

CORE CONCEPT AND DERIVATION

The hydrolysis of a nitrile containing "n" carbon atoms always yields a carboxylic acid with the exact same number of "n" carbon atoms.

Formula:



Solution:

- Methyl cyanide (CH_3CN), also known as acetonitrile, contains 2 carbon atoms.
- Upon complete hydrolysis, the $-\text{CN}$ group transforms into a $-\text{COOH}$ group.
- The resulting 2-carbon carboxylic acid is acetic acid (ethanoic acid).

Why other options are incorrect:

Formic acid has 1 carbon, propanoic acid has 3 carbons, and butanoic acid has 4 carbons. None of these match the 2-carbon skeleton of methyl cyanide.

Question #84 Key: (B)

MDCAT 2013

The formation of ester from acetic acid in presence of acid and ethanol is a:

CORE CONCEPT AND DERIVATION

Esterification is formally classified as a Nucleophilic Acyl Substitution reaction.

Formula:



Solution:

- In Fischer esterification, the oxygen atom of the alcohol acts as a **nucleophile**.
- It attacks the electron-deficient carbonyl carbon of the protonated carboxylic acid.
- Following proton transfers, a water molecule is eliminated (acts as a leaving group), completely **substituting** the original $-\text{OH}$ group of the acid with the $-\text{OR}'$ group.

Why other options are incorrect:

It is not a pure addition because a leaving group (water) is expelled. Electrophiles do not attack the carbon skeleton in this mechanism.

Question #85 Key: (B)

MDCAT 2013

*[Formula] The final products formed are:***CORE CONCEPT AND DERIVATION**

Heating a carboxylic acid with ammonia first forms an ammonium salt, which upon strong heating dehydrates to form an amide.

Formula:**Solution:**

- Acetic acid and ammonia initially undergo an acid-base reaction to form ammonium acetate.
- Applying heat causes the thermal decomposition (dehydration) of ammonium acetate.
- A water molecule (H_2O) is lost, yielding acetamide (CH_3CONH_2).

Why other options are incorrect:

The reaction is a dehydration, so water (H_2O) is the byproduct, not CO_2 , H_2 , or HCl .

Question #86 Key: (A)

MDCAT 2012

When *[Formula]* is oxidized in the presence of *[Formula]* and *[Formula]*, the product formed is:

CORE CONCEPT AND DERIVATION

Primary alcohols are completely oxidized to carboxylic acids under strong acidic oxidizing conditions (like acidic dichromate).

Formula:**Solution:**

- Ethanol ($\text{CH}_3\text{CH}_2\text{OH}$) is a primary alcohol.
- In the presence of $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4$, it first oxidizes to acetaldehyde.
- Since dichromate is a strong oxidizing agent, it rapidly oxidizes the aldehyde further into acetic acid (CH_3COOH).

Why other options are incorrect:

Option B is a ketone (from a secondary alcohol). Option C is formic acid (from methanol). Option D is an ester.

Question #87 Key: (D)

MDCAT 2012

When ethanoyl chloride reacts with methylamine an amide is formed. What is the structure of the amide formed?

CORE CONCEPT AND DERIVATION

Acid chlorides react readily with primary amines via nucleophilic acyl substitution to form N-substituted amides.

Formula:**Solution:**

- Ethanoyl chloride provides the CH_3CO - (acetyl) group.
- Methylamine provides the -NHCH_3 nucleophile.
- The chlorine atom is expelled as a leaving group, resulting in N-methylethanamide ($\text{CH}_3\text{-C(=O)-NHCH}_3$).

Why other options are incorrect:

Option A and C contain propanoyl groups instead of ethanoyl. Option B is formed if ammonia is used instead of methylamine.

Question #88 Key: (D)

MDCAT 2011

[Formula] in presence of water in the above reaction A and B are:

CORE CONCEPT AND DERIVATION

The acid-catalyzed hydrolysis of an alkyl nitrile (methyl cyanide) yields a carboxylic acid and an ammonium salt.

Formula:



Solution:

- Methyl cyanide (CH_3CN) undergoes complete hydrolysis in the presence of water and HCl .
- The product is ethanoic acid (acetic acid) and ammonium chloride (NH_4Cl).

Why other options are incorrect:

Ammonia is formed only during base-catalyzed hydrolysis. Methyl chloride and acid amides are not the final stable products of complete acidic hydrolysis.

Question #89 Key: (C)

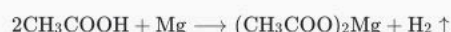
MDCAT 2011

Consider the following reaction: [Formula] What product will form?

CORE CONCEPT AND DERIVATION

Active metals like magnesium react with weak organic acids like acetic acid to displace hydrogen gas and form a metal salt.

Formula:



Solution:

- Acetic acid (CH_3COOH) donates its acidic proton.
- Magnesium, being a highly reactive alkaline earth metal, replaces the hydrogen to form the salt magnesium acetate.

Why other options are incorrect:

Magnesium formate would require formic acid as a reactant. "Magnesium ion" and "Carboxylate ion" are incomplete answers as they do not name the isolated salt compound formed.

Question #90 Key: (C)

MDCAT 2011

[Formula] the products of the above reaction are:

CORE CONCEPT AND DERIVATION

Phosphorus pentachloride (PCl_5) is a strong chlorinating agent that substitutes the hydroxyl ($-\text{OH}$) group of a carboxylic acid with a chlorine atom to form an acid chloride.

Formula:



Solution:

- The $-\text{OH}$ group in acetic acid is replaced by $-\text{Cl}$, yielding acetyl chloride (CH_3COCl).
- The byproducts of this substitution are phosphorus oxychloride (POCl_3) and hydrogen chloride (HCl).

Why other options are incorrect:

Option A has an incorrect byproduct (POCl_2). Option B suggests cleavage of the $\text{C}-\text{C}$ bond (forming methyl chloride), which does not happen. Option D lists H_2 gas instead of HCl .

Question #91 Key: (A)

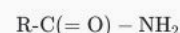
MDCAT 2011

The [Formula] group is called:

CORE CONCEPT AND DERIVATION

Functional groups dictate the chemical class of organic molecules. The $-\text{CONH}_2$ group is the defining feature of primary amides.

Formula:



Solution:

- The carbon double-bonded to oxygen and single-bonded to an amino group ($-\text{NH}_2$) is specifically named the amide functional group.

Why other options are incorrect:

An amino group is simply $-\text{NH}_2$. A peptide linkage (or protein linkage) specifically describes the $-\text{CONH}-$ bond connecting two amino acid residues, not a primary $-\text{CONH}_2$ terminal group.

Question #92 Key: (B)

MDCAT 2011

Relative acidic strength of alcohol, phenol, water and carboxylic acids is:

CORE CONCEPT AND DERIVATION

The acidic strength of a compound depends directly on the stability of its conjugate base.

Formula:



Solution:

- **Carboxylic acids** form highly stable carboxylate ions due to resonance across two electronegative oxygen atoms (Strongest).
- **Phenols** form phenoxide ions stabilized by resonance in the benzene ring, but less stable than carboxylate.
- **Water** forms hydroxide (OH^-), which is stable but lacks resonance stabilization.
- **Alcohols** form alkoxide ions where the alkyl group exhibits an electron-donating (+I) effect, intensifying the negative charge and making it the least stable conjugate base (Weakest acid).

Why other options are incorrect:

Only Option B correctly orders the resonance stability and +I effects governing the respective conjugate bases.

Question #93 Key: (C)

MDCAT 2010

Hydrolysis of cyano group by an aqueous acid results into:

CORE CONCEPT AND DERIVATION

The acidic hydrolysis of an alkyl cyanide (nitrile group) completely converts the cyano group into a carboxyl group.

Formula:



Solution:

- When boiled with an aqueous mineral acid, the triple bond of the cyano group breaks.
- The nitrogen atom picks up protons to form an ammonium salt.
- The carbon atom oxidizes to form a carboxylic acid.

Why other options are incorrect:

Acid amides are intermediate products of partial hydrolysis. Cyano hydrides and formaldehyde are structurally unrelated to the hydrolysis of nitriles.

Question #94 **Key: (D)**

MDCAT 2010

Which of the following compounds in the form of aqueous solution will produce [Formula] on reaction with sodium...

CORE CONCEPT AND DERIVATION

Carboxylic acids are stronger acids than carbonic acid and can displace it from its salts (like sodium carbonate), leading to the evolution of carbon dioxide gas.

Formula:**Solution:**

- Identify the functional groups in the options: A, B, and C are esters, while D is propanoic acid (a carboxylic acid).
- Esters do not react with sodium carbonate to release CO_2 .
- Propanoic acid reacts with Na_2CO_3 to form sodium propanoate, water, and CO_2 gas.

Why other options are incorrect:

Esters (options A, B, and C) lack an acidic hydrogen and are neutral compounds; they cannot decompose carbonates.