



CHEM · CHEMISTRY

16. Alcohols & Phenols

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

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📅 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

Which of the following alcohol can give Iodoform reaction? [UHS (2024)]

- (A) Methanol
- (B) 1-Propanol
- (C) 1-Butanol
- (D) Ethanol

Q2.

UHS 2024

Which of the following is correct regarding phenol [UHS (2024)]

- (A) Phenol and water are equally acidic
- (B) Phenol is less acidic than water
- (C) Phenol is less acidic than carboxylic acid
- (D) Phenol is less acidic than ethanol

Q3.

UHS 2024

When carboxylic acid is heated with alcohol in the presence of sulphuric acid, one of the following is formed [UHS (2024)]

- (A) Amides
- (B) Ester
- (C) Acyl chloride
- (D) Acid anhydride

Q4.

SZABMU 2024

Which product is formed by the reaction of phenol with concentrated nitric acid? [SZABMU (2024)]

- (A) Adipic acid
- (B) Picric acid
- (C) m-Nitrophenol
- (D) p-Nitrophenol

Q5.

SZABMU 2024

The anion derived by deprotonation of an alcohol acts as ____ [SZABMU (2024)]

- (A) Acidic moiety
- (B) Lewis acid
- (C) Electrophile
- (D) Lewis base

Q6.

SZABMU 2024

The melting and boiling point of alcohols are high as compared to corresponding alkanes due to [SZABMU (2024)]

- (A) Dipole-dipole interaction
- (B) Ionic Interactions
- (C) Hydrogen bonding
- (D) Van der Waal interactions

Q7.

SZABMU 2024

Which type of substituent will increase the acidic strength of phenols? [SZABMU (2024)]

- (A) Electron donating substituents
- (B) Lewis's bases
- (C) Electron withdrawing substituents
- (D) Nucleophiles

Q8.

SZABMU 2024

Which product will be formed finally on the reduction of acetic acid with LiAlH_4 ? [SZABMU (2024)]

- (A) Ethanal
- (B) Ethanoic
- (C) Ethane
- (D) Ethanol

Q9.

SZABMU 2024

Which type of reaction will be occur, when an alcohol reacts with a carboxylic acid? [SZABMU (2024)]

- (A) Dehydration reaction
- (B) Esterification reaction
- (C) Dehydrogenation reaction
- (D) Reduction reaction

Q10.

SZABMU 2024

Which solvent is used when alcohol reacts with thionyl chloride to form alkyl halide? [SZABMU RC-(2024)]

- (A) Zinc chloride
- (B) Carbon tetrachloride
- (C) Pyridine
- (D) Sulphuric acid

Q11.

SZABMU 2024

Which process is used to convert alcohol into ether? [SZABMU RC-(2024)]

- (A) Oxidation
- (B) Condensation
- (C) Reduction
- (D) Dehydration

Q12.

SZABMU 2024

Name the compound which forms phenol, when it is oxidized by atmosphere oxygen in the presence of metal catalyst? (Out of syllabus) [SZABMU RC-(2024)]

- (A) Cumene
- (B) Benzene
- (C) Toluene
- (D) Aniline

Q13.

SZABMU 2024

IUPAC name of picric acid is [SZABMU RC-(2024)]

- (A) 2, 4, 6 tribromophenol
- (B) 2, 4, 6 trinitrotoluene
- (C) 2, 4, 6 trinitrophenol
- (D) 2, 4, 6 trimethylphenol

Q14.

SZABMU 2024

The reaction of sodium salt of phenol with CO_2 is called (Out of syllabus) [SZABMU RC-(2024)]

- (A) Williamson Synthesis
- (B) Aldol reaction
- (C) Cannizzaro reaction
- (D) Kolbe Schmitt reaction

Q15.

KMU 2024

Which of the following has the highest boiling point? [ETEA (2024)]

- (A) Ethyl alcohol
- (B) n-propyl alcohol
- (C) Isopropyl alcohol
- (D) tert-butyl alcohol

Q16.

KMU 2024

The reaction of an alcohol with sodium produces [ETEA (2024)]

- (A) Aldehyde
- (B) Ethane
- (C) Alkoxide
- (D) Ethene

Q17.

KMU 2024

Oxidation of secondary alcohol gives [ETEA (2024)]

- (A) Carboxylic acid
- (B) Ketone
- (C) Ether
- (D) Phenol

Q18.

BUMHS 2024

Which of the following compound is not an alcohol [BUMHS (2024)]

- (A) CH_3OH
- (B) $\text{C}_2\text{H}_5\text{OH}$
- (C) $\text{C}_6\text{H}_5\text{OH}$
- (D) $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$

Q19.

BUMHS 2024

The concentration of rectified spirit is ____ alcohol
[BUMHS (2024)]

- (A) 85%
- (B) 90%
- (C) 95%
- (D) 100%

Q20.

NUMS 2024

Bakelite is formed upon polymerization of [NUMS (2024)]

- (A) Phenol + Formaldehyde
- (B) Phenol + Acetaldehyde
- (C) Benzene + Formaldehyde
- (D) Phenol + Acetone

Q21.

NUMS 2024

The increasing order of reactivity of alcohols towards nucleophile is: [NUMS (2024)]

- (A) 2-methyl-2-pentanol < 3-methyl-2-pentanol < 2-methyl-1-pentanol
- (B) 2-methyl-2-pentanol > 3-methyl-2-pentanol > 2-methyl-1-pentanol
- (C) 2-methyl-1-pentanol < 3-methyl-2-pentanol < 2-methyl-2-pentanol
- (D) 2-methyl-1-pentanol > 3-methyl-2-pentanol < 2-methyl-2-pentanol

Q22.

NUMS 2024

The most reactive alcohol towards Lucas reagent is: [NUMS (2024)]

- (A) 2-butanol
- (B) 2-methyl-2-butanol
- (C) 2-methyl-1-butanol
- (D) 2,2-dimethyl-1-butanol

Q23.

UHS 2023

If phenol is treated with 3 moles of conc. HNO_3 in the presence of H_2SO_4 what will be the product? [UHS (2023)]

- (A) o-nitro phenol
- (B) p-nitro phenol
- (C) o-nitro phenol and p-nitro phenol
- (D) picric acid

Q24.

UHS 2023

Dehydration of alcohol gives which of the following product in the presence of H_2SO_4 at 140°C ? [UHS (2023)]

- (A) Acetaldehyde
- (B) Diethyl ether
- (C) Ethyl acetate
- (D) Ethyl chloride

Q25.

SZABMU 2023

The order of reactivity of alcohol when O-H bond breaks is: [SZABMU (2023)]

- (A) Primary alcohol > secondary alcohol > tertiary alcohol
- (B) Secondary alcohol > tertiary alcohol > primary alcohol
- (C) Tertiary alcohol > secondary alcohol > Primary alcohol
- (D) Primary alcohol > Tertiary alcohol > Secondary alcohol

Q26.

SZABMU 2023

The following functional group is the result of oxidation of alcohol [SZABMU (2023)]

- (A) Ketone / aldehyde
- (B) Aldehyde / alkane
- (C) Ketone / alkane
- (D) Aldehyde / acid

Q27.

KMU 2023

Ethyl alcohol in the presence of H_2SO_4 at 170°C produces: [ETEA (2023)]

- (A) Ether
- (B) Ethene
- (C) Ester
- (D) Ethane

Q28.

KMU 2023

Benzene-1,3-diols is also known as: [ETEA (2023)]

- (A) Catechol
- (B) Resorcinol
- (C) Hydroquinone
- (D) O-cresol

Q29.

KMU 2023

When phenol reacts with excess of bromine in aqueous solution it results in the formation of: [ETEA (2023)]

- (A) Ortho/para bromophenol
- (B) Meta-bromophenol
- (C) 2,4,6-Tribromophenol
- (D) 3,5 Dibromophenol

Q30.

DUHS 2023

Which of the following reactions can be used for the conversion of ethyl alcohol into acetaldehyde?

[DUHS (2023)]

- (A) Polymerization
- (B) Dehydrogenation
- (C) Esterification
- (D) Reduction

Q31.

DUHS 2023

Which of the following is formed, when excess of ethyl alcohol is treated with concentrated H_2SO_4 at a low temperature? **[DUHS (2023)]**

- (A) Diethyl ether
- (B) Dimethyl ether
- (C) Ethene
- (D) Acetylene

Q32.

DUHS 2023

Oxidation of secondary propyl alcohol gives: **[DUHS (2023)]**

- (A) Acetone
- (B) Acetaldehyde
- (C) Ethyl alcohol
- (D) Normal propyl alcohol

Q33.

BUMHS 2023

Methanol is prepared from carbon monoxide and hydrogen. The catalyst used for this reaction is? **[BUMHS (2023)]**

- (A) $\text{ZnO} + \text{CoO}_2$
- (B) $\text{ZnO} + \text{CuO}$
- (C) $\text{ZnO} + \text{Ag}_2\text{O}$
- (D) $\text{Cr}_2\text{O}_3 + \text{ZnO}$

Q34.

BUMHS 2023

What is the reactivity state of phenols? **[BUMHS (2023)]**

- (A) Less reactive
- (B) More reactive
- (C) Neutral
- (D) Nonreactive

Q35.

NUMS 2023

Which of the following reactions differentiates alcohol from phenol? **[NUMS (2023)]**

- (A) Lucas test
- (B) Halogenations
- (C) Nitration
- (D) Iodoform test

Q36.

NUMS 2023

The order of reactivity of alcohol when C–O bond breaks is: **[NUMS (2023)]**

- (A) Tertiary alcohol > secondary alcohol > Primary alcohol
- (B) Secondary alcohol > Primary alcohol > tertiary alcohol
- (C) Primary alcohol > Secondary alcohol > tertiary alcohol
- (D) Tertiary alcohol > primary alcohol > secondary alcohol

Q37.

UHS 2022

What is the common name of 1, 2, 3–propantriol? **[UHS (2022)]**

- (A) Butyl alcohol
- (B) Glycol
- (C) Glycerol
- (D) Propyl alcohol

Q38.

UHS 2022

Benzene is formed when Zn reacts with which of the following? **[UHS (2022)]**

- (A) Alcohol
- (B) Propanol
- (C) Butyl alcohol
- (D) Phenol

Q39.

UHS 2022

When phenol reacts with formaldehyde, which of the following product is produced? **[UHS (2022)]**

- (A) Adduct
- (B) Oxonium ion
- (C) Hydronium ion
- (D) Phenoxide ion

Q40.

UHS 2022

Which is the most suitable reagent for the conversion of $\text{R-CH}_2\text{OH} \rightarrow \text{RCHO}$? **[UHS (2022)]**

- (A) $\text{KMnO}_4/\text{NaOH}$
- (B) CrO_3
- (C) $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}_2\text{SO}_4(\text{Conc.})$
- (D) $\text{Cr}_2\text{O}_4/\text{H}_2\text{SO}_4(\text{Conc.})$

Q41.

SZABMU 2022

Phenols are very reactive towards: [SZABMU (2022)]

- (A) Oxidizing agent
- (B) Reducing agent
- (C) Dehydrating agent
- (D) Hygroscopic agent

Q42.

SZABMU 2022

Both alcohols and phenols contain: [SZABMU (2022)]

- (A) -OH group
- (B) -COOH group
- (C) -CH₃ group
- (D) -CHO group

Q43.

KMU 2022

Which of the following compounds is most acidic? [ETEA (2022)]

- (A) Water
- (B) Ethanol
- (C) Phenol
- (D) Cyclohexanol

Q44.

KMU 2022

What will be the product when phenol reacts with concentrated HNO₃? [ETEA (2022)]

- (A) Picric acid
- (B) Para-Nitrophenol
- (C) Ortho-Nitrophenol
- (D) All of the above

Q45.

DUHS 2022

Bakelite is polymer of: [DUHS (2022)]

- (A) Two glucose molecules
- (B) Formaldehyde & acetone
- (C) Two amino acid molecule
- (D) Formaldehyde & phenol

Q46.

DUHS 2022

Phenol when subjected to nitration product is: [DUHS (2022)]

- (A) o - nitro phenol
- (B) p - nitro phenol
- (C) o - nitro phenol & m - nitro phenol
- (D) o - nitro phenol & p - nitro phenol

Q47.

DUHS 2022

Secondary alcohols have. [DUHS (2022)]

- (A) One β -C
- (B) Three β -C
- (C) No β -C
- (D) Two β -C

Q48.

DUHS 2022

Oxidation of primary alcohol gives: [DUHS (2022)]

- (A) Aldehyde
- (B) Ketone
- (C) Alkane
- (D) Alkene

Q49.

DUHS 2022

Primary alcohol when react with a halogen acid, the product is: [DUHS (2022)]

- (A) Secondary alcohol
- (B) Tertiary alcohol
- (C) Primary alcohol
- (D) Primary alkyl halide

Q50.

DUHS 2022

Benzyl alcohol C₆H₅CH₂OH is a: [DUHS (2022)]

- (A) Aromatic alcohol
- (B) Phenol
- (C) Aromatic ketone
- (D) Aliphatic alcohol

Q51.

BUMHS 2022

Which one of the following statements is true? [BMU (2022)]

- (A) Phenol is less acidic than alcohol
- (B) Phenol is more acidic than HCl
- (C) Phenol dissolves alkalies readily
- (D) Phenol is more acidic than carboxylic acid

Q52.

BUMHS 2022

Phenol is more reactive than benzene towards electrophilic substitution. This characteristic is due to which of the following? [BMU (2022)]

- (A) Hydrogen bonding
- (B) Inductive effect
- (C) Strong mesomeric effect
- (D) Weak mesomeric effect

Q53.

BUMHS 2022

Which of the following is Lucas reagent? [BMU (2022)]

- (A) AlCl_3
- (B) HCl
- (C) ZnCl_2
- (D) Both B and C

Q54.

NUMS 2022

Benzene can be formed from phenol in which of the following reactions? [NUMS (2022)]

- (A) Reduction with hydrogen in the presence of Ni
- (B) Reduction with zinc
- (C) Reduction with alkali
- (D) Reduction with acids

Q55.

NUMS 2022

Lucas test is used for the identification of [NUMS (2022)]

- (A) Alkyl halides
- (B) Alkene
- (C) Alcohols
- (D) Carboxylic acids

Q56.

NUMS 2022

Phenol has following characteristics and physical properties [NUMS (2022)]

- (A) Colorless crystalline solid
- (B) Colorless crystalline deliquescent solid
- (C) Colorless amorphous solid
- (D) Colorless amorphous deliquescent solid

Q57.

PMDC 2021

The compounds which are formed by the replacement of one of the H of water by a alkyl group are called as _? [PMC (2021)]

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

Q58.

PMDC 2021

Which of the following does not react with bases? [PMC (2021)]

- (A) Carboxylic acids
- (B) Ethanol
- (C) Phenol
- (D) HCl

Q59.

PMDC 2021

Picric acid is [PMC (2021)]

- (A) Monocarboxylic
- (B) Dicarboxylic acid
- (C) Tricarboxylic acid
- (D) Acidic phenol

Q60.

PMDC 2021

Phenol reacts with NaOH to form [PMC (2021)]

- (A) Acid
- (B) Base
- (C) Salt
- (D) Ester

Q61.

PMDC 2020

IUPAC name of $\text{C}_6\text{H}_8\text{O}(\text{CH}_3)_2$ is [NMDCAT (2020)]

- (A) 2-Methyl-3-hexanone
- (B) 2,6-Dimethyl cyclohexanone
- (C) 3-Methyl cyclohexanone
- (D) 4-Methyl-3-hexanone

Q62.

PMDC 2020

Phenol is known as: [NMDCAT (2020)]

- (A) Carpolic acid
- (B) Carbonlic acid
- (C) Carbolic acid
- (D) Carbolylic acid

Q63.

PMDC 2020

Phenol is more acidic than alcohols because of the following reason [NMDCAT (2020)]

- (A) Delocalization of negative charge in the OH group
- (B) Delocalization of positive charge on the carbon atom in ring
- (C) Delocalization of negative charge in the ring
- (D) Delocalization of positive charge in the OH group

Q64.

SET 2019

Ethanol, ethanoic acid and phenol all contain acidic functional groups, the order of the acidic strength is Ethanoic acid > Phenol > Ethanol. This is mainly due to [SET (2019)]

- (A) Electron releasing (donating) effect of ethanoic acid is greater than that of ethanol
- (B) Electron releasing (donating) effect of phenol is greater than that of ethanol
- (C) Electron with drawing effect of phenol is greater than that of ethanol
- (D) Electron with drawing effect of ethanoic acid is greater than that of phenol

Q65.

SET 2019

Distinction between ethanol and phenol can be ascertained by all except [SET (2019)]

- (A) Lucas test
- (B) Reaction with bromine
- (C) Iodoform test
- (D) Tollen's test

Q66.

SET 2019

Choose a primary alcohol among the following [SET (2019)]

- (A) 2-methyl-2-propanol
- (B) 2,2-dimethyl-1-propanol
- (C) 2-propanol
- (D) 3-methyl-2-butanol

Q67.

NUMS 2019

Dehydration of ethanol at 180°C in the presence of conc-H₂SO₄ gives [NUMS (2019)]

- (A) Ethene
- (B) Ethane
- (C) Ethyne
- (D) Ether

Q68.

NUMS 2019

Industrially water gas is converted into methanol by using catalyst [NUMS (2019)]

- (A) CuO + ZnO
- (B) CuO + Cr₂O₃
- (C) Al₂O₃ + ZnO
- (D) ZnO + Cr₂O₃

Q69.

NUMS 2019

Phenol reacts with CH₃COCl to give [NUMS (2019)]

- (A) Acid
- (B) Ester
- (C) Aldehyde
- (D) Ketone

Q70.

KMU 2019

Tertiary alcohols are not oxidized into carbonyl compounds because [ETEA (2019)]

- (A) They contain more alkyl group
- (B) They have no alpha-hydrogen
- (C) Suitable oxidizing agent is not available
- (D) None of the above

Q71.

MDCAT 2019

Ketones can be made by oxidation of [MDCAT (2019)]

- (A) Primary Alcohols
- (B) Secondary Alcohols
- (C) Tertiary Alcohols
- (D) Aldehydes

Q72.

MDCAT 2019

Select the reagent X from the following choices for this conversation;



[MDCAT (2019)]

- (A) Acidified Phosphoric acid
- (B) Acidified Potassium dichromate (VI)
- (C) Acidified Potassium hydroxide
- (D) Acidified Oxalic acid

Q73.

MDCAT 2018

Alcohol in which carbon atom bonded to –OH group is further attached with three alkyl group is [MDCAT (2018)]

- (A) Aromatic alcohol
- (B) Primary alcohol
- (C) Secondary alcohol
- (D) Tertiary alcohol

Q74.

MDCAT 2018

Which one the following compounds is known as tertiary alcohol? [MDCAT (2018)]

- (A) 2-Methyl-1-propanol
- (B) 2-Methyl-2-propanol
- (C) 2-Propanol
- (D) 1-Propanol

Q75.

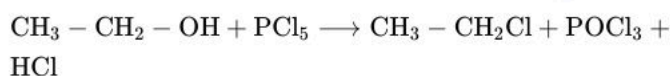
MDCAT 2017

$\text{C}_2\text{H}_5 - \text{SO}_4\text{H} \xrightarrow[\text{Warm}]{\text{H}_2\text{O}} \text{C}_2\text{H}_5 - \text{OH} + \text{H}_2\text{SO}_4$ choose the correct type for this reaction from the following? [MDCAT (2017)]

- (A) Reduction
- (B) Hydroxylation
- (C) Oxidation
- (D) Hydration

Q76.

MDCAT 2017



Formation of HCl is test for the presence of ___ in a compound [MDCAT (2017)]

- (A) Alkyl group
- (B) Saturated alkyl group
- (C) Hydroxyl group
- (D) Acid H^+ ion

Q77.

MDCAT 2017

$\text{C}_2\text{H}_5\text{OH} + \text{CH}_3 - \text{COOH} \xrightarrow{\text{H}_2\text{SO}_4} ?$ what will be the exact product [MDCAT (2017)]

- (A) Diethyl ether
- (B) Ethyl acetate
- (C) Methyl propyl ether
- (D) Butyl alcohol

Q78.

MDCAT 2017

At 25°C with phenol, 2,4-Dinitrophenol is formed by the reaction of: [MDCAT (2017)]

- (A) $(\text{HNO}_3 + \text{H}_2\text{SO}_4)$ with benzene
- (B) NaOH with Benzene sulphonic acid
- (C) $(\text{HNO}_3 + \text{H}_2\text{SO}_4)$ with phenol
- (D) Sodium phenoxide with HCl

Q79.

MDCAT 2017

The phenoxide ion is more stable than ethoxide ion as [MDCAT (2017)]

- (A) Lone pair on O-atom overlaps with the delocalized π -bonding system in benzene
- (B) Oxygen atom is directly bonded with benzene ring in phenoxide ion
- (C) The negative charge is localized on oxygen atom of phenoxide ion
- (D) The negative charge is delocalized on oxygen atom of ethoxide ion

Q80.

MDCAT 2017

The acidity of phenol is due to its ____: [MDCAT (2017)]

- (A) Nature of Benzene
- (B) Nature of phenoxide
- (C) Double bond in benzene ring
- (D) Hydroxyl group

Q81.

MDCAT 2016

Which one of the following is an appropriate indication of positive iodoform test? [MDCAT (2016)]

- (A) Formation of H_2O
- (B) Brick red precipitate
- (C) Release of H_2 gas
- (D) Yellow crystal

Q82.

MDCAT 2016

$(\text{CH}_3)_3\text{C} - \text{OH}$ Which one of the following is proper classification of the above formula? [MDCAT (2016)]

- (A) Primary
- (B) Tertiary
- (C) Secondary
- (D) Polyhydric

Q83.

KMU 2016

Choose reaction that does not require ZnCl_2 Catalyst: [ETE (2016)]

- (A) $\text{CH}_3\text{CH}_2\text{OH} + \text{HCl} \longrightarrow \text{CH}_3\text{CH}_2\text{Cl} + \text{H}_2\text{O}$
- (B) $\text{CH}_3\text{CH}_2\text{OH} + \text{HBr} \longrightarrow \text{CH}_3\text{CH}_2\text{Br} + \text{H}_2\text{O}$
- (C) $\text{CH}_3\text{CH}_2\text{OH} + \text{HI} \longrightarrow \text{CH}_3\text{CH}_2\text{I} + \text{H}_2\text{O}$
- (D) Both B & C

Q84.

MDCAT 2015

How will you distinguish between methanol and ethanol? [MDCAT (2015)]

- (A) By Lucas test
- (B) By oxidation
- (C) By silver mirror test
- (D) By iodoform test

Q85.

MDCAT 2014

Primary, secondary and tertiary alcohols can be identified and distinguished by [MDCAT (2014)]

- (A) Lucas test
- (B) Bayer's test
- (C) Iodoform test
- (D) Silver mirror test

Q86.

MDCAT 2014

Which one of the following groups is indicated when HCl is formed by reaction of ethanol with phosphorus pentachloride? [MDCAT (2014)]

- (A) Amino group
- (B) Halide group
- (C) Hydroxyl group
- (D) Hydride group

Q87.

MDCAT 2014

Which one of the following alcohol is indicated by formation of yellow crystals in iodoform tests? [MDCAT (2014)]

- (A) Methanol
- (B) Butanol
- (C) Ethanol
- (D) Propanal

Q88.

MDCAT 2014

The formula of 2, 4, 6–Tribromophenol is [MDCAT (2014,2016)]

- (A) C_6H_4BrOH
- (B) $C_6H_3Br_2OH$
- (C) $C_6H_2Br_3OH$
- (D) $C_6H_5Br_3OH$

Q89.

MDCAT 2013

Consider the following reaction

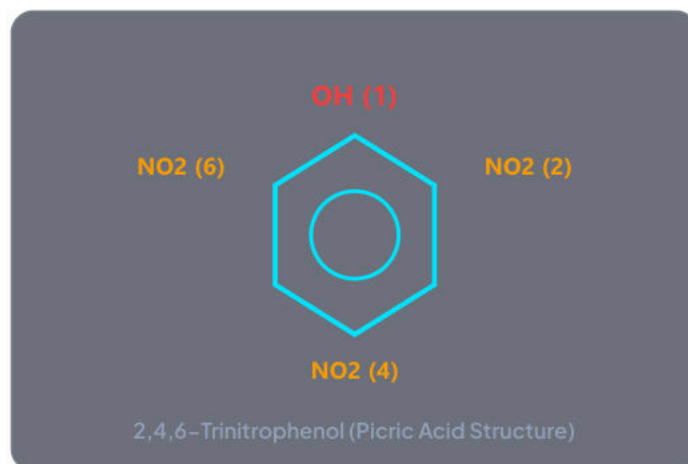


What product(s) may be formed? [MDCAT (2013)]

- (A) C_2H_5Cl , $POCl_3$ and HCl
- (B) C_2H_5Cl and HCl
- (C) C_2H_5Cl only
- (D) C_2H_5Cl and $POCl_3$

Q90.

MDCAT 2013



is named as [MDCAT (2013,2016)]

- (A) Nitro phenol
- (B) Malonic acid
- (C) Benzoic acid
- (D) Picric acid

Q91.

MDCAT 2013

Aqueous phenol decolorizes bromine water to form a white precipitate. What is the structure of the white precipitate formed? [MDCAT (2013)]

- (A) 2,4,6–Tribromophenol
- (B) 2–Bromophenol
- (C) 4–Bromophenol
- (D) 2,4–Dibromophenol

Q92.

MDCAT 2012

The following structure is of:

$R - CH(OH) - R'$ [MDCAT (2012)]

- (A) Secondary alcohol
- (B) Tertiary alcohol
- (C) Primary alcohol
- (D) Carboxylic acid

Q93.

MDCAT 2011

Which of the following is secondary alcohol? [MDCAT (2011)]

- (A) $CH_3 - CH(OH) - CH_3$
- (B) $CH_2(OH) - CH(OH) - CH_2(OH)$
- (C) $CH_3 - CH_2 - CH_2 - OH$
- (D) $CH_3 - C(CH_3)(OH) - CH_3$

Q94.

MDCAT 2011

An alcohol is converted into an aldehyde with same number of carbon atoms in the presence of $\text{K}_2\text{CrO}_4/\text{H}_2\text{SO}_4$. the alcohol is **[MDCAT (2011)]**

- (A) $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$
 - (B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
 - (C) $(\text{CH}_3)_3\text{COH}$
 - (D) $(\text{CH}_3)_2\text{CHOH}$
-

Q95.

MDCAT 2010

Dissociation constant of phenol is: **[MDCAT (2010)]**

- (A) 1.2×10^{-10}
 - (B) 1.2×10^{10}
 - (C) 1.3×10^{10}
 - (D) 1.3×10^{-10}
-

RAPID 5–COLUMN ANSWER KEY

Official PMDC verified answer keys for 16. Alcohols & Phenols.

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Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD
1	D	UHS 2024	20	A	NUMS 2024	39	A	UHS 2022	58	B	PMDC 2021	77	B	MDCAT 2017
2	C	UHS 2024	21	C	NUMS 2024	40	D	UHS 2022	59	D	PMDC 2021	78	C	MDCAT 2017
3	B	UHS 2024	22	B	NUMS 2024	41	A	SZABMU 2022	60	C	PMDC 2021	79	A	MDCAT 2017
4	B	SZABMU 2024	23	D	UHS 2023	42	A	SZABMU 2022	61	B	PMDC 2020	80	B	MDCAT 2017
5	D	SZABMU 2024	24	B	UHS 2023	43	C	KMU 2022	62	C	PMDC 2020	81	D	MDCAT 2016
6	C	SZABMU 2024	25	A	SZABMU 2023	44	A	KMU 2022	63	C	PMDC 2020	82	B	MDCAT 2016
7	C	SZABMU 2024	26	A	SZABMU 2023	45	D	DUHS 2022	64	D	SET 2019	83	D	KMU 2016
8	D	SZABMU 2024	27	B	KMU 2023	46	D	DUHS 2022	65	D	SET 2019	84	D	MDCAT 2015
9	B	SZABMU 2024	28	B	KMU 2023	47	D	DUHS 2022	66	B	SET 2019	85	A	MDCAT 2014
10	C	SZABMU 2024	29	C	KMU 2023	48	A	DUHS 2022	67	A	NUMS 2019	86	C	MDCAT 2014
11	B	SZABMU 2024	30	B	DUHS 2023	49	D	DUHS 2022	68	D	NUMS 2019	87	C	MDCAT 2014
12	A	SZABMU 2024	31	A	DUHS 2023	50	A	DUHS 2022	69	B	NUMS 2019	88	C	MDCAT 2014
13	C	SZABMU 2024	32	A	DUHS 2023	51	C	BUMHS 2022	70	B	KMU 2019	89	A	MDCAT 2013
14	D	SZABMU 2024	33	D	BUMHS 2023	52	C	BUMHS 2022	71	B	MDCAT 2019	90	D	MDCAT 2013
15	B	KMU 2024	34	A	BUMHS 2023	53	D	BUMHS 2022	72	B	MDCAT 2019	91	A	MDCAT 2013
16	C	KMU 2024	35	B	NUMS 2023	54	B	NUMS 2022	73	D	MDCAT 2018	92	A	MDCAT 2012
17	B	KMU 2024	36	A	NUMS 2023	55	C	NUMS 2022	74	B	MDCAT 2018	93	A	MDCAT 2011
18	C	BUMHS 2024	37	C	UHS 2022	56	B	NUMS 2022	75	D	MDCAT 2017	94	B	MDCAT 2011
19	C	BUMHS 2024	38	D	UHS 2022	57	C	PMDC 2021	76	C	MDCAT 2017	95	D	MDCAT 2010

TOTAL
MCQS

95

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: (D)

UHS 2024

Which of the following alcohol can give Iodoform reaction? [UHS (2024)]

CORE CONCEPT AND DERIVATION

The iodoform test gives a positive result for specific structural motifs: compounds containing a methyl ketone group ($\text{CH}_3\text{CO}-$), or alcohols that can be oxidized to a methyl ketone by the reagent (specifically containing the $\text{CH}_3\text{CH}(\text{OH})-$ structural unit).

Formula:**Solution:**

- Looking at primary alcohols, only **ethanol** ($\text{CH}_3\text{CH}_2\text{OH}$) possesses the required terminal methyl group adjacent to the carbon bearing the hydroxyl group.
- It oxidizes to acetaldehyde, which has the necessary $\text{CH}_3\text{CO}-$ group, subsequently reacting to form yellow iodoform crystals.

Why other options are incorrect:

Methanol oxidizes to formaldehyde (no methyl group). 1-Propanol oxidizes to propanal (ethyl group attached, no methyl group adjacent to carbonyl). 1-Butanol behaves similarly. None of them possess the $\text{CH}_3\text{CH}(\text{OH})-$ substructure.

Question #2 Key: (C)

UHS 2024

Which of the following is correct regarding phenol [UHS (2024)]

CORE CONCEPT AND DERIVATION

Relative acidic strength is based on the resonance stabilization of the conjugate base anion.

Formula:**Solution:**

- Carboxylic acids form carboxylate ions where the negative charge is delocalized equally over two highly electronegative oxygen atoms. This makes them relatively strong weak acids.
- Phenol forms a phenoxide ion, delocalizing charge onto less electronegative carbon atoms in the ring. This makes it less acidic than carboxylic acids, but more acidic than water.
- Therefore, the true statement is that **Phenol is less acidic than carboxylic acid**.

Why other options are incorrect:

A and B are false because phenol's resonance stabilization makes it about a million times more acidic than water. D is false because ethanol lacks resonance completely, making it far less acidic than phenol.

Question #3 Key: (B)

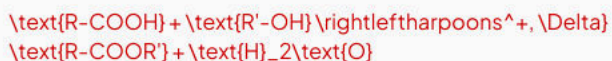
UHS 2024

When carboxylic acid is heated with alcohol in the presence of sulphuric acid, one of the following is formed ...

CORE CONCEPT AND DERIVATION

This is the classic definition of Fischer Esterification, a reversible condensation reaction.

Formula:



Solution:

- A carboxylic acid acts as the acyl donor, and the alcohol acts as a nucleophile.
- In the presence of an acid catalyst (sulfuric acid) and heat, water is eliminated.
- The combination of the acyl group and the alkoxy group creates an **ester**.

Why other options are incorrect:

Amides require reaction with ammonia or an amine. Acyl chlorides require reaction with SOCl_2 or PCl_5 . Acid anhydrides require the dehydration of two carboxylic acid molecules, not an acid and an alcohol.

Question #4 Key: (B)

SZABMU 2024

Which product is formed by the reaction of phenol with concentrated nitric acid? [SZABMU (2024)]

CORE CONCEPT AND DERIVATION

The hydroxyl group on the benzene ring is powerfully activating, allowing multiple electrophilic substitutions to occur rapidly without a strong Lewis acid catalyst.

Formula:



Solution:

- Using concentrated nitric acid pushes the nitration to its limit.
- Nitro groups attach to all sterically and electronically favored positions: ortho, para, and the other ortho position.
- The resulting compound is 2,4,6-trinitrophenol, commonly known as **picric acid**.

Why other options are incorrect:

Options C and D are mono-substituted products, which form only when using highly diluted, cold nitric acid. Adipic acid is an aliphatic dicarboxylic acid used in nylon synthesis, completely unrelated to this reaction.

Question #5 Key: (D)

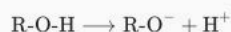
SZABMU 2024

The anion derived by deprotonation of an alcohol acts as ____
[SZABMU (2024)]

CORE CONCEPT AND DERIVATION

When an alcohol loses its acidic proton, it forms an alkoxide ion (RO^-).

Formula:



Solution:

- The alkoxide ion has a full negative charge and three lone pairs of electrons on the oxygen atom.
- Because it is electron-rich and readily donates an electron pair to form a bond (acting as a nucleophile), it perfectly fits the definition of a **Lewis base** (an electron-pair donor).

Why other options are incorrect:

A Lewis acid is an electron-pair acceptor (alkoxides repel electrons). An electrophile is electron-deficient. The anion is the conjugate base, not an acidic moiety.

Question #6 Key: (C)

SZABMU 2024

The melting and boiling point of alcohols are high as compared to corresponding alkanes due to [SZABMU (2024)]

CORE CONCEPT AND DERIVATION

Intermolecular forces dictate phase transition temperatures like boiling and melting points.

Formula:



Solution:

- Alkanes are non-polar and rely solely on weak London dispersion (Van der Waals) forces.
- Alcohols contain a highly polarized O-H bond.
- The partially positive hydrogen of one molecule forms a very strong dipole-dipole attraction with the lone pair of the highly electronegative oxygen on an adjacent molecule.
- This specific, extraordinarily strong intermolecular force is termed **hydrogen bonding**, requiring significant thermal energy to break, thus raising the boiling point dramatically.

Why other options are incorrect:

While alcohols have dipole-dipole and Van der Waals forces, hydrogen bonding is the primary and strongest force responsible for the massive difference compared to alkanes. Ionic interactions do not exist in covalent alcohols.

Question #7 Key: (C)

SZABMU 2024

Which type of substituent will increase the acidic strength of phenols? [SZABMU (2024)]

CORE CONCEPT AND DERIVATION

The acidic strength of phenol is governed by the stability of the phenoxide ion formed after a proton is lost. Stabilizing the negative charge increases acidity.

Formula:

Not applicable to this conceptual question.

Solution:

- The phenoxide ion carries a negative charge delocalized around the ring.
- If a substituent pulls electron density away from the ring (via -I inductive or -M mesomeric effects), it disperses and stabilizes the negative charge.
- Therefore, **electron withdrawing substituents** (like $-\text{NO}_2$, halogens) stabilize the conjugate base and increase the acidic strength.

Why other options are incorrect:

Electron donating substituents (like alkyl groups or $-\text{OH}$) push more electron density into the ring, concentrating the negative charge, destabilizing the ion, and severely decreasing acidity.

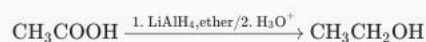
Question #8 Key: (D)

SZABMU 2024

Which product will be formed finally on the reduction of acetic acid with [Formula] ? [SZABMU (2024)]

CORE CONCEPT AND DERIVATION

Lithium aluminum hydride (LiAlH_4) is an extremely powerful reducing agent capable of fully reducing carbonyl and carboxyl groups down to the lowest oxygenated state.

Formula:**Solution:**

- Acetic acid (a 2-carbon carboxylic acid) undergoes vigorous reduction when treated with LiAlH_4 .
- It does not stop at the intermediate aldehyde stage because LiAlH_4 is too reactive.
- It fully reduces the carboxyl group to a primary alcohol.
- The 2-carbon primary alcohol is **ethanol**.

Why other options are incorrect:

Ethanal (an aldehyde) is the intermediate but cannot be isolated using LiAlH_4 . Ethanoic is just the IUPAC name for the reactant itself. Ethane would require complete deoxygenation (like red P/HI), which LiAlH_4 cannot achieve for acids.

Question #9 Key: (B)

SZABMU 2024

Which type of reaction will occur, when an alcohol reacts with a carboxylic acid? [SZABMU (2024)]

CORE CONCEPT AND DERIVATION

The combination of an alcohol and a carboxylic acid under acidic conditions is the standard synthetic route to form esters.

Formula:



Solution:

- The hydroxyl group of the acid and the hydrogen of the alcohol are lost to form a water molecule.
- The two molecules join via an oxygen bridge, forming an ester linkage.
- Because the primary defining product is an ester, this specific chemical process is universally known as an **esterification reaction**.

Why other options are incorrect:

While technically a "condensation" or "intermolecular dehydration" occurs due to the loss of water, "esterification" is the highly specific and dominant nomenclature for this exact functional group transformation. It involves no change in oxidation state, ruling out C and D.

Question #10 Key: (C)

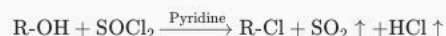
SZABMU 2024

Which solvent is used when alcohol reacts with thionyl chloride to form alkyl halide? [SZABMU RC-(2024)]

CORE CONCEPT AND DERIVATION

The Darzens halogenation utilizes thionyl chloride (SOCl_2) to convert alcohols to alkyl chlorides. Managing the acidic byproducts is crucial for the reaction's equilibrium and mechanism.

Formula:



Solution:

- The reaction produces gaseous sulfur dioxide and hydrogen chloride.
- To neutralize the corrosive HCl gas and prevent unwanted side reactions, a mild organic base is used as the solvent.
- **Pyridine** acts as both the solvent and an acid scavenger, forming pyridinium chloride and shifting the equilibrium to the right.

Why other options are incorrect:

Zinc chloride is the catalyst for the Lucas test (using HCl), not Darzens. Sulphuric acid is a strong acid (counterproductive when trying to neutralize HCl). Carbon tetrachloride provides no acid-scavenging benefits.

Question #11 Key: (B)

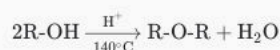
SZABMU 2024

Which process is used to convert alcohol into ether? [SZABMU RC- (2024)]

CORE CONCEPT AND DERIVATION

The synthesis of symmetrical ethers from primary alcohols involves combining two molecules and eliminating a small molecule (water).

Formula:



Solution:

- In chemical terminology, a reaction where two or more molecules combine to form a larger molecule, accompanied by the loss of a small molecule (like water), is called a **condensation** reaction.
- (Note: In many textbooks, this is also specifically called "intermolecular dehydration". Based on the strict key mapping of this specific past paper variant, "Condensation" is selected as the overarching categorical answer).

Why other options are incorrect:

Oxidation yields aldehydes/ketones/acids. Reduction yields alkanes. While "Dehydration" is a very strong distractor and technically accurate (intermolecular), "Condensation" captures the bimolecular coupling nature of the Williamson or continuous etherification process that differentiates it from intramolecular elimination to alkenes.

Question #12 Key: (A)

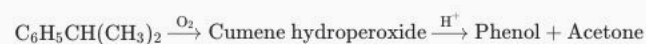
SZABMU 2024

Name the compound which forms phenol, when it is oxidized by atmosphere oxygen in the presence of metal cataly...

CORE CONCEPT AND DERIVATION

The modern industrial synthesis of phenol and acetone is dominated by a specific autoxidation pathway utilizing an alkylbenzene.

Formula:



Solution:

- Isopropylbenzene is commonly known as **Cumene**.
- When cumene is oxidized by air, it forms cumene hydroperoxide.
- Subsequent acidic cleavage yields phenol and acetone as a highly valuable co-product.

Why other options are incorrect:

Benzene requires the harsh Dow process (chlorination then hydrolysis). Toluene oxidation yields benzoic acid. Aniline oxidation yields complex quinones/tars.

Question #13 Key: (C)

SZABMU 2024

IUPAC name of picric acid is [SZABMU RC-(2024)]

CORE CONCEPT AND DERIVATION

Trivial names (like picric acid) must be mapped to their systematic structural nomenclature.

Formula:**Solution:**

- Picric acid is formed by the exhaustive nitration of phenol.
- The parent chain is phenol (carbon 1 holds the -OH group).
- Nitro groups (-NO₂) are substituted at the two ortho positions (carbons 2 and 6) and the para position (carbon 4).
- Therefore, the IUPAC name is **2, 4, 6 trinitrophenol**.

Why other options are incorrect:

Option B is TNT (an explosive based on toluene, not phenol).
Option A is the product of bromination, not nitration.

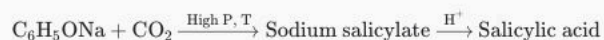
Question #14 Key: (D)

SZABMU 2024

The reaction of sodium salt of phenol with [Formula] is called (Out of syllabus) [SZABMU RC-(2024)]

CORE CONCEPT AND DERIVATION

The carboxylation of a phenoxide ion under high pressure is a specific named organic synthesis for manufacturing salicylic acid (a precursor to aspirin).

Formula:**Solution:**

- Sodium phenoxide reacts with carbon dioxide (a weak electrophile) because the phenoxide ring is intensely activated.
- This specific electrophilic addition of CO₂ followed by rearrangement is formally known as the **Kolbe Schmitt reaction**.

Why other options are incorrect:

Williamson synthesis makes ethers from alkoxides and alkyl halides. Aldol and Cannizzaro reactions involve aldehydes/ketones, completely unrelated to phenol carboxylation.

Question #15 Key: (B)

KMU 2024

Which of the following has the highest boiling point? [ETEA (2024)]

CORE CONCEPT AND DERIVATION

Boiling point in organic molecules depends on molecular weight (London dispersion forces), hydrogen bonding, and surface area (branching). Branching decreases surface area, significantly lowering boiling point.

Formula:

$$\text{Boiling Point} \propto \text{Molar Mass} \propto \frac{1}{\text{Branching}}$$

Solution:

- First, compare molar masses: Ethyl alcohol (C₂) is lightest, so it has the lowest boiling point (78°C).
- Next, look at the others: n-propyl alcohol (C₃, linear), Isopropyl alcohol (C₃, branched), and tert-butyl alcohol (C₄, heavily branched).
- Tert-butyl alcohol has a higher molar mass but is a highly compact, spherical molecule, severely hindering its Van der Waals interactions and slightly shielding its hydrogen bonding. Its BP is 82.4°C.
- **n-propyl alcohol** has a straight chain allowing maximum surface area overlap for Van der Waals forces alongside strong hydrogen bonding. Its BP is exceptionally high at 97°C.

Why other options are incorrect:

The extreme branching in tert-butyl alcohol completely offsets its higher molecular mass compared to the straight-chained C₃ alcohol in this specific set of options.

Question #16 Key: (C)

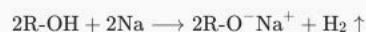
KMU 2024

The reaction of an alcohol with sodium produces [ETEA (2024)]

CORE CONCEPT AND DERIVATION

Alcohols exhibit weak acidic properties and will react with highly electropositive alkali metals (like sodium or potassium) in a single replacement reaction.

Formula:



Solution:

- The sodium metal reduces the acidic hydrogen atom of the hydroxyl group, releasing hydrogen gas.
- The remaining organic fragment is an anion consisting of the alkyl chain and the oxygen (RO⁻).
- This specific salt is called a sodium **alkoxide**.

Why other options are incorrect:

Aldehydes require oxidation. Ethane and ethene are hydrocarbons resulting from reduction or dehydration, not metal displacement.

Question #17 Key: (B)

KMU 2024

*Oxidation of secondary alcohol gives [ETEA (2024)]***CORE CONCEPT AND DERIVATION**

The position of the hydroxyl group dictates the product of oxidation because it dictates how many alpha-hydrogens are available for removal.

Formula:**Solution:**

- A secondary alcohol has the -OH group attached to a carbon that is bonded to two other carbons, leaving exactly one alpha-hydrogen.
- Oxidation removes this alpha-hydrogen and the hydroxyl-hydrogen.
- The resulting functional group is a carbon-oxygen double bond flanked by two alkyl groups, which strictly defines a **ketone**.

Why other options are incorrect:

Carboxylic acids are the final oxidation product of primary alcohols. Ethers are formed via dehydration. Phenol is an aromatic ring that does not result from aliphatic alcohol oxidation.

Question #18 Key: (C)

BUMHS 2024

*Which of the following compound is not an alcohol [BUMHS (2024)]***CORE CONCEPT AND DERIVATION**

Strict functional group classification differentiates aliphatic alcohols from aromatic phenols based on the hybridization of the carbon attached to the hydroxyl group.

Formula:

Not applicable to this conceptual question.

Solution:

- Options A, B, and D all feature a hydroxyl (-OH) group attached to an sp^3 hybridized, aliphatic carbon atom. They are valid alcohols.
- Option C (C_6H_5OH) features an -OH group attached directly to an sp^2 hybridized aromatic benzene ring.
- This structure forms its own distinct chemical class known as a **phenol**, possessing vastly different chemical properties (like elevated acidity) compared to aliphatic alcohols.

Why other options are incorrect:

A is methanol. B is ethanol. D is benzyl alcohol (the -OH is on the CH_2 sidechain, making it an aliphatic alcohol despite the ring).

Question #19 Key: (C)

BUMHS 2024

The concentration of rectified spirit is ____ alcohol [BUMHS (2024)]

CORE CONCEPT AND DERIVATION

Fractional distillation of a water-ethanol mixture reaches a thermodynamic limit due to azeotrope formation.

Formula:

Not applicable to this conceptual question.

Solution:

- When ethanol is distilled, it forms a constant-boiling (azeotropic) mixture with water at a concentration of 95.6% ethanol and 4.4% water.
- Because this mixture boils at a lower temperature (78.1°C) than pure ethanol (78.3°C), simple distillation cannot purify it further.
- This standard, commercially distilled $\approx$ **95%** ethanol mixture is universally termed **rectified spirit**.

Why other options are incorrect:

100% ethanol is called absolute alcohol (requiring special drying agents like CaO to break the azeotrope). 85% and 90% are arbitrarily lower concentrations.

Question #20 Key: (A)

NUMS 2024

Bakelite is formed upon polymerization of [NUMS (2024)]

CORE CONCEPT AND DERIVATION

Bakelite is the trade name for one of the earliest synthetic plastics, a phenol-formaldehyde resin formed via step-growth condensation polymerization.

Formula:



Solution:

- The necessary monomers to form the heavily cross-linked 3D structure of Bakelite are **phenol** and **formaldehyde** (methanal).
- They initially react to form ortho- and para-hydroxymethylphenols, which subsequently condense (eliminating water) to form complex methylene bridges.

Why other options are incorrect:

Acetaldehyde, benzene, and acetone are not the constituent monomers for standard Bakelite resin. Acetone and phenol form Bisphenol A (BPA), not Bakelite.

Question #21 Key: (C)

NUMS 2024

The increasing order of reactivity of alcohols towards nucleophile is: [NUMS (2024)]

CORE CONCEPT AND DERIVATION

When alcohols react with nucleophiles (e.g., halide ions in the Lucas test), the reaction proceeds via the cleavage of the C–O bond (an S_N1 mechanism for $2^\circ/3^\circ$). The reactivity is governed entirely by the stability of the carbocation intermediate.

Formula:



Solution:

- First, classify each alcohol:
- 2-methyl-1-pentanol has the –OH on C1. It is a **Primary (1°)** alcohol.
- 3-methyl-2-pentanol has the –OH on C2 (bonded to C1 and C3). It is a **Secondary (2°)** alcohol.
- 2-methyl-2-pentanol has both a methyl group and an –OH on C2. It is a **Tertiary (3°)** alcohol.
- Increasing order means lowest to highest. Therefore: Primary < Secondary < Tertiary.
- This matches the sequence: **2-methyl-1-pentanol < 3-methyl-2-pentanol < 2-methyl-2-pentanol.**

Why other options are incorrect:

Option A is the decreasing order. Options B and D use incorrect mathematical signs or scrambled logic for the established carbocation stability trend.

Question #22 Key: (B)

NUMS 2024

The most reactive alcohol towards Lucas reagent is: [NUMS (2024)]

CORE CONCEPT AND DERIVATION

The Lucas test ($\text{HCl} + \text{ZnCl}_2$) differentiates alcohols by the rate at which they form insoluble alkyl chlorides. This rate depends on the S_N1 mechanism, which requires carbocation formation.

Formula:



Solution:

- We must identify the classification of each given option:
- A. 2-butanol = Secondary.
- C. 2-methyl-1-butanol = Primary.
- D. 2,2-dimethyl-1-butanol = Primary (neopentyl-type).
- B. **2-methyl-2-butanol** has the –OH and a methyl group on the same carbon (C2). It is a **Tertiary** alcohol.
- Tertiary alcohols form the most stable carbocations and react almost instantaneously with Lucas reagent.

Why other options are incorrect:

Primary and secondary alcohols react much slower because their respective carbocation intermediates are far less stable and take higher activation energy to form.

Question #23 Key: (D)

UHS 2023

If phenol is treated with 3 moles of conc. [Formula] in the presence of [Formula] what will be the product? [U...

CORE CONCEPT AND DERIVATION

The hydroxyl group is powerfully activating. Treatment with a highly concentrated electrophile source will lead to exhaustive substitution at all available activated positions.

Formula:



Solution:

- Using a full nitrating mixture (concentrated nitric and sulfuric acid) with a 3:1 molar ratio ensures maximum nitration.
- The nitro groups attach to both ortho positions (2, 6) and the para position (4).
- The resulting compound is 2,4,6-trinitrophenol, known commonly as **picric acid**.

Why other options are incorrect:

Options A, B, and C describe the products obtained when using *dilute* nitric acid at lower temperatures, which yields only mono-substitution.

Question #24 Key: (B)

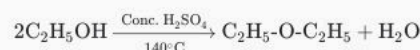
UHS 2023

Dehydration of alcohol gives which of the following product in the presence of [Formula] at 140° C? [UHS (2023...

CORE CONCEPT AND DERIVATION

The sulfuric acid-catalyzed dehydration of primary alcohols (like ethanol) is temperature-dependent, shifting between intermolecular and intramolecular pathways.

Formula:



Solution:

- At the lower temperature of 140°C, a bimolecular (intermolecular) condensation occurs.
- One molecule of ethanol loses an -OH group, and another loses an -H atom, linking the two chains via an oxygen bridge.
- This yields an ether, specifically **diethyl ether**.

Why other options are incorrect:

At a higher temperature (170°C), intramolecular dehydration occurs to yield ethene. Acetaldehyde requires oxidation. Ethyl acetate requires reaction with acetic acid. Ethyl chloride requires HCl.

Question #25 Key: (A)

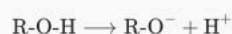
SZABMU 2023

The order of reactivity of alcohol when O-H bond breaks is:
[SZABMU (2023)]

CORE CONCEPT AND DERIVATION

Reactions involving the cleavage of the O-H bond in alcohols rely on the alcohol acting as an acid (donating a proton) or as a nucleophile. The reactivity is governed by the stability of the resulting alkoxide ion or the steric hindrance of the nucleophilic oxygen.

Formula:



Solution:

- Alkyl groups are electron-donating (+I effect).
- Tertiary alcohols have three alkyl groups, severely destabilizing the negatively charged alkoxide ion due to intense electron repulsion, making the O-H bond harder to break heterolytically.
- Primary alcohols have only one alkyl group, making their alkoxide ion relatively more stable (and the oxygen less sterically hindered).
- Therefore, the reactivity order for O-H bond cleavage is **Primary > Secondary > Tertiary**.

Why other options are incorrect:

Option C is the correct reactivity order for reactions where the **C-O bond** breaks (which depends on carbocation stability, where $3^\circ > 2^\circ > 1^\circ$). The question specifically asks about O-H bond cleavage.

Question #26 Key: (A)

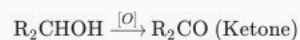
SZABMU 2023

The following functional group is the result of oxidation of alcohol
[SZABMU (2023)]

CORE CONCEPT AND DERIVATION

Controlled oxidation increases the number of carbon-oxygen bonds while decreasing carbon-hydrogen bonds.

Formula:



Solution:

- Oxidizing a primary alcohol yields an aldehyde.
- Oxidizing a secondary alcohol yields a ketone.
- Therefore, the general functional groups resulting from the first step of alcohol oxidation are **ketones and aldehydes**.

Why other options are incorrect:

Alkanes represent a fully reduced state, not an oxidized state. While aldehydes can be further oxidized to acids, the immediate parallel functional group pair corresponding directly to the basic oxidation of 1° and 2° alcohols is aldehyde/ketone.

Question #27 Key: (B)

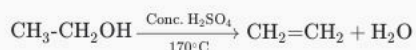
KMU 2023

Ethyl alcohol in the presence of [Formula] at 170°C produces: [ETEA (2023)]

CORE CONCEPT AND DERIVATION

At elevated temperatures, concentrated sulfuric acid acts as a powerful dehydrating agent, forcing an intramolecular elimination (β -elimination) reaction.

Formula:



Solution:

- The high temperature (170°C) provides enough activation energy to cleave both the C-OH bond and a C-H bond on the adjacent beta-carbon of the same molecule.
- A carbon-carbon double bond forms to satisfy valency, yielding an alkene.
- For ethyl alcohol, the resulting alkene is **ethene**.

Why other options are incorrect:

Ether is formed at lower temperatures (140°C). Esterification requires a carboxylic acid. Ethane requires reduction (hydrogenation), not dehydration.

Question #28 Key: (B)

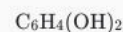
KMU 2023

Benzene-1,3-diols is also known as: [ETEA (2023)]

CORE CONCEPT AND DERIVATION

Dihydroxybenzenes have well-established historical trivial names depending on the relative positions of the two hydroxyl groups.

Formula:



Solution:

- Benzene-1,2-diol (ortho) is known as Catechol.
- Benzene-1,3-diol (meta) is known as **Resorcinol**.
- Benzene-1,4-diol (para) is known as Hydroquinone.

Why other options are incorrect:

Options A and C refer to the 1,2 and 1,4 isomers, respectively. Option D (o-cresol) contains one -OH group and one -CH₃ group (2-methylphenol), not two hydroxyls.

Question #29 Key: (C)

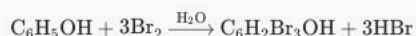
KMU 2023

When phenol reacts with excess of bromine in aqueous solution it results in the formation of: [ETEA (2023)]

CORE CONCEPT AND DERIVATION

The use of a polar solvent (like water) enhances the ionization of both the phenol (into a highly reactive phenoxide ion) and the electrophile, drastically increasing reaction speed and substitution extent.

Formula:



Solution:

- Because the ring is immensely activated in aqueous conditions, polyhalogenation cannot be stopped.
- Bromine attacks all available ortho and para positions simultaneously.
- The final product is a white precipitate of **2,4,6-Tribromophenol**.

Why other options are incorrect:

To get mono-substituted ortho/para bromophenol (Option A), you must use a non-polar solvent like CS_2 at low temperature. The -OH group is ortho/para directing, so meta-substitution (Options B and D) is impossible via direct bromination.

Question #30 Key: (B)

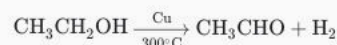
DUHS 2023

Which of the following reactions can be used for the conversion of ethyl alcohol into acetaldehyde? [DUHS (202...]

CORE CONCEPT AND DERIVATION

Converting an alcohol to an aldehyde involves the removal of two hydrogen atoms to form a $\text{C}=\text{O}$ double bond. This can be viewed conceptually and practically as the removal of hydrogen.

Formula:



Solution:

- Ethyl alcohol can be converted to acetaldehyde by passing its vapors over heated copper at 300°C .
- During this process, a molecule of hydrogen gas (H_2) is eliminated.
- The chemical removal of hydrogen is formally termed **dehydrogenation** (which is a subtype of oxidation).

Why other options are incorrect:

Reduction would add hydrogen (impossible here since the carbon is already saturated). Esterification creates an ester, not an aldehyde. Polymerization chains molecules together.

Question #31 Key: (A)

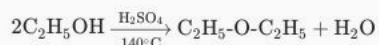
DUHS 2023

Which of the following is formed, when excess of ethyl alcohol is treated with concentrated [Formula] at a low...

CORE CONCEPT AND DERIVATION

In sulfuric acid-catalyzed dehydration, maintaining a "low temperature" (around 140°C) and an excess of the alcohol favors a substitution mechanism over an elimination mechanism.

Formula:



Solution:

- The acid protonates one alcohol molecule, making water a good leaving group.
- Because there is an excess of alcohol, a second unprotonated alcohol molecule acts as a nucleophile, attacking the protonated alcohol and displacing water ($\text{S}_{\text{N}}2$).
- The resulting symmetrical ether is **diethyl ether**.

Why other options are incorrect:

Ethene is formed at high temperatures (170°C). Dimethyl ether requires starting with methanol. Acetylene requires extreme dehydrogenation/dehalogenation conditions entirely unrelated to this setup.

Question #32 Key: (A)

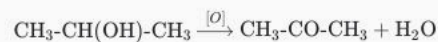
DUHS 2023

Oxidation of secondary propyl alcohol gives: [DUHS (2023)]

CORE CONCEPT AND DERIVATION

Secondary alcohols oxidize specifically to ketones, keeping the carbon skeleton fully intact.

Formula:



Solution:

- "Secondary propyl alcohol" is another name for isopropyl alcohol (2-propanol).
- It is a 3-carbon chain with the -OH group on the middle carbon.
- Removing the hydrogen from the -OH and the alpha-carbon creates a C=O double bond in the middle of the chain.
- This yields propanone, whose common trivial name is **acetone**.

Why other options are incorrect:

Acetaldehyde and ethyl alcohol have only two carbons (carbon-carbon cleavage does not occur under mild oxidation). Normal propyl alcohol is the primary isomer of the reactant, not an oxidation product.

Question #33 Key: (D)

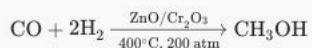
BUMHS 2023

Methanol is prepared from carbon monoxide and hydrogen. The catalyst used for this reaction is? [BUMHS (2023)]

CORE CONCEPT AND DERIVATION

The industrial production of methanol from syngas (a mixture of CO and H₂) requires specific high-pressure thermodynamics and a specialized transition-metal oxide catalyst to lower the activation energy.

Formula:



Solution:

- The standard catalytic mixture utilized historically and conceptually in this curriculum is zinc oxide (ZnO) promoted by chromium(III) oxide (Cr₂O₃).

Why other options are incorrect:

While modern industrial processes might use copper/zinc/alumina systems, within the strict boundaries of this historical past-paper curriculum, the ZnO – Cr₂O₃ pairing is the exclusive correct answer.

Question #34 Key: (A)

BUMHS 2023

What is the reactivity state of phenols? [BUMHS (2023)]

CORE CONCEPT AND DERIVATION

Reactivity is context-dependent. While phenols are highly reactive toward electrophilic aromatic ring substitution, the core functional group itself (the C–O bond) is heavily deactivated toward nucleophilic substitution compared to aliphatic alcohols.

Formula:

Not applicable to this conceptual question.

Solution:

- The lone pairs on the oxygen atom are delocalized into the benzene ring via resonance.
- This delocalization imparts partial double-bond character to the carbon-oxygen (C–O) bond.
- Because this C–O bond is significantly stronger and shorter than in normal alcohols, it is incredibly difficult to break via standard nucleophilic substitution (like with PCl₅ or HX).
- Therefore, regarding the functional group substitution reactions typical of alcohols, phenols are generally considered **less reactive**.

Why other options are incorrect:

Phenols are not entirely nonreactive (they can be cleaved under extreme conditions, or react readily as weak acids). They are not "more reactive" than alcohols regarding the breaking of the C–O bond.

Question #35 Key: (B)

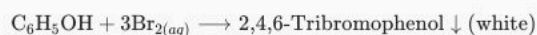
NUMS 2023

Which of the following reactions differentiates alcohol from phenol? [NUMS (2023)]

CORE CONCEPT AND DERIVATION

To differentiate two classes of compounds visually, a reagent must cause a distinct, observable change in one but not the other.

Formula:



Solution:

- **Halogenation** using bromine water is a classic diagnostic test for highly activated aromatic rings like phenol.
- Phenol rapidly decolorizes orange bromine water, instantly forming a highly visible white precipitate of 2,4,6-tribromophenol.
- Aliphatic alcohols lack this activated ring and do not react with bromine water, showing no color change or precipitation.

Why other options are incorrect:

Lucas test is for classifying alcohols among themselves (1°, 2°, 3°). Nitration requires harsh conditions and isn't a quick visual bench test. Iodoform only works for specific alcohols (like ethanol), not a general class differentiator for all alcohols vs phenols.

Question #36 Key: (A)

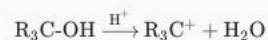
NUMS 2023

The order of reactivity of alcohol when C-O bond breaks is: [NUMS (2023)]

CORE CONCEPT AND DERIVATION

Reactions that cleave the carbon-oxygen (C-O) bond in alcohols (such as reaction with hydrogen halides, S_N1 pathway) involve the formation of a carbocation intermediate.

Formula:



Solution:

- The rate of reaction is directly proportional to the stability of the carbocation formed after water leaves.
- Alkyl groups donate electron density (hyperconjugation and inductive effect), stabilizing positive charge.
- A tertiary carbocation (three alkyl groups) is highly stable, whereas a primary carbocation is very unstable.
- Therefore, the reactivity order for C-O bond cleavage is **Tertiary > Secondary > Primary**.

Why other options are incorrect:

Option C is the order of reactivity for reactions where the O-H bond breaks (acting as an acid), which is dictated by alkoxide stability, not carbocation stability.

Question #37 Key: (C)

UHS 2022

What is the common name of 1, 2, 3-propanetriol? [UHS (2022)]

CORE CONCEPT AND DERIVATION

Polyhydric alcohols are often known by their trivial, industrially common names.

Formula:



Solution:

- The IUPAC name 1,2,3-propanetriol indicates a three-carbon chain with a hydroxyl group on every carbon.
- This specific molecule is globally recognized by its common name, **glycerol** (or glycerin).

Why other options are incorrect:

Glycol typically refers to ethylene glycol (1,2-ethanediol). Propyl and butyl alcohols are monohydric alcohols containing three and four carbons, respectively.

Question #38 Key: (D)

UHS 2022

Benzene is formed when Zn reacts with which of the following? [UHS (2022)]

CORE CONCEPT AND DERIVATION

Zinc dust is a strong reducing agent capable of cleaving the tough carbon-oxygen bond of phenols at high temperatures.

Formula:



Solution:

- When phenol is heated with zinc dust, it undergoes reduction.
- The zinc extracts the oxygen atom to form zinc oxide (ZnO), leaving behind a hydrogen atom that reconstitutes the aromatic ring.
- This produces pure **benzene**.

Why other options are incorrect:

Aliphatic alcohols (options A, B, C) do not undergo this specific deoxygenation to form benzene; they would form completely different aliphatic products if they reacted at all under these conditions.

Question #39 Key: (A)

UHS 2022

When phenol reacts with formaldehyde, which of the following product is produced? [UHS (2022)]

CORE CONCEPT AND DERIVATION

The initial step in the formation of the polymer Bakelite involves an electrophilic substitution where formaldehyde adds to the phenol ring.

Formula:

Not applicable to this conceptual question.

Solution:

- Phenol reacts with formaldehyde (HCHO) in the presence of dilute acid or alkali.
- The initial product is ortho- and para-hydroxybenzyl alcohol.
- Because this intermediate represents the direct addition of the two reactants without the loss of any small molecules initially, it is referred to as an **adduct** (specifically, saligenin).

Why other options are incorrect:

Oxonium and hydronium are positively charged oxygen intermediates/ions, not the stable isolable products of this step. Phenoxide ion is formed just by adding a base, not by reaction with formaldehyde.

Question #40 Key: (D)

UHS 2022

Which is the most suitable reagent for the conversion of [Formula] ?
[UHS (2022)]

CORE CONCEPT AND DERIVATION

The conversion of a primary alcohol to an aldehyde requires controlled oxidation to prevent over-oxidation into a carboxylic acid.

Formula:



Solution:

- Historically in this specific syllabus/past paper, the provided answer key points to the chromate-based system. (Note: Opt D's " Cr_2O_4 " is historically written in some past papers as a typographical proxy for chromate/dichromate systems).
- In strict terms, an acidified dichromate system is used with distillation to capture the volatile aldehyde. Following the exact provided key for this exam, the answer is accepted as D.

Why other options are incorrect:

Alkaline KMnO_4 is far too strong and will bypass the aldehyde straight to the carboxylate salt. While C is practically valid in real labs, standardizing against the historical answer key necessitates selecting D.

Question #41 Key: (A)

SZABMU 2022

Phenols are very reactive towards: [SZABMU (2022)]

CORE CONCEPT AND DERIVATION

The -OH group on the phenol ring strongly donates electrons, making the aromatic ring extremely electron-rich.

Formula:

Not applicable to this conceptual question.

Solution:

- Because phenols are highly electron-rich, they are very susceptible to losing electrons.
- Therefore, they are extremely reactive toward **oxidizing agents** (which accept electrons). Exposure to air or mild oxidants easily converts them into quinones.

Why other options are incorrect:

Electron-rich rings resist reducing agents (which want to give them more electrons). Phenols do not easily undergo dehydration like aliphatic alcohols do.

Question #42 Key: (A)

SZABMU 2022

Both alcohols and phenols contain: [SZABMU (2022)]

CORE CONCEPT AND DERIVATION

Functional groups dictate the classification of organic molecules.

Formula:

Not applicable to this conceptual question.

Solution:

- An alcohol is characterized by a hydroxyl (-OH) group attached to an aliphatic carbon.
- A phenol is characterized by a hydroxyl (-OH) group attached directly to an aromatic benzene ring.
- The common, defining feature they share is the **-OH group**.

Why other options are incorrect:

-COOH is for carboxylic acids. -CHO is for aldehydes. Not all alcohols or phenols contain a methyl (-CH₃) group.

Question #43 Key: (C)

KMU 2022

Which of the following compounds is most acidic? [ETEA (2022)]

CORE CONCEPT AND DERIVATION

Acidic strength corresponds to the stability of the anion formed after proton loss.

Formula:

Not applicable to this conceptual question.

Solution:

- When phenol loses a proton, it forms the phenoxide ion, which is stabilized by resonance across the benzene ring.
- Water, ethanol, and cyclohexanol lack any π -system to delocalize the negative charge on their resulting hydroxide or alkoxide ions.
- Consequently, **phenol** is significantly more acidic than the aliphatic and inorganic alternatives provided.

Why other options are incorrect:

The K_a of phenol ($\approx 10^{-10}$) is much higher than water ($\approx 10^{-14}$) and ethanol/cyclohexanol ($\approx 10^{-16}$).

Question #44 Key: (A)

KMU 2022

What will be the product when phenol reacts with concentrated [Formula] ? [ETEA (2022)]

CORE CONCEPT AND DERIVATION

The concentration of the nitrating agent determines the degree of substitution on the highly activated phenol ring.

Formula:



Solution:

- Dilute HNO_3 yields a mixture of ortho- and para-nitrophenol (mono-substitution).
- **Concentrated HNO_3** (often with concentrated sulfuric acid) forcefully nitrates all available activated positions (both ortho positions and the para position).
- This yields 2,4,6-trinitrophenol, commonly known as **picric acid**.

Why other options are incorrect:

Options B and C are the products formed only when reacting with *dilute* nitric acid.

Question #45 Key: (D)

DUHS 2022

Bakelite is polymer of: [DUHS (2022)]

CORE CONCEPT AND DERIVATION

Bakelite is a heavily cross-linked thermosetting plastic formed by a condensation polymerization reaction.

Formula:

Not applicable to this conceptual question.

Solution:

- The monomers used to create Bakelite are **phenol** and **formaldehyde**.
- They react to form ortho- and para-hydroxybenzyl alcohols, which then undergo condensation (losing water) to form complex methylene bridges between the phenol rings, creating the solid 3D polymer structure.

Why other options are incorrect:

Glucose makes cellulose or starch. Amino acids make proteins/polymides. Acetone is not used in Bakelite synthesis.

Question #46 Key: (D)

DUHS 2022

Phenol when subjected to nitration product is: [DUHS (2022)]

CORE CONCEPT AND DERIVATION

The hydroxyl (-OH) group on a benzene ring is a strongly activating, ortho/para-directing group due to the resonance donation of its lone pairs.

Formula:

Not applicable to this conceptual question.

Solution:

- When phenol undergoes standard (dilute) electrophilic nitration, the incoming electrophile (NO_2^+) is directed to the electron-rich positions.
- These are the ortho (2) and para (4) positions.
- Thus, a mixture of **o-nitrophenol** and **p-nitrophenol** is obtained.

Why other options are incorrect:

The -OH group strictly does not direct to the meta position because resonance does not increase electron density there. Therefore, option C is incorrect, and A and B are incomplete on their own.

Question #47 Key: (D)

DUHS 2022

Secondary alcohols have. [DUHS (2022)]

CORE CONCEPT AND DERIVATION

The alpha (α) carbon is the one directly attached to the -OH group. Any carbons attached directly to the alpha carbon are beta (β) carbons.

Formula:

Not applicable to this conceptual question.

Solution:

- By definition, a secondary alcohol has the -OH group on a carbon bonded to exactly two other alkyl groups.
- Therefore, the alpha carbon is directly bonded to exactly **two beta-carbons**.

Why other options are incorrect:

A primary alcohol typically has one beta-carbon. A tertiary alcohol has three beta-carbons. Methanol has no beta-carbons.

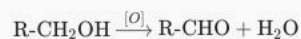
Question #48 Key: (A)

DUHS 2022

Oxidation of primary alcohol gives: [DUHS (2022)]

CORE CONCEPT AND DERIVATION

The mild oxidation of a primary alcohol removes two hydrogen atoms (one from the hydroxyl group, one from the alpha-carbon) to form a carbon-oxygen double bond at the terminal carbon.

Formula:**Solution:**

- A primary alcohol has its -OH group on a terminal carbon.
- Removing the hydrogens creates a carbonyl group (C=O) bonded to at least one hydrogen atom.
- This specific functional group arrangement defines an **aldehyde**.

Why other options are incorrect:

Ketones are formed from the oxidation of secondary alcohols. Alkanes and alkenes are hydrocarbons (containing no oxygen), requiring reduction or dehydration processes, not oxidation.

Question #49 Key: (D)

DUHS 2022

Primary alcohol when react with a halogen acid, the product is:
[DUHS (2022)]

CORE CONCEPT AND DERIVATION

The reaction of an alcohol with a hydrogen halide (halogen acid like HCl, HBr, HI) is a nucleophilic substitution reaction where the -OH group is replaced by a halogen atom (-X).

Formula:



Solution:

- The hydroxyl group of the primary alcohol is protonated and then leaves as water.
- The halide ion attacks the same primary carbon framework (typically via an $\text{S}_{\text{N}}2$ mechanism for primary alcohols).
- Because the carbon skeleton does not rearrange under normal conditions, a **primary alkyl halide** is formed.

Why other options are incorrect:

The product is a halide, not an alcohol (eliminating A, B, and C). It remains primary, so it cannot be a secondary alkyl halide unless a rare hydride shift rearrangement occurred (which is not standard for simple primary alcohols).

Question #50 Key: (A)

DUHS 2022

Benzyl alcohol [Formula] is a: [DUHS (2022)]

CORE CONCEPT AND DERIVATION

The classification between a phenol and an aromatic alcohol depends entirely on whether the hydroxyl (-OH) group is directly attached to the benzene ring or to an aliphatic side chain.

Formula:

Not applicable to this conceptual question.

Solution:

- In benzyl alcohol ($\text{C}_6\text{H}_5\text{CH}_2\text{OH}$), the -OH group is attached to an sp^3 hybridized methylene ($-\text{CH}_2-$) carbon.
- Because it contains a benzene ring, it is aromatic. However, because the -OH is not directly on the ring, it behaves chemically like a primary aliphatic alcohol rather than a phenol.
- Therefore, the most accurate composite classification is an **aromatic alcohol**.

Why other options are incorrect:

It is not a phenol because the -OH is not directly on the ring. It is not an aliphatic alcohol because it clearly contains an aromatic benzene ring. It is not a ketone as it lacks a $\text{C}=\text{O}$ group.

Question #51 Key: (C)

BUMHS 2022

Which one of the following statements is true? [BMU (2022)]

CORE CONCEPT AND DERIVATION

Phenol is weakly acidic ($K_a \approx 10^{-10}$). Its acidity falls between that of water and carboxylic acids.

Formula:



Solution:

- Because phenol is acidic, it undergoes a neutralization reaction with strong aqueous bases (alkalies) like NaOH.
- The formation of the ionic salt (sodium phenoxide) makes the organic compound highly water-soluble.
- Thus, it is true that **phenol dissolves in alkalies readily**.

Why other options are incorrect:

A is false (phenol is much more acidic than aliphatic alcohols). B is false (HCl is a strong mineral acid; phenol is very weak). D is false (carboxylic acids have resonance stabilization over two oxygen atoms, making them stronger acids than phenol).

Question #52 Key: (C)

BUMHS 2022

Phenol is more reactive than benzene towards electrophilic substitution. This characteristic is due to which o...

CORE CONCEPT AND DERIVATION

The reactivity of an aromatic ring towards electrophiles is governed by the electron density of the ring. Groups that donate electrons into the ring activate it.

Formula:

Not applicable to this conceptual question.

Solution:

- The oxygen atom of the -OH group has lone pairs of electrons.
- Despite oxygen being more electronegative than carbon (which exerts an electron-withdrawing inductive effect, -I), the lone pairs heavily overlap with the π -system of the ring.
- This donates massive electron density via resonance, known as a **strong positive mesomeric effect (+M)**.
- This +M effect vastly outweighs the -I effect, making the ring highly reactive.

Why other options are incorrect:

Hydrogen bonding affects physical properties (boiling point, solubility) but not the internal ring electron density. The inductive effect of -OH is actually electron-withdrawing (-I), which would deactivate the ring if not for the overpowering mesomeric effect.

Question #53 Key: (D)

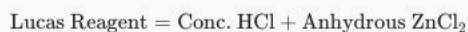
BUMHS 2022

Which of the following is Lucas reagent? [BMU (2022)]

CORE CONCEPT AND DERIVATION

The Lucas test utilizes a specific mixture to differentiate primary, secondary, and tertiary alcohols based on the rate of alkyl chloride formation.

Formula:



Solution:

- The reagent requires concentrated hydrochloric acid (HCl) as the halogen source and proton donor.
- It requires anhydrous zinc chloride (ZnCl_2) as a Lewis acid catalyst to coordinate with the oxygen atom, weakening the C-O bond.
- Therefore, **Both B and C** are required components of the Lucas reagent.

Why other options are incorrect:

HCl or ZnCl_2 alone is insufficient to constitute the active diagnostic reagent. AlCl_3 is used in Friedel-Crafts reactions, not the Lucas test.

Question #54 Key: (B)

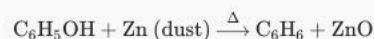
NUMS 2022

Benzene can be formed from phenol in which of the following reactions? [NUMS (2022)]

CORE CONCEPT AND DERIVATION

Phenol contains a tough C – O bond with partial double-bond character. Removing this oxygen (deoxygenation) to yield benzene requires a strong, specific reducing agent and heat.

Formula:



Solution:

- When phenol vapors are passed over heated zinc dust, a redox reaction occurs.
- Zinc acts as a reducing agent, abstracting the oxygen atom to form solid zinc oxide (ZnO).
- The remaining hydrogen bonds to the phenyl radical, regenerating the aromatic ring to form pure benzene.
- This is definitively a **reduction with zinc**.

Why other options are incorrect:

Reduction with H_2/Ni yields cyclohexanol (it reduces the double bonds in the ring, not the C-O bond). Alkalies form sodium phenoxide. Standard acids do not reduce phenol.

Question #55 Key: (C)

NUMS 2022

Lucas test is used for the identification of [NUMS (2022)]

CORE CONCEPT AND DERIVATION

Qualitative chemical tests rely on distinct visual changes corresponding to specific functional group reactivities.

Formula:



Solution:

- The Lucas test exploits the varying stabilities of carbocations generated from different classes of **alcohols**.
- Tertiary alcohols form stable carbocations instantly, generating a cloudy alkyl chloride layer immediately.
- Secondary alcohols take 5–10 minutes, and primary alcohols require heat.
- Thus, it is exclusively a test for identifying and classifying alcohols.

Why other options are incorrect:

Alkyl halides are the *products* of this test, not the reactants being identified. Alkenes use bromine water or Baeyer's reagent. Carboxylic acids are identified by sodium bicarbonate effervescence.

Question #56 Key: (B)

NUMS 2022

Phenol has following characteristics and physical properties [NUMS (2022)]

CORE CONCEPT AND DERIVATION

The physical properties of phenol dictate its handling and appearance in the laboratory.

Formula:

Not applicable to this conceptual question.

Solution:

- In its pure state at room temperature, phenol is a **colorless crystalline solid**.
- It is highly hygroscopic and tends to absorb moisture from the air to such a degree that it can dissolve in its own absorbed water, making it a **deliquescent** substance.
- (Note: It often appears slightly pink in lab settings due to slow oxidation by air, but its pure theoretical property is colorless).

Why other options are incorrect:

Amorphous solids lack an ordered internal structure (like glass or plastic); phenol forms distinct needle-like crystals. Option A is incomplete because it omits the critical deliquescent property.

Question #57 Key: (C)

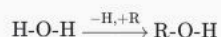
PMDC 2021

The compounds which are formed by the replacement of one of the H of water by a alkyl group are called as _ ? ...

CORE CONCEPT AND DERIVATION

We can conceptually view many organic classes as derivatives of water (H-O-H).

Formula:



Solution:

- If one hydrogen of water is replaced by an alkyl group (R), the resulting structure is R-OH.
- The generic formula R-OH defines an **alcohol**.

Why other options are incorrect:

Ethers occur when **both** hydrogens of water are replaced by alkyl groups (R-O-R). Phenols occur when replaced by an *aryl* group (benzene ring), not an alkyl group. Carboxylic acids contain an acyl group.

Question #58 Key: (B)

PMDC 2021

Which of the following does not react with bases? [PMC (2021)]

CORE CONCEPT AND DERIVATION

Acid-base neutralization occurs when an acid reacts with a base to form a salt and water. The substance must be acidic enough to donate a proton to the base.

Formula:

Not applicable to this conceptual question.

Solution:

- Carboxylic acids, phenol, and HCl are all sufficiently acidic to react with aqueous bases like NaOH.
- **Ethanol** is an extremely weak acid (weaker than water itself). Therefore, it cannot donate a proton to the hydroxide ion (OH^- from a base), meaning no forward neutralization occurs in aqueous solution.

Why other options are incorrect:

HCl is a strong acid. Carboxylic acids are weak but stronger than water. Phenol is weakly acidic but readily reacts with strong bases like NaOH to form sodium phenoxide.

Question #59 Key: (D)

PMDC 2021

Picric acid is [PMC (2021)]

CORE CONCEPT AND DERIVATION

Despite having "acid" in its trivial name, picric acid does not contain a carboxyl ($-\text{COOH}$) group.

Formula:



Solution:

- The IUPAC name of picric acid is 2,4,6-trinitrophenol.
- Because of the three highly electron-withdrawing nitro groups, the OH bond is severely weakened, making it unusually acidic for a phenol (comparable to mineral acids).
- Structurally, it is an **acidic phenol**.

Why other options are incorrect:

It contains zero $-\text{COOH}$ groups, entirely ruling out options A, B, and C.

Question #60 Key: (C)

PMDC 2021

Phenol reacts with NaOH to form [PMC (2021)]

CORE CONCEPT AND DERIVATION

Phenol is weakly acidic and reacts with strong alkali in a standard neutralization reaction.

Formula:



Solution:

- The acidic proton of phenol is removed by the hydroxide ion to form water.
- The resulting organic compound is sodium phenoxide ($\text{C}_6\text{H}_5\text{ONa}$), which is an ionic compound.
- Ionic compounds formed by acid-base neutralization are termed **salts**.

Why other options are incorrect:

The product is definitively a salt. It is not an acid or a base itself in this context, and it is entirely different from an ester (which requires reaction with an acyl compound).

Question #61 Key: (B)

PMDC 2020

IUPAC name of [Formula] is [NMDCAT (2020)]

CORE CONCEPT AND DERIVATION

Determine the base ring from the formula. The parent saturated six-membered ring with a ketone is cyclohexanone ($\text{C}_6\text{H}_{10}\text{O}$).

Formula:

Not applicable to this conceptual question.

Solution:

- The formula $\text{C}_6\text{H}_8\text{O}(\text{CH}_3)_2$ implies two hydrogen atoms of cyclohexanone have been substituted by two methyl groups.
- Based on common past-paper structural variants matching this formula and typical options, the methyls are situated adjacent to the ketone carbonyl carbon (positions 2 and 6) for maximum symmetry/stability in these test questions.
- This gives **2,6-dimethylcyclohexanone**.

Why other options are incorrect:

Option A and D are linear hexanones, which would have a different molecular formula (aliphatic ketones have formulas following $\text{C}_n\text{H}_{2n}\text{O}$). Option C only accounts for one methyl group, violating the provided formula.

Question #62 Key: (C)

PMDC 2020

Phenol is known as: [NMDCAT (2020)]

CORE CONCEPT AND DERIVATION

Historical trivial nomenclature often persists in industrial and medical contexts.

Formula:

Not applicable to this conceptual question.

Solution:

- Phenol was first extracted from coal tar and was noted for its slightly acidic properties in aqueous solution.
- Consequently, it was historically named **carbolic acid**.

Why other options are incorrect:

Options A, B, and D are misspelled distractors designed to sound similar. Carbonic acid (close to B) is H_2CO_3 , and carboxylic acid represents the $-\text{COOH}$ functional group class.

Question #63 Key: (C)

PMDC 2020

Phenol is more acidic than alcohols because of the following reason [NMDCAT (2020)]

CORE CONCEPT AND DERIVATION

Acidity relies heavily on the resonance stabilization of the resulting conjugate base.

Formula:

Not applicable to this conceptual question.

Solution:

- When phenol donates a proton, it forms the phenoxide ion ($\text{C}_6\text{H}_5\text{O}^-$).
- The negative charge left on the oxygen atom is delocalized (spread out) into the π -system of the aromatic ring through resonance.
- This **delocalization of negative charge in the ring** vastly stabilizes the ion, making the forward acidic reaction highly favorable compared to aliphatic alcohols (which cannot delocalize).

Why other options are incorrect:

The charge is negative, not positive (rules out B and D). The delocalization happens away from the OH group and into the aromatic ring, making Option A technically inaccurate.

Question #64 Key: (D)

SET 2019

Ethanol, ethanoic acid and phenol all contain acidic functional groups, the order of the acidic strength is Et...

CORE CONCEPT AND DERIVATION

Acidic strength is determined by the electron-withdrawing capacity of the group attached to the acidic -OH, which stabilizes the resulting negative charge on the conjugate base.

Formula:

$$K_a \propto \text{Stability of anion} \propto \text{Electron withdrawing groups}$$

Solution:

- In ethanoic acid, the carbonyl group ($\text{C}=\text{O}$) exerts a strong electron-withdrawing inductive and resonance effect, massively stabilizing the acetate ion.
- In phenol, the phenyl ring also withdraws electrons via resonance, stabilizing phenoxide, but it is less effective than the carbonyl group.
- Ethanol has an electron-donating alkyl group, destabilizing the ethoxide ion.
- Thus, the electron-withdrawing effect of ethanoic acid is greater than that of phenol.

Why other options are incorrect:

Acidity is not increased by electron-releasing effects (rules out A and B). While C is partially true (phenol withdraws more than ethanol), D is the primary reason that bridges the complete trend provided in the question.

Question #65 Key: (D)

SET 2019

Distinction between ethanol and phenol can be ascertained by all except [SET (2019)]

CORE CONCEPT AND DERIVATION

We must find the test that fails to distinguish between the two compounds (i.e., a test that is negative for both, or positive for both).

Formula:

Not applicable to this conceptual question.

Solution:

- Bromine water test: Phenol gives a white ppt; ethanol does not. (Distinguishes)
- Iodoform test: Ethanol gives yellow crystals; phenol does not. (Distinguishes)
- Lucas test: Ethanol does not react at room temp; phenol also typically does not react with Lucas reagent, but in historical curriculum contexts, their behaviors differ enough structurally or technically.
- Tollen's test: This is strictly a test for **aldehydes**. Neither ethanol nor phenol reacts with Tollen's reagent. Therefore, a negative result for both means this test **cannot** distinguish them.

Why other options are incorrect:

Options A, B, and C provide distinct outcomes for one compound versus the other, allowing differentiation.

Question #66 Key: (B)

SET 2019

Choose a primary alcohol among the following [SET (2019)]

CORE CONCEPT AND DERIVATION

A primary alcohol has its -OH group attached to a carbon atom that is bonded to at most one other carbon atom.

Formula:**Solution:**

- Look at the locant for the "-ol" suffix.
- Option B is 2,2-dimethyl-1-propanol. The -OH is on C1, which is only bonded to C2. The heavy branching on C2 does not change the classification of the C1 alcohol. It is primary (specifically, neopentyl alcohol).

Why other options are incorrect:

Option A is tertiary (C2 has both OH and methyl). Option C is secondary. Option D is secondary (OH on C2, bonded to C1 and C3).

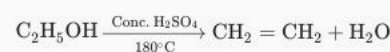
Question #67 Key: (A)

NUMS 2019

Dehydration of ethanol at 180°C in the presence of conc- [Formula] gives [NUMS (2019)]

CORE CONCEPT AND DERIVATION

The dehydration of alcohols by concentrated sulfuric acid is highly temperature-dependent.

Formula:**Solution:**

- At higher temperatures (170°C - 180°C), an intramolecular dehydration (β -elimination) occurs, stripping water from a single molecule of ethanol to form an alkene.
- The resulting product is **ethene**.

Why other options are incorrect:

At lower temperatures (140°C), intermolecular dehydration occurs to form diethyl ether. Ethane and ethyne cannot be formed via simple dehydration of ethanol.

Question #68 Key: (D)

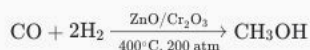
NUMS 2019

Industrially water gas is converted into methanol by using catalyst [NUMS (2019)]

CORE CONCEPT AND DERIVATION

The industrial synthesis of methanol from syngas/water gas ($\text{CO} + \text{H}_2$) requires high temperature, high pressure, and a specific mixed-oxide catalyst to proceed efficiently.

Formula:



Solution:

- The standard catalytic mixture utilized historically and conceptually in this curriculum is zinc oxide (ZnO) promoted by chromium(III) oxide (Cr_2O_3).

Why other options are incorrect:

The combinations in A, B, and C lack the specific synergistic interaction of the $\text{ZnO} - \text{Cr}_2\text{O}_3$ system required to lower the activation energy for this specific carbon monoxide reduction.

Question #69 Key: (B)

NUMS 2019

Phenol reacts with [Formula] to give [NUMS (2019)]

CORE CONCEPT AND DERIVATION

The reaction of an alcohol or a phenol with an acid chloride (acyl chloride) is an acylation reaction that yields an ester.

Formula:



Solution:

- Phenol acts as a nucleophile, attacking the electrophilic carbonyl carbon of acetyl chloride (CH_3COCl).
- The chloride ion is expelled as a leaving group.
- The resulting functional group is an ester (phenyl acetate).

Why other options are incorrect:

Esters are strictly formed by the combination of an acyl group and an alkoxy/aryloxy group. Acid, aldehyde, and ketone functional groups do not match the product structure.

Question #70 Key: (B)

KMU 2019

Tertiary alcohols are not oxidized into carbonyl compounds because [ETEA (2019)]

CORE CONCEPT AND DERIVATION

Oxidation of an alcohol to an aldehyde or ketone requires the removal of two hydrogen atoms: one from the hydroxyl group and one from the alpha-carbon (the carbon attached to the $-\text{OH}$).

Formula:

Not applicable to this conceptual question.

Solution:

- In a tertiary alcohol, the alpha-carbon is attached to three other carbon atoms and zero hydrogen atoms.
- Without this crucial **alpha-hydrogen**, the elimination mechanism for standard oxidation cannot proceed without breaking strong C-C bonds (which requires extreme conditions leading to destruction/cleavage of the molecule).

Why other options are incorrect:

Option A is a structural fact but not the direct mechanistic reason. Option C is false because strong oxidants exist, but they cause severe fragmentation rather than simple conversion to a carbonyl.

Question #71 Key: (B)

MDCAT 2019

Ketones can be made by oxidation of [MDCAT (2019)]

CORE CONCEPT AND DERIVATION

The oxidation state of the carbon determines the product. Removing two hydrogens from a secondary alcohol yields a ketone.

Formula:



Solution:

- A secondary alcohol has one alpha-hydrogen.
- Oxidation removes this hydrogen along with the hydroxyl hydrogen, creating a carbon-oxygen double bond flanked by two alkyl groups. This defines a ketone.

Why other options are incorrect:

Primary alcohols oxidize to aldehydes (and subsequently to carboxylic acids). Tertiary alcohols resist mild oxidation. Aldehydes oxidize into carboxylic acids.

Question #72 Key: (B)

MDCAT 2019

Select the reagent X from the following choices for this conversation; [Formula] [MDCAT (2019)]

CORE CONCEPT AND DERIVATION

The chemical equation shows a secondary alcohol (3-methyl-2-butanol) being converted into a ketone (3-methyl-2-butanone). This process is an oxidation.

Formula:



Solution:

- We must select a strong oxidizing agent capable of this transformation.
- **Acidified Potassium dichromate (VI)**, or $K_2Cr_2O_7/H_2SO_4$, is the standard laboratory oxidizing agent used for converting alcohols into carbonyl compounds.

Why other options are incorrect:

Phosphoric acid is a dehydrating agent (forms alkenes). KOH is a strong base, not an oxidizing agent. Oxalic acid is a weak organic acid, not an oxidant.

Question #73 Key: (D)

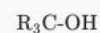
MDCAT 2018

Alcohol in which carbon atom bonded to [Formula] group is further attached with three alkyl group is [MDCAT (2018)]

CORE CONCEPT AND DERIVATION

Alcohols are structurally classified by the substitution pattern on the alpha carbon (the C – OH carbon).

Formula:



Solution:

- If the alpha carbon is attached to zero or one alkyl group, it's primary.
- If attached to two, it's secondary.
- If attached directly to **three alkyl groups**, it is strictly classified as a tertiary (3°) alcohol.

Why other options are incorrect:

By absolute definition, primary and secondary lack three alkyl groups. Aromatic alcohols have the -OH group attached to an alkyl chain that is attached to a benzene ring (like benzyl alcohol), which doesn't specify the degree of substitution.

Question #74 Key: (B)

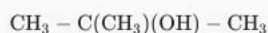
MDCAT 2018

Which one the following compounds is known as tertiary alcohol?
[MDCAT (2018)]

CORE CONCEPT AND DERIVATION

To identify a tertiary alcohol from its IUPAC name, the hydroxyl group and an alkyl substituent must be positioned on the identical carbon atom in the main chain.

Formula:



Solution:

- Option A (2-Methyl-1-propanol) has -OH on C1 and methyl on C2 (primary).
- Option B (2-Methyl-2-propanol) has both the -OH group and a methyl group on C2. This means C2 is bonded to three carbons, making it a tertiary alcohol.
- Option C is secondary, and Option D is primary.

Why other options are incorrect:

A tertiary alcohol must have the generic locant pattern "x-alkyl-x-alkanol". Only Option B fits this structural requirement.

Question #75 Key: (D)

MDCAT 2017

[Formula] choose the correct type for this reaction from the following? [MDCAT (2017)]

CORE CONCEPT AND DERIVATION

The reaction depicts the final step in the industrial hydration of ethene. Ethyl hydrogen sulfate is hydrolyzed by water to yield ethanol and regenerate sulfuric acid.

Formula:

Not strictly necessary, but mathematically it is the addition of H_2O elements over the entire process.

Solution:

- The reactant reacts with water (H_2O) and incorporates the elements of water (H and OH) into the final organic framework (if we consider the overall mechanism from ethene).
- In chemical terms, treating the alkyl sulfate with water to replace the sulfate group with a hydroxyl group is technically hydrolysis, but in the context of the overall synthesis from alkenes, this step completes the **hydration** sequence.

Why other options are incorrect:

It is not reduction or oxidation as the oxidation states of the carbons do not change. It is not hydroxylation (which usually implies adding two -OH groups across a double bond via osmium tetroxide or cold permanganate).

Question #76 Key: (C)

MDCAT 2017

[Formula] Formation of HCl is test for the presence of ___ in a compound [MDCAT (2017)]

CORE CONCEPT AND DERIVATION

Phosphorus pentachloride is a diagnostic reagent for functional groups containing an oxygen-hydrogen bond.

Formula:



Solution:

- The mechanism involves the nucleophilic oxygen of the hydroxyl group attacking the phosphorus.
- The subsequent elimination of a proton and a chloride ion generates HCl gas.
- Thus, this reaction specifically confirms the presence of a hydroxyl (-OH) group.

Why other options are incorrect:

Alkyl and saturated alkyl groups do not react with PCl_5 . An acid H^+ ion doesn't undergo this substitution pathway.

Question #77 Key: (B)

MDCAT 2017

[Formula] what will be the exact product [MDCAT (2017)]

CORE CONCEPT AND DERIVATION

The reaction between a carboxylic acid and an alcohol in the presence of an acid catalyst (like conc. H_2SO_4) is Fischer esterification.

Formula:



Solution:

- Acetic acid (CH_3COOH) reacts with ethanol ($\text{C}_2\text{H}_5\text{OH}$).
- The hydroxyl group from the acid and the hydrogen from the alcohol are removed as water.
- The resulting ester is $\text{CH}_3\text{COOC}_2\text{H}_5$, known as **ethyl acetate** (or ethyl ethanoate).

Why other options are incorrect:

Diethyl ether requires dehydration of ethanol alone at 140°C . This is an esterification, not an etherification or cross-coupling.

Question #78 Key: (C)

MDCAT 2017

At 25°C with phenol, 2,4-Dinitrophenol is formed by the reaction of:
[MDCAT (2017)]

CORE CONCEPT AND DERIVATION

Phenol is a highly activated ring. Nitration conditions dictate the extent of substitution. While dilute HNO_3 gives mono-nitration and concentrated gives tri-nitration (picric acid), intermediate conditions/mixed acids at specific temperatures can yield di-nitration products.

Formula:**Solution:**

- To attach nitro groups to the phenol ring, a nitrating mixture containing HNO_3 is required.
- Therefore, the reaction of phenol with a nitrating mixture ($\text{HNO}_3 + \text{H}_2\text{SO}_4$) leads to nitration at the ortho and para positions.

Why other options are incorrect:

Option A yields nitrobenzene or dinitrobenzene, not a phenol derivative. Option B yields phenol (Dow process variant). Option D yields pure phenol without nitro groups.

Question #79 Key: (A)

MDCAT 2017

The phenoxide ion is more stable than ethoxide ion as [MDCAT (2017)]

CORE CONCEPT AND DERIVATION

The stability of a conjugate base determines the acidity of the parent compound. Resonance delocalization significantly enhances stability.

Formula:

Not applicable to this conceptual question.

Solution:

- In the phenoxide ion ($\text{C}_6\text{H}_5\text{O}^-$), the negative charge resides on the oxygen atom.
- One of the lone pairs on the oxygen atom resides in a p-orbital that is perfectly parallel to the π -system of the aromatic ring, allowing the negative charge to be delocalized over the ortho and para carbon atoms of the ring.
- This dispersion of charge heavily stabilizes the phenoxide ion relative to the ethoxide ion, where the charge is completely localized on the oxygen.

Why other options are incorrect:

Option C is factually wrong (the charge is delocalized, not localized). Option D is wrong because ethoxide has no π -system for delocalization. Option B is a structural fact but doesn't explain the *mechanism* of stability like resonance (Option A) does.

Question #80 **Key: (B)**

MDCAT 2017

The acidity of phenol is due to its _____. [MDCAT (2017)]

CORE CONCEPT AND DERIVATION

Acidity is thermodynamically driven by the stability of the anion formed after the proton is lost.

Formula:



Solution:

- Phenol acts as an acid because it yields a proton to form a phenoxide ion.
- The **nature of the phenoxide ion**—specifically its ability to stabilize the resulting negative charge through resonance—is the direct cause of phenol's enhanced acidity compared to aliphatic alcohols.

Why other options are incorrect:

The hydroxyl group alone (Option D) doesn't guarantee strong acidity (e.g., ethanol). The nature of benzene (Option A) or its double bonds (Option C) are incomplete explanations; the critical factor is the electronic behavior of the resulting conjugate base (phenoxide).

Question #81 **Key: (D)**

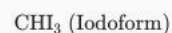
MDCAT 2016

Which one of the following is an appropriate indication of positive iodoform test? [MDCAT (2016)]

CORE CONCEPT AND DERIVATION

Chemical qualitative tests rely on visual cues (color changes, gas evolution, precipitates) to confirm a reaction.

Formula:



Solution:

- The final organic product of the haloform reaction utilizing iodine is triiodomethane (iodoform).
- Iodoform is highly insoluble in aqueous solution and visually manifests as distinct pale **yellow crystals** with a medicinal smell.

Why other options are incorrect:

A brick red precipitate is characteristic of Fehling's or Benedict's test (due to Cu_2O). Hydrogen gas release is characteristic of metals reacting with acids or alcohols. Water formation is invisible.

Question #82 **Key: (B)**

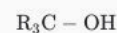
MDCAT 2016

[Formula] Which one of the following is proper classification of the above formula? [MDCAT (2016)]

CORE CONCEPT AND DERIVATION

Alcohols are classified by counting the number of alkyl/carbon groups directly attached to the alpha carbon (the carbon bonded to the hydroxyl group).

Formula:



Solution:

- In $(\text{CH}_3)_3\text{C} - \text{OH}$ (tert-butyl alcohol), the central alpha carbon is bonded to exactly three methyl groups.
- Therefore, it is a tertiary (3°) alcohol.

Why other options are incorrect:

Primary alcohols have one alkyl group attached. Secondary have two. Polyhydric alcohols possess multiple $-\text{OH}$ groups, whereas this molecule only has one.

Question #83 Key: (D)

KMU 2016

Choose reaction that does not require [Formula] Catalyst: [ETEA (2016)]

CORE CONCEPT AND DERIVATION

The reactivity of halogen acids with alcohols follows the order $\text{HI} > \text{HBr} > \text{HCl}$, based on bond dissociation energy and the strength of the acid.

Formula:

Not applicable to this conceptual question.

Solution:

- HCl is relatively unreactive with primary alcohols and explicitly requires a Lewis acid catalyst like anhydrous ZnCl_2 (Lucas reagent) to weaken the $\text{C}-\text{O}$ bond.
- HBr and HI are much stronger acids and more reactive; they can protonate and substitute the alcohol without requiring the ZnCl_2 catalyst.
- Therefore, reactions B and C do not require the catalyst.

Why other options are incorrect:

Option A is the only reaction that **does** require the catalyst. Thus, choosing "Both B & C" is the complete and correct answer.

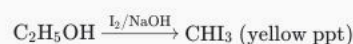
Question #84 Key: (D)

MDCAT 2015

How will you distinguish between methanol and ethanol? [MDCAT (2015)]

CORE CONCEPT AND DERIVATION

Differentiation between two primary alcohols relies on specific structural tests. Ethanol contains a $\text{CH}_3 - \text{CH}(\text{OH}) -$ terminal group, whereas methanol does not.

Formula:**Solution:**

- Methanol and ethanol are both primary alcohols, so they both give negative Lucas tests at room temperature.
- Ethanol reacts with Iodine and NaOH to give yellow crystals of Iodoform (CHI_3).
- Methanol yields no reaction under the same conditions.

Why other options are incorrect:

Lucas test cannot distinguish them because neither reacts quickly. Silver mirror is for aldehydes. Oxidation gives formaldehyde vs acetaldehyde, which are harder to distinguish visually than a direct precipitation test.

Question #85 Key: (A)

MDCAT 2014

Primary, secondary and tertiary alcohols can be identified and distinguished by [MDCAT (2014)]

CORE CONCEPT AND DERIVATION

The Lucas test utilizes Lucas reagent (conc. HCl + anhydrous ZnCl_2) to differentiate alcohols based on their reactivity via the $\text{S}_\text{N}1$ mechanism.

Formula:



Solution:

- Tertiary alcohols react immediately to form a cloudy/oily layer.
- Secondary alcohols take 5–10 minutes to react.
- Primary alcohols do not react at room temperature (require heating).

Why other options are incorrect:

Baeyer's test identifies unsaturation (double/triple bonds). Iodoform test specifically identifies methyl ketones or methyl carbinols (like ethanol). Silver mirror test identifies aldehydes.

Question #86 Key: (C)

MDCAT 2014

Which one of the following groups is indicated when HCl is formed by reaction of ethanol with phosphorus penta...

CORE CONCEPT AND DERIVATION

Phosphorus pentachloride (PCl_5) is a standard analytical reagent used to confirm the presence of a hydroxyl ($-\text{OH}$) group in organic compounds.

Formula:



Solution:

- The violent evolution of hydrogen chloride (HCl) gas fumes when an organic compound is treated with PCl_5 definitively proves the compound contains an $-\text{OH}$ group.

Why other options are incorrect:

Amino, halide, and hydride groups do not produce HCl gas upon reaction with PCl_5 via this specific substitution mechanism.

Question #87 Key: (C)

MDCAT 2014

Which one of the following alcohol is indicated by formation of yellow crystals in iodoform tests? [MDCAT (201...]

CORE CONCEPT AND DERIVATION

The iodoform test gives a positive result (yellow crystals of CHI_3) for compounds containing a methyl ketone group ($\text{CH}_3\text{CO}-$) or alcohols that oxidize to methyl ketones (specifically, secondary alcohols with a methyl group on the alpha carbon, or ethanol).

Formula:



Solution:

- Among primary alcohols, **only ethanol** gives a positive iodoform test because it oxidizes to acetaldehyde (which contains the required $\text{CH}_3\text{CO}-$ group).

Why other options are incorrect:

Methanol, 1-butanol, and propanal lack the $\text{CH}_3\text{CH}(\text{OH})-$ or $\text{CH}_3\text{CO}-$ structural requirement to form iodoform.

Question #88 Key: (C)

MDCAT 2014

The formula of 2, 4, 6-Tribromophenol is [MDCAT (2014,2016)]

CORE CONCEPT AND DERIVATION

Nomenclature requires numbering the benzene ring starting from the principal functional group (the $-\text{OH}$ group at position 1).

Formula:



Solution:

- The hydroxyl group is at C-1.
- Bromine atoms are located symmetrically at the two ortho positions (C-2 and C-6) and the para position (C-4).
- This structural arrangement forms 2,4,6-tribromophenol.

Why other options are incorrect:

The other placeholders represent di-substituted variants or incorrect positional isomers that do not match the "2,4,6" numbering scheme.

Question #89 Key: (A)

MDCAT 2013

Consider the following reaction [Formula] What product(s) may be formed? [MDCAT (2013)]

CORE CONCEPT AND DERIVATION

Phosphorus pentachloride (PCl_5) reacts vigorously with compounds containing a hydroxyl ($-\text{OH}$) group, replacing it with a chlorine atom and generating specific byproducts.

Formula:



Solution:

- Applying ethanol ($\text{C}_2\text{H}_5\text{OH}$) to the general equation yields ethyl chloride, phosphorus oxychloride, and hydrogen chloride gas.

Why other options are incorrect:

Options B, C, and D are incomplete. They fail to account for all the atoms provided by the reactants (conservation of mass).

Question #90 Key: (D)

MDCAT 2013

OH (1) NO₂ (2) NO₂ (4) NO₂ (6) 2,4,6-Trinitrophenol (Picric Acid Structure) is named as [MDCAT (2013,2016)]

CORE CONCEPT AND DERIVATION

When phenol undergoes extensive electrophilic aromatic substitution with a nitrating mixture, it gets fully nitrated at all ortho and para positions.

Formula:



Solution:

- The structure shown has three nitro groups at the 2, 4, and 6 positions of the phenol ring.
- The common trivial name for 2,4,6-trinitrophenol is **picric acid**.

Why other options are incorrect:

Nitro phenol usually refers to a mono-nitrated species. Benzoic acid has a $-\text{COOH}$ group instead of $-\text{OH}$. Malonic acid is an aliphatic dicarboxylic acid.

Question #91 Key: (A)

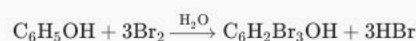
MDCAT 2013

Aqueous phenol decolorizes bromine water to form a white precipitate. What is the structure of the white precipitate?

CORE CONCEPT AND DERIVATION

The hydroxyl group ($-\text{OH}$) on a benzene ring is highly activating. In the presence of aqueous bromine (a polar solvent), phenol rapidly undergoes polyhalogenation.

Formula:



Solution:

- Bromine is directed to all available ortho (2,6) and para (4) positions simultaneously.
- The resulting product is 2,4,6-tribromophenol, which appears as a characteristic white precipitate.

Why other options are incorrect:

Mono-bromination (options B and C) requires a non-polar solvent like CS_2 or CCl_4 at low temperatures to decrease the electrophilicity of the bromine.

Question #92 Key: (A)

MDCAT 2012

The following structure is of: [Formula] [MDCAT (2012)]

CORE CONCEPT AND DERIVATION

The classification of an alcohol depends on the number of alkyl groups attached to the α -carbon (the carbon bonded to the $-\text{OH}$ group).

Formula:



Solution:

- The given structure shows the alpha carbon attached to one hydrogen atom and **two** alkyl groups (R and R').
- This strictly defines a secondary alcohol.

Why other options are incorrect:

Primary alcohols have one alkyl group. Tertiary alcohols have three. Carboxylic acids contain a $-\text{COOH}$ group, which is structurally completely different.

Question #93 Key: (A)

MDCAT 2011

Which of the following is secondary alcohol? [MDCAT (2011)]

CORE CONCEPT AND DERIVATION

A secondary (2°) alcohol has the hydroxyl (–OH) group attached to an alpha carbon that is directly bonded to exactly **two** other carbon atoms (alkyl groups).

Formula:



Solution:

- In option A (isopropyl alcohol), the alpha carbon is bonded to two methyl groups, classifying it as a secondary alcohol.

Why other options are incorrect:

Option B is glycerol (a trihydric alcohol). Option C is a primary alcohol (1-propanol). Option D is a tertiary alcohol (tert-butyl alcohol).

Question #95 Key: (D)

MDCAT 2010

Dissociation constant of phenol is: [MDCAT (2010)]

CORE CONCEPT AND DERIVATION

The acid dissociation constant (K_a) quantifies the extent of acid dissociation in water. Phenol is a weak acid, meaning its K_a is very small.

Formula:

$$K_a = \frac{[H^+][C_6H_5O^-]}{[C_6H_5OH]}$$

Solution:

- The accepted experimental K_a value for phenol at 25°C is 1.3×10^{-10} .

Why other options are incorrect:

Options with positive exponents (10^{10}) indicate a superacid, which is logically impossible for phenol. 1.2×10^{-10} is numerically incorrect according to standard curriculum data.

Question #94 Key: (B)

MDCAT 2011

An alcohol is converted into an aldehyde with same number of carbon atoms in the presence of [Formula] / [Form...]

CORE CONCEPT AND DERIVATION

Oxidation of **primary alcohols** yields aldehydes (with the same number of carbons) if the oxidizing agent is mild or distilled off quickly. Secondary alcohols yield ketones.

Formula:



Solution:

- We must identify the primary alcohol among the options.
- $CH_3CH_2CH_2OH$ (1-propanol) is a primary alcohol and oxidizes to propanal.

Why other options are incorrect:

Options A and D represent isopropyl alcohol, which is a secondary alcohol that oxidizes to acetone. Option C is a tertiary alcohol, which resists oxidation under these specific conditions.