ENTRANCE TEST – 2020
MDCAT – CHEMISTRY

TEST # 04 UHS TOPIC – 2 (Organic Chemistry)
TOPIC: HYDROCARBONS

Q.51 **The reactivity of halogens with alkanes falls in the order of:

A) $I_2 < F_2 < Cl_2 < Br_2$
B) $I_2 < Cl_2 < F_2 < Br_2$
C) $F_2 < Cl_2 < Br_2 < I_2$
D) $I_2 < Br_2 < Cl_2 < F_2$

Q.52 **Consider the following statements:

I. Markownikov's rule is sometimes phrased "the richer get richer"
II. Substituents in IUPAC system are listed in alphabetical order
III. The main molecular forces present in alkenes are Van der Waal's forces
IV. Alkenes are prepared in the laboratory by dehydration of alcohols
Which of the above statements is/are correct?

A) I only
B) II only
C) III and IV
D) I, II, III and IV

Q.53 **Catalytic hydrogenation of alkenes is used:

A) For manufacture of vegetable ghee from vegetable oil in the industry only
B) As a synthetic as well as analytical tool in the laboratory only
C) Both 'A' and 'B'
D) Neither 'A' nor 'B'

Q.54 **Which of the following reaction shows free radical substitution reaction?

A) Nitration of benzene in the presence of conc. H_2SO_4 at 50 – 55°C
B) Chlorination of benzene in the presence of $FeCl_3$
C) Hydrogenation of benzene in the presence of Ni at 200°C
D) Chlorination of toluene in the presence of sunlight

Q.55 ** Which of the following is not use of methane?

It is used:

A) As a fuel
B) For the preparation of carbon black which is used in paints, printing inks and automobile tyres
C) For the manufacture of urea fertilizer
D) As a general anesthetic substance

Q.56 **Benzene does not undergo:

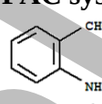
A) Polymerization process only
B) Elimination reaction only
C) Both 'A' and 'B'
D) Neither 'A' nor 'B'

Answer Explanation: (C)

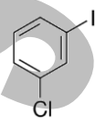
Benzene does not undergo:

- Polymerization process
- Elimination reaction

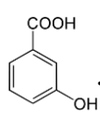
Q.57 Which of the following is not correct name according to IUPAC system of the given structures?

A) 

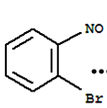
..... 2-Aminobenzaldehyde

B) 

…… 3-Chloroiodobenzene

C) 

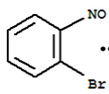
..... 3-Hydroxybenzoic acid

**D) 

..... 2-Nitrobromobenzene**

Answer Explanation: (D)

It is incorrect statement. The correct name of the given strucutre is:

D)  **..... 2-Bromonitrobenzene**

Q.58 Consider the following reaction:

Ethyl alcohol $\xrightarrow{\text{conc.}H_2SO_4}$ **X** $\xrightarrow[CCl_4]{Br_2}$ **Y** $\xrightarrow[KOH]{\text{alcoholic}}$ **Z**

Which of the following is correct sequence for the product shown as: X, Y, Z?

A) Ethene, 1,2-Dibromoethane, Ethyne
B) Ethane,1,2-Dibromoethene, Ethyne
C) Ethyne, 1,2-Dibromoethene, Ethane
D) Ethyne, ethane, 1,2-Dibromoethane

Answer Explained: (A)

$$CH_3 - CH_2 - OH \xrightarrow[\text{Dehydration}]{\text{Conc.}H_2SO_4} CH_2 = CH_2 \xrightarrow[\text{halogenation}]{Br_2/CCl_4} \underset{\displaystyle Br}{\overset{\displaystyle |}{CH_2}} - \underset{\displaystyle Br}{\overset{\displaystyle |}{CH_2}} \xrightarrow{2KOH\,(\text{alcoholic})} CH \equiv CH + 2KBr + 2H_2O$$

Q.59 Bromine reacts with ethene to form 1,2-dibromoethane:

What is the correct description of the organic intermediate in this reaction?

A) It has a negative charge
B) It is a free radical
C) It is a nucleophile
D) It is an electrophile

Answer Explanation: (D)

It is an electrophile (already discussed).

Q.60 Polymerization of ethene gives polythene:

How does the carbon-carbon bond in polythene compare with that in ethene?

A) The carbon-carbon bond is longer and stronger in polythene
B) The carbon-carbon bond is longer and weaker in polythene
C) The carbon-carbon bond is shorter and stronger in polythene
D) The carbon-carbon bond is shorter and weaker in polythene

Answer Explanation: (B)

Polymerization of ethane gives polythene. The carbon-carbon bond is longer and weaker in poly polythene.

Q.61 Incomplete oxidation of methane occurs in a limited supply of oxygen or air and results in the formation of:

A) CO + C
B) CO_2 + CO
C) CO_2 + C
D) C + H_2O

Answer Explanation: (A)

Burning of alkane in the presence of oxygen is known as combustion. There are two types of combustion

(i) Complete combustion in the presence of excess oxygen or air,

$$\mathbf{CH_{4(g)} + 2O_{2(g)} \xrightarrow{Flame} CO_{2(g)} + 2H_2O_{(g)} + 891 kJmol^{-1}}$$

Heat of combustion ($\Delta H_{comb.}$): It is the amount of heat evolved when one mole of hydrocarbon is burnt to produce CO_2 and H_2O.

(ii) (Partial oxidation incomplete combustion) in a limited supply of oxygen.

$$\mathbf{3CH_{4(g)} + 4O_{2(g)} \xrightarrow{Flame} 2CO_{(g)} + 6H_2O_{(g)} + C_{(s)}}$$

Q.62 Identify the correct statement for the reactions of benzene:

A) Reduction of benzene with H_2 gas in the presence of Ni at 200°C act as a catalyst to form cyclohexane
B) Bromination of benzene in the presence of sunlight to form 1,2,3,4,5,6-Hexabromocyclohexane
C) Both A and B
D) Neither A nor B

Answer Explanation: (C)

Both statements are correct.

Q.63 Which of the following are optimum conditions in order to get good quality of polythene as a result of polymerization of ethene?

I. Temperature 400°C
II. Pressure 100atm
III. Amount of oxygen 0.1%
IV. Catalyst $Al(C_2H_5)_3 + TiCl_4$

A) I and II only
C) I, III and IV
B) I, II and III
D) I, II, III and IV

Answer Explanation: (D)

Following are optimum conditions in order to get good quality of polythene as a result of polymerization of ethene

I. Temperature 400°C
II. Pressure 100atm
III. Amount of oxygen 0.1%
IV. Catalyst $Al(C_2H_5)_3 + TiCl_4$

Q.64 When purely alcoholic solution of sodium/potassium hydroxide and halogenoalkanes are treated, an alkene is formed. What we call this reaction?

A) β-Elimination
C) Debromination
B) Dehydration
D) Reduction of benzene

Answer Explanation: (A)

We call this β-elimination reaction as shown below:

$$CH_3 - CH_2 - Br + KOH \xrightarrow{\text{Alcohol}} CH_2 = CH_2 + KBr + H_2O$$

Q.65 Aromatic hydrocarbons are derivatives of:

A) Normal series of paraffins
C) Benzene
B) Alkenes
D) Cyclohexane

Answer Explanation: (C)

- **Aromatic hydrocarbons are derivatives of benzene.**
- **The term aromatic was derived word 'aroma' meaning 'fragrant' and was used in organic chemistry for a special class of compounds.**
- **These compounds have a low hydrogen to carbon ratio in their molecular formula.**
- **It was observed that almost all the aromatic compounds have a six carbon unit in their molecule like benzene.**
- **Hence, benzene was recognized and simplest and parent member of this class of compound**

Q.66 Alkanes are known as paraffins, which means that they are least reactive. Which of the following is not cause of their least reactivity?

A) In sigma bond the electrons are very tightly held between the nuclei
B) Electronegativity difference between C and H in alkane is less than 0.5
C) They can act as electrophiles
D) Non-polarity of bonds

Answer Explanation: (C)

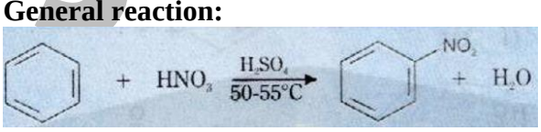
- **Alkanes do not act as electrophile**
- **The electron present in a sigma bond of a alkane can neither act as electrophile nor a nucleophile.**
- **Because they are saturated hydrocarbons.**
- **A gas is decolourized by alkaline $KMnO_4$ solution in cold state but gives no precipitate with ammonical cuprous chloride.**

Q.67 During nitration of benzene, the active nitrating agent is:

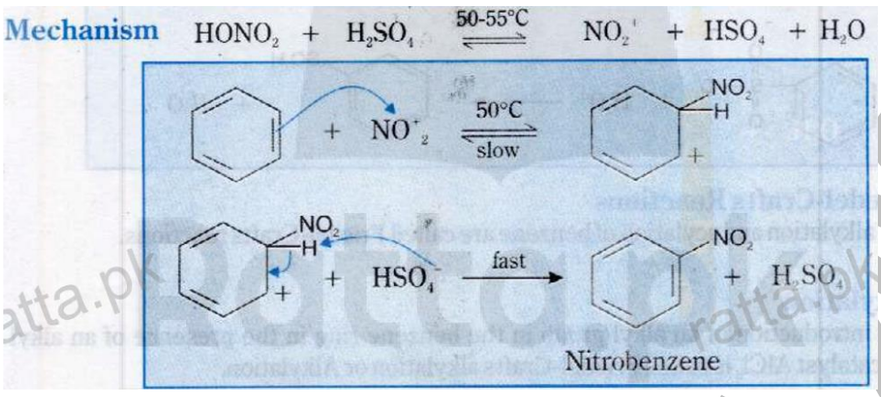
A) N_2O
C) NO_2
B) NO_2^+
D) HNO_3

Answer Explanation: (B)

General reaction:



Mechanism of reaction:



…… i (NO^{+}_{2} is activating nitrating agent)

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Q.68 Which of the following is more reacting substance?

A) Ethane C) Methane

B) Ethene D) Acetylene

Answer Explanation: (B)

Ethene is a gas which is decolourized by alkaline $KMnO_4$ solution in cold state but gives no precipitate with ammonical cuprous chloride.
The reacting substance is ethene.

Q.69 In benzene electrons are delocalized making it a very stable molecule. Greater is the resonance energy, greater is the stability. The resonance energy of benzene is:

A) $-150.5 kJmol^{-1}$ C) $-358 kJmol^{-1}$

B) $+150.5 kJmol^{-1}$ D) $+358 kJmol^{-1}$

Answer Explanation: (B)

The resonance energy of benzene is $+150.5 kJmol^{-1}$.
Calculation for resonance energy:

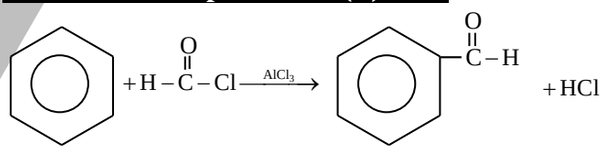
- **Heat of hydrogenation of 1,3,5-cyclohexatriene = 3 x -119.5 = $-358.5 kJmol^{-1}$**
- **Heat of hydrogenation of benzene = $-208.0 kJmol^{-1}$**
- **According to the definition of resonance energy**
  = Actual heat of hydrogenation of benzene – Heat of hydrogenation of 1,3,5-cyclohexatriene (hypothetical)
  = -208.0 – (-358.5)
  = $+150.5 kJmol^{-1}$

Q.70 The introduction of ($H\text{-}\overset{O}{\overset{\|}{C}}{}^{+}$) group in benzene is called:

A) Alkylation C) Acetylation

B) Formylation D) Carbonyl reduction

Answer Explanation: (B)



Phenyl methanal (formylbenzene)

Q.71 Which of the following reactions will yield 2-Bromopropane:

A) $CH_3 - C \equiv CH + 2HBr$ C) $CH \equiv CH + 2HBr$

B) $CH_3 - C \equiv CBr + HBr$ **D)** $CH_3 - CH = CH_2 + HBr$

Answer Explanation: (D)

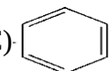
In option 'D' ($CH_3 - CH = CH_2 + HBr$) will yield 2-Bromopropane

- **Markownikov's rule is obeyed**

i. $CH_3 - CH = CH + HBr \longrightarrow \underset{\text{2-Bromopropene}}{H_3C - \overset{Br}{\overset{|}{CH}} - CH_3}$

Q.72 Which of the following is resonance hybrid structure of benzene?

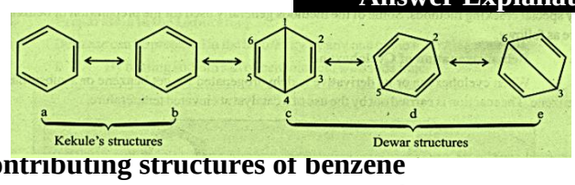
A) 

C) 

B) 

D) 

Answer Explanation: (D)



5 Contributing structures of benzene = **Resonance hybrid of benzene**

Q.73 $AlCl_3$ catalyzes certain reactions by forming carbocation (carbonium ion) with chloroalkane as shown in the following equation:

$$R - Cl + AlCl_3 \rightarrow R^+ + AlCl^-_4$$

This can occur because:

A) $AlCl_3$ is a covalent molecule

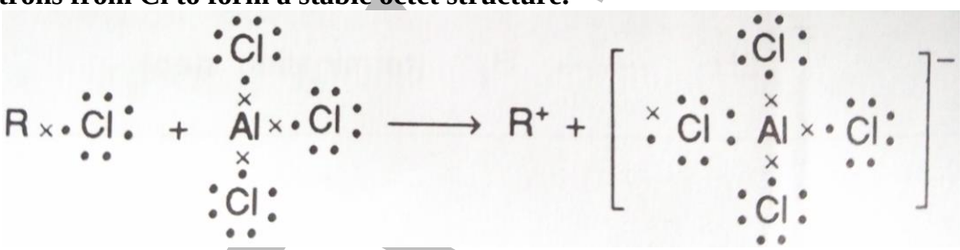
B) $AlCl_3$ exist in the dimeric form (Al_2Cl_6)

C) Al-atom in $AlCl_3$ has an incomplete octet of electrons

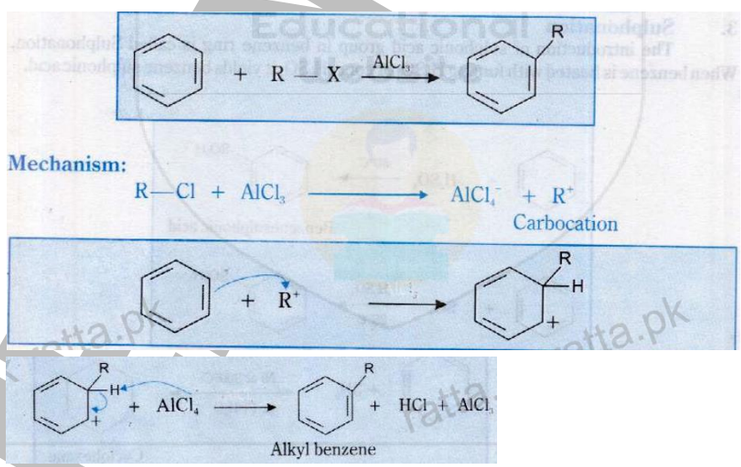
D) Cl-atom in R-Cl has a vacant p-orbital

Answer Explanation: (C)

- **The Al atom has a sextet electronic configuration, 2-electrons short of an octet structure. This gives Al the ability to attract a pair of electrons from Cl to form a stable octet structure.**



- **$AlCl_3$ catalyzes certain reactions by forming carbocation (carbonium ion) with chloroalkane as shown in the following equation $R - Cl + AlCl_3 \rightarrow R^+ + AlCl^-_4$. This can occur because Al-atom in $AlCl_3$ has an incomplete octet of electrons.**



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Q.74 Which one of the following is more stable alkene?

A) 1-Butene

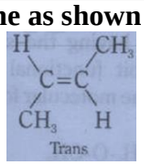
B) Cis-2-Butene

C) Trans-2-Butene

D) 1,3-Butadiene

Answer Explanation: (C)

Trans-2-Butene is the more stable alkene as shown in the structure:



Reason:

- **Symmetrical molecule**
- **Non-polar**
- **High melting point and low boiling point**

Q.75 Benzene is an extra ordinary stable molecule. This stability is due the extensive delocalization of electron cloud. Which of the following methods/techniques does not explain the stability of benzene:

A) Resonance method
C) Crystal field theory
B) Atomic orbital treatment of benzene
D) Resonance energy

Answer Explanation: (C)

Crystal field theory does not explain the stability of benzene. It explain colours shown by the coordination compounds of transition elements.

Q.76 Which one of the following is a propagation step in the reaction between methane and chlorine?

A) $Cl_2 \rightarrow 2Cl^{\bullet}$
C) $CH_3^{\bullet} + Cl_2 \rightarrow CH_3Cl + Cl^{\bullet}$
B) $CH_3^{\bullet} + HCl \rightarrow CH_3Cl + H^{\bullet}$
D) $CH_2Cl^{\bullet} + HCl \rightarrow CH_3Cl + Cl^{\bullet}$

Answer Explanation: (C)

The propagation step in the reaction between methane and chlorine is $CH_3^{\bullet} + Cl_2 \rightarrow CH_3Cl + Cl^{\bullet}$**.**

Q.77 A hydrocarbon, which is liquid at room temperature and decolorizes bromine in the presence of CCl_4 (solvent). What could be the molecular formula of the compound?

A) C_2H_2
C) C_7H_{16}
B) C_2H_4
D) $\mathbf{C_{10}H_{20}}$

Answer Explanation: (D)

A hydrocarbon, which is liquid at room temperature and decolorizes bromine in the presence of CCl_4 (solvent). The molecular formula of the compound is $C_{10}H_{20}$.

Q.78 Which reaction is not an electrophilic addition?

A) $CH_2 = CH_2 + HI \longrightarrow CH_3CH_2I$

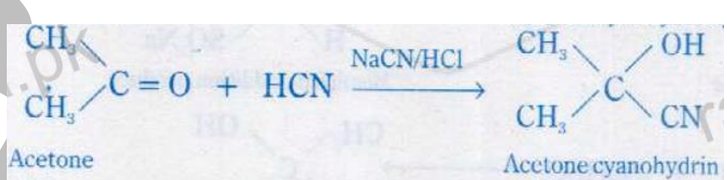
B) $CH_3CH = CH_2 + Br_2 \longrightarrow CH_3CHBrCH_2Br$

C) $CH_3CH = CH_2 + H_2O \xrightarrow{\text{conc. } H_2SO_4} CH_3CH(OH)CH_3$

D) $CH_3COCH_3 + HCN \longrightarrow CH_3C(OH)CN$ (with CH_3 branch)

Answer Explanation: (D)

It is not an electrophilic addition reaction. In fact, it is an example of nucleophilic addition reaction.

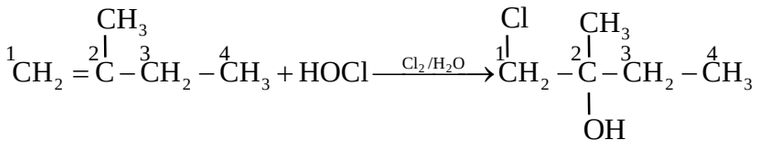


Q.79 The major product obtained when hypochlorous acid is treated with 2-Methyl-1-butene is:

A) 2-Chloro-1-hydroxy-2-methyl butane
B) 1-Chloro-2-methyl-2-butanol
C) 1-Chloro-3-hydroxy-2-methyl butane
D) 3-Chloro-2-hydroxy-2-methyl butane

Answer Explanation: (B)

- **The major product obtained when hypochlorous acid is treated with 2-Methyl-1-butene is 1-Chloro-2-methyl-2-butanol as shown in the reaction.**



Q.80 Which of the following is not ortho and para directing group:

A) -NH_2 C) -OH

B) -OCH_3 **D) -SO_3H**

Answer Explanation: (D)

-SO_3H is not ortho or para directing group. In fact, it is meta directing group. It is strongly deactivating group. It decreases reactivity of benzene.

Q.81 Both methane and ethane can be prepared in one step by the reaction of:

A) C_2H_4 **C) CH_3Br**

B) CH_3CH_2OH D) CH_3OH

Answer Explanation: (C)

Both methane and ethane can be prepared in one step by the reaction of CH_3Br as shown in the reaction:

- **Preparation of methane by hydrogenolysis of bromomethane**

$$CH_3 - Br + H_2 \xrightarrow{C/Pd} CH_4 + HBr$$

- **Preparation of ethane by Wurtz's reaction**

$$2CH_3 - Br + 2Na \xrightarrow{\text{dry ether}} H_3C - CH_3 + 2Na$$

Q.82 Addition of halogen to alkene is an electrophilic addition reaction. Number of steps involved in the mechanism of reaction is/are:

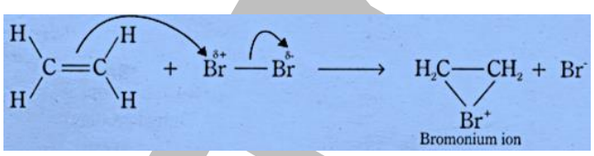
A) 2 C) 1

B) 3 D) 4

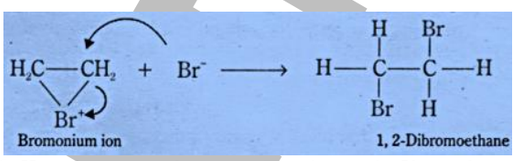
Answer Explanation: (A)

Number of steps involved in the mechanism of reaction is 2 as shown below:

STEP – i



STEP – ii



Q.83 Which of the following species are 3,5 (meta) directing groups when second group is introduced into the benzene ring?

I = -NH_2 **II = -CHO**

III = -COOH **IV = -CH_3**

A) II, III and IV C) I and IV

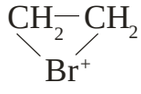
B) II and III D) I, II and IV

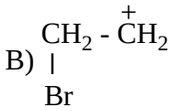
Answer Explanation: (B)

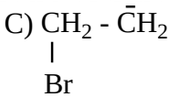
Difference Between 2,4-(o-, p-)directing groups and 3,5-(m-)directing groups

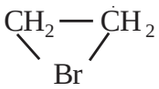
2,4-directing groups	3,5-directing groups
They are electron donating groups	They are electron withdrawing groups
They increase reactivity of benzene	They decrease reactivity of benzene
They have lone pair at the central atom EXCEPT alkyl group	They have multiple bonds
e.g. $-N(CH_3)_2$, $-NH_2$, –OH, $-OCH_3$, –Cl, –Br, I	**e.g. $-N^+R_3$, –C≡N, –COOH, –CHO, –COR**

Q.84 In the reaction of ethene with bromine the intermediate formed is:

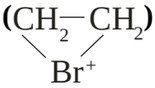
A) 

B) 

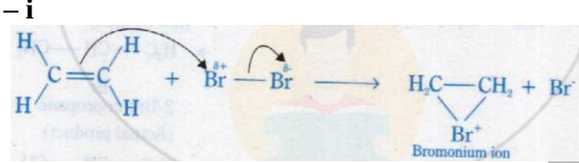
C) 

D) 

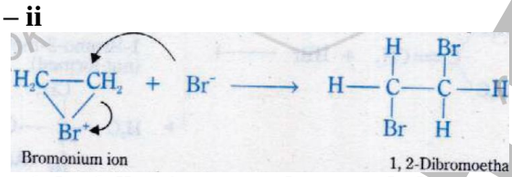
Answer Explanation: (A)

In the reaction of ethene with bromine the intermediate formed is bromonium ion ( **) as shown in the mechanism of the reaction:**

STEP – i



STEP – ii



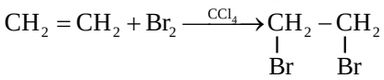
Q.85 Which of the following tests does not help us to distinguish between alkane (ethane) and alkene (ethene)?

A) Baeyer's test
B) Ammonical cuprous chloride test
C) Br_2 / CCl_4 test
D) Cl_2 / CCl_4 test

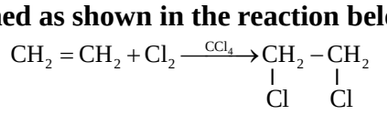
Answer Explanation: (B)

- **It is incorrect statement.**
- **The correct statement is given below:**
- **<u>Baeyer's test</u>**
- **When alkene (ethene) is treated with Baeyers's reagent (1% alkaline $KMnO_4$ solution) at low temperature, the pink colour of $KMnO_4$ is discharged during the reaction as shown below. It is test for the unsaturation in the molecule.**

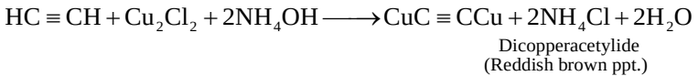
- **<u>Br_2 / CCl_4 test</u>**
- **When the alkene (e.g. ethene) is treated with bromine in CCl_4 inert solvent at room temperature, the red colour of bromine is discharged as shown in the reaction below:**



- **<u>While alkanes do not give this test.</u>**
- **When the alkene (e.g. ethene) is treated with Cl_2 in CCl_4 at room temperature the Dutch oily liquid is formed as shown in the reaction below:**



- **While alkanes do not give this test**
- **<u>Ammonical Cuprous chloride test</u>**
- **<u>(NH_4OH + Cu_2Cl_2)</u>**
- **This test is given by alkynes having acidic hydrogen.**



- **Alkanes and alkenes do not give this test.**