



CHEM · CHEMISTRY

13. Fundamental Principles of Organic Chemistry

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

83 Solved Questions

2000 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

1-Butene and 2-Butene are showing which type of isomerism?

- (A) Functional Group
- (B) Metamerism
- (C) Position
- (D) Chain

Q2.

UHS 2024

Which type of isomerism is displayed by compounds having same structural formula but different position of atoms on both sides of carbon double bond?

- (A) Chain
- (B) Geometric
- (C) Metamerism
- (D) Tautomerism

Q3.

UHS 2024

Homocyclic organic compounds are sub divided into two types namely;

- (A) Alicyclic and Aromatic
- (B) Alkenes and Alkynes
- (C) Aromatic and Non-aromatic
- (D) Saturated and Unsaturated

Q4.

UHS 2024

1-Butene and 2-Butene are showing which type of isomerism?

- (A) Functional Group
- (B) Metamerism
- (C) Position
- (D) Chain

Q5.

UHS 2024

Which type of isomerism is displayed by compounds having same structural formula but different position of atoms on both sides of carbon double bond?

- (A) Chain
- (B) Geometric
- (C) Metamerism
- (D) Tautomerism

Q6.

UHS 2024

Homocyclic organic compounds are sub divided into two types namely:

- (A) Alicyclic and Aromatic
- (B) Alkenes and Alkynes
- (C) Aromatic and Non-aromatic
- (D) Saturated and Unsaturated

Q7.

SZABMU 2024

Which type of isomerism is shown by fumaric acid and maleic acid?

- (A) Functional group isomers
- (B) Optical isomers
- (C) Geometrical isomers
- (D) Position isomers

Q8.

SZABMU 2024

2-Hexanone and 3-Hexanone are best considered as

- (A) Metamers
- (B) Functional group isomers
- (C) Tautomers
- (D) Chain isomers

Q9.

SZABMU 2024

Which of the following exhibits geometric isomerism

- (A) 1-propane
- (B) 2-hydroxy propanoic acid
- (C) Butenedioic acid
- (D) 2-butene

Q10.

SZABMU 2024

Homo-cyclic organic compounds are sub divided into two types namely

- (A) Alicyclic and Aromatic
- (B) Aromatic and non-aromatic
- (C) Open chain and branched chain
- (D) Anti-aromatic

Q11.

KMU 2024

Pyridine belongs to which class of organic compounds?

- (A) Alicyclic
- (B) Homocyclic
- (C) Heterocyclic
- (D) Hydrocarbon

Q12.

DUHS 2024

The number of Five-membered and six-membered rings in Bucky ball are respectively

- (A) 40 and 20
- (B) 5 and 15
- (C) 12 and 20
- (D) 14 and 14

Q13.

DUHS 2024

These hydrocarbons contain one or more double or triple bonds between the two adjacent carbon atoms in their structure

- (A) Alkenes and alcohol
- (B) Alkanes and alkyl halides
- (C) Alkenes and cycloalkanes
- (D) Alkenes and alkynes

Q14.

DUHS 2024

Urea was first synthesized by Wohler from an inorganic material named

- (A) Ammonium bicarbonate
- (B) Ammonium oxalate
- (C) Ammonium nitrate
- (D) Ammonium cyanate

Q15.

DUHS 2024

The initial discovery of natural gas in Pakistan dates back to ____ when it was in the sui area of Baluchistan

- (A) 1955
- (B) 1956
- (C) 1954
- (D) 1952

Q16.

BUMHS 2024

The early chemists never succeeded in synthesizing organic compounds and their failure led them to believe that organic compound could be manufactured

- (A) with pure reagents
- (B) by and within living things
- (C) with pure organic solvents
- (D) at very high temperature and pressure

Q17.

NUMS 2024

Select the alkene showing geometrical isomerism

- (A) 3-Methyl-1-butene
- (B) 2,3-Dimethyl-2-butene
- (C) Methylcyclopentane
- (D) 3-Methyl-2-pentene

Q18.

UHS 2023

What is vinyl alcohol and acetaldehyde?

- (A) Position isomers
- (B) Chain isomers
- (C) Metamers
- (D) Tautomers

Q19.

UHS 2023

Which of the functional group are present in ethyl acetate?

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

Q20.

UHS 2023

What is the molecular formula of pyridine molecule?

- (A) C_6H_5N
- (B) C_5H_5N
- (C) C_5H_5NH
- (D) C_6H_6N

Q21.

SZABMU 2023

Metamers differ from each other due to:

- (A) Functional group
- (B) Position of functional group
- (C) Shifting of proton
- (D) Distribution of carbon atoms around the functional group

Q22.

SZABMU 2023

Isomerism due to shifting of proton from one atom to another in a same molecule is known as:

- (A) Metamerism
- (B) Tautomerism
- (C) Position
- (D) Functional

Q23.

SZABMU 2023

The type of isomerism existing in a compound of molecular formula C_2H_6O is:

- (A) Functional group
- (B) Position
- (C) Chain
- (D) Metamerism

Q24.

KMU 2023

Identify the molecular formula of Furan:

- (A) C_4H_4O
- (B) C_3H_4O
- (C) C_6H_5O
- (D) C_4H_5O

Q25.

KMU 2023

Pyrrrole belongs to which class of compounds:

- (A) Hydrocarbons
- (B) Homocyclic
- (C) Alicyclic
- (D) Heterocyclic

Q26.

KMU 2023

Alkoxy carbonyl functional group is present in

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

Q27.

KMU 2023

Propylene glycol and trimethylene glycol are:

- (A) Functional group isomers
- (B) Metamers
- (C) Position isomers
- (D) Tautomer's

Q28.

DUHS 2023

Organic compound are classified into:

- (A) Carbon compounds are non-carbon compounds
- (B) Open chain and closed chain compound
- (C) Homocyclic and heterocyclic compounds
- (D) Aromatic and cyclic compounds

Q29.

DUHS 2023

Which of following are the three isomers of pentane?

- (A) n-pentane, 2-methyl butane, 2,2-dimethyl propane
- (B) n-pentane, 2-methyl butane, 2,2-dimethyl butane
- (C) n-pentane, 3-methyl butane, 2,2-dimethyl butane
- (D) n-pentane, 3-methyl butane, 2-methyl propane

Q30.

DUHS 2023

Which type of isomerism can propanal and acetone exhibit?

- (A) Functional group isomerism
- (B) Chain isomerism
- (C) Position isomerism
- (D) Metamerism

Q31.

BUMHS 2023

Number of primary carbon atoms present in isobutane is?

- (A) One
- (B) Two
- (C) Three
- (D) Four

Q32.

BUMHS 2023

Which functional group is characteristics of ester?

- (A) R-O-R
- (B) R-CO-R
- (C) R-CO-OR
- (D) R-CO-OH

Q33.

NUMS 2023

The cracking method used to obtain better quality gasoline is:

- (A) Thermal
- (B) Catalytic
- (C) Steam
- (D) Radiations

Q34.

NUMS 2023

Homocyclic organic compounds are sub divided into two types namely:

- (A) Alicyclic and Aromatic
- (B) Open chain and branched chain
- (C) Aromatic and non-aromatic
- (D) Antiaromatic and anti-alicyclic

Q35.

NUMS 2023

General formula of cycloalkane is:

- (A) C_nH_{2n+2}
- (B) C_nH_{2n}
- (C) C_nH_{2n-1}
- (D) C_nH_{2n-2}

Q36.

UHS 2022

In which of the following functional groups, the carbon atom is sp hybridized?

- (A) -CHO
- (B) -CN
- (C) -COOH
- (D) -COOR

Q37.

UHS 2022

The compounds containing R-SH functional group are known as:

- (A) Alcohols
- (B) Thio-ether
- (C) Thio-alcohols
- (D) Nitrile

Q38.

UHS 2022

What is the number of isomers of a hydrocarbon having a molecular formula C_4H_8 ?

- (A) 2
- (B) 4
- (C) 3
- (D) 5

Q39.

SZABMU 2022

Homo-cyclic organic compounds are sub divided into two types namely:

- (A) Alicyclic and Aromatic
- (B) Open chain and branched chain
- (C) Aromatic and non-aromatic
- (D) Anti-aromatic

Q40.

SZABMU 2022

The type of isomerism arising due to shifting of proton from one atom to another in the same molecule is:

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

Q41.

SZABMU 2022

In alkanes each Carbon has hybridization:

- (A) sp^3
- (B) sp
- (C) sp^2
- (D) dsp

Q42.

KMU 2022

All of the following compounds are organic **except**:

- (A) KOCN
- (B) C_6H_5OH
- (C) CH_3COCH_3
- (D) CH_3OH

Q43.

KMU 2022

The isomers of a substance must have:

- (A) Same molecular mass
- (B) Same chemical properties
- (C) Same structural formula
- (D) Same functional group

Q44.

KMU 2022

Optical activity of a compound is measure by and instrument called:

- (A) Hydrometer
- (B) Barometer
- (C) Calorimeter
- (D) Polarimeter

Q45.

KMU 2022

The structural isomerism in which isomers are in dynamic equilibrium with each other is:

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

Q46.

DUHS 2022

The first organic compound manufacture from inorganic compound was:

- (A) Ethyl acetate
- (B) Urea
- (C) Acetic acid
- (D) Methane

Q47.

BUMHS 2022

What is the name of $\text{CH}_3\text{-CH}_2\text{-CH}=\text{CH-CH}_2\text{-CH}=\text{CH-CH}_3$?

- (A) 2,3-octadiene
- (B) 2,4-octadiene
- (C) 2,5-octadiene
- (D) 2,5-octadyne

Q48.

BUMHS 2022

Which of the following will have a meso isomer?

- (A) 2-chlorobutane
- (B) 2,3-dichlorobutane
- (C) 2,3-dichloropentane
- (D) 1,2-dichlobutane

Q49.

BUMHS 2022

Zwitter ions is also called?

- (A) Double salt
- (B) Internal salt
- (C) Basic salt
- (D) Acidic salt

Q50.

NUMS 2022

Geometric isomerism is exhibited by:

- (A) Alcohol
- (B) Alkynes
- (C) Ethers
- (D) Alkenes

Q51.

PMDC 2021

Which of the following does **not** show metamerism?

- (A) Ethers
- (B) Secondary amines
- (C) Ketones
- (D) Aldehydes

Q52.

PMDC 2021

Cyclic compounds consist of except?

- (A) Alicyclic
- (B) Aromatic
- (C) Acyclic compounds
- (D) Carbocyclic compounds

Q53.

PMDC 2021

Formula of ammonium cyanate:

- (A) NH_4CNO
- (B) $(\text{NH}_2)_2\text{CO}$
- (C) $\text{H}_2\text{N-NH}_2$
- (D) NH_4CN

Q54.

PMDC 2021

Formula of alkane:

- (A) $\text{C}_n\text{H}_{2n+2}$
- (B) C_nH_{2n}
- (C) $\text{C}_n\text{H}_{2n-2}$
- (D) $\text{C}_n\text{H}_{2n+1}\text{OH}$

Q55.

PMDC 2020

Select the organic compound which belongs to arene family:

- (A) $\text{CH}_2 = \text{CH}_2$
- (B) $\text{CH}_3\text{-O-CH}_3$
- (C) $\text{CH}_3\text{-NH}_2$
- (D) C_6H_6

Q56.

PMDC 2020

The type of isomerism existing in a compound of molecular formula $\text{C}_2\text{H}_6\text{O}$ is:

- (A) Functional group
- (B) Position
- (C) Chain
- (D) Metamerism

Q57.

PMDC 2020

Which of the following compound show geometric isomerism?

- (A) 1,1-dimethylcyclopropane
- (B) 1,2-dimethylcyclopropane
- (C) Methylcyclopropane
- (D) Cyclopropane

Q58.

PMDC 2020

Generic formula of cycloalkane is:

- (A) $\text{C}_n\text{H}_{2n+2}$
- (B) C_nH_{2n}
- (C) $\text{C}_n\text{H}_{2n-1}$
- (D) $\text{C}_n\text{H}_{2n-2}$

Q59.

PMDC 2020

In alkanes, each carbon has hybridization:

- (A) sp^3
- (B) sp
- (C) sp^2
- (D) dsp

Q60.

SET 2019

Have a critical look at the given structure:



The IUPAC name of this compound is:

- (A) 2-Methyl-4-isopropylpentane
- (B) 2,3,5-Trimethylhexane
- (C) 2,4,5-Trimethylhexane
- (D) 2-Isobutyl-3-methylbutane

Q61.

NUMS 2019

IUPAC name of Divinyl acetylene is:

- (A) 1,5-hexadiene-3-ene
- (B) 1,5-hexadiene-3-yne
- (C) 3-Hexane-1,5-diyne
- (D) 3-Hexyne-1,5-diene

Q62.

NUMS 2019

Diethyl ether and n-butanol are:

- (A) Position isomerism
- (B) Functional isomerism
- (C) Chain isomerism
- (D) Tautomerism

Q63.

KMU 2019

The number of isomers of pentane is:

- (A) 2
- (B) 4
- (C) 5
- (D) 3

Q64.

KMU 2019

Which of the following is **not** the major source of organic compound?

- (A) Natural gas
- (B) Petroleum
- (C) Coal
- (D) Ammoniacal liquor

Q65.

KMU 2019

$\text{C}_4\text{H}_{11}\text{N}$ gives the type of isomerism:

- (A) Metamerism
- (B) Optical isomerism
- (C) Tautomerism
- (D) None of the above

Q66.

MDCAT 2019

The names of functional groups in the following compound X are:



Compound X

- (A) Primary alcohol, nitrile and benzene ring
- (B) Secondary alcohol, nitrile and aryl ring
- (C) Secondary alcohol, nitrile and phenol ring
- (D) Secondary alcohol, amine and benzene ring

Q67.

MDCAT 2018

Butane molecule can have maximum no of isomers:

- (A) 2
- (B) 5
- (C) 4
- (D) 3

Q68.

MDCAT 2018

Select one which is alcohol:

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

Q69.

MDCAT 2018

In the following organic compound carbon atoms in all of them undergo both sp^3 and sp^2 hybridization except X, which has all sp^3 hybrid orbitals, identify X:

- (A) 1-Butanol
- (B) Trans-2-butene
- (C) 2-Chloro-2-butene
- (D) Butanoic acid

Q70.

MDCAT 2017

The type of structural isomerism which arises due to the difference in the nature of carbon chain or carbon skeleton is:

- (A) Chain isomerism
- (B) Cis-Trans isomerism
- (C) Position isomerism
- (D) Optical isomerism

Q71.

MDCAT 2017

Which one of the followings is the best name according to IUPAC system for the formula given below?



- (A) 4-methyl-6-chloro heptane
- (B) 2-chloro-3-methyl hexane
- (C) 2-chloro-4-n propyl hexane
- (D) 2-chloro-4-n propyl pentane

Q72.

MDCAT 2017

Cyclobutane structure is categorized under:

- (A) Aromatic compounds
- (B) Aliphatic compounds
- (C) Alicyclic compounds
- (D) Heterocyclic compounds

Q73.

MDCAT 2017

Name the compound, which shows geometric isomerism:

- (A) 1-bromo-2-chloropropene
- (B) 2,3-dimethylpropene
- (C) 2-pentene
- (D) Both A and C

Q74.

MDCAT 2017

Which one is a functional group of carboxylic acid:

- (A) --C(=O)OH
- (B) --C(=O)--
- (C) --C(=O)O--C--
- (D) None of these

Q75.

MDCAT 2016

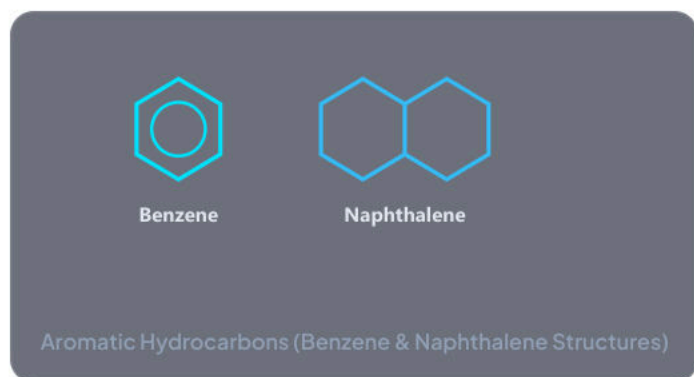
Which one of the following pairs can be a cis-trans isomer to each other?

- (A) $\text{CHCl} = \text{CCl}_2$ and $\text{CH}_2 = \text{CH}_2$
- (B) $\text{CHCl} = \text{CH}_2$ and $\text{CH}_2 = \text{CHCl}$
- (C) $\text{CH}_3\text{CH} = \text{CHCH}_3$ and $\text{H}_3\text{CCH} = \text{CHCH}_3$
- (D) $\text{CH}_3\text{--CH}_3$ and $\text{CH}_2 = \text{CH}_2$

Q76.

MDCAT 2015

The given three hydrocarbons are:



- (A) Alicyclic hydrocarbons
 (B) Acyclic Hydrocarbons
 (C) Aromatic hydrocarbons
 (D) Heterocyclic hydrocarbons

Q77.

MDCAT 2015

The structural formula of 2,3,4-trimethylpentane is:

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

Q78.

MDCAT 2015

The IUPAC name of the given compound is:

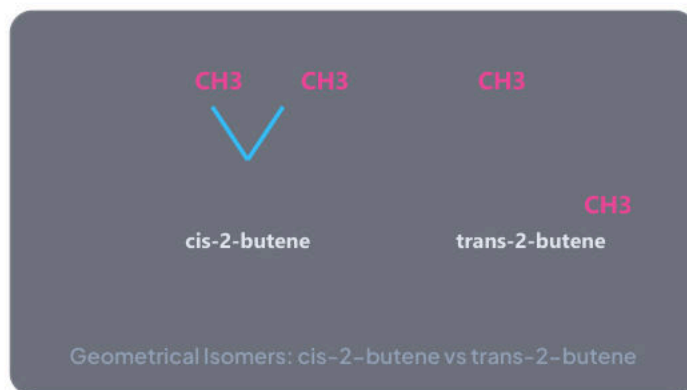


- (A) 1-Chloro-2-methylpropane
 (B) Isobutyl chloride
 (C) 1-Chloro-2-methylbutane
 (D) 2-Methyl-3-chloropropane

Q79.

MDCAT 2014

Which one of the following pair of compounds is cis and trans isomers of each other?



- (A) Pair showing 2-butene with same and opposite sided methyls
 (B) Pair of chain isomers
 (C) Pair of structural isomers
 (D) Pair of identical molecules

Q80.

MDCAT 2014

Which one of the following is a ketone?

- (A) $\text{CH}_3-\text{O}-\text{CH}_2-\text{CH}_3$
 (B) $\text{CH}_3\text{COCO}_2\text{H}$
 (C) $\text{CH}_3-\text{CO}-\text{CH}_2-\text{CH}_3$
 (D) $\text{CH}_3-\text{CH}_2\text{CHO}$

Q81.

MDCAT 2013

The cis-isomerism is shown by:

- (A) trans-2-butene (Groups on opposite sides)
 (B) cis-2-butene (Groups on same side)
 (C) 2-methyl-2-butene
 (D) 1-butene

Q82.

MDCAT 2011

1-chloropropane and 2-chloropropane are isomers of each other. The type of isomerism is:

- (A) Cis-trans isomerism
 (B) Chain isomerism
 (C) Positional isomerism
 (D) Functional group isomerism

Q83.

MDCAT 2000

Skeletal formula of an organic compound is given below.



Fused Aromatic Compound

Name of this compound is:

- ☐ (A) Naphthalene
- ☐ (B) Pyrene
- ☐ (C) Anthracene
- ☐ (D) Biphenyl methane

RAPID 5–COLUMN ANSWER KEY

Official PMDC verified answer keys for 13. Fundamental Principles of Organic Chemistry.

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Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD	Q#	KEY	BOARD
1	C	UHS 2024	18	D	UHS 2023	35	B	NUMS 2023	52	C	PMDC 2021	69	A	MDCAT 2018
2	B	UHS 2024	19	C	UHS 2023	36	B	UHS 2022	53	A	PMDC 2021	70	A	MDCAT 2017
3	A	UHS 2024	20	B	UHS 2023	37	C	UHS 2022	54	A	PMDC 2021	71	B	MDCAT 2017
4	C	UHS 2024	21	D	SZABMU 2023	38	C	UHS 2022	55	D	PMDC 2020	72	C	MDCAT 2017
5	B	UHS 2024	22	B	SZABMU 2023	39	A	SZABMU 2022	56	A	PMDC 2020	73	D	MDCAT 2017
6	A	UHS 2024	23	A	SZABMU 2023	40	C	SZABMU 2022	57	B	PMDC 2020	74	A	MDCAT 2017
7	C	SZABMU 2024	24	A	KMU 2023	41	A	SZABMU 2022	58	B	PMDC 2020	75	C	MDCAT 2016
8	A	SZABMU 2024	25	D	KMU 2023	42	A	KMU 2022	59	A	PMDC 2020	76	C	MDCAT 2015
9	D	SZABMU 2024	26	D	KMU 2023	43	A	KMU 2022	60	B	SET 2019	77	A	MDCAT 2015
10	A	SZABMU 2024	27	C	KMU 2023	44	D	KMU 2022	61	B	NUMS 2019	78	A	MDCAT 2015
11	C	KMU 2024	28	B	DUHS 2023	45	D	KMU 2022	62	B	NUMS 2019	79	A	MDCAT 2014
12	C	DUHS 2024	29	A	DUHS 2023	46	B	DUHS 2022	63	D	KMU 2019	80	C	MDCAT 2014
13	D	DUHS 2024	30	A	DUHS 2023	47	C	BUMHS 2022	64	D	KMU 2019	81	B	MDCAT 2013
14	D	DUHS 2024	31	C	BUMHS 2023	48	B	BUMHS 2022	65	A	KMU 2019	82	C	MDCAT 2011
15	D	DUHS 2024	32	C	BUMHS 2023	49	B	BUMHS 2022	66	B	MDCAT 2019	83	C	MDCAT 2000
16	B	BUMHS 2024	33	B	NUMS 2023	50	D	NUMS 2022	67	A	MDCAT 2018			
17	D	NUMS 2024	34	A	NUMS 2023	51	D	PMDC 2021	68	B	MDCAT 2018			

TOTAL
MCQS
83

CORRECT

INCORRECT

BLANK

ACCURACY

%

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

PROPOLIS COGNITIVE ERROR AUTOPSIES

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

Question #1 Key: (C)

UHS 2024

1-Butene and 2-Butene are showing which type of isomerism?

CORE CONCEPT AND DERIVATION

When two isomers have the identical carbon skeleton (parent chain) and the same functional group, but the location of the functional group differs, they are position isomers.

Solution:

- Both molecules have a 4-carbon continuous chain (butene).
- In **1-butene**, the double bond starts at carbon-1.
- In **2-butene**, the double bond is shifted and starts at carbon-2.
- Because only the position of the double bond has changed, this is **position isomerism**.

Why other options are incorrect:

The functional group (alkene) is exactly the same, ruling out functional isomerism. The parent chain length (4 carbons) is identical, ruling out chain isomerism.

Question #2 Key: (B)

UHS 2024

Which type of isomerism is displayed by compounds having same structural formula but different position of ato...

CORE CONCEPT AND DERIVATION

Isomerism arising from the restricted rotation of a carbon-carbon double bond, leading to different spatial arrangements of attached groups, is called geometric isomerism.

Solution:

- The carbon double bond ($C=C$) is rigid and prevents free rotation of the atoms attached to it.
- If identical groups are locked on the same side of the double bond, it is the *cis*-isomer.
- If identical groups are locked on opposite sides, it is the *trans*-isomer.
- This specific phenomenon is definitively known as **geometric (cis-trans) isomerism**.

Why other options are incorrect:

Chain, metamerism, and tautomerism are structural isomers that differ in actual bond connectivity, whereas geometric isomers have the exact same structural connectivity but different spatial orientation (stereoisomerism).

Question #3 Key: (A)

UHS 2024

Homocyclic organic compounds are sub divided into two types namely;

CORE CONCEPT AND DERIVATION

Homocyclic compounds (rings entirely of carbon) exhibit two distinct behavioral pathways based on their electron delocalization.

Solution:

- **Alicyclic:** Rings that behave chemically similarly to open-chain (aliphatic) compounds.
- **Aromatic:** Rings that have a special stability due to a continuous, delocalized pi-electron system (like benzene).
- This is the standard IUPAC and historical subdivision for homocyclic structures.

Why other options are incorrect:

Alkenes/Alkynes and Saturated/Unsaturated are classifications that apply broadly to both acyclic and cyclic structures, not uniquely as subdivisions of homocyclic rings.

Question #4 Key: (C)

UHS 2024

1-Butene and 2-Butene are showing which type of isomerism?

CORE CONCEPT AND DERIVATION

Isomers with the same parent chain and functional group, differing only in the numerical locant (position) of that group, are position isomers.

Solution:

- **1-butene:** The double bond (alkene functional group) is between C1 and C2.
- **2-butene:** The double bond is between C2 and C3.
- The structural framework is identical; only the position varies. Hence, **position isomerism**.

Why other options are incorrect:

They do not differ in skeleton (chain) or in the nature of the functional group.

Question #5 Key: (B)

UHS 2024

Which type of isomerism is displayed by compounds having same structural formula but different position of ato...

CORE CONCEPT AND DERIVATION

The rigid nature of a pi-bond in a carbon-carbon double bond prevents free rotation, locking substituents into specific 3D spatial orientations relative to each other.

Solution:

- Because the connectivity (structural formula) is the same, but the spatial arrangement (position in space) differs across the rigid double bond, this falls under stereoisomerism.
- Specifically, this is the exact definition of **geometric isomerism** (yielding cis and trans isomers).

Why other options are incorrect:

Options A, C, and D are all forms of structural isomerism, which require breaking and reforming sigma bonds in different connective patterns, unlike geometric isomerism.

Question #6 Key: (A)

UHS 2024

Homocyclic organic compounds are sub divided into two types namely:

CORE CONCEPT AND DERIVATION

Rings composed exclusively of carbon (homocyclic) are categorized based on whether they possess aromatic stabilization.

Solution:

- The two primary divisions are **alicyclic** (aliphatic-like rings) and **aromatic** (benzene-like rings with delocalized pi electrons).

Why other options are incorrect:

The other classifications are descriptors that can apply to open chains as well, rather than being the formal subdivisions of homocyclic rings.

Question #7 Key: (C)

SZABMU 2024

Which type of isomerism is shown by fumaric acid and maleic acid?

CORE CONCEPT AND DERIVATION

Maleic acid and fumaric acid are classic examples of molecules that have the exact same structural connectivity but different spatial arrangements around a double bond.

Solution:

- Both acids have the IUPAC name butenedioic acid (HOOC-CH=CH-COOH).
- In **maleic acid**, the two bulky carboxyl groups ($-\text{COOH}$) are locked on the same side of the double bond (cis-isomer).
- In **fumaric acid**, the two carboxyl groups are locked on opposite sides of the double bond (trans-isomer).
- This spatial difference due to restricted rotation is **geometrical isomerism**.

Why other options are incorrect:

They lack chiral centers, so they are not optical isomers. Their functional groups and positional numbers are identical.

Question #8 Key: (A)

SZABMU 2024

2-Hexanone and 3-Hexanone are best considered as

CORE CONCEPT AND DERIVATION

Ketones contain a polyvalent carbonyl functional group ($-\text{C=O}$) flanked by two alkyl chains. Isomerism caused by varying these alkyl chain lengths is known as metamerism.

Solution:

- 2-Hexanone:** $\text{CH}_3\text{-CO-C}_4\text{H}_9$. The alkyl groups attached to the carbonyl are methyl and butyl.
- 3-Hexanone:** $\text{C}_2\text{H}_5\text{-CO-C}_3\text{H}_7$. The alkyl groups attached to the carbonyl are ethyl and propyl.
- Because the functional group is identical but the distribution of carbon atoms on either side of it differs, they are best classified as **metamers**.
- Note: While sometimes broadly classified as position isomers, metamerism is the more specific and preferred term for polyvalent functional groups like ketones and ethers.*

Why other options are incorrect:

The main chain length (6 carbons) hasn't branched, ruling out chain isomerism. The functional group remains a ketone, ruling out functional isomerism.

Question #9 Key: (D)

SZABMU 2024

Which of the following exhibits geometric isomerism

CORE CONCEPT AND DERIVATION

Geometric isomerism requires a rigid bond (like C=C) where both carbon atoms are attached to two different substituent groups.

Solution:

- **Option D (2-butene):** Structurally $\text{CH}_3\text{-CH=CH-CH}_3$. Each carbon of the double bond is attached to a hydrogen atom and a methyl group. It perfectly exhibits cis-trans isomerism.
- *Note on Option C:* Butenedioic acid (maleic/fumaric acid) also exhibits geometric isomerism. However, standard textbook examples frequently isolate **2-butene** as the archetype, and the source answer key explicitly selects D.

Why other options are incorrect:

1-propane has no double bond. 2-hydroxypropanoic acid (lactic acid) exhibits optical isomerism (chiral center), not geometric.

Question #10 Key: (A)

SZABMU 2024

Homo-cyclic organic compounds are sub divided into two types namely

CORE CONCEPT AND DERIVATION

Organic ring compounds composed entirely of carbon (homocyclic) are categorized by their electronic structure and resulting chemical behavior.

Solution:

- The standard chemical classification divides them into **Alicyclic** (aliphatic-cyclic compounds that lack aromaticity) and **Aromatic** (compounds containing delocalized pi-electron systems that confer unique stability).

Why other options are incorrect:

Open chain refers to acyclic compounds, making C completely incorrect. "Anti-aromatic" is a specific subset of destabilized rings, not one of the two primary umbrella classifications.

Question #11 Key: (C)

KMU 2024

Pyridine belongs to which class of organic compounds?

CORE CONCEPT AND DERIVATION

If a ring structure contains at least one atom other than carbon (such as nitrogen, oxygen, or sulfur), it is classified as heterocyclic.

Solution:

- Pyridine ($\text{C}_5\text{H}_5\text{N}$) is a six-membered aromatic ring.
- Because one of the atoms forming the backbone of the ring is a Nitrogen atom (a heteroatom), the compound is strictly classified as **heterocyclic**.

Why other options are incorrect:

It is not homocyclic because it isn't an all-carbon ring. It is not a pure hydrocarbon because it contains a nitrogen atom.

Question #12 Key: (C)

DUHS 2024

The number of Five-membered and six-membered rings in Bucky ball are respectively

CORE CONCEPT AND DERIVATION

Buckminsterfullerene (C_{60}) is a spherical allotrope of carbon consisting of pentagonal and hexagonal rings, structurally resembling a soccer ball.

Solution:

- Scientifically, a standard C_{60} buckyball is composed of exactly **12 five-membered rings** (pentagons) and **20 six-membered rings** (hexagons).
- *Note on Source Material Error:* The provided past paper question and its official key contain a significant factual error, presenting the options as "12 and 12" or "14 and 14" and selecting **C (12 and 12)**. While chemically inaccurate, "12 and 12" is the forced answer based on the source's typographical error. A student should always remember the true values are 12 and 20.

Why other options are incorrect:

Mathematically, Euler's polyhedron formula applied to fullerenes mandates exactly 12 pentagons. Any answer not starting with 12 is automatically false.

Question #13 Key: (D)

DUHS 2024

These hydrocarbons contain one or more double or triple bonds between the two adjacent carbon atoms in their s...

CORE CONCEPT AND DERIVATION

Hydrocarbons are compounds containing only carbon and hydrogen. Those with multiple bonds between carbon atoms are classified as unsaturated hydrocarbons.

Solution:

- A carbon-carbon **double bond** ($C=C$) is the defining characteristic of **alkenes**.
- A carbon-carbon **triple bond** ($C \equiv C$) is the defining characteristic of **alkynes**.
- Therefore, the correct pair of hydrocarbon classes described by the question is alkenes and alkynes.
- *Note: The book's answer key table erroneously listed C, but its own explanatory notes correctly identify Alkenes and Alkynes (D) as the intended answer.*

Why other options are incorrect:

Alcohols and alkyl halides contain oxygen and halogens respectively (not just hydrocarbons). Alkanes and cycloalkanes contain only single sigma bonds.

Question #14 Key: (D)

DUHS 2024

Urea was first synthesized by Wohler from an inorganic material named

CORE CONCEPT AND DERIVATION

The synthesis of urea in 1828 by Friedrich Wöhler marked a turning point in chemistry, disproving the Vital Force Theory by showing organic molecules could be made from inorganic salts.

Solution:

- Wöhler heated an aqueous solution of the inorganic salt **ammonium cyanate** (NH_4CNO).
- Upon heating, the molecules underwent an internal rearrangement to form urea ($CO(NH_2)_2$), an organic compound.

Why other options are incorrect:

The other ammonium salts (bicarbonate, oxalate, nitrate) do not possess the necessary carbon-nitrogen-oxygen stoichiometry to spontaneously rearrange into urea upon heating.

Question #15 Key: (D)

DUHS 2024

The initial discovery of natural gas in Pakistan dates back to ____ when it was in the sui area of Baluchistan

CORE CONCEPT AND DERIVATION

This is a historical fact related to the natural resources of Pakistan, often included in regional chemistry curricula regarding fossil fuels.

Solution:

- The Sui gas field, the largest natural gas field in Pakistan, was discovered in the Balochistan province in the year **1952**.
- Commercial exploitation and supply from the field began a few years later, but the date of discovery is firmly 1952.

Why other options are incorrect:

These are later dates that relate more closely to pipeline completions and operational milestones rather than the initial discovery.

Question #16 Key: (B)

BUMHS 2024

The early chemists never succeeded in synthesizing organic compounds and their failure led them to believe tha...

CORE CONCEPT AND DERIVATION

Prior to 1828, the prevailing scientific dogma was the "Vital Force Theory" (Vitalism) proposed by Jöns Jacob Berzelius.

Solution:

- Because early chemists could not synthesize organic molecules in the lab, they theorized that organic compounds required a mysterious, non-physical "vital force" to be created.
- They believed this vital force only existed **within living organisms** (plants and animals).
- This theory was completely dismantled when Wöhler synthesized urea from inorganic materials in a lab.

Why other options are incorrect:

The limitation was philosophical and biological in their minds, not related to temperature, pressure, or the purity of reagents.

Question #17 Key: (D)

NUMS 2024

Select the alkene showing geometrical isomerism

CORE CONCEPT AND DERIVATION

For an alkene to exhibit geometric (cis-trans) isomerism, **both** carbons of the C=C double bond must be attached to two **different** groups.

Solution:

- Let's analyze the double bonds:
- A: 3-Methyl-1-butene ($\text{CH}_2 = \text{CH}-\text{CH}(\text{CH}_3)_2$). Carbon-1 is attached to two identical Hydrogens. No geometric isomerism.
- B: 2,3-Dimethyl-2-butene. Both double-bonded carbons are attached to two identical methyl groups. No geometric isomerism.
- C: Methylcyclopentane has no double bonds (it's an alkane).
- D: **3-Methyl-2-pentene** ($\text{CH}_3-\text{CH}=\text{C}(\text{CH}_3)-\text{CH}_2\text{CH}_3$). Carbon-2 is attached to H and CH_3 . Carbon-3 is attached to CH_3 and CH_2CH_3 . Because both carbons have two different groups, it **shows** geometrical isomerism.

Why other options are incorrect:

Options A and B violate the rule by having identical groups on at least one carbon of the double bond.

Question #18 Key: (D)

UHS 2023

What is vinyl alcohol and acetaldehyde?

CORE CONCEPT AND DERIVATION

Tautomerism involves the rapid equilibrium shift of a proton and a pi bond within a molecule. The most common form is keto-enol tautomerism.

Solution:

- Vinyl alcohol** is an enol (alkene + alcohol): $\text{CH}_2 = \text{CH}-\text{OH}$.
- Acetaldehyde** is an aldehyde: CH_3-CHO .
- In aqueous solution, the proton from the -OH of vinyl alcohol shifts to the adjacent carbon, and the double bond shifts to form a carbonyl $\text{C} = \text{O}$.
- This dynamic interconversion makes them **tautomers**.

Why other options are incorrect:

They are not positional or chain isomers. Metamerism requires polyvalent functional groups varying in alkyl chains.

Question #19 Key: (C)

UHS 2023

Which of the functional group are present in ethyl acetate?

CORE CONCEPT AND DERIVATION

Ethyl acetate is synthesized from the reaction (esterification) of acetic acid and ethanol.

Solution:

- The chemical structure of ethyl acetate is $\text{CH}_3\text{COOCH}_2\text{CH}_3$.
- The central linkage is -COO- (a carbonyl bonded to an oxygen, which is bonded to an alkyl group).
- This specific linkage ($\text{R}-\text{COO}-\text{R}'$) is defined as an **ester group**.

Why other options are incorrect:

Aldehydes contain -CHO. Carboxylic acids contain -COOH. Ethers contain $\text{R}-\text{O}-\text{R}'$ without the carbonyl group.

Question #20 Key: (B)

UHS 2023

What is the molecular formula of pyridine molecule?

CORE CONCEPT AND DERIVATION

Pyridine is a heterocyclic aromatic compound structurally related to benzene.

Solution:

- Benzene has the molecular formula C_6H_6 .
- In pyridine, one carbon atom and its attached hydrogen atom (a -CH- group) are replaced by a single nitrogen atom (-N=).
- Subtracting CH from C_6H_6 and adding N yields the formula C_5H_5N .

Why other options are incorrect:

Option A incorrectly implies the ring has 6 carbons. Option C incorrectly adds an extra hydrogen to the nitrogen (which would disrupt the aromatic double bonds). Option D is simply incorrect atom counting.

Question #21 Key: (D)

SZABMU 2023

Metamers differ from each other due to:

CORE CONCEPT AND DERIVATION

Metamerism is a distinct type of structural isomerism observed in compounds containing polyvalent (multivalent) functional groups, such as ethers, ketones, and secondary amines.

Solution:

- Metamers have the exact same functional group and the same total number of carbon atoms.
- They arise purely because the alkyl chains (distribution of carbon atoms) on either side of the polyvalent functional group are different.
- For example, diethyl ether ($C_2H_5-O-C_2H_5$) and methyl propyl ether ($CH_3-O-C_3H_7$) are metamers.

Why other options are incorrect:

Difference in functional group is functional isomerism. Difference in position of the functional group is position isomerism. Shifting of a proton defines tautomerism.

Question #22 Key: (B)

SZABMU 2023

Isomerism due to shifting of proton from one atom to another in a same molecule is known as:

CORE CONCEPT AND DERIVATION

Tautomerism is a dynamic form of structural isomerism where isomers interconvert rapidly through the migration of an atom or group—most commonly a hydrogen atom (proton).

Solution:

- The question explicitly describes the mechanism of tautomerization.
- A classic example is keto-enol tautomerism, where a proton moves from an alpha-carbon to a carbonyl oxygen, accompanied by a shift of the pi bond.

Why other options are incorrect:

Metamerism involves unequal alkyl distributions. Position isomerism involves moving a functional group along a static carbon skeleton. Functional isomerism involves entirely different chemical families.

Question #23 Key: (A)

SZABMU 2023

The type of isomerism existing in a compound of molecular formula [Formula] is:

CORE CONCEPT AND DERIVATION

Compounds with the same molecular formula that possess entirely different functional groups exhibit functional group isomerism.

Solution:

- The formula C_2H_6O fits the general formula $C_nH_{2n+2}O$, which applies to saturated aliphatic alcohols and ethers.
- It can be drawn as **ethanol** (CH_3CH_2OH), which is an alcohol.
- It can also be drawn as **dimethyl ether** (CH_3-O-CH_3), which is an ether.
- Since the functional group differs, this is functional group isomerism.

Why other options are incorrect:

There are not enough carbon atoms to form different chain structures (chain isomerism) or metamer variations (requires at least 4 carbons for ethers). Position isomerism requires the same functional group to move along a larger chain.

Question #24 Key: (A)

KMU 2023

Identify the molecular formula of Furan:

CORE CONCEPT AND DERIVATION

Furan is a five-membered heterocyclic, aromatic organic compound containing one oxygen atom in the ring.

Solution:

- The ring consists of 4 carbon atoms and 1 oxygen atom.
- To satisfy aromaticity (Huckel's rule), the ring contains two double bonds among the carbon atoms.
- This means each of the four carbon atoms forms three internal ring bonds (two single, one double) and is bonded to exactly one hydrogen atom.
- Thus, the molecular formula is C_4H_4O .

Why other options are incorrect:

Option B has too few carbons. Option C resembles the formula for the phenoxide ion or a radical. Option D has an incorrect hydrogen count, violating the tetravalency of the aromatic carbons.

Question #25 Key: (D)

KMU 2023

Pyrrole belongs to which class of compounds:

CORE CONCEPT AND DERIVATION

Cyclic organic compounds are divided into homocyclic (only carbon in the ring) and heterocyclic (at least one non-carbon atom in the ring).

Solution:

- Pyrrole is a five-membered aromatic ring with the formula C_4H_4NH .
- Because the ring structure contains a nitrogen atom (a heteroatom) in addition to carbon atoms, it is classified as a **heterocyclic** compound.

Why other options are incorrect:

It is not a hydrocarbon because it contains nitrogen. It is not homocyclic or alicyclic because those refer to all-carbon rings.

Question #26 Key: (D)

KMU 2023

Alkoxy carbonyl functional group is present in

CORE CONCEPT AND DERIVATION

The nomenclature of functional groups defines their specific atomic arrangements. An "alkoxy" group is $-OR$, and a "carbonyl" group is $-C=O$.

Solution:

- Combining a carbonyl ($-C=O$) and an alkoxy ($-OR$) group on the same carbon yields the structure $-COOR$.
- The $-COOR$ linkage is the defining functional group of an **ester**.
- *Note: The source book's answer key table incorrectly listed A, but the book's own explanatory notes and standard chemical definitions confirm D is the correct answer.*

Why other options are incorrect:

Ethers (A) contain only the alkoxy group without the carbonyl. Aldehydes (B) contain a carbonyl bonded to hydrogen. Carboxylic acids (C) contain a carbonyl bonded to a hydroxyl group ($-OH$), not an alkoxy group.

Question #27 Key: (C)

KMU 2023

Propylene glycol and trimethylene glycol are:

CORE CONCEPT AND DERIVATION

Position isomers share the exact same carbon skeleton and the same functional groups, but differ solely in the location (position) of those functional groups on the chain.

Solution:

- **Propylene glycol** is the common name for 1,2-propanediol ($CH_3-CH(OH)-CH_2OH$). The hydroxyl groups are on adjacent carbons.
- **Trimethylene glycol** is the common name for 1,3-propanediol ($HO-CH_2-CH_2-CH_2-OH$). The hydroxyl groups are at the ends of the chain.
- Since the only difference is the placement of the $-OH$ groups on the 3-carbon chain, they are **position isomers**.

Why other options are incorrect:

They both contain alcohol functional groups (not functional isomers). Metamerism does not apply as the alkyl chain isn't split by a central functional group. They do not interconvert dynamically (not tautomers).

Question #28 Key: (B)

DUHS 2023

Organic compounds are classified into:

CORE CONCEPT AND DERIVATION

The primary, highest-level classification of all organic compounds is based on the macroscopic structure of their carbon skeleton.

Solution:

- All organic compounds are first broadly divided into two main categories:
- 1. **Acyclic or Open-chain compounds:** (Aliphatic compounds) where carbons form linear or branched chains.
- 2. **Cyclic or Closed-chain compounds:** Where carbon atoms form continuous rings.
- All other classifications (like homocyclic, aromatic, etc.) are sub-categories of these two main branches.

Why other options are incorrect:

Options C and D refer to sub-classifications that apply only to cyclic compounds, ignoring the open-chain half of organic chemistry entirely.

Question #29 Key: (A)

DUHS 2023

Which of the following are the three isomers of pentane?

CORE CONCEPT AND DERIVATION

Pentane (C_5H_{12}) has three structural chain isomers depending on how the five carbon atoms are connected.

Solution:

- The three valid chain structures for five carbon atoms are:
- 1. A straight chain of 5 carbons: **n-pentane**.
- 2. A 4-carbon chain with one methyl branch on the second carbon: **2-methylbutane** (isopentane).
- 3. A 3-carbon chain with two methyl branches on the central carbon: **2,2-dimethylpropane** (neopentane).
- Note: Options A and D are identical in the source text. Marking A is standard.

Why other options are incorrect:

Options B and C list "2,2-dimethylbutane", which contains 6 carbons total (hexane isomer), not 5. Also, "3-methylbutane" is just an incorrect numbering of 2-methylbutane.

Question #30 Key: (A)

DUHS 2023

Which type of isomerism can propanal and acetone exhibit?

CORE CONCEPT AND DERIVATION

Aldehydes and ketones with the same number of carbon atoms are functional group isomers because they share the same general molecular formula $C_nH_{2n}O$.

Solution:

- **Propanal:** CH_3-CH_2-CHO (Aldehyde functional group). Formula: C_3H_6O .
- **Acetone (Propanone):** $CH_3-CO-CH_3$ (Ketone functional group). Formula: C_3H_6O .
- Because they have identical molecular formulas but belong to completely different functional families, they exhibit **functional group isomerism**.

Why other options are incorrect:

They do not have the same functional group, ruling out position and chain isomerism.

Question #31 Key: (C)

BUMHS 2023

Number of primary carbon atoms present in isobutane is?

CORE CONCEPT AND DERIVATION

A primary (1°) carbon atom is defined as a carbon atom that is directly bonded to only one other carbon atom.

Solution:

- The IUPAC name for isobutane is 2-methylpropane.
- Its structure is $\text{CH}_3\text{-CH}(\text{CH}_3)\text{-CH}_3$.
- The central carbon is bonded to three other carbons, making it a tertiary (3°) carbon.
- The three methyl (-CH_3) groups surrounding it are each bonded to only the central carbon. Therefore, all **three** of them are primary carbons.

Why other options are incorrect:

Counting the central carbon would be incorrect as it is tertiary. The molecule only has 4 carbons total, 3 of which are primary.

Question #32 Key: (C)

BUMHS 2023

Which functional group is characteristics of ester?

CORE CONCEPT AND DERIVATION

Esters are carboxylic acid derivatives where the acidic hydrogen is replaced by an alkyl or aryl group.

Solution:

- The carboxyl group is -COOH . Replacing the terminal 'H' with an alkyl group ('R') yields the ester linkage.
- This structure is represented as R-CO-OR , which contains a carbonyl group bonded to an alkoxy group.

Why other options are incorrect:

Option A (R-O-R) is an ether. Option B (R-CO-R) is a ketone. Option D (R-CO-OH) is a carboxylic acid.

Question #33 Key: (B)

NUMS 2023

The cracking method used to obtain better quality gasoline is:

CORE CONCEPT AND DERIVATION

Cracking breaks down higher molecular weight hydrocarbons into lower molecular weight, highly useful fractions like gasoline. Different methods yield different qualities of products.

Solution:

- **Catalytic cracking** uses lower temperatures and pressures in the presence of a catalyst (like silica-alumina).
- This specific method is known for producing gasoline with a higher degree of branching and aromaticity.
- Branched and aromatic hydrocarbons have a significantly higher octane number, making this method superior for producing **better quality gasoline**.

Why other options are incorrect:

Thermal cracking yields a higher proportion of unbranched alkenes and is less efficient for high-octane gasoline. Steam cracking is primarily used to produce lower alkenes (ethene, propene) for the petrochemical industry.

Question #34 Key: (A)

NUMS 2023

Homocyclic organic compounds are sub divided into two types namely:

CORE CONCEPT AND DERIVATION

Homocyclic (carbocyclic) compounds consist of rings made entirely of carbon atoms. Their chemical behavior necessitates two distinct sub-classifications.

Solution:

- **Alicyclic:** Ring compounds that lack aromatic stabilization and generally mimic the chemical properties of open-chain aliphatic compounds (e.g., cyclohexane).
- **Aromatic:** Ring compounds that contain a stable, delocalized pi-electron cloud obeying Huckel's rule (e.g., benzene), displaying unique substitution chemistry.
- Thus, homocyclic compounds are divided into alicyclic and aromatic.

Why other options are incorrect:

Open and branched chains refer to acyclic compounds. Option D contains fabricated terms ("anti-alicyclic").

Question #35 Key: (B)

NUMS 2023

General formula of cycloalkane is:

CORE CONCEPT AND DERIVATION

Forming a ring structure structurally costs two hydrogen atoms compared to an open-chain alkane.

Solution:

- The general formula for an open-chain, saturated alkane is C_nH_{2n+2} .
- To close the chain into a ring, the two terminal carbon atoms must bond to each other, requiring the removal of one hydrogen from each end (total loss of 2 H atoms).
- This changes the formula to C_nH_{2n} , making cycloalkanes functional isomers of mono-alkenes.

Why other options are incorrect:

A is the formula for acyclic alkanes. D is the formula for alkynes or dienes.

Question #36 Key: (B)

UHS 2022

In which of the following functional groups, the carbon atom is sp hybridized?

CORE CONCEPT AND DERIVATION

A carbon atom is sp hybridized when it forms two sigma bonds and two pi bonds, typically seen in triple bonds or consecutive double bonds.

Solution:

- Let's analyze the bonding of the carbon atom in each group:
- A: -CHO (Aldehyde) contains a $C=O$ double bond $\rightarrow sp^2$.
- C, D: -COOH and -COOR contain a $C=O$ double bond $\rightarrow sp^2$.
- B: -CN (Nitrile or Cyano group) consists of a carbon triply bonded to a nitrogen ($-C \equiv N$). The carbon forms one sigma bond with N, one sigma bond with the R-group, and two pi bonds with N.
- This linear geometry requires **sp hybridization**.

Why other options are incorrect:

Aldehydes, carboxylic acids, and esters all contain a carbonyl carbon, which is sp^2 hybridized.

Question #37 Key: (C)

UHS 2022

The compounds containing [Formula] functional group are known as:

CORE CONCEPT AND DERIVATION

When the oxygen atom of a functional group is replaced by a sulfur atom, the prefix "thio-" is used.

Solution:

- The generic formula for an alcohol is $R-OH$.
- If we replace the oxygen with sulfur, we get $R-SH$.
- This class of compounds is known as thiols or **thio-alcohols** (mercaptans).

Why other options are incorrect:

Alcohols are $R-OH$. Thio-ethers are $R-S-R'$. Nitriles are $R-CN$.

Question #38 Key: (C)

UHS 2022

What is the number of isomers of a hydrocarbon having a molecular formula [Formula] ?

CORE CONCEPT AND DERIVATION

The formula C_4H_8 matches the alkene general formula C_nH_{2n} . Past paper conventions often ask specifically for open-chain structural isomers unless specified otherwise.

Solution:

- The acyclic (alkene) structural isomers for C_4H_8 are:
- 1. 1-butene ($CH_2 = CH-CH_2-CH_3$)
- 2. 2-butene ($CH_3-CH = CH-CH_3$)
- 3. 2-methylpropene (isobutylene)
- According to the official exam key provided, the intended answer considers these **3** structural alkene isomers.

Why other options are incorrect:

While including cis-trans stereoisomers makes 4, and including cycloalkanes (cyclobutane, methylcyclopropane) makes 6, standard local test keys often only count the structural alkene isomers, landing on 3.

Question #39 Key: (A)

SZABMU 2022

Homo-cyclic organic compounds are sub divided into two types namely:

CORE CONCEPT AND DERIVATION

Homocyclic (carbocyclic) compounds contain rings made exclusively of carbon atoms. They are broadly classified based on their electronic properties.

Solution:

- Homocyclic compounds are fundamentally subdivided into:
- **Alicyclic compounds:** Ring compounds that behave chemically like aliphatic compounds (no delocalized pi-electron ring).
- **Aromatic compounds:** Ring compounds containing a stable, delocalized pi-electron system (like benzene).

Why other options are incorrect:

Open and branched chains apply to acyclic compounds. While "non-aromatic" is technically true, "alicyclic" is the formal organic chemistry nomenclature for that specific branch of homocyclic rings.

Question #40 Key: (C)

SZABMU 2022

The type of isomerism arising due to shifting of proton from one atom to another in the same molecule is:

CORE CONCEPT AND DERIVATION

Isomerism caused by the migration of a hydrogen atom (proton) accompanied by the switching of a single and double bond is known as tautomerism.

Solution:

- **Tautomers** are dynamic structural isomers that exist in equilibrium with each other.
- The most common example is keto-enol tautomerism, where a proton shifts from an alpha-carbon to the carbonyl oxygen, forming an enol.
- The question explicitly defines this proton-shifting phenomenon.

Why other options are incorrect:

Chain, position, and metamerism do not involve dynamic equilibrium proton shifts.

Question #41 Key: (A)

SZABMU 2022

In alkanes each Carbon has hybridization:

CORE CONCEPT AND DERIVATION

Hybridization depends on the steric number (number of sigma bonds + lone pairs).

Solution:

- Alkanes are saturated hydrocarbons.
- Every carbon atom in an alkane forms exactly four single (sigma) bonds with adjacent carbon or hydrogen atoms.
- A carbon forming 4 sigma bonds requires 4 hybrid orbitals, which are formed by mixing one s and three p orbitals.
- This is sp^3 hybridization.

Why other options are incorrect:

sp^2 requires a double bond, and sp requires a triple bond. Alkanes possess neither.

Question #42 Key: (A)

KMU 2022

All of the following compounds are organic except :

CORE CONCEPT AND DERIVATION

Organic compounds are fundamentally carbon-based, usually possessing C-C and C-H bonds. Certain simple carbon compounds (carbonates, cyanates, carbides, oxides) are classified historically and chemically as inorganic salts.

Solution:

- B: Phenol (C_6H_5OH) is an aromatic organic compound.
- C: Acetone (CH_3COCH_3) is an organic ketone.
- D: Methanol (CH_3OH) is an organic alcohol.
- A: Potassium cyanate (**KOCN**) is an ionic salt. Despite containing carbon, cyanates are universally studied under inorganic chemistry.

Why other options are incorrect:

Options B, C, and D are classical, covalent organic molecules.

Question #43 Key: (A)

KMU 2022

The isomers of a substance must have:

CORE CONCEPT AND DERIVATION

Isomers are defined as different compounds that share the exact same molecular formula.

Solution:

- Because isomers have the exact same molecular formula (same number and types of atoms), they must inherently have the **same molecular mass**.
- This is the absolute baseline requirement for any two molecules to be considered isomers.

Why other options are incorrect:

Isomers often have different chemical properties (B), always have different structural formulas or spatial arrangements (C), and functional isomers have different functional groups (D).

Question #44 Key: (D)

KMU 2022

Optical activity of a compound is measure by and instrument called:

CORE CONCEPT AND DERIVATION

Optical activity is the ability of a chiral compound to rotate the plane of plane-polarized light.

Solution:

- A **polarimeter** is the specific scientific instrument designed to measure the angle of rotation caused by passing polarized light through an optically active substance.

Why other options are incorrect:

A hydrometer measures specific gravity (density). A barometer measures atmospheric pressure. A calorimeter measures heat of reaction.

Question #45 Key: (D)

KMU 2022

The structural isomerism in which isomers are in dynamic equilibrium with each other is:

CORE CONCEPT AND DERIVATION

Tautomerism is a unique form of structural isomerism where isomers readily interconvert and exist in a state of dynamic equilibrium.

Solution:

- In tautomerism, a rapid shift of a proton and a double bond occurs within the molecule.
- Because the activation energy for this interconversion is very low, the two forms (e.g., keto and enol forms) exist simultaneously in a solution, constantly converting back and forth (dynamic equilibrium).

Why other options are incorrect:

Chain, position, and metamerism involve stable, isolable compounds that do not spontaneously interconvert under normal conditions.

Question #46 Key: (B)

DUHS 2022

The first organic compound manufacture from inorganic compound was:

CORE CONCEPT AND DERIVATION

The "Vital Force Theory" posited that organic compounds could only be produced by living organisms. Friedrich Wöhler disproved this in 1828.

Solution:

- Wöhler accidentally synthesized **urea** (an organic compound found in urine) while attempting to prepare ammonium cyanate (an inorganic salt) by heating it.
- $\text{NH}_4\text{CNO} \xrightarrow{\Delta} \text{CO}(\text{NH}_2)_2$
- This was the first laboratory synthesis of an organic compound from inorganic precursors.

Why other options are incorrect:

Acetic acid was synthesized later by Kolbe. Methane was synthesized by Berthelot.

Question #47 Key: (C)

BUMHS 2022

What is the name of [Formula]?

CORE CONCEPT AND DERIVATION

When naming dienes, the longest chain containing both double bonds is chosen, and numbered from the end closest to a double bond.

Solution:

- **Chain length:** 8 carbons long → "octa".
- **Numbering right to left:** Double bonds start at carbons 2 and 5 (sum = 7).
- **Numbering left to right:** Double bonds start at carbons 3 and 6 (sum = 9).
- We use the lowest numbers: 2,5.
- Since there are two double bonds, we use the suffix "-diene".
- The name is **2,5-octadiene** (or octa-2,5-diene).

Why other options are incorrect:

Incorrect numbering schemes result in 2,3 or 2,4. Option D uses "dyne", implying triple bonds, but the formula clearly shows double bonds.

Question #48 Key: (B)

BUMHS 2022

Which of the following will have a meso isomer?

CORE CONCEPT AND DERIVATION

A meso compound is an achiral molecule that contains multiple chiral centers but possesses an internal plane of symmetry.

Solution:

- To have a plane of symmetry, the two halves of the molecule must be identical.
- 2,3-dichlorobutane:** $\text{CH}_3\text{--CH}(\text{Cl})\text{--CH}(\text{Cl})\text{--CH}_3$. It has two chiral centers (C2 and C3) with identical substituent sets.
- In the (2R, 3S) or (2S, 3R) configuration, the molecule can be rotated to show a plane of symmetry splitting the C2–C3 bond.
- Thus, it exists as a **meso** isomer.

Why other options are incorrect:

2-chlorobutane and 1,2-dichlorobutane lack symmetric halves. 2,3-dichloropentane has different ends (an ethyl group vs a methyl group), preventing an internal plane of symmetry.

Question #49 Key: (B)

BUMHS 2022

Zwitter ions is also called?

CORE CONCEPT AND DERIVATION

A zwitterion is a molecule that contains an equal number of positively and negatively charged functional groups, resulting in a net charge of zero.

Solution:

- Amino acids form zwitterions when the acidic carboxyl group donates a proton to the basic amino group within the same molecule.
- Because this acid-base neutralization reaction occurs entirely within a single molecule, forming a dipolar ion, it is commonly referred to as an **internal salt**.

Why other options are incorrect:

A double salt involves two different crystalline salts. Basic and acidic salts refer to inorganic salts formed from incomplete neutralization.

Question #50 Key: (D)

NUMS 2022

Geometric isomerism is exhibited by:

CORE CONCEPT AND DERIVATION

Geometric isomerism requires restricted rotation around a bond so that groups can be fixed in space relative to one another.

Solution:

- Alkenes** contain a carbon-carbon double bond (pi bond) that restricts free rotation.
- If each carbon of the double bond has two different substituents attached, it will exhibit geometric (cis-trans) isomerism.

Why other options are incorrect:

Alcohols and ethers typically have only single bonds which undergo free rotation. Alkynes possess a linear geometry around the triple bond (sp hybridization), leaving no spatial variability for substituents.

Question #51 Key: (D)

PMDC 2021

Which of the following does not show metamerism?

CORE CONCEPT AND DERIVATION

Metamerism requires a polyvalent (multivalent) functional group flanked by alkyl chains on at least two sides so that the alkyl groups can be varied.

Solution:

- Ethers** (R--O--R'), **Secondary amines** (R--NH--R'), and **Ketones** (R--CO--R') all have a central functional group bonded to two alkyl groups. Changing the length of these alkyl groups creates metamers.
- Aldehydes** (R--CHO) have the carbonyl group at the terminal end of the chain. It is monovalent (attached to only one R group and one fixed Hydrogen).
- Because the aldehyde group can only exist at the end of a chain, it cannot shift between different alkyl groups, making metamerism impossible.

Why other options are incorrect:

Options A, B, and C possess polyvalent functional groups that allow for unequal distribution of carbon atoms on either side, hence they do show metamerism.

Question #52 Key: (C)

PMDC 2021

Cyclic compounds consist of except?

CORE CONCEPT AND DERIVATION

Compounds are broadly divided into cyclic (closed-ring) and acyclic (open-chain) compounds.

Solution:

- The question asks which category is **not** a subset or type of cyclic compound.
- **Acyclic** literally means "without a ring" or open-chain (like straight-chain alkanes).
- Therefore, acyclic compounds can never be classified under cyclic compounds.

Why other options are incorrect:

Alicyclic, aromatic, and carbocyclic are all specific sub-classifications of cyclic (ring-containing) organic compounds.

Question #53 Key: (A)

PMDC 2021

Formula of ammonium cyanate:

CORE CONCEPT AND DERIVATION

Ammonium cyanate is an inorganic salt famous for being the precursor in Wöhler's synthesis of urea, bridging inorganic and organic chemistry.

Solution:

- The compound is composed of two ions:
- The ammonium cation: NH_4^+
- The cyanate anion: CNO^-
- Combining them yields the formula: NH_4CNO .

Why other options are incorrect:

Option B is urea (the organic product of heating ammonium cyanate). Option C is hydrazine. Option D is ammonium cyanide.

Question #54 Key: (A)

PMDC 2021

Formula of alkane:

CORE CONCEPT AND DERIVATION

Alkanes are acyclic, saturated hydrocarbons. They contain the maximum possible number of hydrogen atoms per carbon atom.

Solution:

- The generic formula for a non-cyclic, fully saturated hydrocarbon (alkane) is $\text{C}_n\text{H}_{2n+2}$.
- For example, if $n = 1$ (methane), $\text{H} = 2(1) + 2 = 4 \rightarrow \text{CH}_4$.

Why other options are incorrect:

Option B represents alkenes (or cycloalkanes). Option C represents alkynes (or dienes). Option D represents alcohols.

Question #55 Key: (D)

PMDC 2020

Select the organic compound which belongs to arene family:

CORE CONCEPT AND DERIVATION

The term **arene** is synonymous with aromatic hydrocarbons, which contain one or more benzene rings.

Solution:

- Let's classify each option:
- A: $\text{CH}_2 = \text{CH}_2$ is ethene (an alkene).
- B: $\text{CH}_3\text{--O--CH}_3$ is dimethyl ether.
- C: $\text{CH}_3\text{--NH}_2$ is methylamine (an amine).
- D: C_6H_6 is **benzene**, the parent compound of the arene family.

Why other options are incorrect:

None of the other options possess the highly stable, delocalized pi-electron ring system required to be classified as an arene.

Question #56 Key: (A)

PMDC 2020

The type of isomerism existing in a compound of molecular formula [Formula] is:

CORE CONCEPT AND DERIVATION

Functional group isomerism occurs when two molecules share a molecular formula but belong to entirely different chemical families (have different functional groups).

Solution:

- The formula C_2H_6O corresponds to the general formula $C_nH_{2n+2}O$, which characterizes saturated alcohols and ethers.
- It can be drawn as:
 - **Ethanol:** CH_3CH_2OH (Alcohol)
 - **Dimethyl ether:** CH_3-O-CH_3 (Ether)
- Since the functional group changes completely, this is functional group isomerism.

Why other options are incorrect:

Position and chain isomerism require the functional group to remain the same. Metamerism requires a polyvalent functional group with at least 4 carbons to show different alkyl distributions.

Question #57 Key: (B)

PMDC 2020

Which of the following compound show geometric isomerism?

CORE CONCEPT AND DERIVATION

Geometric (cis-trans) isomerism is possible in cyclic compounds when two separate carbon atoms in the ring are each bonded to two different substituent groups. The rigid ring prevents free rotation.

Solution:

- **A. 1,1-dimethylcyclopropane:** Both methyls are on the same carbon. No geometric isomerism possible.
- **B. 1,2-dimethylcyclopropane:** Carbon-1 is bonded to H and CH_3 . Carbon-2 is bonded to H and CH_3 . Because they are on different carbons, the methyls can be on the same side of the ring (cis) or opposite sides (trans). It **shows** geometric isomerism.
- **C & D:** Do not have enough substituents on different carbons to exhibit spatial variation relative to a plane.

Why other options are incorrect:

The lack of two distinct substituted chiral centers in the ring prevents the formation of distinct cis and trans configurations.

Question #58 Key: (B)

PMDC 2020

Generic formula of cycloalkane is:

CORE CONCEPT AND DERIVATION

The general formula connects the number of carbon atoms (n) to hydrogen atoms. Forming a ring from an open chain requires the removal of two hydrogen atoms to connect the ends.

Solution:

- An open-chain alkane has the formula C_nH_{2n+2} .
- To form a single ring (a cycloalkane), two ends of the chain join together, expelling 2 hydrogen atoms.
- Therefore, the formula becomes C_nH_{2n} .
- (Note: This is the same general formula as mono-alkenes).

Why other options are incorrect:

Option A is for straight-chain alkanes. Option D is for alkynes or dienes.

Question #59 Key: (A)

PMDC 2020

In alkanes, each carbon has hybridization:

CORE CONCEPT AND DERIVATION

Hybridization of carbon depends on the number of sigma bonds it forms. Four sigma bonds result in sp^3 hybridization.

Solution:

- Alkanes are saturated hydrocarbons, meaning every carbon atom is bonded to four other atoms entirely via single (sigma) bonds.
- The mixing of one s-orbital and three p-orbitals generates four equivalent sp^3 hybrid orbitals, arranged tetrahedrally.
- Therefore, every carbon in an alkane is sp^3 hybridized.

Why other options are incorrect:

sp^2 is found in alkenes (one double bond). sp is found in alkynes (one triple bond).

Question #60 Key: (B)

SET 2019

Have a critical look at the given structure: [Formula]
 $\text{H}_3\text{C}-\text{CH}(\text{CH}_3)-\text{CH}(\text{CH}_3)-\text{CH}_2-\text{CH}_2-\text{CH}_3$

CORE CONCEPT AND DERIVATION

To name a branched alkane: 1) Identify the longest continuous chain. 2) Number from the end closest to the first branch. 3) Group identical substituents using multipliers (di, tri, etc.).

Solution:

- Longest chain:** The straight horizontal chain contains 6 carbons (hexane).
- Numbering:**
 - Numbering left-to-right gives branches at 2, 3, and 5 (Sum = 10).
 - Numbering right-to-left gives branches at 2, 4, and 5 (Sum = 11).
 - The lowest locant set is 2,3,5.
- Substituents:** There are three methyl groups at positions 2, 3, and 5. This makes it "trimethyl".
- Putting it together gives **2,3,5-trimethylhexane**.

Why other options are incorrect:

Option A fails to identify the longest chain (6 instead of 5).
Option C uses incorrect numbering (from the wrong side).
Option D uses non-IUPAC branching rules.

Question #61 Key: (B)

NUMS 2019

IUPAC name of Divinyl acetylene is:

CORE CONCEPT AND DERIVATION

To determine the IUPAC name from a common name, deduce the structure first. The "vinyl" group is $-\text{CH}=\text{CH}_2$. Acetylene is $\text{HC}\equiv\text{CH}$.

Solution:

- **Structure:** Divinyl acetylene means two vinyl groups attached to an acetylene core: $\text{CH}_2=\text{CH}-\text{C}\equiv\text{C}-\text{CH}=\text{CH}_2$.
- **Chain length:** The longest continuous chain has 6 carbons (hexa).
- **Numbering:** Numbering from either side gives the double bonds at C1 and C5, and the triple bond at C3.
- **Suffixes:** According to IUPAC, "ene" comes before "yne". The main chain is a 1,5-diene, and a 3-yne.
- Combining them: **hexa-1,5-dien-3-yne** (or 1,5-hexadiene-3-yne).

Why other options are incorrect:

Option A incorrectly uses "ene" twice. Option C misidentifies the molecule as having two triple bonds (diyne). Option D improperly places "hexyne" before "diene" violating standard IUPAC assembly order.

Question #62 Key: (B)

NUMS 2019

Diethyl ether and n-butanol are:

CORE CONCEPT AND DERIVATION

Compounds that share the same molecular formula but have completely different functional groups exhibit **functional group isomerism**.

Solution:

- **Diethyl ether:** $\text{CH}_3\text{CH}_2-\text{O}-\text{CH}_2\text{CH}_3$ (Functional group: Ether). Molecular formula: $\text{C}_4\text{H}_{10}\text{O}$.
- **n-butanol:** $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$ (Functional group: Alcohol). Molecular formula: $\text{C}_4\text{H}_{10}\text{O}$.
- Because they have identical formulas but different functional groups (ether vs. alcohol), they are functional isomers.

Why other options are incorrect:

Chain isomers differ in skeleton, position isomers differ in location of the same functional group, and tautomers are dynamic equilibrium isomers.

Question #63 Key: (D)

KMU 2019

The number of isomers of pentane is:

CORE CONCEPT AND DERIVATION

Pentane (C_5H_{12}) only exhibits chain isomerism. We must draw all possible unique carbon skeletons.

Solution:

- 1. Straight chain (5 carbons): **n-pentane**.
- 2. Branched chain with 4 carbons and one methyl group: **isopentane** (2-methylbutane).
- 3. Branched chain with 3 carbons and two methyl groups: **neopentane** (2,2-dimethylpropane).
- There are exactly **3** structural isomers possible.

Why other options are incorrect:

Butane has 2. Hexane has 5. Pentane definitively only has 3.

Question #64 Key: (D)

KMU 2019

Which of the following is not the major source of organic compound?

CORE CONCEPT AND DERIVATION

The primary natural sources of organic compounds are fossil fuels, which include coal, petroleum (crude oil), and natural gas.

Solution:

- Coal, petroleum, and natural gas yield thousands of organic chemicals upon fractional distillation, cracking, and destructive distillation.
- Ammoniacal liquor** is an aqueous solution of ammonia (NH_3) and other inorganic nitrogen compounds obtained as a byproduct of coal gasification. It is an inorganic source/mixture, not a major source of organic compounds.

Why other options are incorrect:

Options A, B, and C are the foundational pillars of the petrochemical industry and are the largest sources of organic compounds on Earth.

Question #65 Key: (A)

KMU 2019

[Formula] gives the type of isomerism:

CORE CONCEPT AND DERIVATION

Metamerism occurs when isomers have the same molecular formula but differ in the distribution of alkyl groups on either side of a polyvalent functional group (like an amine, ether, or ketone).

Solution:

- The formula $\text{C}_4\text{H}_{11}\text{N}$ represents a saturated amine.
- Secondary amines ($\text{R}-\text{NH}-\text{R}'$) are polyvalent.
- Possible structures include:
 - Diethylamine: $\text{CH}_3\text{CH}_2-\text{NH}-\text{CH}_2\text{CH}_3$
 - Methylpropylamine: $\text{CH}_3-\text{NH}-\text{CH}_2\text{CH}_2\text{CH}_3$
- Since the alkyl groups around the central $-\text{NH}-$ change, it exhibits **metamerism**.

Why other options are incorrect:

While it can show structural chain isomerism, among the given choices, metamerism is the distinct and most characteristic isomerism for polyvalent functional groups like amines.

Question #66 Key: (B)

MDCAT 2019

The names of functional groups in the following compound X are:
[Formula] Compound X

CORE CONCEPT AND DERIVATION

A molecule can contain multiple distinct functional groups that must be individually identified.

Solution:

- Based on standard versions of this past paper question, Compound X is usually a benzene ring substituted with a $-\text{CH}(\text{OH})\text{CH}_3$ group and a $-\text{CH}_2\text{CN}$ group.
- 1) **Aryl Ring**: The central benzene ring acts as the core (aryl group).
- 2) **Secondary Alcohol**: The $-\text{CH}(\text{OH})\text{CH}_3$ group features an $-\text{OH}$ attached to a carbon bonded to two other carbons (the ring and the methyl). This is a secondary alcohol.
- 3) **Nitrile**: The $-\text{CN}$ group is a nitrile.
- Hence, the correct combination is secondary alcohol, nitrile, and aryl ring.

Why other options are incorrect:

It is not a primary alcohol because the $-\text{OH}$ carbon is bonded to two carbons. It is not an amine (which would be $-\text{NH}_2$). It is not a phenol because the $-\text{OH}$ is not directly attached to the benzene ring.

Question #67 Key: (A)

MDCAT 2018

Butane molecule can have maximum no of isomers:

CORE CONCEPT AND DERIVATION

Isomers are compounds with the same molecular formula but different structural arrangements. For simple alkanes, only chain isomerism is possible.

Solution:

- The molecular formula for butane is C_4H_{10} .
- We can arrange 4 carbon atoms in a straight chain: **n-butane** ($CH_3-CH_2-CH_2-CH_3$).
- We can arrange them in a branched chain: **isobutane** (2-methylpropane).
- No other structural arrangements are possible for C_4H_{10} . Thus, the maximum number is 2.

Why other options are incorrect:

Higher numbers (3, 4, 5) apply to higher alkanes like pentane (3 isomers) and hexane (5 isomers).

Question #68 Key: (B)

MDCAT 2018

Select one which is alcohol:

CORE CONCEPT AND DERIVATION

Alcohols are organic compounds characterized by the presence of one or more hydroxyl (-OH) functional groups attached to an aliphatic carbon atom.

Solution:

- Option A is dimethyl ether (ether functional group).
- Option B is ethanol, containing the -OH group attached to an alkyl chain. This is an **alcohol**.
- Option C is acetic acid (carboxylic acid functional group).
- Option D is ethyl bromide (alkyl halide).

Why other options are incorrect:

They represent different classes of organic compounds (ethers, carboxylic acids, and halides) rather than alcohols.

Question #69 Key: (A)

MDCAT 2018

In the following organic compound carbon atoms in all of them undergo both sp^3 and sp^2 hybridization except X,...

CORE CONCEPT AND DERIVATION

Carbon atoms forming only single (sigma) bonds are sp^3 hybridized. Carbon atoms forming one double bond are sp^2 hybridized.

Solution:

- We must find the compound where **all** carbon atoms have solely single bonds.
- **Trans-2-butene (B)** and **2-Chloro-2-butene (C)** contain a $C=C$ double bond (sp^2 carbons).
- **Butanoic acid (D)** contains a $C=O$ double bond in the carboxyl group (sp^2 carbon).
- **1-Butanol (A)** ($CH_3CH_2CH_2CH_2OH$) contains only single bonds throughout the molecule. Therefore, every single carbon atom is sp^3 hybridized.

Why other options are incorrect:

Options B, C, and D contain at least one sp^2 hybridized carbon due to the presence of double bonds.

Question #70 Key: (A)

MDCAT 2017

The type of structural isomerism which arises due to the difference in the nature of carbon chain or carbon sk...

CORE CONCEPT AND DERIVATION

Isomerism caused by a rearrangement of the carbon skeleton (straight vs. branched chains) while maintaining the same molecular formula is explicitly defined as chain isomerism (or skeletal isomerism).

Solution:

- The question stem directly defines the phenomenon: difference in the nature of the carbon chain.
- Examples include n-butane (straight chain) and isobutane (branched chain).

Why other options are incorrect:

Position isomerism involves moving a functional group. Cis-trans and optical isomerism are stereoisomerisms (spatial differences), not structural skeleton changes.

Question #71 Key: (B)

MDCAT 2017

Which one of the followings is the best name according to IUPAC system for the formula given below? [Formula] ...

CORE CONCEPT AND DERIVATION

According to IUPAC rules, find the longest continuous carbon chain, number it to give the lowest locants to the substituents, and list substituents alphabetically.

Solution:

- **Longest chain:** The main chain has 6 carbon atoms (hexane).
- **Numbering:** Numbering from left to right gives substituents at positions 2 and 3. Numbering right to left gives 4 and 5. We choose the lower set (2,3).
- **Substituents:** A chlorine atom at C2 (chloro) and a methyl group at C3 (methyl).
- Alphabetically arranging them gives: **2-chloro-3-methylhexane**.

Why other options are incorrect:

Option A has an incorrect parent chain length and numbering. Options C and D misidentify the substituents and parent chain.

Question #72 Key: (C)

MDCAT 2017

Cyclobutane structure is categorized under:

CORE CONCEPT AND DERIVATION

Organic compounds forming closed rings composed entirely of carbon atoms, but which do not possess aromatic character, are called **alicyclic** (aliphatic cyclic) compounds.

Solution:

- Cyclobutane is a four-membered carbon ring (C_4H_8).
- It does not have alternating double bonds (no delocalized pi electrons), so it is not aromatic.
- Because it is a ring, it is alicyclic.

Why other options are incorrect:

Aliphatic usually implies open-chain (though alicyclic is a subset, "alicyclic" is the most precise and correct category here). It is not aromatic, nor is it heterocyclic (as there are no non-carbon atoms in the ring).

Question #73 Key: (D)

MDCAT 2017

Name the compound, which shows geometric isomerism:

CORE CONCEPT AND DERIVATION

Geometric isomerism is exhibited by alkenes where **both** carbons of the double bond are attached to two different groups.

Solution:

- Let's test each molecule:
- **A. 1-bromo-2-chloropropene:** C1 has H and Br; C2 has Cl and CH_3 . Since each carbon has two different groups, it **shows** geometric isomerism.
- **B. 2,3-dimethylpropene:** (Wait, propene only has 3 carbons. A substituent at C3 of propene makes it butene. Assuming it means 2-methylpropene, C1 has two H's). It does not show geometric isomerism.
- **C. 2-pentene:** ($CH_3CH = CHCH_2CH_3$). C2 has H and CH_3 ; C3 has H and CH_2CH_3 . It **shows** geometric isomerism.
- Therefore, both A and C exhibit the property.

Why other options are incorrect:

Selecting only A or C is incomplete. Option B is incorrect due to identical groups on one end of the double bond.

Question #74 Key: (A)

MDCAT 2017

Which one is a functional group of carboxylic acid:

CORE CONCEPT AND DERIVATION

A functional group is a specific arrangement of atoms responsible for the chemical properties of a molecule. Carboxylic acids contain the carboxyl group.

Solution:

- The carboxyl group is composed of a carbonyl ($C = O$) bonded to a hydroxyl ($-OH$).
- This is written structurally as $-COOH$ or $-C(=O)OH$.
- Option A matches this exactly.

Why other options are incorrect:

Option B represents a ketone (carbonyl) group. Option C represents an ester linkage ($-COOR$).

Question #75 Key: (C)

MDCAT 2016

Which one of the following pairs can be a *cis-trans* isomer to each other?

CORE CONCEPT AND DERIVATION

For geometric (*cis-trans*) isomerism to exist, the molecule must contain a restricted rotation center (like a double bond), and **each** carbon of the double bond must be attached to two **different** groups.

Solution:

- Let's analyze the options for the capacity to form *cis* and *trans* isomers:
- A: $\text{CH}_2 = \text{CH}_2$ has identical hydrogens on both carbons. No geometric isomerism.
- B: $\text{CHCl} = \text{CH}_2$ has two identical hydrogens on one carbon. No geometric isomerism.
- C: 2-butene ($\text{CH}_3\text{CH} = \text{CHCH}_3$). Each double-bonded carbon is attached to one H and one CH_3 . This satisfies the conditions, allowing it to exist as both *cis*-2-butene and *trans*-2-butene.

Why other options are incorrect:

The other molecules either lack a double bond entirely (like ethane in D) or have two identical substituent groups on at least one sp^2 hybridized carbon, making *cis-trans* arrangements identical.

Question #76 Key: (C)

MDCAT 2015

The given three hydrocarbons are: Benzene Naphthalene Aromatic Hydrocarbons (Benzene & Naphthalene Structures)

CORE CONCEPT AND DERIVATION

Hydrocarbons that contain one or more benzene rings (or adhere to Huckel's rule of aromaticity) are classified as **aromatic hydrocarbons** (arenes).

Solution:

- The image depicts Benzene (1 ring), Naphthalene (2 fused rings), and Anthracene (3 fused rings).
- All three of these compounds consist solely of carbon and hydrogen and contain delocalized pi-electron systems characteristic of benzene rings.
- Therefore, they fall under the category of aromatic hydrocarbons.

Why other options are incorrect:

They are not acyclic (open-chain) or alicyclic (non-aromatic rings). They are not heterocyclic because they contain only carbon atoms in their rings.

Question #77 Key: (A)

MDCAT 2015

The structural formula of 2,3,4-trimethylpentane is:

CORE CONCEPT AND DERIVATION

To write the structural formula from an IUPAC name, first identify the parent chain, then place substituents at the specified carbon numbers.

Solution:

- Parent chain:** "pentane" indicates a 5-carbon continuous chain ($\text{C}-\text{C}-\text{C}-\text{C}-\text{C}$).
- Substituents:** "2,3,4-trimethyl" indicates three separate methyl ($-\text{CH}_3$) groups attached to carbons 2, 3, and 4.
- Adding the correct number of hydrogens gives:
 $\text{CH}_3-\text{CH}(\text{CH}_3)-\text{CH}(\text{CH}_3)-\text{CH}(\text{CH}_3)-\text{CH}_3$.
- This matches Option A.

Why other options are incorrect:

Option B is 3,3-dimethylpentane. Option C is 2,2-dimethylbutane. Option D represents a different heavily branched isomer.

Question #78 **Key: (A)**

Key: (A)

MDCAT 2015

The IUPAC name of the given compound is: [Formula]

CORE CONCEPT AND DERIVATION

In IUPAC nomenclature, the longest continuous carbon chain containing the functional group is selected. Numbering starts from the end that gives the lowest possible number to the substituents.

Solution:

- The longest chain containing the carbon attached to the chlorine is 3 carbons long (propane).
- Numbering starts from the right to give the chloro group the lowest locant: C1 has -Cl, C2 has -CH₃.
- Alphabetically, "chloro" comes before "methyl".
- Therefore, the name is **1-chloro-2-methylpropane**.

Why other options are incorrect:

Isobutyl chloride (B) is the common name, not IUPAC. C has the wrong parent chain length (butane). D uses incorrect numbering (substituents must have lowest numbers).

Question #79 **Key: (A)**

Key: (A)

MDCAT 2014

Which one of the following pair of compounds is cis and trans isomers of each other? CH_3CH_3 cis-2-butene CH_3CH_3 ...

CORE CONCEPT AND DERIVATION

A cis-trans isomer pair must have the exact same connectivity (same IUPAC name excluding the prefix) but differ in spatial arrangement around a rigid bond, such as a C = C double bond.

Solution:

- The correct pair must show one molecule with identical groups on the same side of the double bond (cis) and the other with identical groups on opposite sides (trans).
- Option A represents the geometric isomers of 2-butene.

Why other options are incorrect:

Other pairs represent molecules that differ in connectivity (structural isomers) or lack the necessary conditions for geometric isomerism entirely.

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

Key: (C)

MDCAT 2014

Which one of the following is a ketone?

CORE CONCEPT AND DERIVATION

A **ketone** is an organic compound that contains a carbonyl group ($C=O$) bonded to two alkyl or aryl carbon groups ($R-CO-R'$).

Solution:

- Let's analyze the options:
- A: Contains an oxygen between two alkyl groups ($R-O-R'$), so it is an **ether**.
- B: Contains a carboxylic acid group ($-COOH$).
- C: Contains a carbonyl carbon flanked by a methyl group and an ethyl group. This fits the $R-CO-R'$ formula, so it is a **ketone** (2-butanone).
- D: Contains a formyl group ($-CHO$), making it an **aldehyde**.

Why other options are incorrect:

They represent different functional classes: ether (A), carboxylic acid derivative (B), and aldehyde (D).

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

Key: (B)

MDCAT 2013

The cis-isomerism is shown by:

CORE CONCEPT AND DERIVATION

Geometric (cis-trans) isomerism occurs in alkenes where there is restricted rotation around the double bond, and each carbon atom of the double bond is attached to two different groups.

Solution:

- **Cis-isomerism** dictates that identical or similar groups (like two methyl groups or two hydrogen atoms) are on the **same side** of the double bond.
- Option B represents a structure where the two bulky methyl groups are on the same side, creating a cis-geometry.

Why other options are incorrect:

Option A is the trans-isomer (groups on opposite sides).
Options C and D do not exhibit cis-trans isomerism because one of the double-bonded carbons has two identical substituent groups.

Question #82 Key: (C)

MDCAT 2011

1-chloropropane and 2-chloropropane are isomers of each other. The type of isomerism is:

CORE CONCEPT AND DERIVATION

Structural isomers that have the same carbon skeleton but differ in the position of the functional group or substituent are called **positional isomers**.

Solution:

- In 1-chloropropane ($\text{CH}_3\text{CH}_2\text{CH}_2\text{Cl}$), the chlorine atom is attached to carbon-1.
- In 2-chloropropane ($\text{CH}_3\text{CH}(\text{Cl})\text{CH}_3$), the chlorine atom is attached to carbon-2.
- Because the carbon chain remains exactly the same (propane) and only the position of the chloro-substituent changes, this is positional isomerism.

Why other options are incorrect:

They are not chain isomers because the main chain length is identical. They are not functional isomers because the functional group (halide) remains the same.

Question #83 Key: (C)

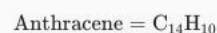
MDCAT 2000

Skeletal formula of an organic compound is given below. Fused Aromatic Compound Name of this compound is:

CORE CONCEPT AND DERIVATION

Aromatic hydrocarbons consisting of fused benzene rings have specific common names based on the number and arrangement of the rings.

Formula:



Solution:

- Naphthalene consists of **two** fused benzene rings.
- Anthracene consists of **three** linearly fused benzene rings.
- Since the image shows three rings fused in a straight line, it is anthracene.

Why other options are incorrect:

Naphthalene has only two rings. Pyrene has four fused rings. Biphenyl methane is not a fused-ring structure.