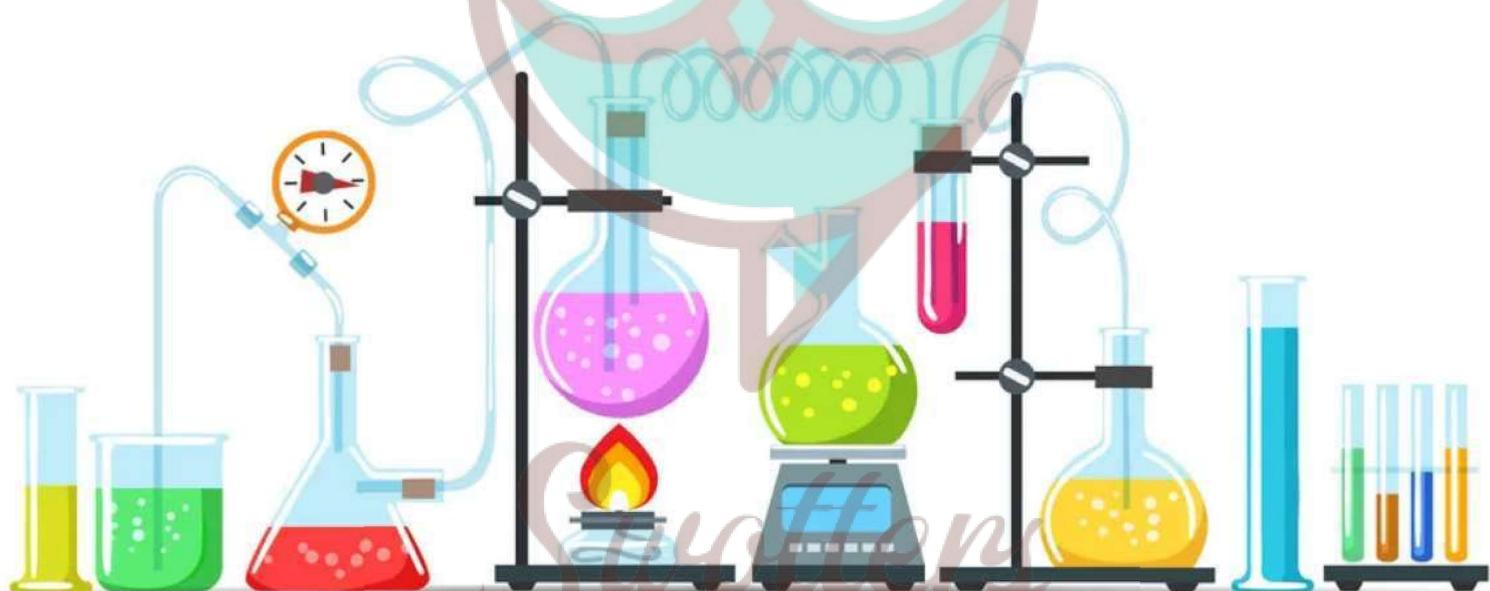# CHEMISTRY

Important Questions

Multiple Choice questions-

Question 1. Which among the following statement is not true?

(a) In liquid, particles are less regularly arranged and are free to move

(b) Boiling involves breaking up of group of molecules in liquid

(c) Boiling involves separation of oppositely charged ions

(d) Thermal energy of particles overcome cohesive forces that hold them

Question 2. Identify the chiral molecule among the following:

(a) Isopropyl alcohol

(b) 2-pentanol

(c) 1-bromo 3-butene

(d) Isobutyl alcohol

Question 3. Which element is estimated by Carius method?

(a) Carbon

(b) Hydrogen

(c) Halogen

(d) Nitrogen

Question 4. A solution of (+) – 2 – chloro – 2 – phenylethane in toluene racemises slowly in the presence of small amounts of SbCl5 due to the formation of

(a) Carbanion

(b) Carbene

(c) Free radical

(d) Carbocation

Question 5. Which of the following acids has the smallest dissociation constant?

(a) $CH_3CHFCOOH$

(b) FCH_2CH_2COOH

(c) $BrCH_2CH_2COOH$

(d) $CH_3CHBrCOOH$

Question 6. What is the correct IUPAC name of?
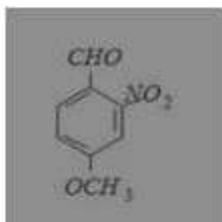
(a) 4-methoxy-2-nitrobenzaldehyde

(b) 4-formyl-3-nitro anisole

(c) 4-methoxy-6-nitrobenzaldehyde

(d) 2-formyl-5-methoxy nitrobenzene

Question 7. 0.5 g of hydrocarbon gave 0.9 g water on combustion. The percentage of carbon in hydrocarbon is

(a) 75.8

(b) 80.0

(c) 56.6

(d) 28.6

Question 8. 0.92 g of an organic compound was analysed by combustion method. The mass of the U- tube increased by 1.08 g. What is the percentage of hydrogen in the compound?

(a) 13.04%

(b) 52.17%

(c) 65.21%

(d) 11.30%

Question 9. What is the state of hybridisation of carbon in carbanion?

(a) sp

(b) sp^2

(c) sp^3

(d) sp^2d.

Question 10. An organic compound contains C = 38.8 H = 16 and N = 45.2. Empirical formula of the compound is

(a) CH_3NH_2

(b) CH_3CN

(c) C_2H_5CN

(d) $CH_2(NH)_2$

Question 11. 59 g of an amide obtained from a carboxylic acid, RCOOH, liberated 17 g of

ammonia upon heating with alkali. The acid is

(a) Formic Acid

(b) Acetic Acid

(c) Propionic Acid

(d) Benzoic Acid

Question 12. The displacement of electrons in a multiple bond in the presence of attacking reagent is called

(a) Inductive effect

(b) Electrometric effect

(c) Resonance

(d) Hyper conjugation

Question 13. The molecular formula C_5H_{12} contains how many isomeric alkanes?

(a) 1

(b) 2

(c) 3

(d) 4

Question 14. If two compounds have the same empirical formula but different molecular formula, they must have

(a) Different percentage composition

(b) Different molecular weight

(c) Same viscosity

(d) Same vapour density

Question 15. Inductive effect involves

(a) Displacement of σ electrons

(b) Delocalization of π electrons

(c) delocalization of σ-electrons

(d) Displacement of π-electrons

Very Short:

1. What type, of hybridisation, is involved in

    (i) planar and

CHEMISTRY ORGANIC CHEMISTRY SOME BASIC PRINCIPLES AND TECHNIQUES

(ii) linear molecules?

2. Arrange the following in increasing order of C – C bond strength:

C_2H_6, $C_2H_4C_2H_2$

3. Arrange the following in decreasing order of C — C bond length:

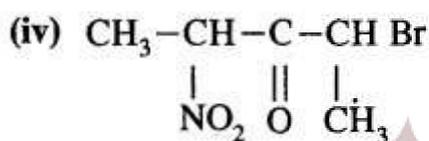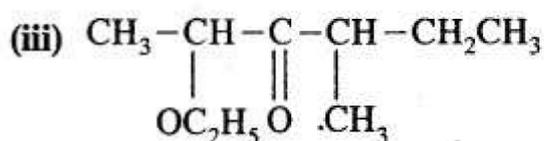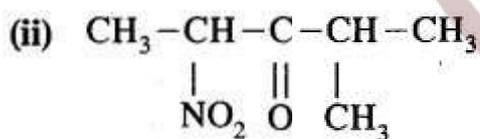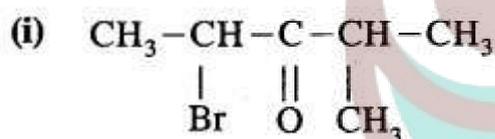4. What is the type of hybridisation of C atoms in benzene?

5. What are isomers?

6. Select electrophiles out of the following:

H^+ Na^+, Cl^-, C^2HSOH, $AlCl^3$, SO^3, $CN-$, CH^3CH^2+,: CCl^2, R-X.

7. Select nucleophiles from the following.

BF_3 $NH3$ $OH-$, R-X, C_2H_5OH, H_3O+, NO_2, $CN-$.

8. Give the I.U.P.A.C. names of the following compounds

(i) $\underset{\underset{Br}{|}}{CH_3-CH}-\underset{\underset{O}{||}}{C}-\underset{\underset{CH_3}{|}}{CH}-CH_3$

(ii) $\underset{\underset{NO_2}{|}}{CH_3-CH}-\underset{\underset{O}{||}}{C}-\underset{\underset{CH_3}{|}}{CH}-CH_3$

(iii) $\underset{\underset{OC_2H_5}{|}}{CH_3-CH}-\underset{\underset{O}{||}}{C}-\underset{\underset{.CH_3}{|}}{CH}-CH_2CH_3$

(iv) $\underset{\underset{NO_2}{|}}{CH_3-CH}-\underset{\underset{O}{||}}{C}-\underset{\underset{CH_3}{|.}}{CH}\,Br$
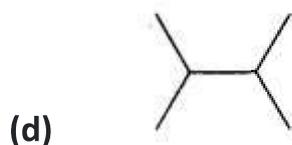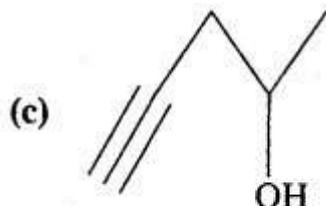
(v) $(CH_3)4C$

(vi) $(CH_3)_2CHCOOH$.

9. What is a functional group?

10. Arrange the following in increasing order of-I effect.
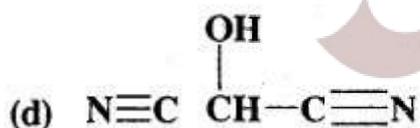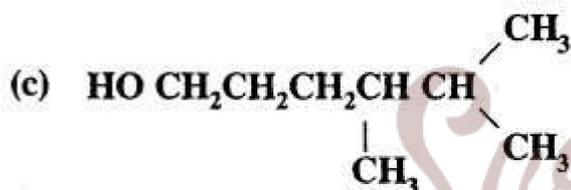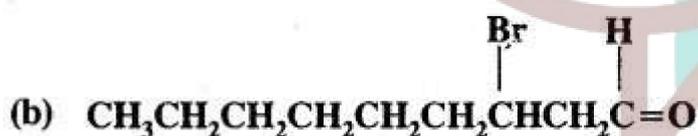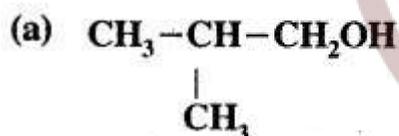
(i) $-NO_2$, -COOH, -F, -CN, – I.

Short Questions:

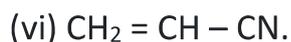1. Expand each of the following bond-line formulae to show all the atoms including carbon and hydrogen.
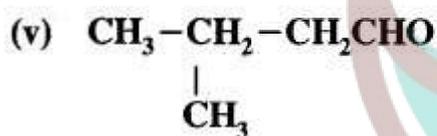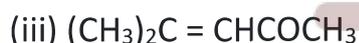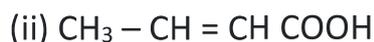
(a)

(b)

(c)

(d)

2. For each of the following compounds, write a more condensed and also their bond line formulae.

(a) $CH_3-CH-CH_2OH$
          $|$
          CH_3

(b) $CH_3CH_2CH_2CH_2CH_2CH_2CHCH_2C=O$
with Br and H above:
$CH_3CH_2CH_2CH_2CH_2CH_2\overset{Br}{\underset{|}{C}}HCH_2\overset{H}{\underset{|}{C}}=O$

(c) $HO\ CH_2CH_2CH_2CH\ CH$
with substituents:
$HO\ CH_2CH_2CH_2\underset{\underset{CH_3}{|}}{CH}\ CH\overset{\diagup CH_3}{\diagdown CH_3}$

(d) $N\equiv C\ \overset{OH}{\underset{|}{CH}}-C\equiv N$

3. What is the type of hybridisation of each carbon in the following compounds?

(a) CH_3Cl

(b) $(CH_3)_2CO$

(c) CH_3CN

(d) $HCONH_2$

(e) $CH_3CH = CHCN$.

4. What is the shape of the following molecules:

    (a) $H_2C = O$

    (b) CH_3F

    (c) $H-C \equiv N$?

5. Give the I.U.P. A.C. names of the following compounds:

    (i) $\underset{\underset{CH_2}{\overset{||}{}}}{C_2H_5-C-CH_2OH}$

    (ii) $CH_3 - CH = CH\ COOH$

    (iii) $(CH_3)_2C = CHCOCH_3$

    (iv) $\underset{O\ H}{Cl} $

    (v) $\underset{\underset{CH_3}{\overset{|}{}}}{CH_3-CH_2-CH_2CHO}$

    (vi) $CH_2 = CH - CN$.
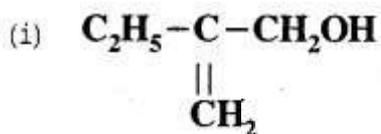
6. Write the I.U.P.A.C. names of

    (i)

    (ii)
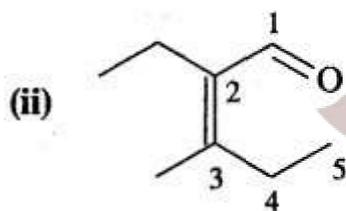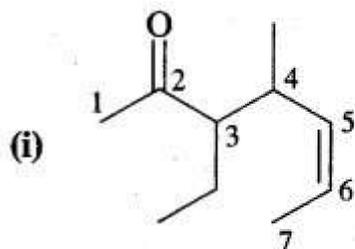
Long Questions:

1. Explain the principle of steam distillation.

2. Dehydrobromination of compounds (A) and (B) yield the same alkene (c) Alkene (c) Can regenerate (A) and (B) by the addition of HBr in the presence and absence of peroxide respectively. Hydrolysis of A and B give isomeric products (D) and (E) respectively. 1, 1-Diphenyl ethane is obtained on the reaction of (C) of benzene in the presence of H+ ions.

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Give structures of A to E with reactions.

3. What are reaction intermediates? How are they generated by bond fission?

4. 0.395 g of an organic compound by various method for the estimation of sulphur gave 0.582g of BaSO4. Calculate the percentage of Sulphur.

5. 0.15g of an organic compound gave 0.12g of AgBr by carius method. Find the percentage of bromine in the compound.

Assertion Reason Questions:

1. In the following questions, a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct option out of the choices given below each question.

   Assertion (A) : Simple distillation can help in separating a mixture of

   propan-1-ol (boiling point 97°C) and propanone (boiling point 56°C).

   Reason (R) : Liquids with a difference of more than 20°C in their boiling

   points can be separated by simple distillation.

   (i) Both A and R are correct and R is the correct explanation of A.

   (ii) Both A and R are correct but R is not the correct explanation of A.

   (iii) Both A and R are not correct.

   (iv) A is not correct but R is correct.

2. In the following questions, a statement of Assertion (A) followed by a statement of Reason (R) is given. Choose the correct option out of the choices given below each question.

   Assertion (A) : Energy of resonance hybrid is equal to the average of energies

   of all canonical forms.

   **Reason (R) :** Resonance hybrid cannot be presented by a single structure.

   (i) Both A and R are correct and R is the correct explanation of A.

   (ii) Both A and R are correct but R is not the correct explanation of A.

   (iii) Both A and R are not correct.

   (iv) A is not correct but R is correct.

Case Study Based Question:

1. Read the passage given below and answer the following questions:

   The electron displacements due to the influence of an atom or a substituent group

   present in the molecule cause permanent polarisation of the bond (called electronic effect),

e.g.

$$CH_3 \overset{\delta\delta+}{-CH_2} \overset{\delta+}{-CH_2} \overset{\delta-}{-F}.$$
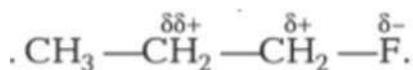
In above example, polar C—F bond induce polarity in the adjacent bonds. Such polarisation of adjacent σ- bond is referred to as the inductive effect. This effect decreases rapidly as the number of intervening bonds increases. The resonance effect is defined as the polarity produced in the molecule by the interaction of two π-bonds or in conjugated system.

When the group or atom release electron density then electron density of conjugated system increases while the group or atom attract/withdraw electron density then electron density of conjugated system decreases.

(1) In which molecule dipole moment is the maximum?

(a) $CH_3CH_2CH_2 — Cl$

(b) $CH_3CH_2CH_2 — NO_2$

(c) $CH_3CH_2CH_2 — OH$

(d) $CH_3—CH_2—NH—\underset{\underset{O}{\|}}{C}—CH_3$

(2) In which benzene ring electron density is maximum?
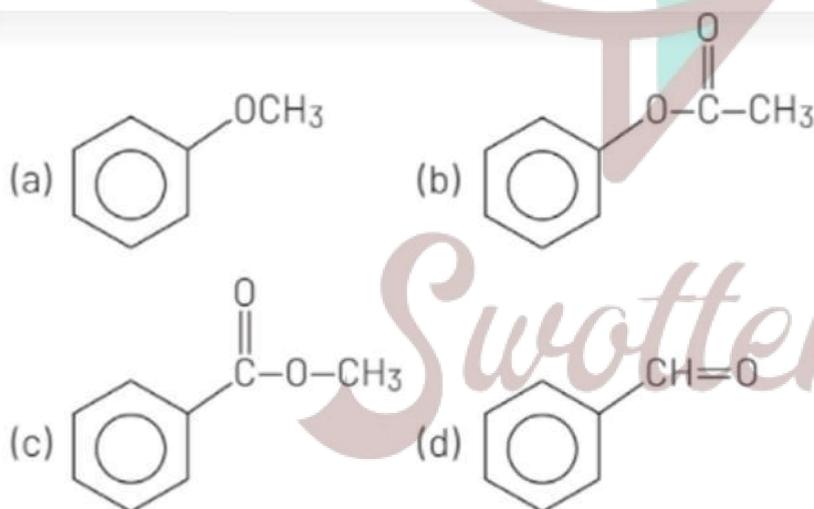
(3) Which of the following system show abnormal behaviour in their properties (like-stability, polarity ... etc.) ?

(a) NH_2 — cyclohexane amine structure

(b) NH_2 — benzene amine structure

(c) cyclohexene structure

(d) OCH_3 — cyclohexene methoxy structure
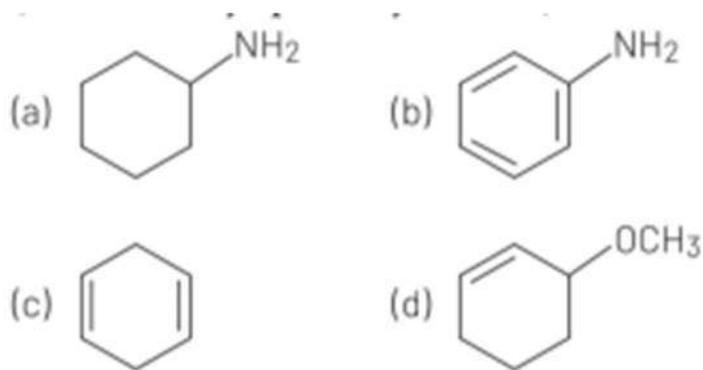
(4) The permanent displacement of electron through a chain involving only σ-bonds is called

    (a) Inductive effect

    (b) Hyperconjugation effect

    (c) Electrometric effect

    (d) Mesmeric effect

2. Read the following passage and answer the question accordingly.

An intermediate is a molecular entity, that is formed from the reactants and reacts further to give the directly observed products of a chemical reaction. Most chemical reactions are stepwise, that is they take more than one elementary step to complete. An intermediate is the reaction product of each of these steps, except for the last one, which forms the final very isolated. Also, owing to the short lifetime, they do not remain in the product mixture.

In certain cases, they are separated and stored. For example matrix isolation and low temperature. Matrix isolation is a technique that is used experimentally in physics and chemistry that includes a material that has been trapped with in an unreactive material. Host matrix generally comprises guest particles that are generally embedded. Guest particles can be molecules, atoms and ions. The guest is isolated within the host matrix.

(1) Relative stabilities of the following carbocations will be in the order

$$\overset{\oplus}{C}H_3, \ CH_3\overset{\oplus}{C}H_2, \ \overset{\oplus}{C}H_2OCH_3$$
$$(A) \qquad (B) \qquad (C)$$
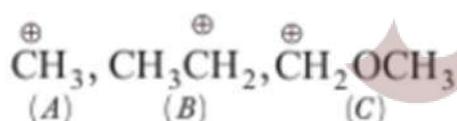
    (a) C > B > A

    (b) C < B < A

    (c) B > C > A

    (d) C > A > B

(2) $CH_3 CH_2 Cl$ undergoes homolytic fission, produces.

(a) $CH_3 \overset{\bullet}{C}H_2$ and $\overset{\bullet}{C}l$ (b) $CH_3 \overset{\oplus}{C}H_2$ and Cl^-

(c) $CH_3 \overset{\oplus}{C}H_2$ and $\overset{\oplus}{C}l$ (d) $CH_3 \overset{\bullet}{C}H_2$ and Cl^-

(3) The shape of carbocation is:

(a) square planar

(b) trigonal planar

(c) octahedral

(d) trigonal pyramidal

(4) Compare stability of free radicals.

I. $CH_3 \overset{\bullet}{C}H \text{—} CH_3$

II. benzene ring $\text{—}\overset{\bullet}{C}H_2$

III. $\overset{\bullet}{C}H_2 \text{—} CH(CH_3)_2$

IV. $\overset{\bullet}{C}H_2 \text{—} CH_3$
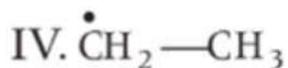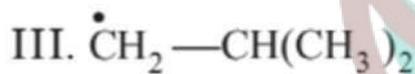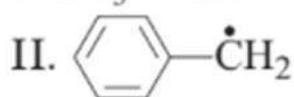
(a) II > I > III > IV

(b) II > I > IV > III

(c) I > II > III > IV

(d) IV > III > I > II

Answer Key:

MCQ

1. (c) Boiling involves separation of oppositely charged ions

2. (d) Isobutyl alcohol

3. (c) Halogen

4. (d) Carbocation

5. (c) $BrCH_2CH_2COOH$

6. (a) 4-methoxy-2-nitrobenzaldehyde

7. (b) 80.0

8. (a) 13.04%

9. (c) sp^3

10. (a) CH_3NH_2

11. (b) Acetic Acid

12. (b) Electrometric effect

13. (c) 3

14. (b) Different molecular weight

15. (a) Displacement of σ electrons

Very Short Answer:

1. (i) sp^2

   (ii) sp.

2. $C_2H_6 < C_2H_4 < C_2H_2$.

3. $C_2H_6 > C_2H_4 > C_2H_2$.

4. It is an sp2 type of hybridisation.

5. Compounds having the same molecular formula, but different physical and chemical properties are called isomers.

6. H^+, Na^+, A1Cl3, SO3, CH3CH$_2$+,: CCl_2, R-X.

7. NH_3, OH, C_2H_5OH, CN

8. (i) 2-Bromo-4 – methyl pent-3- one

   (ii) 4-Methyl-2-nitro pent – 3 – one

   (iii) 2 – Ethoxy – 4 – methoxypent – 3 – one

   (iv) 2-Bromo-4-nitro pent-3-one

   (v) 2, 2-Dimethylpropane

   (vi) 2-Methyl propanoic acid.

9. The atom or group of atoms present in a molecule that determines its chemical properties is called the functional group.
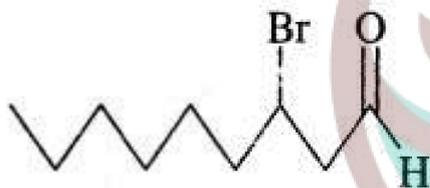
10. $-I < -F < -COOH < -CN < -NO_2$.

Short Answer:

Ans: 1.

(a)
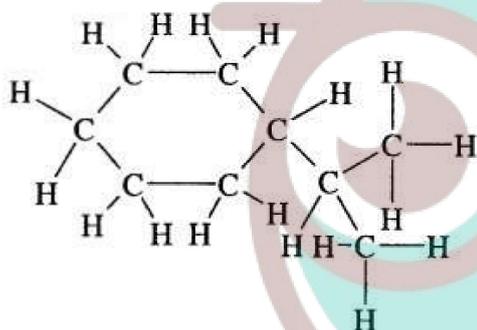
(b)
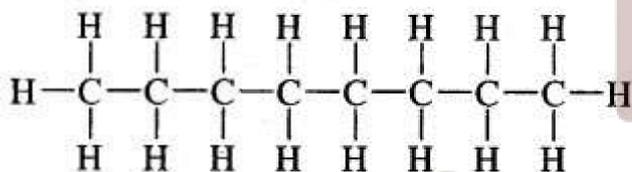
(c)
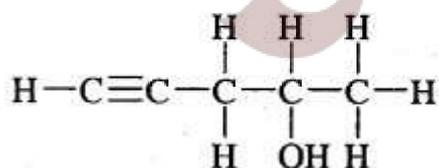
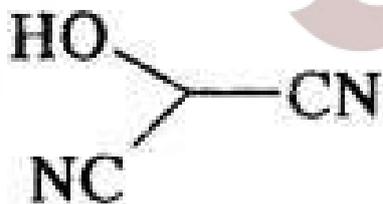(d)
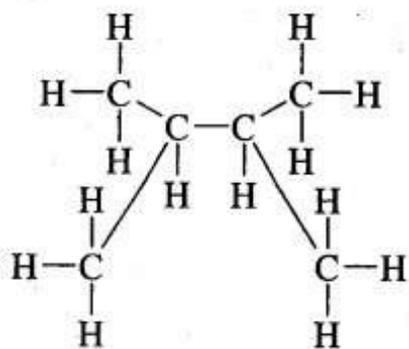
Ans: 2. (a) Condensed formulae are

$(CH_3)_2CH CH_2 OH$

(b) $CH_3(CH_2)_5 CHBr CH_2 CHO$

(c) $HO(CH_2)_3 CH(CH_3) CH(CH_3)_2$

(d) $HOCH(CN)_2$

Ans: 3.

(a) $\overset{sp^3}{CH_3}-Cl$

(b)
$$\overset{sp^3}{CH_3} \diagdown \overset{sp^2}{C=O}$$
$$\overset{sp^3}{\diagup}$$
$$CH_3$$

(c)
$$\overset{sp^3}{CH_3} - \overset{sp}{C} \equiv N$$

(d)
$$H - \overset{sp^2}{\underset{\underset{O}{\parallel}}{C}} - \overset{\cdot\cdot}{N}H_2$$

(d)
$$\overset{sp^3}{CH_3} - \overset{sp^2}{CH} = \overset{sp^2}{CH} - \overset{sp}{C} \equiv N$$
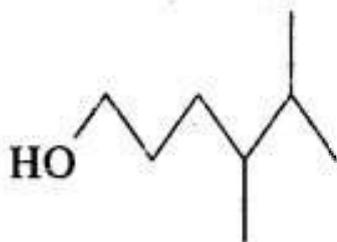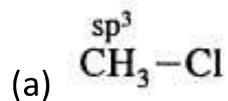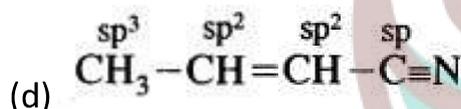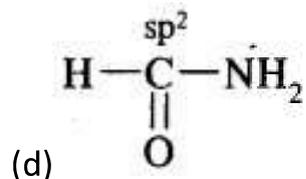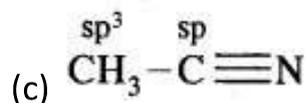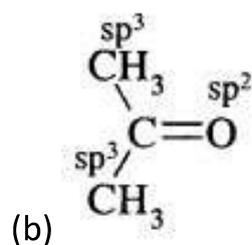
Ans: 4. (a) In $H_2C = O$; C is sp^2 hybridised, hence its shape is H trigonal planar

$$\overset{H}{\underset{H}{\diagdown}} C = O$$
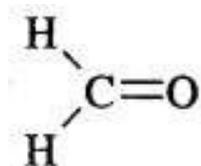
(b) In CH_3F -F; C is sp3 hybridized

∴ it is tetrahedral

$$H - \overset{\overset{H}{\vert}}{\underset{\underset{H}{\vert}}{C}} - H$$
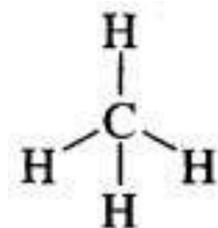
(c) In $H-C \equiv N$; C is sp-hybridized, hence HCN is linear

$H — C \equiv N.$
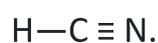
Ans: 5. (i) 2-Ethylprop-2-en-l-ol

(ii) But-2-en-l-oic acid

(iii) 4-Methylpent-3-en-2-one

(iv) 3-Chloropropanal

(v) 3-Methylbutane-l-al

(vi) Prop-2-en-1-nitrile.

Ans: 6. (i) 3-Ethyl-4-methylhept-5-en-2-one

(ii) 2-Ethyl-3-methylpent-2-en-1 -one.

Long Answer:

Ans: 1. Steam distillation: The process of steam distillation is employed in the purification of substance from non-volatile impurities provided the substance itself is volatile in steam and insoluble in water.

This method is based on the facts that

1. A liquid boils at a temperature when its vapour pressure becomes equal to the atmospheric pressure.

2. The vapour pressure of a mixture of two immiscible liquids is equal to the sum of the vapour pressures of the individual liquids.

In the actual process, steam is continuously passed through the impure organic liquid. Steam heats the liquid and it gets practically condensed to water. After some time, mixture of the liquid and water begins to boil, because the vapour pressure of the mixture becomes equal to the atmospheric pressure.

Obviously, this happens at a temperature that is lower than the boiling point of the substance or that of water. Thus an organic compound boils below its boiling points and chances of decomposition avoided. For example, a mixture of aniline (b.p 453 K) with decomposition and water (b.p. 373 K) under normal atmospheric pressure boils at 371K. At this temperature the
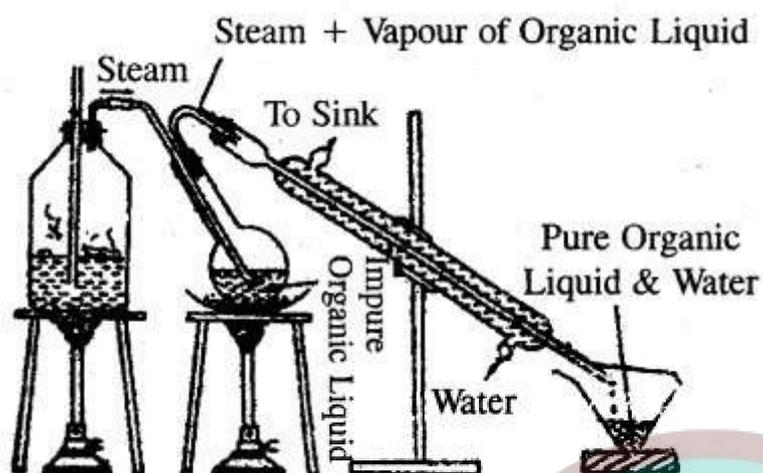
Steam Distillation

water boils at 371 K. At this temperature, the vapour pressure of water is 717 mm and that of aniline is 43 mm and therefore the total pressure is equal, to 760 mm. Thus in steam distillation, the liquid gets distilled at a temperature lower than its boiling point and chances of decomposition avoided. The proportion of water and liquid in the mixture that distils over is given by the relation.

$$\frac{w_1}{w_2} = \frac{P_1 \times 18}{P_2 \times M}$$

where w_1 and w_2 stand for the masses of water and liquid that distils over. P_1 and P_2 are vapour pressure of water and of liquid at the distillation temperature and M is the molecular mass of the liquid.

Ans: 2. Alkene (C) on reaction with benzene in the presence of H+ ions give 1, 1-Diphenyl ethane. Therefore, C must be styrene as depicted below
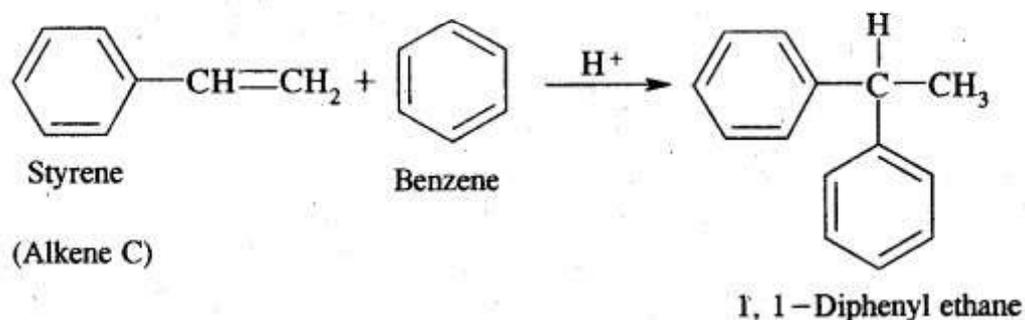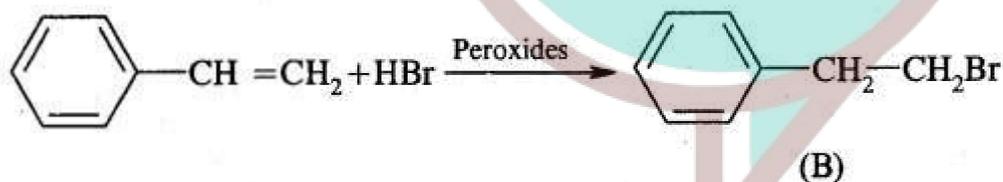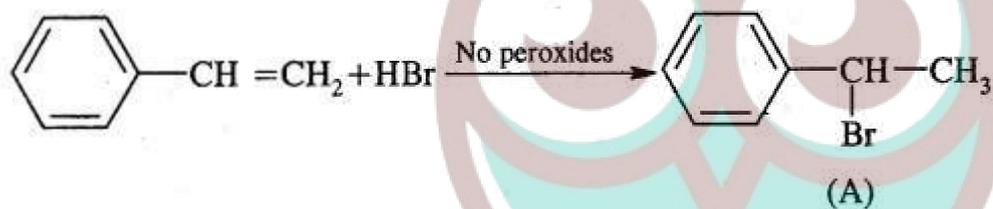

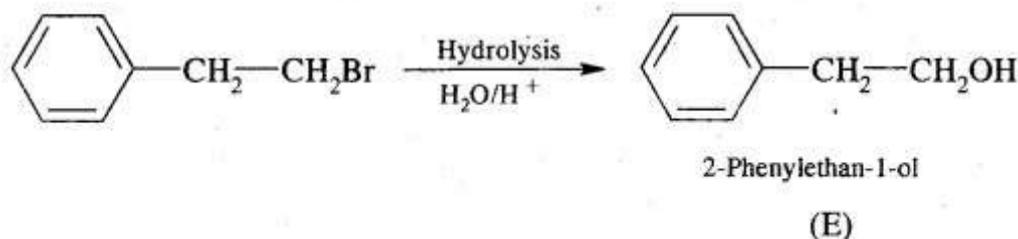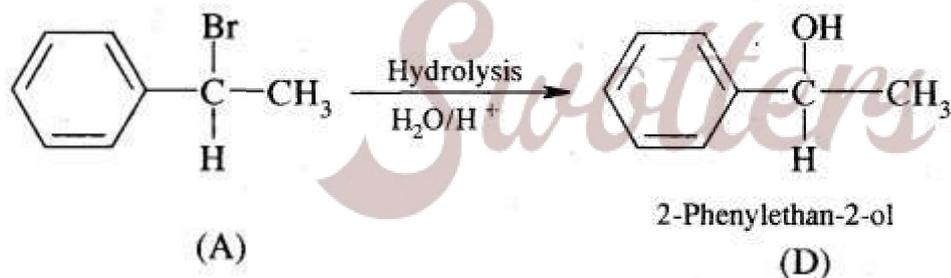Now dehydrobromination of A and B give the same alkene C, i.e., styrene.

∴ A and B must be isomeric alkyl bromide

(a) → (c)

(b) → (c)
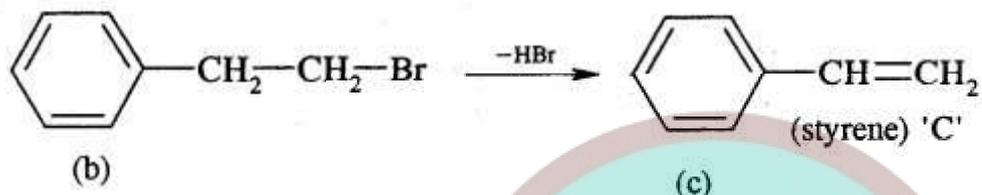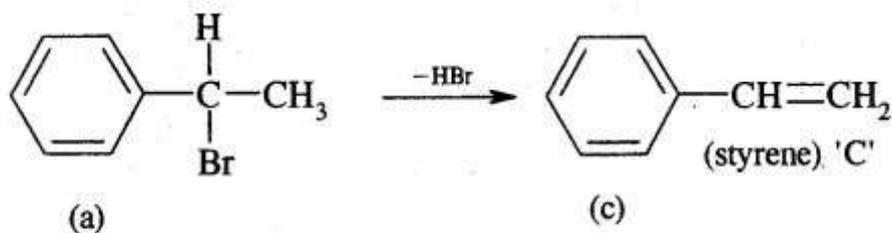
A and B can be obtained by the addition of HBr in the presence and absence of peroxide to styrene.

(A)

(B)

Hydrolysis of A and B give isomeric alcohols (D) & (E) as

2-Phenylethan-2-ol
(A)   (D)

2-Phenylethan-1-ol
(E)

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Ans: 3. The species which are generated as a result of bond fission are called reaction intermediates. The important reaction intermediates are:

1. Free Radicals: A free radical may be defined as an atom or group of atoms having an impaired electron. These are obtained as a result of homolytic fission of covalent bonds.

$$A:B \xrightarrow{\text{Homolytical Fission}} A^{\bullet} + B^{\bullet}$$
(Free radicals)

These free radicals are neutral particles, extremely transient, (short-lived) and highly reactive. They get consumed as soon as they are formed. They pair up their electron with another electron from wherever it is available. They occur only as a reaction intermediate. Their presence is felt in reactions, but cannot be isolated in a free state. For example dissociation of Cl2 gas in the presence of Ultraviolet light produces free radicals.

$$Cl:Cl \xrightarrow{\text{UV light}} \cdot Cl + \cdot Cl$$
(Free radicals)
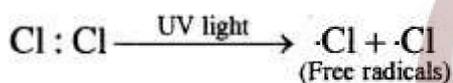
The alkyl free radicals are obtained when free radical: Cl reacts with alkanes.

Free radical may be primary, secondary, tertiary depending upon whether, one, two or three carbon atom attached to the carbon atoms carrying the odd electron.
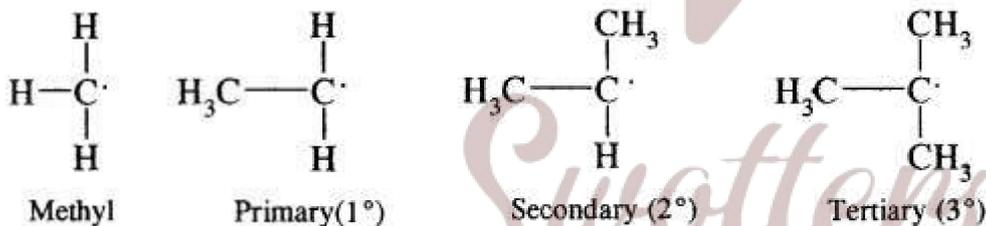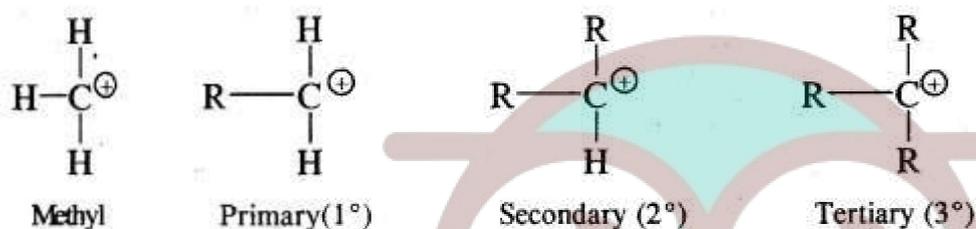

The stability is $CH_3 < 1° < 2° < 3°$.

2. Carbocation or carbonium ion: It is defined as a group of atoms that contain positively charged carbon having only six electrons. It is obtained by heterolytic fission of a covalent bond involving a carbon atom.
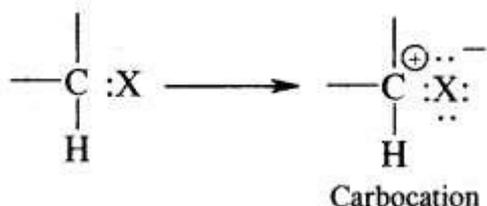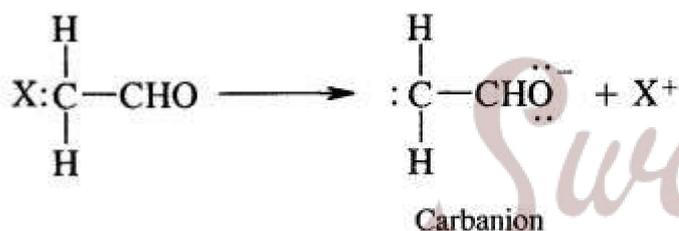
Carbocation

They are also classified as primary, secondary and tertiary depending upon whether one, two or three carbon atoms are attached to the carbon bearing the positive charge as:


| Methyl | Primary(1°) | Secondary (2°) | Tertiary (3°) |

Thus, the order of stability if CH3+ < 1° < 2° < 3°.

3. Carbanion: A carbanion may be defined as a species containing a carbon atom carrying a negative charge. These are generated by the atom in which the atom linked to carbon goes without the bonding electrons. As a result of this carbon acquires a negative charge. For example, the removal of hydrogen of methyl part of acetaldehyde molecule as H+ ion leaving both the electron on carbon.


Carbanion

They are also very reactive species. They are also classified as primary, secondary and tertiary depending upon whether one, two or three carbon atoms are attached to the carbon atom bearing negative
charge.

| Methyl | Primary(1°) | Secondary (2°) | Tertiary (3°) |
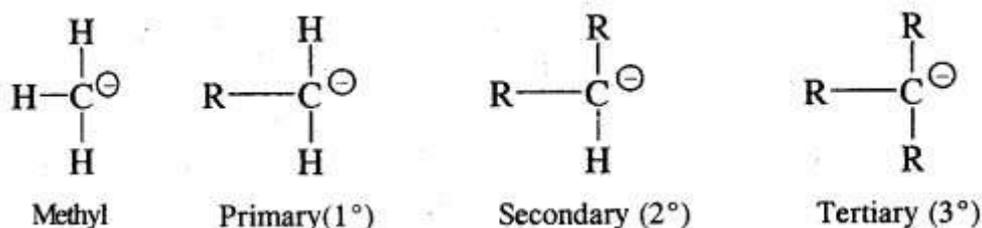
The order of stability is the reverse of free radicals and carbocations
$CH_3^- > 1° > 2° > 3°$.
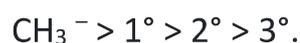
(iv) Carbenes: The carbenes are reactive neutral species in which carbon atom has six electrons in the valency shell out of which two are shared. The simplest carbene is methylene (CH2). It is formed when diazomethane is decomposed by the action of light.

$$CH_2N_2 \xrightarrow{\text{light}} :CH_2 + N_2$$

Diazomethane   Methylene carbene
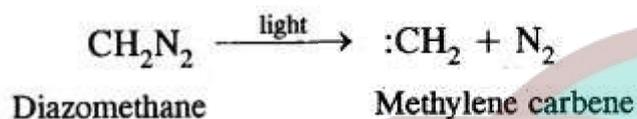
It is very reactive. It reacts with alkenes by adding to the double bond forming cyclopropane.

$$>C=C< \ + \ :CH_2 \qquad >C-C<$$

Alkene   Methylene

CH_2

Cyclopropane
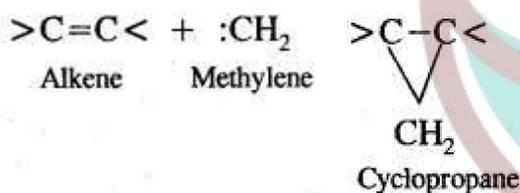
Ans: 4. Mass of $BaSO_4$ = 0.582 g

$BaSO_4$ = S

233 = 32

233g of $BaSO_4$ contain sulphur = 32g

0.582 g of $BaSO_4$ contains sulphur

$$= \frac{32 \times 0.582}{233}$$

$$\text{Percentage of sulphur} = \frac{\text{Wt. of sulphur}}{\text{Wt. of compound}} \times 100$$

$$= \frac{32 \times 0.582}{233 \times 0.395} \times 100$$

$$= 20.24\%$$

Ans: 5. Mass of AgBr formed = 0.12g

188 g of AgBr contains bromine = 80g.

Therefore, 0.12g of AgBr will contain bromine

$= \dfrac{80 \times 0.12}{188}$ = 0.051 g

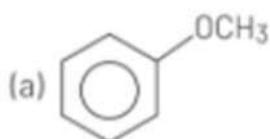Percentage of bromine $= \dfrac{0.051}{0.15} \times 100$ = 34%

Assertion Reason Answer:

1. (i) Both A and R are correct and R is the correct explanation of A.
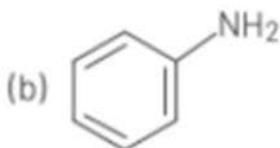
2. (iv) A is not correct but R is correct.

Case Study Answer:

1. **Answer:**

   (1) (b) $CH_3 \, CH_2 \, CH_2 — NO_2$

   (2)

   (a) OCH₃

   (b) NH₂

   (3)

   (4) (a) Inductive effect

2. **Answer:**

   (1) (a) C > B > A

   (2) (a) $CH_3 \, \overset{\bullet}{C}H_2$ and $\overset{\bullet}{C}l$

   (3) (b) trigonal planar

   (4) (b) II > I > IV > III