13.ALKENES

SOLUTIONS

TEACHING TASK

JEE MAINS LEVEL QUESTIONS

1. The structural formula of a compound is $CH_3-CH=C=CH_2$. The type of hybridization at the four carbon atoms from left to right

(FA & SA- 3 Marks / 5 Marks)

A) sp^2, sp, sp^2, sp^3 B) sp^2, sp^3, sp^2, sp C) sp^3, sp^2, sp, sp^2 D) sp^3, sp^2, sp^2, sp^2

Answer:C

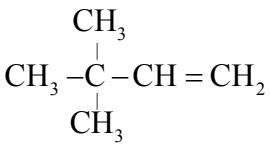
Solution:C1 (CH_3–):Forms 3 σ bonds (with 3 H) and 1 σ bond with C2 $\rightarrow$ 4 σ bonds $\rightarrow sp^3$

C2 (–CH=):Connected to C1 (single bond) and C3 (double bond = 1 σ + 1 π) $\rightarrow$ 3 σ bonds total $\rightarrow sp^2$

C3 (=C=):Central carbon of cumulated double bonds (two π bonds, two σ bonds) $\rightarrow$ sp

C4 (–CH_2):Connected to C3 by a double bond (1 σ + 1 π) and two H atoms $\rightarrow$ 3 σ bonds $\rightarrow sp^2$

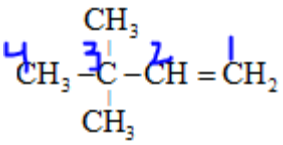
Hybridization order (left $\rightarrow$ right):sp^3, sp^2, sp, sp

2. The IUPAC name of the compound  is

(FA & SA- 5Marks / 8Marks)

A) 3, 3, 3- Trimethylpropane B) 1, 1, 1- Trimethylprop-2-ene
C) 3, 3-Dimethylbut-1-ene D) 2, 2-Dimethylbut-3-ene

Answer:C

Solution: 

Longest chain: 4 carbons including the double bond $\rightarrow$ parent = but-1-ene
Two methyl groups on carbon-3 (when numbering from the double bond end)
IUPAC name: 3,3-Dimethylbut-1-ene

3. Which of the following is the correct statement for the compound C_4H_8?

A) It has a triple bond
B) Such compound is impossible
C) It has a double bond

D) It has either a double bond or a triple bond

Answer:C

Solution: Use the general formulas:

Alkane $\rightarrow C_nH_{2n+2}$

Alkene $\rightarrow C_nH_{2n}$

Alkyne $\rightarrow C_nH_{2n-2}$

Now compare: C_4H_8 fits C_nH_{2n} $\rightarrow$ alkene (one double bond)

4. Ethylene can be prepared by the following method

A) $H-C\equiv CH \xrightarrow[\text{quinoline}]{H_2/Pd-BaSO_4}$

B) Dehalogenation of vicinal dihalide of ethane

C) Electrolysis of potassium fumerate

D) Both 1 and 2

Answer:D

Solution:By dehalogenation of vicinal dihalide of ethane, and

By partial hydrogenation of acetylene using Pd–BaSO4 (Lindlar's catalyst).

5. When ethanol vapours are passed over alumina heated at 350^0C, the main product obtained is

A) C_2H_6 B) C_2H_4 C) C_2H_2 D) $C_2H_5OC_2H_5$

Answer:B

Solution:Dehydration over Al_2O_3 at ~350°C gives ethene C_2H_4

6. Specific reagent for dehydrohalogenation of alkyl halides to get alkenes is

A) Aqueous KOH B) Anhydrous $ZnCl_2$

C) Alcoholic KOH D) Conc. H_2SO_4 at 140^0C

Answer:C

Solution:Dehydrohalogenation (removal of HX) is done using alcoholic KOH

7. Zinc dust in alcoholic solution is a specific reagent in the preparation of alkenes as a

(FA & SA- 2 Marks)

A) Dehydrohalogenating agent B) Dehydrating agent

C) Dehydrogenating agent D) Dehalogenating agent

Answer:D

Solution:Zinc in alcohol removes halogens from vicinal dihalides $\rightarrow$ dehalogenation

8. Dehydrohalogenation of ethyl chloride in presence of alc. KOH produces the following

A) $HC\equiv CH + KCl + H_2O$ B) $CH_4 + KCl + H_2O$

C) $CH_2 = CH_2 + KCl + H_2O$ D) $C_2H_4 + HCl$

Answer:C

Solution: $CH_3CH_2Cl + KOH \xrightarrow{alc.} CH_2 = CH_2 + KCl + H_2O$

9. Which one of the following reagents is used for detection of unsaturation in alkenes

A) $NaOH + CaO$ B) cold dilute alkaline $KMnO_4$

C) $Cl_2 / h\nu$ D) KOH / C_2H_5OH

Answer:B

Solution:Cold dilute alkaline $KMnO_4$ (Baeyer's test).

10. $C_2H_5Cl \xrightarrow{Alcoholic\ KOH} A \xrightarrow{dil\ H_2SO_4/H_2O} B$ Here A and B are

A) C_2H_5OH, C_2H_4 B) C_2H_4, C_2H_5OH C) C_3H_8, C_2H_5OH D) C_2H_2+C_2H_5OH

Answer:B

Solution: $C_2H_5Cl \xrightarrow{alc.KOH} C_2H_4 \xrightarrow{dil.H_2SO_4} C_2H_5OH$

11. $CH_2 = CH_2 \xrightarrow{HCl} A \xrightarrow[\text{Dry ether}]{Mg} B \xrightarrow{\text{Hydrolysis}} C$ then `C' is

A) $CH_3 - CH_2 - Cl$ B) $CH_3 - CH_2 - MgCl$ C) CH_4 D) $CH_3 - CH_3$

Answer:D

Solution:

$\mathbf{CH_2 = CH_2 + HCl \rightarrow CH_3 - CH_2 - Cl}$

$A \rightarrow \mathbf{CH_3 - CH_2 - Cl}$

$\mathbf{CH_3 - CH_2 - Cl + Mg \xrightarrow{Dry\ ether} CH_3 - CH_2 - MgCl}$

$B \rightarrow \mathbf{CH_3 - CH_2 - MgCl}$

$\mathbf{CH_3 - CH_2 - MgCl + H_2O \rightarrow CH_3 - CH_3 + Mg(OH)Cl}$

$C \rightarrow \mathbf{CH_3 - CH_3}$

12. $CH_3 - CH_2 - OH \xrightarrow{Al_2O_3/350^0\,C} A \xrightarrow{Br_2} B$'B'is

A) $CH_3 - CHBr_2$ B) $CH_2Br\,CH_2Br$ C) $CH_2Br_2CHBr_2$ D) $CH_3 - CH_2Br$

Answer:B

Solution:

$CH_3CH_2OH \xrightarrow{Al_2O_3, 350^\circ C} CH_2 = CH_2 + H_2O$

$A \rightarrow CH_2 = CH_2$

$CH_2 = CH_2 + Br_2 \rightarrow CH_2Br - CH_2Br$

$B \rightarrow CH_2Br - CH_2Br$

13. $C_2H_6 \xrightarrow[Sunlight]{1Mole\ Cl_2} A \xrightarrow{Alc.KoH} B \xrightarrow[200^0C]{H_2/Ni} C$. Here 'C' is

A) C_2H_6 B) C_2H_5Cl C) C_2H_4 D) C_4H_{10}

Answer:A

Solution:

$$C_2H_6+Cl_2 \xrightarrow{Sunlight} C_2H_5Cl+HCl$$

$$A \rightarrow C_2H_5Cl$$

$$C_2H_5Cl+Alc.KOH \xrightarrow{\Delta} C_2H_4+KCl+H_2O$$

$$B \rightarrow C_2H_4$$

$$C_2H_4+H_2 \xrightarrow{Ni,200^\circ C} C_2H_6$$

$$C \rightarrow C_2H_6$$

14. $C_2H_6 \xrightarrow[1000^0C]{\Delta} A \xrightarrow{S_2Cl_2} B$. Here 'B' is

A) $(C_2H_5)_2S$ B) $(C_2H_4Cl)_2S$ C) $(CH_3Cl)_2S$ D) $(CH_3)_3S$

Answer:B

Solution:

Step 1: Heating ethane at very high temperature (Δ, 1000 °C) gives ethene (C_2H_4) by dehydrogenation/cracking.

Step 2: Ethene reacts with disulfur dichloride (S_2Cl_2) to give bis(2-chloroethyl) sulfide, i.e. $(ClCH_2CH_2)_2S$ (the notorious "mustard" type thioether)

$$C_2H_6 \xrightarrow{\Delta} CH_2 = CH_2\ (A) \xrightarrow[S_2Cl_2]{100^\circ C} (ClCH_2CH_2)_2S\ (B)$$

15. $CH_3COOK \xrightarrow{Electrolysis} A \xrightarrow[1000^0C]{\Delta} B$, $B \xrightarrow[KMnO_4]{Alkaline} C$. Here 'C' is

A) CH_3COOH B) CH_2OH-CH_2OH C) $CHO-CHO$ D) $COOH-COOH$

Answer:B

Solution:

$$2CH_3COOK \rightarrow CH_3-CH_3 \xrightarrow[1000^0C]{\Delta} CH_2=CH_2 \rightarrow \underset{|}{\overset{OH}{C}}H_2-\underset{|}{\overset{OH}{C}}H_2$$

16. $HC\equiv CH \xrightarrow[Quinoline]{Pd-BaSO_4} A \xrightarrow[AlCl_3]{HCl} B \xrightarrow[Dry\ ether]{Na} C.$ Here 'C' is

A) C_2H_6 B) C_4H_{10} C) C_2H_5Cl D) C_3H_7Cl

Answer:B

Solution: $CH \equiv CH \xrightarrow[pd-BaSO_4]{quinoline} (A)CH_2 = CH_2 \xrightarrow[Hcl]{AlCl_3} (B)CH_3CH_2Cl$

$2CH_3 - CH_2 - Cl \xrightarrow[\text{Dry ether}]{2Na} (C)CH_3 - CH_2 - CH_2 - CH_3$

17. $CH_3 - CH_2Cl \xrightarrow{\text{alcoholic KOH}} A \xrightarrow{Br_2/CCl_4} B \xrightarrow[\Delta]{Zn/\text{alcohol}} C$

C is

A) Acetylene B) Ethylene C) Ethane D) Methane

Answer:B

Solution:

$CH_3 - CH_2Cl \xrightarrow{\text{alc KOH}} CH_2 = CH_2\ (A) \xrightarrow{Br_2/CCl_4} BrCH_2 - CH_2Br\ (B) \xrightarrow{Zn/\text{alcohol}} CH_2 = CH_2(C)$

JEE ADVANCED LEVEL QUESTIONS

Mutli Correct Answer Type :

1. Which of the following reactions can be used to convert an alkene to an alkane?

A) Hydrogenation B) Dehydrohalogenation

C) Hydrohalogenation D) Ozonolysis

Answer:A

Solution:A) Hydrogenation $\rightarrow$ adds H_2, alkene $\rightarrow$ alkane

B) Dehydrohalogenation $\rightarrow$ removes HX, alkane/alkyl halide $\rightarrow$ alkene

C) Hydrohalogenation $\rightarrow$ adds HX, alkene $\rightarrow$ alkyl halide

D) Ozonolysis $\rightarrow$ cleaves double bond to carbonyls

2. Which of the following statements about alkenes are correct?

A) They contain at least one carbon-carbon double bond.

B) They undergo addition reactions with hydrogen halides.

C) They are classified as saturated hydrocarbons.

D) They exhibit cis-trans isomerism.

Answer:A,B,D

Solution:A) They contain at least one C=C double bond

B) They undergo addition reactions with hydrogen halides

C) They are saturated hydrocarbons (they are unsaturated)

D) They exhibit cis-trans isomerism (if each C of double bond has two different substituents)

3. Select all the correct statements about cis-trans isomerism in alkenes:

A) It arises due to restricted rotation about the carbon-carbon double bond.

B) It affects the physical properties of alkenes.

C) Cis isomers have substituents on the same side of the double bond.

D) Trans isomers have substituents on opposite sides of the double bond.

Answer:A,B,C,D

Solution:A) Restricted rotation about C=C
B) Affects physical properties (e.g., boiling point, polarity)
C) Cis: substituents on same side
D) Trans: substituents on opposite sides

4. Which of the following reactions involve the cleavage of the carbon-carbon double bond in alkenes?
A) Hydrogenation B) Hydration C) Ozonolysis D) Halogenation

Answer:C

Solution:Ozonolysis is a powerful organic reaction that uses ozone (O_3) to cleave (break apart) the unsaturated carbon-carbon bond, replacing the multiple bond with carbonyl groups. The reaction is often used to determine the position of a double bond in a molecule.

Assertion and Reason Type :

A) Both (A) and (R) are true and (R) is the correct explanation of(A)
B) Both (A) and (R) are ture and (R) is not the correct explanation of (A)
C) (A) is true but (R) is false
D) (A) is false but (R) is true

5. **Assertion :** Alkenes decolourises bromine in CCl_4
Reason : Double bond is present in alkenes

Answer:A

Solution:Assertion: True — bromine adds to double bond, colour disappears.
Reason: True.
But is the reason the correct explanation? Yes — the double bond is the reactive site that allows bromine to add, causing decolourization.

6. **Assertion :** Alkenes undergo addition reactions with halogens.
Reason : Alkenes contain p bonds which are readily broken to allow addition of electrophiles like halogens.

Answer:A

Solution:Assertion: True.
Reason: True — π bond is electron-rich, attacked by electrophiles.
Correct explanation.

7. **Assertion :** Alkenes can be hydrogenated to form alkanes in the presence of a metal catalyst like palladium.
Reason : Hydrogenation involves the addition of hydrogen across the p bond of the alkene, leading to the saturation of the carbon-carbon double bond.

Answer:A

Solution:A. Assertion true — alkenes hydrogenate to alkanes with metal catalysts (Pd, Pt, Ni).
Reason true — hydrogenation is addition of H_2 across the π bond, saturating the C=C. Reason correctly explains the assertion

8. **Assertion** : Alkenes can exhibit cis-trans isomerism.
   Reason : Cis-trans isomerism arises due to the restricted rotation around the carbon-carbon double bond in alkenes, leading to different spatial arrangements of substituents.

Answer:A

Solution:A. Assertion true — alkenes can show cis–trans isomerism.
Reason true — restricted rotation about the C=C gives distinct spatial arrangements; this is the correct explanation.

Comprehension Type:

Alkenes are a class of organic compounds characterized by the presence of at least one carbon-carbon double bond. They serve as important building blocks in organic synthesis and find numerous applications in various industries.

9. Which of the following statements about alkenes is true?
   A) Alkenes contain at least one carbon-carbon triple bond.
   B) Alkenes are saturated hydrocarbons.
   C) Alkenes contain at least one carbon-carbon double bond.
   D) Alkenes are not reactive due to the presence of double bonds.

Answer:C

Solution:C) Alkenes contain at least one carbon-carbon double bond.
A is wrong – triple bond belongs to alkynes, not alkenes.
B is wrong – alkenes are unsaturated hydrocarbons.
D is wrong – alkenes are reactive due to the double bond (π bond)

10. What type of reaction typically occurs when alkenes react with hydrogen gas in the presence of a metal catalyst?
    A) Substitution B) Elimination C) Addition D) Oxidation

Answer:C

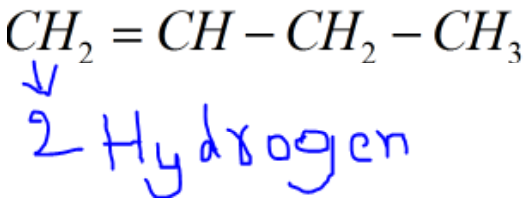
Solution:Hydrogen adds across the double bond, converting alkene $\rightarrow$ alkane.
This is hydrogenation, which is an addition reaction

Integer Type:

11. How many hydrogen atoms are attached to the carbon atom directly bonded to the double bond in 1-butene?

Answer:2

Solution:



12. Calculate the number of pi bonds in the molecule C_6H_{12}.

Answer:1

Solution:C_6H_{12} fits C_nH_{2n}, which is an alkene, so it contains 1 double bond.
Each double bond = 1 π bond

Matrix Matching Type:

A. Alkene + Ozone (O_3) followed by dimethyl sulfide (CH_3SCH_3)	1. Lindlar's catalyst
B. Alkene + Hydrogen gas (H_2) with a palladium catalyst	2. Zinc and water (Zn, H_2O)
C. Alkene + Bromine water	3. Potassium permanganate ($KMnO_4$)

Answer:A-2,B-1,C-3

Solution:

A. Alkene + Ozone (O_3) followed by dimethyl sulfide (CH_3SCH_3)	2. Zinc and water (Zn, H_2O)
B. Alkene + Hydrogen gas (H_2) with a palladium catalyst	1. Lindlar's catalyst
C. Alkene + Bromine water	3. Potassium permanganate ($KMnO_4$)

LEARNERS TASK

CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ'S)

1. Common name of alkenes is

A) Olefins B) Paraffins C) Acetylenes D) Arenes

Answer:A

Solution:Alkenes are commonly called olefins.

2. General formula of alkene is

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

Answer:B

Solution:General formula of alkene is C_nH_{2n}

3. The temperature required for the dehydration of alcohol to get alkene by using Al_2O_3 is

1] 110^0C B) 170^0C C) 250^0C D) 350^0C

Answer:D

Solution:Dehydration of alcohols using Al_2O_3 (alumina) to form alkenes requires a temperature of about 350°C

4. Lindlar's catalyst is used for controlled

A) oxidation B) hydrogenation C) halogenation D) dehydration

Answer:B

Solution:Lindlar's catalyst $\rightarrow$ partial hydrogenation of alkynes to alkenes.

5. In dehydrohalogenation, hydrogen and halogen are removed from

A) the same carbon atom

B) from adjacent carbon atoms

C) from isolate carbon atoms

D) from any two carbon atoms

Answer:B

Solution:In dehydrohalogenation, one hydrogen atom and one halogen atom are removed from adjacent carbon atoms to form a double bond (alkene)

6. Dehydrating agent and dehydro halogenating agents among the following are respectively.
   A) conc H_2SO_4 , Al_2O_3
   B) Al_2O_3 , conc H_2SO_4
   C) conc. H_2SO_4, Alc. KOH
   D) Alc KOH,conc H_2SO_4

Answer:C

Solution:Dehydrating agent: Concentrated sulfuric acid (conc. H_2SO_4) is a powerful dehydrating agent, which means it has a strong affinity for water and can remove water molecules from other compounds. For example, it is used to dehydrate alcohols to form alkenes.Dehydrohalogenating agent: Alcoholic potassium hydroxide (Alc. KOH) is a specific reagent used for dehydrohalogenation reactions. In this reaction, a hydrogen atom and a halogen atom from adjacent carbon atoms in an alkyl halide are eliminated to form an alkene.

7. 1,2 dibromo ethane on heating in presence of zinc gives the following
   A) Ethane B) Ethylene C) Acetylene D) Methane

Answer:B

Solutions:Zn removes halogens $\rightarrow$ C_2H_4 (ethylene)

8. Baeyer's reagent is
   A) Aqueous bromine solution
   B) Neutral permanganate solution
   C) Acidified permanganate solution
   D) Alkaline potassium permanganate solution

Answer:D

Solution:Alkaline $KMnO_4$ (used for oxidation of alkenes).

9. Lindlar catalyst is
   A) Platinised asbestos B) Raney Nickel
   C) Pd - $BaSO_4$ only D) Pd - $BaSO_4$ + Quinoline

Answer:D

Solution:Pd on $BaSO_4$ poisoned with quinoline.

JEE MAINS LEVEL QUESTIONS

1. Anti Markownikoff addition of HBr is not observed in
   A) Propene B) Butene - 1 C) Butene-2 D) Pentene - 2

Answer:C

Solution:Anti-Markovnikov addition occurs only when peroxide (ROOR) is present

and the alkene is asymmetric — that is, when the two double-bonded carbons have different numbers of hydrogens.

Let's check each:

Propene ($CH_3–CH=CH_2$) → asymmetric → anti-Markovnikov possible

1-Butene ($CH_2=CH–CH_2–CH_3$) → asymmetric → anti-Markovnikov possible

2-Butene ($CH_3–CH=CH–CH_3$) → symmetric → both carbons same → no difference → anti-Markovnikov not observed

2-Pentene ($CH_3–CH=CH–CH_2–CH_3$) → asymmetric → possible

2. The reaction condition used for converting 1,2-dibromoethane to ethylene are

A) Zn, alcohol, Δ

B) KOH, alcohol, Δ

C) KOH, water, Δ

D) $NaCl$, alcohol, Δ

Answer:A

Solution:This is dehalogenation using zinc in alcohol under heating.

Zn removes two bromine atoms forming a double bond → C_2H_4 (ethylene)

3. Which one of the following compounds decolourises cold alkaline potassium permanganate soluction?

A) C_2H_6 B) C_2H_5Cl C) C_2H_4 D) $C_2H_5OCH_3$

Answer:C

Solution:Cold alkaline $KMnO_4$ (Baeyer's reagent) decolourises in the presence of unsaturated compounds (those containing C=C or C=C bonds).

Let's check:

A) C_2H_6 → ethane (saturated)

B) C_2H_5Cl → ethyl chloride (saturated)

C) C_2H_4 → ethene (has C=C)

D) $C_2H_5OCH_3$ → ether (saturated)

4. Presence of peroxide affects the addition of

A) HBr B) HCl C) HI D) All

Answer:A

Solution:Peroxide effect (anti-Markovnikov) occurs only for HBr (not HCl or HI).

5. Ethylene is prepared by

A) Dehalogenation of chloroform

B) Pyrolysis of ethane at 450^0C

C)Dehydration of methanol with $Al_2O_3/350^0C$

D) Methyl chloride on reduction

Answer:B

Solution:Thermal cracking/pyrolysis of ethane yields ethylene — lab/industrial

cracking at high T

6. Location of the double bond in unsaturated hydrocarbons can be detected by
A) Ozonolysis reaction B) Baeyer's reagent
C) Br_2 in CCl_4 D) Tollen's reagent

Answer:A

Solution:Ozonolysis cleaves at the C=C and gives carbonyl fragments that reveal the double-bond position

7. In the following reaction, A and B respectively are, $A \xrightarrow{HBr} C_2H_5Br \xrightarrow{B} A$ (E200B)

(FA & SA- 5 Marks / 8 Marks)

A) C_2H_4 and alcoholic KOH/Δ B) C_2H_5Cl and aqueous KOH/Δ
C) C_2H_5OH and aq KOH/Δ D) C_2H_2 and Br_2

Answer:A

Solution:C_2H_5Br can be made from C_2H_4 + HBr.
$C_2H_5Br \rightarrow$ elimination (alc KOH/Δ) $\rightarrow C_2H_4$.
So A = C_2H_4, reagent for elimination = alcoholic KOH/Δ.

8. Which of the following is incorrect regarding uses of Ethylene
A) It is use in the preparation of antifreeze
B) It is use in the preparation of polymers
C) It is use in the preparation of lewisite
D) It is use in the preparation of mustard gas

Answer:C

Solution:Lewisite is an organoarsenic war gas ($C_2H_2AsCl_3$), made from acetylene, not ethylene.

9. $CH_2 = CH_2 + Br_2 \rightarrow X$ **(FA & SA- 2 Marks)**
A) Ethylbromide B) Ethylene dibromide
C) Ethylidine bromide D) Vinyl bromide

Answer:B

Solution: $CH_2 = CH_2 + Br_2 \rightarrow X$
Ethene (CH_2=CH_2) reacts with bromine (Br2) by addition across the double bond, forming $CH_2Br–CH_2Br$.
That product is called ethylene dibromide (IUPAC: 1,2-dibromoethane)

10.Hydrogen bromide is added to $CH_3CH = CH_2$ in

(FA & SA- 3 Marks / 4Marks)

presence of peroxides. The major compound formed is
A) $CH_3CHBrCH_3$ B) $C_2H_5CH_2Br$ C) $CH_2 = CH_2CH_2Br$ D) $CH_3CH_2CH_3$

Answer:B

Solution:When HBr is added to propene $CH_3CH=CH_2$ in the presence of peroxides, the reaction follows the anti-Markovnikov rule (peroxide effect).
The Br atom attaches to the less substituted carbon of the double bond.

$$CH_3-CH=CH_2 \xrightarrow[HBr]{peroxide} CH_3-CH_2-CH_2Br$$

11. $CH_3-CH_2-Cl \xrightarrow{alc.KOH} A \xrightarrow{Br_2/CCl_4} B$ B is

A) $CH_2=CH_2$ B) $HC\equiv HC$ C) CH_2Br-CH_2Br D) CH_3-CHBr_2

Answer:C

Solution: Elimination of HCl: $CH_3CH_2Cl + alc.KOH \xrightarrow{\Delta} \mathbf{A}(CH_2=CH_2) + KCl + H_2O$

Addition of bromine: $CH_2=CH_2 + Br_2/CCl_4 \rightarrow \mathbf{B}(CH_2Br-CH_2Br)$

12. $CH_3CH_2Br \xrightarrow{alcoholicKOH} X \xrightarrow{A}$ Ethylene Chlorohydrine. 'A' is

A) HCl B) HOCl C) $KClO_4$ D) Cl_2

Answer:B

Solution:

$CH_3CH_2Br \xrightarrow{alcoholicKOH} CH_2=CH_2 + KBr + H_2O$

$CH_2=CH_2 \xrightarrow{HOCl} ClCH_2CH_2OH$

A=HOCl

13. $CH_2=CH_2+HBr \rightarrow A \xrightarrow{AlcoholicKOH} B$. B is

A) Carboxylic B) Aldehyde C) Alcohol D) Alkene

Answer:D

Solution: $CH_2=CH_2 + HBr \rightarrow CH_3CH_2Br\ (A) \xrightarrow{alc\ KOH} CH_2=CH_2\ (B)$

B is an alkene.

14. $C_2H_5Cl \xrightarrow{Alc\ KOH} X \xrightarrow{HBr} Y$. Compound 'X' is obtained from 'Y' by the reaction

A) hydrohalogenation B) dehydrohalogenation
C) halogenation D) dehalogenation

Answer:B

Solution:Step 1:C_2H_5Cl —(Alcoholic KOH)→ X
Alcoholic KOH causes elimination (E2).
Removes HCl →forms C_2H_4 (Ethene).
This process is called Dehydrohalogenation (removal of HX).
So, X = Ethene ($CH_2=CH_2$)
Step 2:X —(HBr)→ Y
Ethene + HBr →ethyl bromide (C_2H_5Br)
Compound X is obtained from Y by which reaction
To get back from Y (C2H5Br) to X (CH2=CH2), we must remove HBr, which is exactly Dehydrohalogenation.

15. $CH \equiv CH \xrightarrow[\text{quinoline}]{Pd-BaSO_4} A \xrightarrow{Cl_2/H_2O} B$. 'B' is

A) $C_2H_4Cl_2$ B) C_2H_4Cl C) $Cl-CH_2CH_2OH$ D) $CHCl_3$

Answer:C

Solution: $HC \equiv CH \xrightarrow[H_2]{Pd-BaSO_4/quinoline} CH_2 = CH_2(A) \xrightarrow{Cl_2/H_2O} ClCH_2CH_2OH\ (B)$

JEE ADVANCED LEVEL QUESTIONS

Multicorrect Answer Type:

1. When an alkene undergoes hydrogenation, which of the following statements are true?
   A) The reaction is exothermic.
   B) The reaction proceeds via syn addition.
   C) The addition of hydrogen occurs selectively on one side of the double bond.
   D) The reaction is typically catalyzed by metal catalysts such as palladium or platinum.

Answer:A,B,C,D

Solution:A) Exothermic — True (addition of H_2 to double bond releases heat).
B) Syn addition — True (H atoms add to same face in catalytic hydrogenation).
C) Selectively on one side — True (syn addition means both H on same side).
D) Catalyzed by Pd or Pt — True.

2. Which of the following reactions can be used to convert an alkene to an alcohol?
   a) Hydroboration-oxidation B) Halogenation
   c) Ozonolysis D) Acid-catalyzed hydration

Answer:A,D

Solution:A) Hydroboration-oxidation — True (anti-Markovnikov alcohol).
B) Halogenation — False (gives dihalide).
C) Ozonolysis — False (cleaves to carbonyls).
D) Acid-catalyzed hydration — True (Markovnikov alcohol).

3. Which of the following reactions can be used to prepare alkenes?
   A) Dehydration of alcohols
   B) Reduction of alkynes
   C) Dehydrohalogenation of alkyl halides
   D) Wurtz reaction

Answer:A,B,C

Solution:A) Dehydration of alcohols — True.
B) Reduction of alkynes — True (partial hydrogenation with Lindlar's gives cis-alkene; Na/NH_3 gives trans-alkene).
C) Dehydrohalogenation of alkyl halides — True.
D) Wurtz reaction — False (gives alkanes).

Assertion and Reason Type :

A) Both (A) and (R) are true and (R) is the correct explanation of(A)
B) Both (A) and (R) are ture and (R) is not the correct explanation of (A)
C) (A) is true but (R) is false
D) (A) is false but (R) is true

4. **Assertion :** Heating alkenes with a catalytic amount of palladium on calcium carbonate leads to the formation of saturated hydrocarbons.
Reason : This reaction proceeds via the addition of hydrogen across the carbon-carbon double bond.

Answer:D

Solution:Assertion: Heating alkenes with $Pd/CaCO_3$ leads to saturated hydrocarbons.

False — $Pd/CaCO_3$ (Lindlar's catalyst) is for partial hydrogenation of alkynes to alkenes, not for alkenes to alkanes. Heating alkene with Pd/C without H2 does nothing; with H_2 it gives alkane, but Pd/CaCO3 specifically is Lindlar's for alkynes.

Reason: This reaction proceeds via addition of H2 across double bond.

True for catalytic hydrogenation in general, but not for the given catalyst with out H_2 gas.

So Assertion false, Reason true.

5. **Assertion :** Alkenes undergoes elimination reactions to form alkynes.
Reason : Elimination reactions of alkenes involve the removal of two substituents from adjacent carbon atoms, leading to the formation of a carbon-carbon triple bond characteristic of alkynes.

Answer:D

Solution:An alkene does not typically undergo a single elimination to give an alkyne directly. In practice, formation of an alkyne usually requires halogenation to give a vicinal dihalide followed by two successive dehydrohalogenations (or oxidative/dehydrogenation routes).

The reason's description (removal of substituents from adjacent carbons leading to a triple bond) correctly describes how a triple bond is generated in principle, so the reason is essentially true while the bare assertion (that alkenes themselves directly undergo elimination to give alkynes) is false/ misleading.

6. **Assertion :** The addition of water to an alkene follows Markovnikov's rule.
Reason : Markovnikov's rule states that in the addition of water to an alkene, the hydrogen atom adds to the carbon with more substituents, leading to the formation of more stable carbocation intermediates.

Answer:C

Solution:Assertion: Addition of water to alkene follows Markovnikov's rule. $\rightarrow$True for acid-catalyzed hydration.

Reason: Markovnikov's rule states H adds to carbon with more substituents. ?

False — H adds to carbon with more H atoms (less substituted carbon).
So A true, R false.

7. **Assertion** : Alkenes undergo polymerization reactions to form long-chain polymers.
Reason : Alkenes can form polymers through addition polymerization, where monomers with carbon-carbon double bonds add together to form long chains of repeating units.

Answer:A

Solution:Both are true and the reason correctly explains the assertion — this is standard addition (chain-growth) polymerization (e.g., ethene $\rightarrow$ polyethylene)

Comprehension Type:

Alkenes are hydrocarbons containing at least one carbon-carbon double bond. They are important in organic chemistry due to their versatile reactivity.

8. Which of the following is a characteristic reaction of alkenes?
A) Esterification B) Hydrogenation C) Saponification D) Halogenation

Answer:B,D

Solution:Hydrogenation is the addition of hydrogen (H_2) across the carbon-carbon double bond, typically in the presence of a metal catalyst (like nickel or platinum), to form an alkane.
Halogenation is the addition of a halogen molecule (like Br_2 or Cl_2) across the double bond to form a vicinal dihalide. The rapid de-colorization of orange bromine water is a classic test for the presence of unsaturation (a double or triple bond), highlighting its characteristic nature for alkenes.

9. When an alkene undergoes addition reactions, the double bond is broken to form:
A) Two single bonds.
B) One single bond and one triple bond.
C) One single bond and one double bond.
D) Two triple bonds.

Answer:A

Solution:In addition reactions, the π bond of the double bond breaks, and it forms two new σ bonds, resulting in two single bonds

Integer Type:

10. Calculate the number of hydrogen atoms present in 2-methylpropene.

Answer:8

Solution:

$$CH_3-\overset{\overset{CH_3}{|}}{C}=CH_2$$

11. How many pi bonds are present in the compound $CH_2=CHCH_2CH=CH_2$?

Answer:2

Solution:Double bonds at C1–C2 and C4–C5.

Each double bond = 1 π bond.

So total π bonds = 2.

Matrix Matching Type:

12. A. $CH_2=CH_2$ — 1. But-1-ene
B. $CH_3CH=CH_2$ — 2. Ethene
C. $CH_3CH_2CH=CH_2$ — 3. Prop-1-ene

Answer:A -2, B -3, C - 1

Solution:

A. $CH_2=CH_2$ — 2. Ethene
B. $CH_3CH=CH_2$ — 3. Prop-1-ene
C. $CH_3CH_2CH=CH_2$ — 1. But-1-ene

KEY

			TEACHING TASK						
			JEE MAINS LEVEL QUESTIONS						
1	2	3	4	5	6	7	8	9	10
C	C	C	D	B	C	D	C	B	B
11	12	13	14	15	16	17			
D	B	A	B	B	B	B			
			JEE ADVANCED LEVEL QUESTIONS						
1	2	3	4	5	6	7	8	9	10
A	A,B,D	A,B,C,D	C	A	A	A	A	C	C
11	12	13							
2	1	A-2,B-1,C-3							
				LEARNERS TASK					
			CONCEPTUAL UNDERSTANDING QUESTIONS (CUQ'S)						
1	2	3	4	5	6	7	8	9	
A	B	D	B	B	C	B	D	D	
			JEE MAINS LEVEL QUESTIONS						
1	2	3	4	5	6	7	8	9	10
C	A	C	A	B	A	A	C	B	B
11	12	13	14	15					
C	B	D	B	C					
			JEE ADVANCED LEVEL QUESTIONS						
1	2	3	4	5	6	7	8	9	10
A,B,C,D	A,D	A,B,C	D	D	C	A	B,D	A	8
11	12								
2	A -2, B -3, C - 1								