ENTRANCE TEST – 2020 MDCAT – CHEMISTRY

TEST # 03 UHS TOPIC – 2 (Organic Chemistry) TOPIC: HYDROCARBONS

**Which one of the following physical properties is not shown by benzene? Q.51

- A) It is an aromatic hydrocarbon
- B) It is colourless liquid at room temperature and one atmospheric pressure
- C) It is non-flammable
- D) It has a peculiar smell and burning taste

Q.52 **Alkenes are more reactive than alkanes. This is because:

- A) The π electrons of a double bond are located much farther from the carbon nuclei and are thus less firmly bound to them
- B) The overlap of atomic orbitals in forming a π bond is not as effective as that in σ bonds.
- C) Both A and B
- D) Neither A nor B

**Ethene is not used for: Q.53

- A) The preparation of mustard gas
- B) The artificial ripening of the fruits
- C) The manufacture of ethylene glycol
- D) The manufacture of varnish as a solvent

**Consider the following conversions:

$$CH_{3}-CH_{2}-CH_{2}-I \xrightarrow[Alcohol]{KOH} X \xrightarrow{H_{3}O^{+}} Y \xrightarrow{HBr} Z$$

Which of the above compounds represent X, Y, Z respectively in the conversions?

- A) 2-Propanol, Propene, 2-Bromopropane
- B) Propene, 2-Propanol, 2-Bromopropane
- C) 2-Bromopropane, Propene, 2-Propanol
- D) 2-Propanol, 2-Bromopropane, Propene

**Alkanes have _ boiling points because they are _____ and

have_____ intermolecular forces:

A) Low, non-polar, weak

C) High, non-polar, weak

B) High, non-polar, strong

D) High, polar, strong

Q.55 Q.56 Q.56 **Identify the correct statement:

- A) Alkenes are more reactive than alkynes towards electrophilic reagents
- B) Alkynes are more reactive than alkenes towards nucleophilic reagents
- C) Both 'A' and 'B'
- D) Neither 'A' nor 'B'

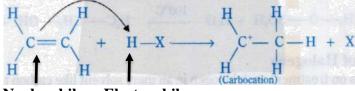
Answer Explanation: (C)

ALKENES

Alkenes usually show the mechanism of electrophilic addition reaction as shown in the reaction.

The addition of a hydrogen halide to an alkene takes place in two steps.

STEP-i

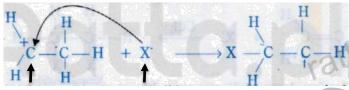


Electrophile Nucleophile

MDCAT TEST # 03

STEP-ii

The carbocation then reacts with the halide ion.



Electrophile Nucleophile

ALKYNES

- Alkynes although contain two π -bonds are less reactive than alkenes towards electrophilic reagents.
- This because the bond distance between the two triple bonded carbon atoms is very short and hence the π -electrons are not available to be attacked by electrophilic reagents.
- Alkynes are, however, more reactive than alkenes towards nucleophilic reagents.
- Q.57 **If excess of methane is used in the reaction of chlorine with methane, the major product obtained is:

A) Chloromethane

C) Trichloromethane

B) Dichloromethane

D) Tetrachloromethane

- Q.58 **Consider the following statements about benzene:
 - I. It is highly unsaturated hydrocarbon
 - II. It is highly stable due to extensive delocalization of π -electrons
 - III. The word benzene comes from "gum benzoin" (a natural product)
 - IV. The word phene is derived from Greek word phena means "I bear light" Which of the above statements is/are correct?

A) I only

C) III and IV

B) II only

D) I, II, III and IV

Q.59 **Kolbe's electrolytic method is not used to prepare:

A) Ethene

C) Ethane

B) Ethyne

D) Methane

- **Consider the following statements about hydrocarbons. **Q.60**
 - I. Saturated hydrocarbons (alkanes)

.... Carbon atoms are bonded by

single covalent bond

II. Unsaturated open chain hydrocarbons The carbon chain which contains

carbon-carbon multiple bonds

(alkenes and alkynes) III. Saturated cyclic hydrocarbons

.... Carbon atoms are bonding in the form of ring

IV. Aromatic hydrocarbons

.... Contains benzene as the parent member

Which of the above statement is/are correct?

A) I only

C) III and IV

B) II only

D) I, II, III and IV

**Complete combustion of CH₄ gives: Q.61

 $A) CO_2 + H_2O$

C) $CO_2 + C$

B) $CO + CO_2 + H_2O$

D) CO

Which of the following statements about alkene and arenes is incorrect?

	Opt.	Alkenes (e.g. ethene)	Arenes (e.g. benzene)
4	A)	Less stable	More stable
	B)	Localized pi electrons	Delocalized pi electrons
	C)	Electrophilic addition reactions	Electrophilic substitution reactions
	D)	Pi electrons are less exposed	Pi electrons are more exposed

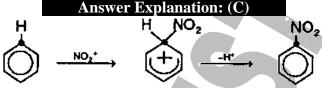


It is incorrect statement. The correct statement is as follow:

Opt.	Alkenes (e.g. ethene)	Arenes (e.g. benzene)
D)	Pi electrons are more exposed due	Pi electrons are less exposed due to
	to localization of pi electrons	extensive delocalization of pi electrons

Q.63 During the nitration of benzene, a nitro group (-NO₂) substitutes at a carbon atom. Which one of the following statements gives the arrangement of the bonds at this carbon atom during the reaction?

Opt.	At the start	In the intermediate	At the end of
Opt.	of reaction	complex	reaction
A)	Planar	Planar	Planar
B)	Planar	Tetrahedral	Tetrahedral
C)	Planar	Tetrahedral	Planar
D)	Tetrahedral	Planar	Tetrahedral



•sp2 : planar

• sp³: tetrahedral

•sp² : planar

Q.64 When ethene is treated with cold dilute KMnO₄ in basic medium, the product formed will be?

A) 1,2-Ethanediol

C) 1,1-Ethanediol

B) 1,3-Propanediol

D) Ethanol

Answer Explanation: (A)

• Baeyer's Test

When alkene (ethene) is treated with Baeyers's reagent (1% alkaline KMnO₄ solution) at low temperature, the pink colour of KMnO₄ is discharged during the reaction as shown below. It is test for the unsaturation in the molecule.

$$3H_{2}C = CH_{2} + 2KMnO_{4} + 4H_{2}O \xrightarrow{Cold state} 3H_{2}C - CH_{2} + 2MnO_{2} + 2KOH$$

$$OH OH$$

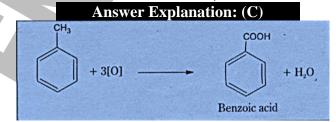
Toulene on oxidation by acidified KMnO₄ or K₂Cr₂O₇ gives which of the following main product?

A) Benzaldehyde

C) Benzoic acid

B) Benzyl alcohol

D) Phenol



Following steps are involved in the formation of benzoic acid by oxidation of toluene:

- i. Toluene on oxidation first of all is converted into benzyl alcohol
- ii. Then benzyl alcohol on oxidation is converted into benzaldehyde
- iii. Finally benzaldehyde on oxidation is converted into benzoic acid
- Q.66 Which of the following statements is incorrect about atomic orbital treatment of benzene?
 - A) Each carbon atom in benzene is sp² hybridized
 - B) Each angle in benzene is 120°
 - C) Overlapping of 2p_z orbitals gives diffused or delocalized electron cloud
 - D) It confirms regular tetrahedral structure of benzene

It is incorrect statement. The correct statement is that it confirms regular hexagonal structure of benzene. A, B and C options are correct.

Q.67 The alkyl halides which give alkenes on dehydrohalogenation with alcoholic potash must have:

C)
$$\beta$$
-H

D)
$$\delta$$
-H

Answer Explanation: (C)

Answer Explanation: (D)

The alkyl halides which give alkenes on dehydrohalogenation with alcoholic potash must have β-H as shown in the reaction:

alcoholic potash must have
$$\beta$$
-H as shown in the reaction:
$$CH_3 - CH - CH_2 + KOH(alc.) \xrightarrow{Alcohol} H_2C = CH_2 + KBr + H_2O$$
 β -hydrogen $\xrightarrow{\delta^+|} H$ Br

α-carbon

The carbon atom which is directly bonded with functional group is called α-carbon.

β-carbon

The carbon atom which is directly bonded with α-carbon is called β-carbon.

β-hydrogen

The hydrogen atom which is directly bonded with β -carbon is called β -hydrogen. It is acidic in nature due to inductive effect. It is source of pi electrons to form double bond in alkene.

- *What happens when one mole of ethane is mixed with six moles of chlorine in the dark at room temperature?
 - A) There is no reaction
 - B) CH₃CCl₃ and HCl are formed
 - C) CH₃CH₂Cl and HCl are formed
 - D) CCl₃CCl₃ and HCl are formed

Answer Explanation: (A)

- To undergo free-radical substitution UV radiation or heating $\xrightarrow{h\nu}$ 2Cl $^{\bullet}$). is required to initiate the reaction $(Cl_2 -$
- Since the experiment is performed in the dark without heating (at room temperature), there is no reaction.
- Which one of the following reactions would not give propene?
 - A) Adding excess hot concentrated sulphuric acid to propan-1-ol
 - B) Adding warm aqueous sodium hydroxide to 2-Bromopropane
 - C) Adding warm ethanolic sodium hydroxide to 1-Bromopropane
 - D) Passing propan-2-ol vapour over heated aluminium oxide

Answer Explanation: (B)

Adding warm aqueous sodium hydroxide to 2-Bromopropane would not give propene. It would give 2-Propanol as shown in the reaction.

Q.70 Which of the following is incorrect statement about differences between elimination and substitution?

between eminiation and substitution.		
Opt.	Elimination	Substitution
A)	Less polar solvent favours it	More polar solvent favours it
B)	A stronger base favours it	A stronger nucleophile favours it
C)_	Steric hindrance favours it	Steric hindrance does not favours it
D)	Low temperature favours it	High temperature favours it



Answer Explanation: (D)

It is incorrect statement. The correct statement is shown in the tabular form:

Opt.	Elimination	Substitution	
D)	High temperature favours it	Low temperature favours it	

- C₂H₅O is more basic and favours elimination while C₂H₅S is stronger nucleophile and favours substitution
- Crowding within the molecule of substrate also generally favours elimination over substitution reaction.
- This is due to greater steric hindrance when the nucleophile approaches towards α -carbon atom of the substrate.
- The greater number of alky groups on the substrate favours elimination over substitution because these alkyl groups stabilize alkene more than the substitution product.
- Q.71 On the chlorination of methane in the presence of diffused sunlight, a mixture of products are obtained. Which of the following is termination step:

A)
$$Cl-Cl\longrightarrow Cl^{\bullet}+Cl^{\bullet}$$

C)
$$CH_3^{\bullet} + Cl^{\bullet} \longrightarrow CH_3 - C$$

B)
$$H_3C - H + Cl^{\bullet} \longrightarrow CH_3^{\bullet} + HCl$$

$$\begin{array}{c} Cl \\ Cl \\ Cl \end{array} \longrightarrow \begin{array}{c} Cl \\ Cl - C \\ Cl \end{array} + HCl$$

Answer Explanation: (C)

Termination step (Radical combines with radical to stop the reaction)

$$CH_3^{\bullet} + Cl^{\bullet} \longrightarrow CH_3 - Cl$$
.

- Q.72 The introduction of (X) group in the presence of FeBr₃ in benzene is called:
 - A) Halogenation

C) Alkylation

B) Carbonyl reduction

D) Formylation

Answer Explanation: (B)

The introduction of (X) group in the presence of FeBr₃ in benzene is called halogenation.

Q.73 Which of the following is free radical substitution reaction?

A)
$$CH_3CHO + HCN \longrightarrow CH_3CH(OH)CN$$

C)
$$C_2H_4 + Br_2 \xrightarrow{CCl_4} C_2H_4Br_2$$

B)
$$C_2H_6 + Cl_2 \xrightarrow{hv} C_2H_5Cl + HCl$$

D)
$$CH_3 - Cl + OH^- \longrightarrow CH_3 - OH + Cl^-$$

Answer Explanation: (B)

- Alkanes react with chlorine and bromine in the presence of sunlight or UV light or at high temperature resulting in the successive replacement of hydrogen atoms with halogens called halogenation.
- Extent of halogenation depends upon the amount of halogen used.
- Reaction of alkanes with fluorine is highly violent and results in a mixture of carbon fluorinated alkanes and hydrofluoric acid.
- Iodine does not substitute directly because the reaction is too slow and reversible.
- The order of reactivity of halogens is $F_2 > Cl_2 > Br_2 > I_2$.
- Halogenation is believed to proceed through free radical mechanism. It involves three steps (imitation, propagation and termination).
- e.g. $C_2H_6 + Cl_2 \xrightarrow{hv} C_2H_5Cl + HCl$
- This reaction involves free radical substitution mechanism

O.74 Benzene shows the following reactions:

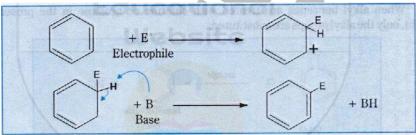
	Type of	Reagents	Chemical reaction	
	reactions			
I	Nitration	Conc. HNO ₃ , Conc. H ₂ SO ₄ 50° - 55° C	+ HNO ₃ + H ₂ O	
II	Sulphonation	Conc. H ₂ SO ₄ 80°C	→ H ₂ SO ₄ → H ₂ O	
III	Alkylation	CH ₃ Cl , AlCl ₃	CH3 + CH3CI → CH3 + HCI	
IV	Acylation	CH ₃ COCl, AlCl ₃	CH ₃ -C + HCI	

The mechanism shown by the above reactions is:

- A) Electrophilic substitution reaction
- C) Acid base reaction
- B) Nucleophilic substitution reaction
- D) β -elimination reaction

Answer Explanation: (A)

The mechanism of the reaction is electrophilic substitution reaction as shown below:



All of the following are correctly matched EXCEPT:

Opt.	Test/Reaction	Identification/Product	
A)	Reaction of ammonical AgNO3 with alkene	Test to detect unsaturation (White ppt are obtained)	
B)	Br ₂ /CCl ₄ with alkene	Test to detect unsaturation reddish brown colour of Br ₂ is discharged	
C)	Ozonolysis of alkene	To locate double bond in alkene	
D)	Catalytic hydrogenation of vegetable oil	Vegetable ghee	

Answer Explanation: (A)

- It is incorrect statement in fact.
- Ammonical AgNO3 does not react with alkene.
- Alkene + ammonical AgNO₃ → No reaction
- Alkynes having acidic hydrogen react with ammonical AgNO₃ to give white ppt. as shown in the reaction

$$HC \equiv CH + 2AgNO_3 + 2NH_4OH \longrightarrow AgC \equiv CAg + 2NH_4NO_3 + 2H_2O$$

Disilver acetylide

Answer Explanation: (B)

(white ppt.)

When different alkenes are treated with hot concentrated KMnO₄ solution, different products are obtained. Which of the following alkenes produces two moles of carboxylic acids?

A)
$$H_2C = CH_2$$

$$C) R^1 R^2 C = CR^3 R^4$$

$$\mathbf{B}$$
) R - CH = CH - R

$$D) R^1 R^2 C = CH^3 R^4$$

 $\xrightarrow{\text{conc. KMnO}_4} 2RCOOH$ R - CH = CH - R + 4[O] -



Q.77 A substance which deactivates the aromatic ring to further substitution is called a deactivating substituent. Which of the following is strongly deactivating group attached with benzene ring:



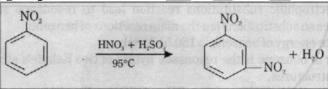




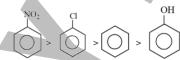


Answer Explanation: (D)

- -NO₂ group is strongly deactivating group attached with benzene ring.
- It is electron withdrawing group. It decreases the reactivity of benzene.
- In its presence the incoming group attacks at m-position on the benzene ring. i.e. it is m-directing group as shown in the reaction:



• Order of decreasing deactivating effect of the mono-substituted benzene as shown below:



- Q.78 **Mark the incorrect statement about mustard gas.
 - A) It is not a gas
 - B) It is a weak vesicant
 - C) It is high boiling liquid
 - D) It is dispersed as a mist of tiny droplets

Answer Explanation: (B) It is incorrect statement

The correct statement is given as:

- It is a powerful vesicant i.e. causes blisters
- Its name comes from its mustard like odour.
- Other Properties of Mustard Gas:
 - It is not a gas
 - It is high boiling liquid
 - It is dispersed as a mist of tiny droplets
- Preparation of Mustard Gas:

It is prepared by the reaction of ethene with S₂Cl₂ as shown below

$$2 \text{ CH}_{2} = \text{CH}_{1} + \text{S}_{2} \text{Cl}_{2} \longrightarrow S$$

$$CH_{2} = \text{CH}_{2} - \text{Cl}_{2}$$

- Uses:
 - It was used as a harmful substance in World War I.
- Q.79 Catalytic oxidation of alkane is used industrially to prepare:
 - A) Higher fatty acids

C) Ketones

B) Alkyl ammine

D) Esters



H_3C-CH_3

acids used in soap and vegetable oil industry as shown in the reaction.
$$H_3C-CH_3 \xrightarrow{Cu} CH_3-CH_2-OH$$

Catalytic oxidation of alkanes is used industrially to prepare higher fatty

$$CH_3 - CH_2 - OH$$

$$Cu \rightarrow CH_3CHO + H_2O$$

$$CH_3CHO + [O]$$

$$\xrightarrow{\text{Cu}} \text{H}_3\text{CCOOH}$$

- Which property of benzene may be directly attributed to the stability Q.80associated with its delocalized electrons?
 - A) It has a low boiling point
 - B) It does not conduct electricity
 - C) Its ΔH_f is positive
 - D) It tends to undergo electrophilic substitution rather than addition reaction

Answer Explanation: (D)

Answer Explanation: (A)

Due to the extra resonance stability of the ring, benzene does not undergo addition reaction in which the ring resonance would be destroyed. Undergoing substitution retains the aromatic system. (already discussed)

- Q.81 Among the following compounds that can be most readily nitrated is:
 - A) Benzoic acid

C) Benzene

B) Bromobenzene

D) Aniline

Answer Explanation: (D)

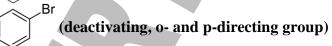
Among the following compounds (Benzoic acid, Bromobenzene, Benzene and Aniline) that can be most readily nitrated is Aniline.

Among the following compounds (Benzoic acid, Bromobenzene, Benzene and Aniline) that can be most readily nitrated is Aniline.

A) Benzoic acid



B) Bromobenzene



C) Benzene



(less deactivating, than bromobenzene)

D) Aniline



(strongly activating, o- and p-directing group)

Conclusion: Order of decreasing activating effect of mono-substituted benzene. Aniline > Benzene > Bromobenzene > Benzoic acid

DETAILED EXPLANATION:

EFFECT OF SUBSTITUENTS ON REACTIVITY OF BENZENE

Substituent	Effect on reactivity
ortho- and para- directing groups	
-OH -NH ₂ , -NHR, -NR ₂	Strongly activating
-R, -CH ₃ , -C ₂ H ₅	Weakly activating
-F, -Cl, -Br, -I	Deactivating
meta- directing groups	
-NO ₂ , -CHO, -COR	Strongly
-SO ₃ H, -CN, -COOH	deactivating

- Which of the following reagents could best be used to distinguish between hex-1-ene and methyl benzene?
 - A) $\left[Ag(NH_3)_2 \right]^+$ in H₂O

C) I₂ in NaOH_(aq)

B) Br₂ in CCl₄

D) 2,4-Dinitrophenylhydrazine

Answer Explanation: (B)

- Being an alkene, hex-1-ene undergoes electrophilic addition reaction readily with Br₂ in CCl₄ and decolourises it.
- Methylbenzene is unable to do so

$$\mathbf{CH_3} - \mathbf{CH_2} - \mathbf{CH_2} - \mathbf{CH_2} - \mathbf{CH_2} - \mathbf{CH_2} + \mathbf{Br_2} \xrightarrow{\mathbf{CCl_4}} \mathbf{CH_3} - \mathbf{CH_2} - \mathbf{CH$$

Q.83 Which of the following methods is not used to prepare alkene:

- A) Dehydration of alcohol
- B) Dehydrohalogenation of alkyl halide
- C) Dehalogenation of vicinal dihalides
- D) Dehalogenation of tetrahalides

Answer Explanation: (D)

A) Dehydration of alcohol

R-CH₂-CH₂-OH
$$\xrightarrow{\text{Al}_2\text{O}_3}$$
 R-CH=CH₂+H₂O

(alkene)

B) Dehydrohalogenation of alkyl halide

$$R \longrightarrow CH_2 \longrightarrow CH_2 \longrightarrow R \longrightarrow CH \longrightarrow CH_2 + KX + H_2O$$

(alkene

C) Dehalogenation of vicinal dihalides

$$X$$
 X $|$ $|$ R — CH — $CH_2 + Zn$ $\xrightarrow{CH_3OH}$ R - CH = $CH_2 + ZnX_2$

(alkene)

D) Dehalogenation of tetrahalides

Q.84 Alkenes containing _

____carbon atoms are in the liquid state:

A) $C_2 - C_4$

C) $C_5 - C_{15}$

B) C₁₆ to onward

D) Both A and C

		Answer Explanation: (C)
Opt.	Range of carbon atoms in alkenes	State
A)	C2 - C4	Ethene, propene and butene in the gaseous state at room temperature
B)	$C_5 - C_{15}$	In the liquid state
C)	C ₁₆ to onward	In the solid state

Q.85 When excess methane is treated with chlorine, the mixture of halogenoalkanes are obtained. Condition for the reaction is/are?

- A) Reaction of methane with chlorine in the presence of dil H₂SO₄
- B) Reaction of methane with chlorine in the presence of catalyst
- C) Reaction of methane with chlorine in the presence of diffused sunlight
- D) Reaction of methane with chlorine in the presence of conc. H₂SO₄

Answer Explanation: (C)

When excess methane is treated with chlorine, the mixture of halogenoalkanes are obtained. Condition for the reaction is that chlorine reacts with methane in the presence of diffused sunlight (already discussed).