Isomerism

EXERCISES

ELEMENTARY

Q.1 (1)

$C_5H_{10}O$

$$C - C - C - C - \overset{\overset{\displaystyle O}{\|}}{C} - H$$

$$C - C - \overset{\overset{\displaystyle O}{\|}}{C} - \overset{\underset{\displaystyle C}{|}}{C} - H$$

$$C - C - \overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle C}{|}}{C^*}} - \overset{\overset{\displaystyle O}{\|}}{C} - H \qquad (2)$$

$$C - \overset{\overset{\displaystyle C}{|}}{C} - \overset{\overset{\displaystyle O}{\|}}{C} - H$$
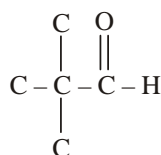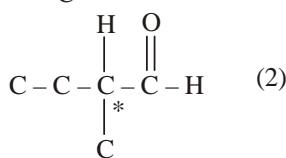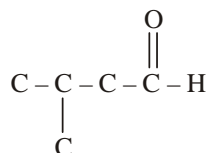
Total aldehydic form = 5
Keto from = 3
Total = 8

Q.2 (4)
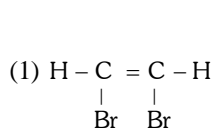Both have same molecular formula but different functional group.

Q.3 (2)
Glucose and fructose have similar molecular formula with difference of functional group, so they are functional isomers
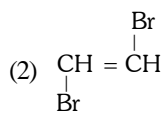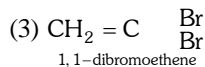
Q.4 (3)
$C_2H_2Br_2$ has three isomers.

(1) $H - \overset{\underset{\displaystyle Br}{|}}{C} = \overset{\underset{\displaystyle Br}{|}}{C} - H$ (2) $\overset{\underset{\displaystyle Br}{|}}{CH} = \overset{\overset{\displaystyle Br}{|}}{CH}$

(cis)
1,2-dibromoethene

(Trans)
1,2-dibromoethene

(3) $CH_2 = C\overset{\displaystyle Br}{\underset{\displaystyle Br}{}}$
1,1–dibromoethene

Q.5 (4)

Q.6 (3)
$CH_3 - O - CH_3$ and C_2H_5OH are functional isomers.

Q.7 (4)

1. $CH_3 - CH_2 - CH_2 - CH_2 - OH$
Butan-1-ol

2. $CH_3 - CH_2 - \overset{*}{\underset{\underset{\displaystyle OH}{|}}{CH}} - CH_3$
Butan-2-ol
(Chiral compoud)

3. $CH_3 - \underset{\underset{\displaystyle CH_3}{|}}{CH} - CH_2 - OH$
2 methyl propan-1-ol

4. $CH_3 - \overset{\overset{\displaystyle CH_3}{|}}{\underset{\underset{\displaystyle OH}{|}}{C}} - CH_3$
2-Methyl propan-2-ol
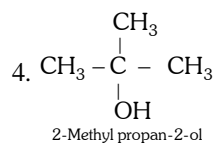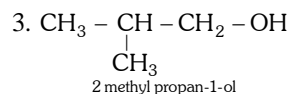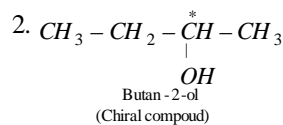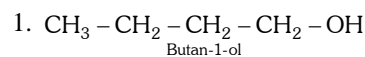
Q.8 (1)
Both have same molecular formula and different alkyl groups attached to polyvalent functional group.
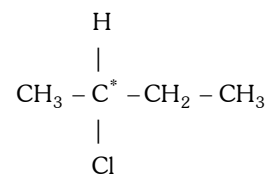
Q.9 (1)

Q.10 (2)
Q.11 (1)
Non superimpossible mirror image –Enantiomers.

Q.12 (1)

$$CH_3 - \overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle Cl}{|}}{C^*}} - CH_2 - CH_3$$
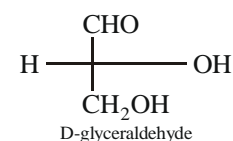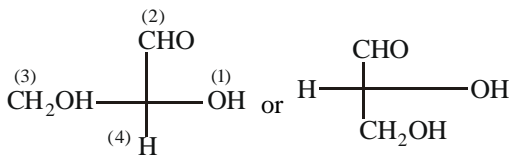
Q.13 (3)
The configuration in which, OH group are on right side, H-atom are on left side, CHO group are on upper side & CH_2OH are on lower side found in fischer projection known as D-configuration.

$$H \overset{\overset{\displaystyle CHO}{|}}{\underset{\underset{\displaystyle CH_2OH}{|}}{\rule{2cm}{0.4pt}}} OH$$

D-glyceraldehyde

1

$$\underset{(3)}{\overset{(2)}{\underset{\overset{|}{CH_2OH}}{\overset{CHO}{\underset{(4)}{H}\underset{|}{\overset{|}{-}}C\overset{|}{\underset{|}{-}}OH_{(1)}}}}}\xrightarrow[\text{H and }CH_2OH]{\text{Intrachange}}$$

$$\underset{(4)}{\overset{(2)}{\underset{H}{\overset{CHO}{CH_2OH\underset{(3)}{-}C\overset{|}{\underset{|}{-}}OH_{(1)}}}}} \quad or \quad \overset{CHO}{\underset{CH_2OH}{H\underset{|}{-}C\overset{|}{\underset{|}{-}}OH}}$$
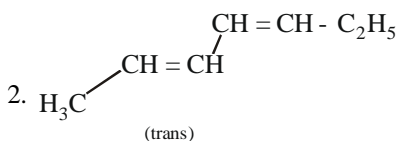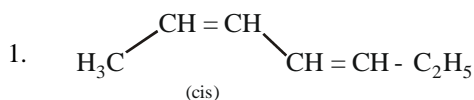
Q.14 (2)
Has chiral carbon.

Q.15 (2)

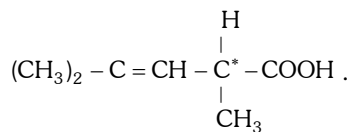**Q.16** (1)

Q.17 (3)
Has chiral carbon and no plane of symmetry.

Q.18 (1)
Q.19 (1)
Geometrical isomerism is not possible in propene.

Q.20 (1)

$$\overset{1}{CH_3}-\overset{2}{CH}=\overset{3}{CH}-\overset{4}{CH}=\overset{5}{CH}-\overset{6,7}{C_2H_5}$$

1. $\underset{(cis)}{\overset{CH=CH}{H_3C \diagup \diagdown CH=CH\text{-}C_2H_5}}$

2. $\underset{(trans)}{H_3C}\diagup\overset{CH=CH\text{-}C_2H_5}{\underset{CH=CH}{}}$

3. $\underset{(cis)}{CH_3\text{-}CH=HC}\diagup\overset{CH=CH}{\diagdown C_2H_5}$

4. $\underset{(trans)}{CH_3\text{-}CH=HC}\diagup\overset{C_2H_5}{CH=HC}$
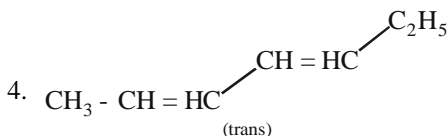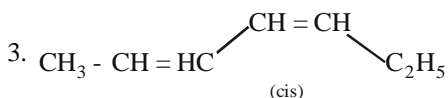
Q.21 (2)
. Optical isomerism because chiral centre is present

$$(CH_3)_2-C=CH-\overset{H}{\underset{CH_3}{\overset{|}{C^*}\underset{|}{-}COOH}}.$$

Q.22 (4)

Q.23 (3)
Both II and IV have different groups on each sp^2 carbon.

Q.24 (2)

Q.25 (2)
If bulky groups are present at anti position then it will be more stable.

**Q.26** (2)
Same molecular formula but different position.

Q.27 (3)
Q.28 (4)
Total number of stereoisomers $= 2^n$.
$n = 3 \therefore 2^3 = 8$

Q.29 (4)

JEE-MAIN

OBJECTIVE QUESTIONS

Q.1 **(3)**
$C_3H_9N \rightarrow$
$1°$ amine $\quad CH_3{-}CH_2{-}CH_2{-}NH_2 \quad$ and
$$CH_3{-}\overset{NH_2}{\underset{|}{CH}}{-}CH_3$$
$2°$ amine $CH_3{-}NH{-}CH_2{-}CH_3$
$3°$ amine $CH_3{-}\overset{|}{\underset{\underset{CH_3}{|}}{N}}{-}CH_3$

So C is correct option.

Q.2 **(3)**

$\diagup\diagdown\diagup\!\!\diagdown$ and $\boxed{\ \ |}$ functional

Q.3 **(3)**
Q.4 **(2)**
Functional isomers

Q.5 **(1)**
$C_5H_{10} \rightarrow$
(i) $CH_3{-}CH_2{-}CH_2{-}CH=CH_2$

(vi)

(ii) CH_3—CH=CH—CH_2—CH_3

(vii)

(iii) CH_3—CH=C—CH_3
            |
            CH_3

(viii)

(iv) CH_3—CH_2—C=CH_2
                |
                CH_3

(ix)

(v) CH_2=CH—CH—CH_3
             |
             CH_3

(x)

Q.6 **(1)**
Anthracene

Only three types of hydrogen so only three structural isomers possible.

Q.7 **(3)**
Q.8 **(2)**

Q.9 **(2)**

Q.10 **(1)**
CH_3–CH_2–CH=C=CH_2
CH_3–CH_2–CH_2–C≡CH

Q.11 **(4)**

Q.12 **(1)**
Carbon skeleton is different in both compounds.

Q.13 CH_3—CH_2—CH—CH_2—CH_3 and
                    |
                    CH_2—CH_3

CH_3—CH_2—CH—CH_2—CH_2—CH_3
                  |
                  CH_3

Carbon skeleton is different in both compounds.

Q.14 CH_3–CH_2–$\boxed{NH–C–H}$;
                      ‖
                      O

CH_3 – CH – CHO ⟵——Aldehyde
          |
         NH_2 ⟵—— 1° Amine

Amide functional group
Aldehyde and 1° amine

Q.15 **(2)**

Q.16 **(1)**

 and

Q.17 (3)
Q.18 (4)
Q.19 (3)

Q.20 (3)

(1) Ph—C—CH—CH=CH_2
       ‖ |
       O   D

(b) Ph—C—C=CH—CH_2D
       ‖ |
       O   D

↓ Several times repeation

Product will be Ph—C—C=CH—CD_3
                   ‖ |
                   O   D

Q.21 **(1)**

3

Q.22 **(3)**

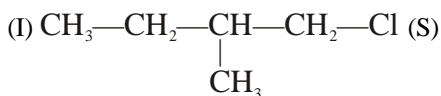Exchanging groups across the horizontal bond and also across the vertical bond

Q.23 **(3)**

(II)
$$
\begin{array}{c}
OH \\
| \\
H—C—CH_3 \\
| \\
CH=CH_2
\end{array}
$$

(IV)
$$
\begin{array}{c}
H \\
| \\
HO—C—CH=CH_2 \\
| \\
CH_3
\end{array}
$$

Q.24 (3) Isopentene

$$CH_3—CH_2—CH—CH_3 \xrightarrow{Cl_2/h\nu}$$
$$\quad\quad\quad\quad\; | $$
$$\quad\quad\quad\quad CH_3$$

Products are

(I) $CH_3—CH_2—CH—CH_2—Cl$ (S)
$$\quad\quad\quad\quad\quad | $$
$$\quad\quad\quad\quad\quad CH_3$$

(II) $Cl–CH_2–\overset{\displaystyle H}{\underset{\displaystyle H}{C}}–CH_2CH_3$ (R)

(III) $CH_3—CH—CH—CH_3$ (S)
$$\quad\quad\quad | \quad\quad | $$
$$\quad\quad\quad Cl \quad\; CH_3$$

(IV) $CH_3 – CH – CHCH_3$ (R)
$$\quad\quad\quad\; | \quad\quad | $$
$$\quad\quad\quad CH_3 \; Cl$$
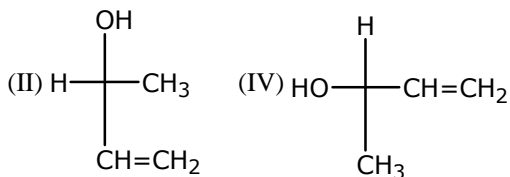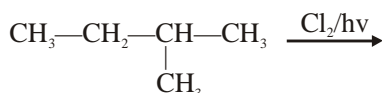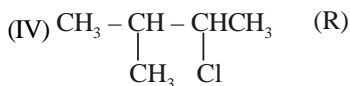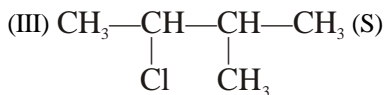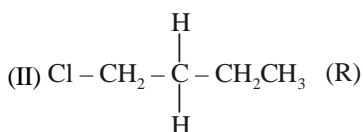
Only (1) and (3) are optically active.

Q.25 (2)

$$
\begin{array}{c}
Cl \quad\;\; Cl \\
| \quad\quad | \\
CH_3—CH—CH—CH_3
\end{array}
$$
total optical isomers = 3

$$
\begin{array}{ccc}
CH_3 & CH_3 & CH_3 \\
H—\!—Cl & Cl—\!—H & H—\!—Cl \\
H—\!—Cl & H—\!—Cl & Cl—\!—H \\
CH_3 & CH_3 & CH_3 \\
(i) & (ii) & (iii)
\end{array}
$$
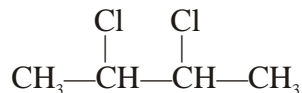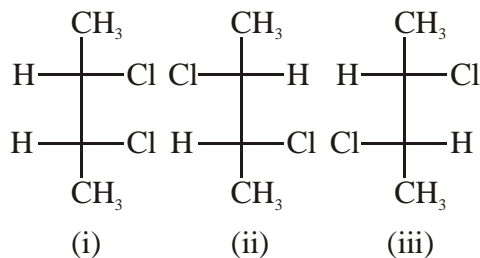
(ii) and (iii) are optically active.

Q.26 (4)

Q.27 **(2)**

A → Planar compound so optically inactive.

B → Non planar and optically active due to absence of POS & COS.

C → Non planar but having POS so, optically inactive.

D → Planar compound.

Q.28 **(1)**

Enantiomers

Q.29 **(2)**

$$
\begin{array}{c}
\overset{2}{C}OOH \\
| \\
HO\overset{1}{\cdots}C \\
\diagup \;\; \diagdown \\
H \quad\quad \overset{3}{C}H_3
\end{array} \;\; S
$$

Q.30 **(A)**

Q.31 **(1)**

Q.32 **(3)**

$$C_2H_5–\overset{*}{C}H–CH_3$$
$$\quad\quad\quad\; | $$
$$\quad\quad\quad Cl$$

Q.33 **(1)**

$$CH_3–CH_2–\overset{*}{C}H–CH_3–CH_2–OH$$
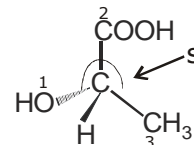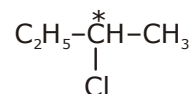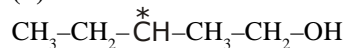
Q.34 **(2)**

Q.35 **(4)**

A and C are enantiomers

Q.36 **(2)**

$$CH_3–\overset{*}{C}H–CH=CH–CH_3$$
$$\quad\quad\; | $$
$$\quad\quad Cl$$
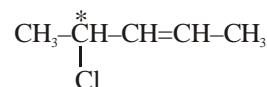
Q.37 **(4)**

Q.38 **(1)**

Enantiomers

Q.39 **(1)**

$$
\begin{array}{c}
CH_3 \quad\quad R \Rightarrow S \\
H—C—OH \\
CH_3—C—OH \quad S \Rightarrow S \\
H
\end{array}
$$
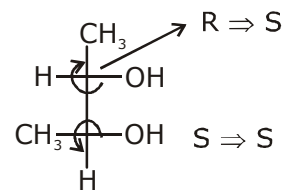
1s, 2s

Q.40 **(1)**
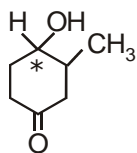
Q.41 **(3)**
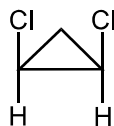
Q.42 **C**

Q.43 **(3)**
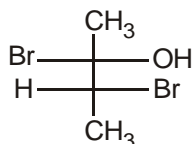
Q.44 **(2)**

Q.45 **(2)**

Q.46 **(1)**

total possible gemtrical Dromer

Q.47 **(3)**

Q.48 **(3)**

Q.49 **(3)**

$A \rightarrow$ Show G.I.

$B \rightarrow$ Show G.I.

$C \rightarrow$ Not Show G.I.

$D \rightarrow$ Show G.I.

Q.50 **(4)**

Q.51 **(4)**

$H_2C=CH–CH_2–COOH$
(Not give geometrical isomers)
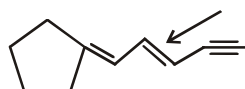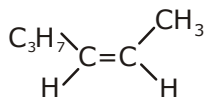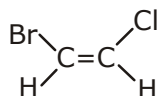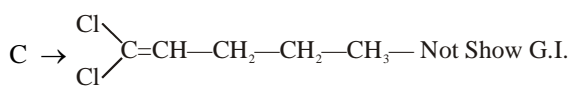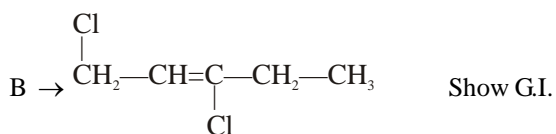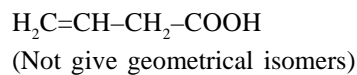
Q.52 **(4)**

Terminal carbon have same compound

Q.53 **(4)**
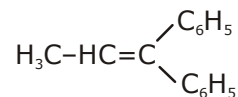
This compound no geometrical isomers

Q.54 **(1)**

2^n

$\Rightarrow n=2 \Rightarrow (4)$

Q.55 **(4)** 1,4-Butanedioic acid

(3)

Q.56 **(3)**

Restricted rotation about the double bond

Q.57 **B**

trans
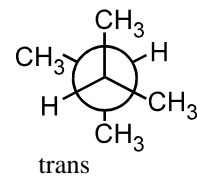
Q.58 **(4)**

Q.59 **(3)**

Q.60 **(4)**

Q.61 **(3)**

Q.62 **(3)**

Q.63 **(2)**

Q.64 **(1)**

Q.65 **(3)**

Self explanatory.

5
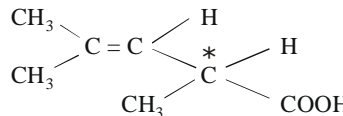
Q.66 **(1)**

Self explanatory.

Q.67 **(2)**

Ethene $\rightarrow CH_2 = CH_2$
Cannot show G.I.
Propene $\rightarrow CH_3 —CH = CH_2$
Cannot show G.I.

Butene $\rightarrow CH_3 —CH=CH—CH_3$
Show G.I. and it also show positional isomerism.

$CH_3 —CH_2 —CH=CH_2$ and $CH_3 —CH=CH—CH_3$.

Q.68 **(3)**

Metamerism
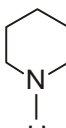
Q.69 **(2)**

1-Propanol (Molecuylar formula is not same)

Q.70 **(1)**

They will have identical physical properties

Q.71 **(3)**

optical isomers
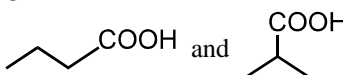
Q.72 **(1)**

Q.73 **(D)**

 This is aromatic compound.

Q.74 **(C)**

. saturated heterocyclic compound.

Q.75 **(D)**

(A)ccording to IUPAC only alkene and alkyne are unsaturated hydrocarbon.

JEE-ADVANCED
OBJECTIVE QUESTIONS

Q.1 **C**

 and
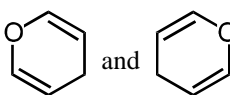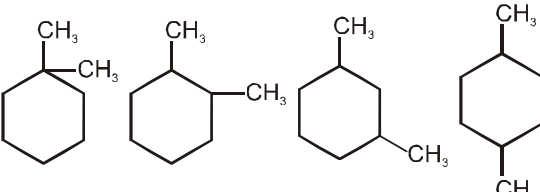
Q.2 **B**

$CH_3–CH_2–\underset{\underset{O}{\|}}{C}–O–CH_3$

$CH_3–\underset{\underset{O}{\|}}{C}–CH_2–O–CH_3$ — Funcatinal isomers
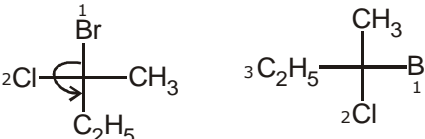
Q.3 **C**

$CH_2=CH–CH_2OH$ and —OH

Q.4 **D**

 and   Identical compound

Q.5 **(B)** 4

Q.6 **D**

$CH_3–CH=CH_2$ $\longleftrightarrow$

Q.7 **(B)**
Q.8 **(B)**
Q.9 **(C)**

(R)   (S)

Q.10 **(B)**
Q.11 **(B)**

(i) $CH_3 – \underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}} – CH_2 – CH_2 – CH_3$

(ii) $CH_3 – \underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}} – \underset{\underset{CH_3}{|}}{CH} – CH_3$

(iii) $CH_3 – CH_2 – \underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}} – CH_2 – CH_3$

Q.12 **D**

$$R-CH_2-N \!\!\rightarrow\!\! O \;\rightleftharpoons\; R-CH=N \!\!\rightarrow\!\! O$$

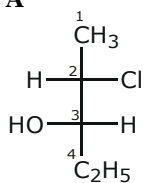(with $\underset{O}{\overset{\|}{}}$ on left and OH on right)
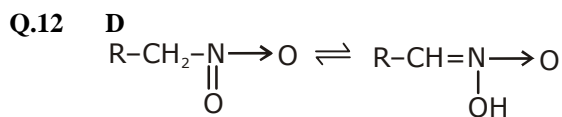
Q.13 (C)

Q.14 **D**
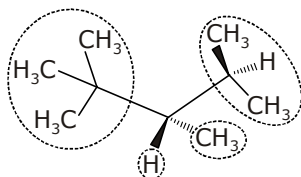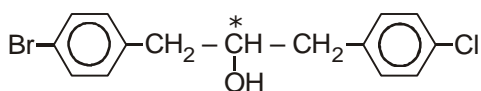

All four substituent are different so it is chiral compound.
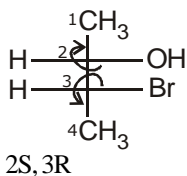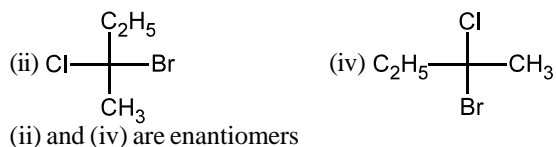
Q.15 **A**

(2S, 3S)-2-chloro-3-hydroxypentane

Q.16 **D**

$Br\!-\!\!\bigcirc\!\!-CH_2-\overset{*}{C}H-CH_2-\!\!\bigcirc\!\!-Cl$ with OH below

Q.17 **B**

$$CH_3-\overset{*}{C}H-\overset{*}{C}H-CH_3$$

with OH OH below

T.N. of Iso $= 2^n$
$\Rightarrow 4$

Q.18 **B**

2S, 3R
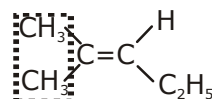
Q.19 **D**

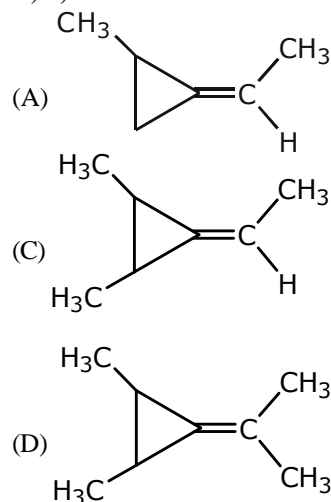(ii) and (iv) are enantiomers
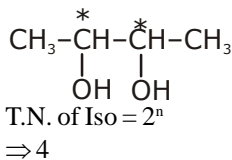
Q.20 **D**

Enatiomers react with a given chiral reagent at the same rates

Q.21 **B**

Q.22 **A, C, D**

Q.23 (C)

Q.24 (D)

Q.25 **C**
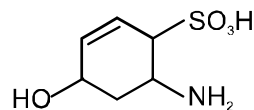
$CH_2=CH–Cl$
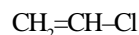
Q.26 (B)

Q.27 (C) I , II are identical and homologue of compound III.

Q.28 (B)

Q.29 **D**

Position isomers

Q.30 (A)

Q.31 (B)

Q.32 **D**

1-bromo-2E, 5Z-heptadiene

Q.33 **D**

$CH_3–CH_2–\underset{OH}{CH}–CH_3$, $CH_3–CH_2–CH_2–\underset{OH}{CH_2}$,

$CH_3–\underset{CH_3}{CH}–CH_2–OH$, $CH_3–\underset{CH_3}{\overset{OH}{C}}–CH_3$

Q.34 **C**

JEE-ADVANCED

MCQ/COMPREHENSION/COLUMN MATCHING

Q.1 (C)

Q.2 (D)

Q.3 (A, B)

Q.4 (B, C)

(A) $CH_3—\overset{\overset{\displaystyle O}{\|}}{C}—H \rightleftharpoons CH_2=\overset{\overset{\displaystyle OH}{|}}{C}—H$

No   G.I.(B)

$CH_3—CH_2—\overset{\overset{\displaystyle O}{\|}}{C}—H \rightleftharpoons CH_3—CH=\overset{\overset{\displaystyle OH}{|}}{C}—H$

Show G.J.

(C)

Show G.I. due to ring contain 8-carbon.

(D)

No G.I.

Q.5 Optically active compound will be resolvable.
Resolution is a process by we separate entionmers and we know that entionmers are individually active so cheack POS and COS.

POS   ☒
COS   ☒
Active ☑

Planer moleculer
Moleculer POS
(Inactive)

SP^3–Sulphur
Non–Planer
POS × COS × (Resolvable)

Q.6 (B)
Check R/S configuration
Fischer is in eclipse form so first we have to convert above compound into total eclipsed form.

or

identical

Q.7 (A, C, D)

(A) $CH_3—\overset{\overset{\displaystyle OH}{|}}{\underset{*}{CH}}—CH_2—CH_3$

chiral carbon So optically active.

(B)

opically inactive

(C)

Does not contain POS or COS so optically active.

(D)

Does not contain POS or COS because both benzene rings are $\perp r$ to each other.

Q.8 (A,B,D)
Groups around the area which rotation has been restricted should be different.
Lone pair and isotopes also counts as a different groups.

restricted Rotation and
different groups

cis

Trans

groups of carbon is
same G.I. absent

Syn

Anti

Q.9 (A, B, D)

(A)

(a) CH_3
(b) H $C=N$ OH   Show G.I. (a ≠ b)

(B) Show G.I.

(C)

(a) CH_3
(b) CH_3 $C=N$ OH   a = b so not show G.I.
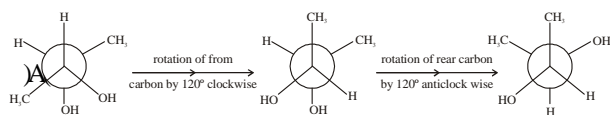
(D)

$N=N$ OH   OH   Show G.I.
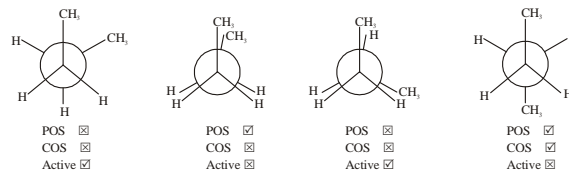
Q.10 (A) (D)
Check conformers of the compounds

Front side   Back side

same compound

(D)
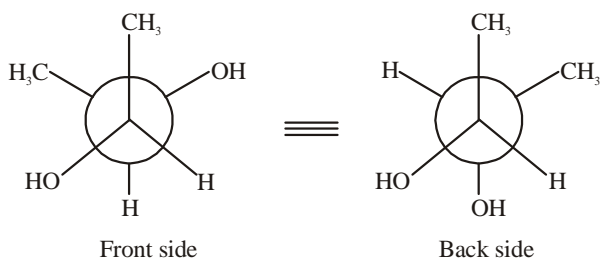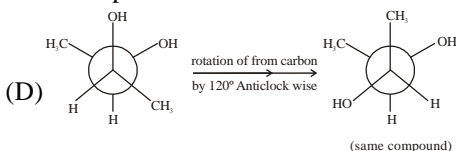
(same compound)

Q.11 (B) (C)
Two different group–H and –CH_3 is present.
When two groups (Bulky) are at 60° Dihedral angle is known as sancle form

POS ☒	POS ☑	POS ☒	POS ☑
COS ☒	COS ☒	COS ☒	COS ☑
Active ☑	Active ☒	Active ☑	Active ☒

Q.12 (B)
(D)
In structural isomerism Connectivity of atoms remains same.
In tautomerism atom must ossilate in the compound.
Geometrical isomerism is shown by many compounds like, alkene, cycloalkanes, oximes, etc.
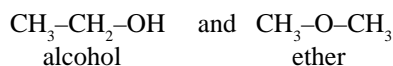
Q.13 (A)
(C)
POS or COS may be present
Meso are these compounds which was minimum 2–chiral carbon or more and having POS or COS or both. For optical activity two necessary condition us compound must be asymmetric. It POS or COS present then it will super impose on its mirror image.

Q.14 (B) (D) – Functional isomer

Q.15 (A) (C) (D)
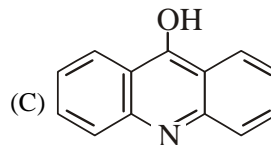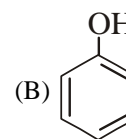Single chiral carbon have two form dexlro totatory and laevorotatory.
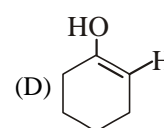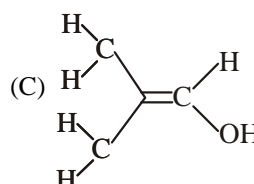Chiral carbon or Asymmetric carbon is always stereo centre.
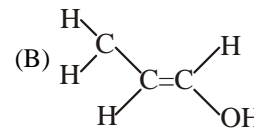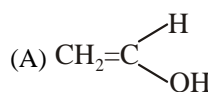CH_3–CH_2–OH   and CH_3–O–CH_3
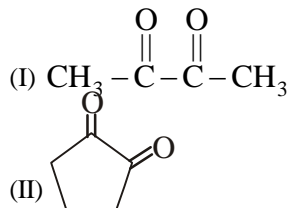   alcohol   ether
Ether and alcohol are functional isomers.

Q.16 (B) (C)

Q.17 (A) $CD_2 = C - Ph$
          DO

(B)

(C)

Q.18 (B)

(A) $CH_2=C$

(B)

(C)

(D)

Q.19   (A) II & IV

(I) $CH_3 - \overset{\overset{O}{\|}}{C} - \overset{\overset{O}{\|}}{C} - CH_3$

(II)

Repulsion can be minimized Keto form is unstable due to repulsion between by rotation.

lone pairs.

(III) $\rightleftharpoons$

(IV) $\rightleftharpoons$
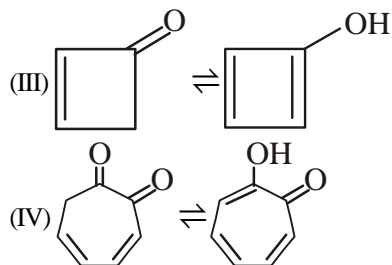
Antiaromatic
Aromatic
When tautomerize enol is
When tautomerize enol is aromatic so IV preferes antiaromatic while
to be in enol form.

Comprehension # 02 (Q. No. 20 & 21)

Q.20   C

Q.21   D   Infinite

Comprehension # 03 (Q. No. 22 to 24)

Q.22   (D) None of these
Specific rotation of $(-)$ MSG

$C = \dfrac{169\,gm}{845\,ml}$ $l = 2dm$

$[\theta°] = \dfrac{\theta}{Cl} = \dfrac{9.6}{169/845 \times 2} = -24°$

Q.23   (C) 91.6 %

Optical of purity $(-)$ MSG $= \dfrac{\theta_{Observed}}{\theta_{Standard}} \times 100 =$

83.33 %
RM = 100 – optical of purity = 100 – 83.33 = 16.66%
(–) MSG total in mixture $\Rightarrow$ 83.33 %
                                       + 8.33 %
                                       ―――――
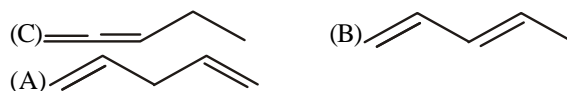   91.66 %

Q.24   (C) + 3.2°
(+) MSG $\Rightarrow$ 33.8 gm in 338 ml
(–) MSG $\Rightarrow$ 16.9 gm in 169 ml

Optical purity in mixture (+) MSG = 16.9 gm in 507 ml solution

$C = \dfrac{16.9}{507}$ gm/ml $l = 4$ dm

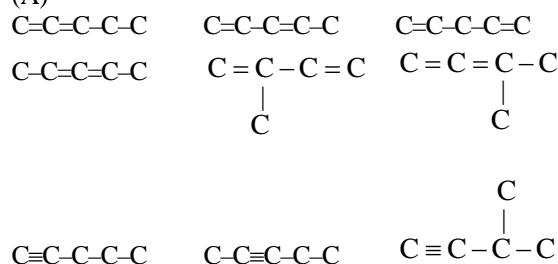$\theta_{Observed} = [\theta°] \times C.l. = 24 \times \dfrac{16.9}{507} \times 4 = +3.2°$

Q.25   (B)
Q.26   (C) C

(C)   (B)
(A)

Q.27   (A)

C=C=C–C–C   C=C–C=C–C   C=C–C–C=C

C–C=C=C–C $C = C - C = C$ $C = C = C - C$
                            | |
                            C   C

                                                               C
                                                               |
C≡C–C–C–C   C–C≡C–C–C $C \equiv C - C - C$
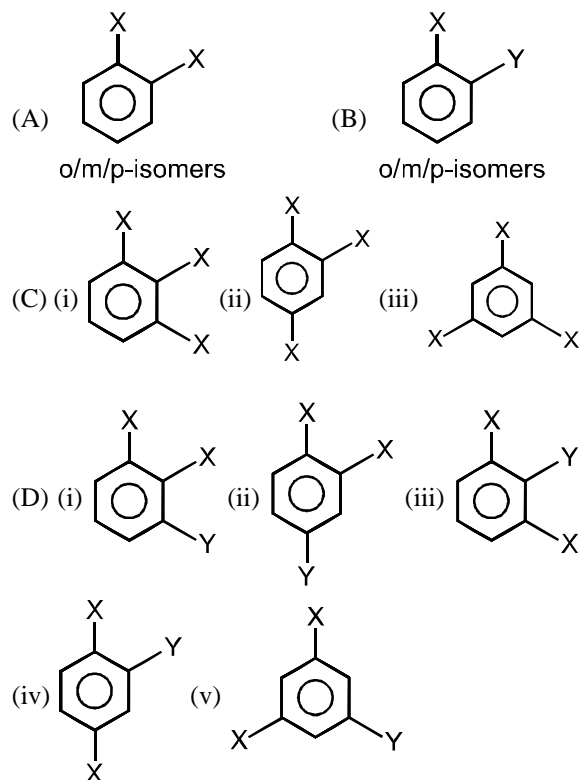

Q.28   (A) P , (B) R ,   (C) Q ,   (D) R

Q.29 $(A \rightarrow p,s)$; $(B \rightarrow q,s,t)$; $(C \rightarrow r,s,t)$; $(D \rightarrow q,s,t)$
Q.30 $(A \rightarrow q)$; $(B \rightarrow q)$; $(C \rightarrow q)$; $(D \rightarrow p)$; $(E \rightarrow t)$

(A)   (B)
o/m/p-isomers   o/m/p-isomers

(C) (i)   (ii)   (iii)

(D) (i)   (ii)   (iii)

(iv)   (v)

Q.31   (A) R , (B) P, (C) Q

Q.32 (a-4-iii) ; (b-3-iv) ; (c-2-ii) ; (d-1-i)

Q.33 $A \to 2, B \to 7, C \to 1, D \to 6, E \to 4, F \to 3, G \to 2,$

Q.34 $(A \to p,s)$; $(B \to q,s,t)$; $(C \to r,s,t)$; $(D \to q,s,t)$

NUMERICAL VALUE BASED

Q.1 [4]

$1,2-(B,N) ; 1,3-(B,B) ; 1,4-(B-N)$ and $1,3-(N,N)$
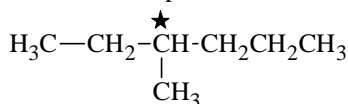
Q.2 [4]

Q.3 [2]

Q.4 [5]

Q.5 [2]

Only one chiral C hence only 2 optical isomer.

Q.6 [3]

In structure (I) , two methyl groups are equatorial

In structure (II) , two axial hydroxyl group forms hydrogen bonding.

Q.7 7

One such compound is

$$\overset{\bigstar}{H_3C-CH_2-CH}-CH_2CH_2CH_3$$
$$\underset{CH_3}{|}$$

Q.8 [3]

Q.9 [4]

CH_3 — $CH_2CH_2CH_2CHO,$

$CH_3 - CH - CH_2 - CHO,$ $CH_3 - \underset{CH_3}{\overset{CH_3}{C}} - CHO,$
$\quad\;\; \underset{CH_3}{|}$

$CH_3 - CH_2 - CH - CHO$
$\qquad\qquad\;\; \underset{CH_3}{|}$

Q.10 [7]

Q.11 [5]

Q.12 [4]

$CH_3 - CH_2 - CH_2 - CH_2 - NH_2$,

$CH_3 - CH_2 - \underset{\underset{CH_3}{|}}{CH} - NH_2$,

$CH_3 - \underset{\underset{CH_3}{|}}{CH} - CH_2 - NH_2$, $CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - NH_2$
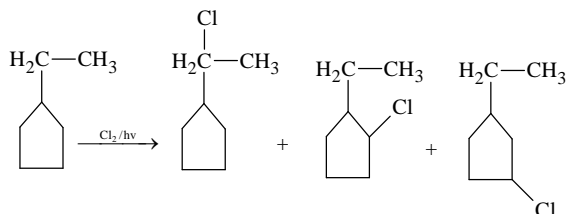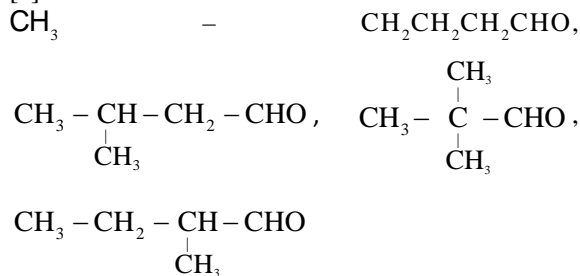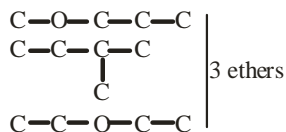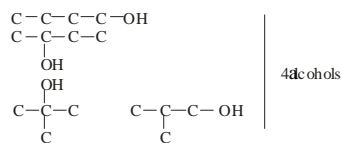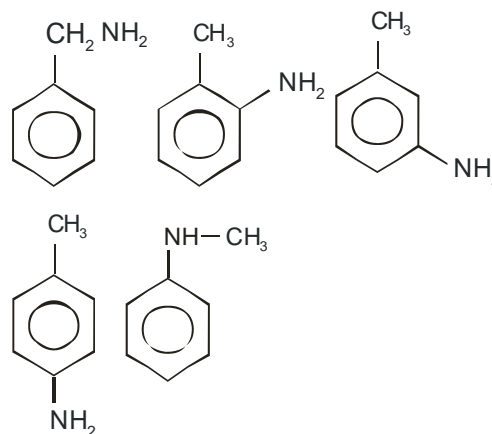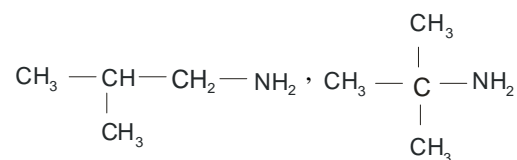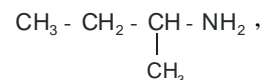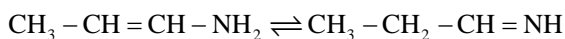
Q.13 [5]
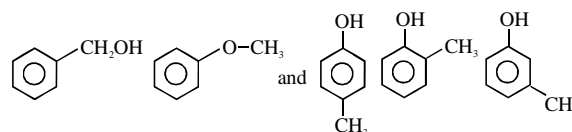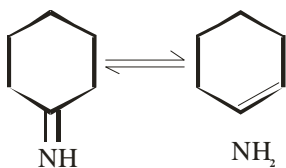

Q.14 [6]
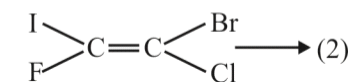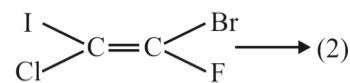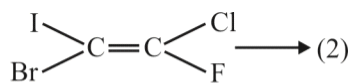
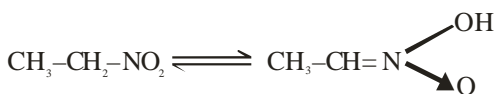**Q.15** [4]
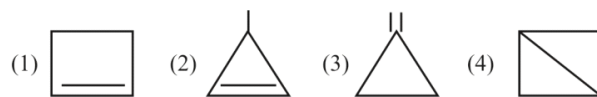
So, total number of possible cyclic isomers in C_4H_6 = 4

Q.16 [4]

$CH_3-CH_2-NO_2 \rightleftharpoons CH_3-CH=N\overset{OH}{\underset{O}{\nwarrow}}$
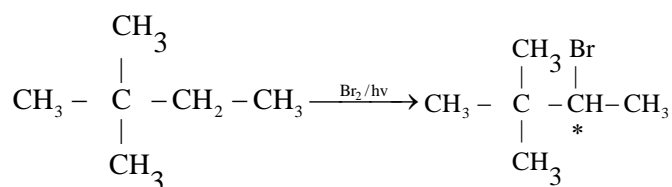

$CH_3 - CH = CH - NH_2 \rightleftharpoons CH_3 - CH_2 - CH = NH$

Q.17 [6]

Q.18 [2]

$CH_3 - \overset{\overset{\displaystyle CH_3}{|}}{\underset{\underset{\displaystyle CH_3}{|}}{C}} - CH_2 - CH_3 \xrightarrow{Br_2/h\nu} CH_3 - \overset{\overset{\displaystyle CH_3}{|}}{\underset{\underset{\displaystyle CH_3}{|}}{C}} - \overset{\overset{\displaystyle Br}{|}}{\underset{*}{CH}} - CH_3$
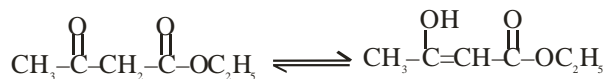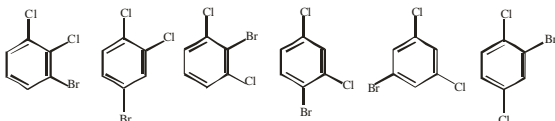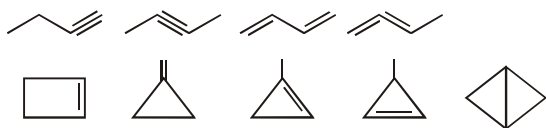
(One chiral carbon)

KVPY
PREVIOUS YEAR'S
ISOMERISM

Q.1 (C)
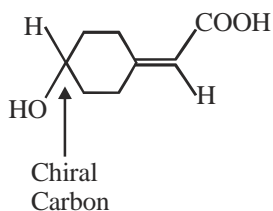Possible structural isomers are nine.

Q.2 Bonus
Incorrect question
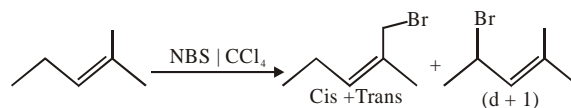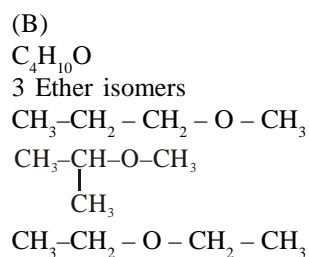The statement optically active (s) – α – methoxy acetaldehyde is incorrect.

Q.3

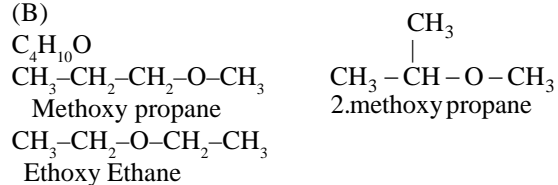Enantionmers Formed because cyclohexa diene shows optical activity.

Q.4 (C)

Q.5 (D)

$\xrightarrow{NBS \,|\, CCl_4}$

Q.6 (B)
$C_4H_{10}O$
3 Ether isomers
$CH_3-CH_2 - CH_2 - O - CH_3$
$CH_3-\underset{\underset{\displaystyle CH_3}{|}}{CH}-O-CH_3$
$CH_3-CH_2 - O - CH_2 - CH_3$

Q.7 (B)
$C_4H_{10}O$
$CH_3-CH_2-CH_2-O-CH_3$
　Methoxy propane
$CH_3-CH_2-O-CH_2-CH_3$
　Ethoxy Ethane

$CH_3 - \underset{\underset{\displaystyle CH_3}{|}}{\overset{\overset{\displaystyle CH_3}{|}}{CH}} - O - CH_3$
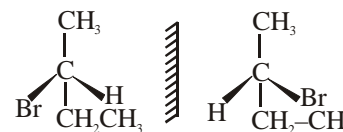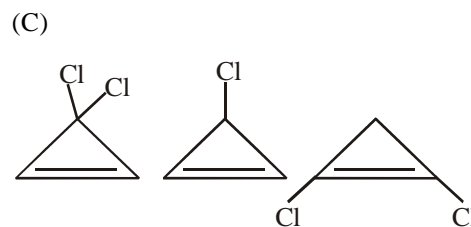2.methoxy propane

Q.8 (B)
This molecule contain 1 chiral centre and molecule having one chiral carbon do not have any type of symmetry so it is optically active
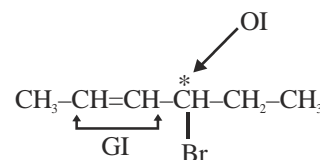

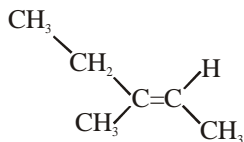Non superimposable on mirror image
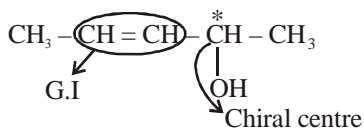
Q.9 (C)

Racemic mixture
(Enantiomer)
pair

Q.10 (C)

n=2 [No. of stereogenic area]
Total stereoisomer = 2^n
[When symm. is/are absent]
Total stereo isomer = $2^2 = 4$

Q.11 (D)

This show E/Z isomerism

Q.12 (D)

$$\text{CH}_3 - \overset{\frown}{\text{CH} = \text{CH}} - \overset{*}{\text{CH}} - \text{CH}_3$$

G.I, OH → Chiral centre
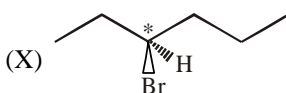
No. of S. I $= 2^n = 2^2 = 4$
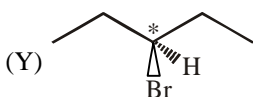cis - R
trans-R
cis - S
trans-S

Q.13 (C)

(X)

Here the * marked carbon is Chiral, as it has 4 different groups attached.

(Y)

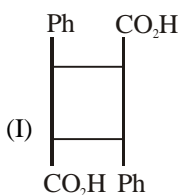Here the * marked carbon is achiral, as it has two identical ethyl group attached.

Q.14 (D)

Both x and y represent meso-2,3-dichlorobutanc. They are conformers, where X is eclipsed and Y is anti from.
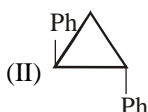
Q.15 (B)

$\text{H}_3\text{C} - \text{C} \quad \text{C} - \text{CH}_3$ (But-2-ene), $\text{H}_3\text{C} - \text{CH}_2 - \text{CH} = \text{CH}_2$ (But-1-ene),

Q.16 (A)

(I)

C.O.S. is present so inactive

(II)
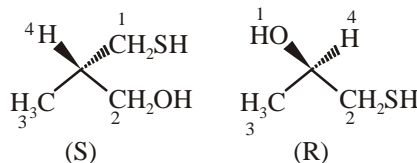
C.O.S. → X
P.O.S. → X

A.A.O.S. → X
so active
(III) P.O.S. is present so inactive
(IV) C.O.S. and P.O.S. both are not present so active
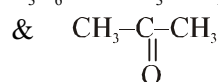(V) C.O.S. and P.O.S. both are not present so active

Q.17 (D)

(S)   (R)

Q.18 (D)

Compound I is alkyne and compound II is alkadiene, so they are functional isomers.

JEE-MAIN
PREVIOUS YEAR'S

Q.1 (4)

$X_3H_6O \Rightarrow XH_3\square XH_2\square XH=O$

& $\text{CH}_3 - \overset{||}{\underset{O}{\text{C}}} - \text{CH}_3$

Τηεψ αρε φυνχτιοναλ γρουπ ισομερισμ.

Q.2 (4)

Q.3 (6)

Q.4 (60)

Q.5 (4)

Q.6 (4)

More stable less potential energy.
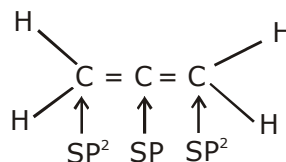Stability order : I > III > IV > II
So
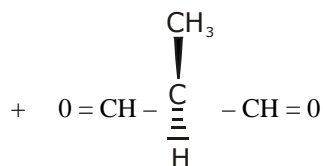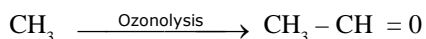Potential energy : II > IV > III > I
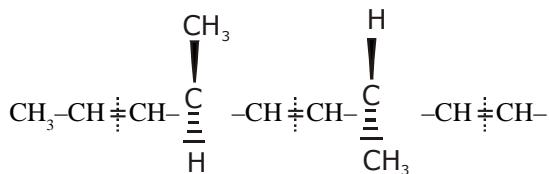
JEE-ADVANCED
PREVIOUS YEAR'S

Q.1 (B,C)
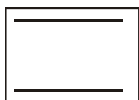
In option (B) & (C) All atom are in out plane

Q.2 (B)

SP^2 SP SP^2

Q.3 (A)

$$CH_3-CH \vdots CH- \underset{\underset{H}{|}}{\overset{\overset{CH_3}{|}}{C}} \quad -CH \vdots CH- \underset{\underset{CH_3}{|}}{\overset{\overset{H}{|}}{C}} \quad -CH \vdots CH-$$

$$CH_3 \xrightarrow{\text{Ozonolysis}} CH_3 - CH = 0$$

$$+ \quad 0=CH- \underset{\underset{H}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH = 0$$

Products are optically inactive.

Q.4 (BC)

At room temperature compound B and C are unstable because both of the

 Compound are anti aromatic

Q.5 (A,B,C)

[O]

[P]
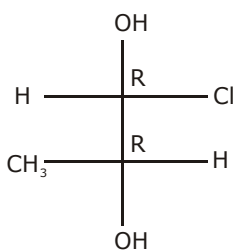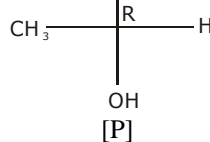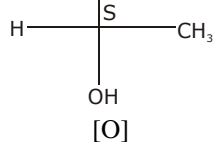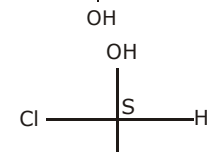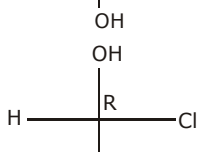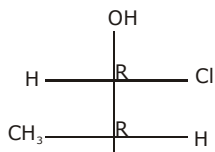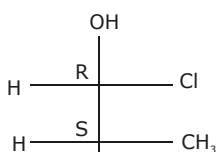
[Q]

M & N ⟶ Diastereomers
M & O ⟶ Identical
M & P ⟶ Enantiomer
M & Q ⟶ Diatereomers

Q.6 (A,C,D)
Q.7 (3)
Q.8 (10.00)

(1) (2) (1) (2) (3) (1)
     (R+S)   (R+S) R,R
                     R,S
                     S,S

(1) (2) (1)

Q.9 (C)
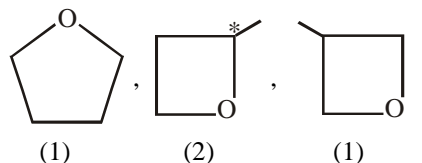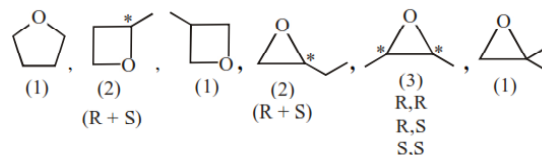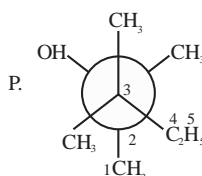
P. 2, 3, 3-trimethyl pentan-2-ol
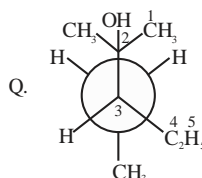
Q. **3**-ethyl-2-methyl pentan-2-ol
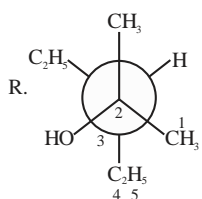
R. **3**-ethyl-2-methyl pentan-2-ol
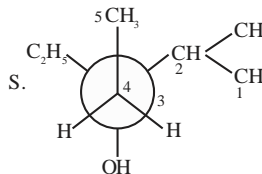
S. **3**-ethyl-2-methyl pentan-3-ol

Q.10 (C)

D-Erythrose

Compound P

It is Identical   P-2

Compound Q

```
        CHO
   HO ——|—— H
    H ——|—— OH
        CH₂–OH
```

It is Diastereomer

```
        CO₂H                    CO₂H
   HO ——|—— H             H ——|—— OH
    H ——|—— OH            H ——|—— OH
   HO ——|—— H            HO ——|—— H
   HO ——|—— H             H ——|—— OH
        CO₂H                    CO₂H
     ↑                        ↑
  dil. HNO₃               dil. HNO₃
```

Compound R

```
        CHO
    H ——|—— OH
   HO ——|—— H
        CH₂–OH
```

Q-1
It is Diastereomer R-1

Compound S

```
        CHO
   HO ——|—— H
   HO ——|—— H
        CH₂–OH
```

It is Enantiomer S-3

Ans. P-2, Q-1, R-1, S-3

Q.11 (B)

```
        CH₃
    H ——|—— OH
    H ——|—— OH      =
        CH₃
```


Most stable conformation with H– bonding

Meso butane –2, 3, –diol

```
     CH = O                   CH = O
  HO ——|—— H             H ——|—— OH
   H ——|—— OH            H ——|—— OH
  HO ——|—— H            HO ——|—— H
  HO ——|—— H             H ——|—— OH
     CH₂OH                   CH₂OH

      (C)                      (D)
```

Q.12 C, D

```
     CH = O                   CO₂H
   H ——|—— OH            H ——|—— OH
  HO ——|—— H            HO ——|—— H
   H ——|—— OH            H ——|—— OH
   H ——|—— OH            H ——|—— OH
     CH₂OH                   CO₂H
         HNO₃ →                     P
```

$[\alpha]_D = 52.7°$

The enantiomer of P has rotation –52.7° is as follows

Hydrocarbons

ELEMENTARY

Q.1 (4)

C_7H_{16} (C_nH_{2n+2})

Q.2 (1)

Q.3 (4)

$2CH_3COONa + 2H_2O \xrightarrow{\text{Electrolysis}}$

$CH_3 - CH_3 + 2CO_2 + 2NaOH + H_2$
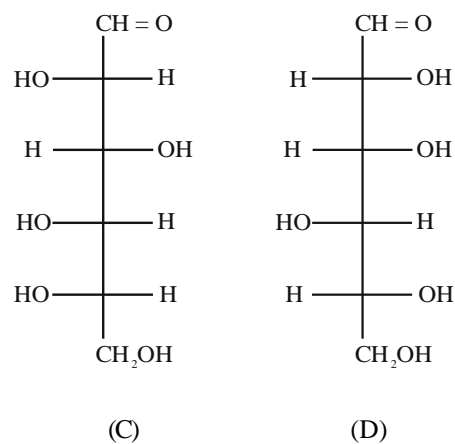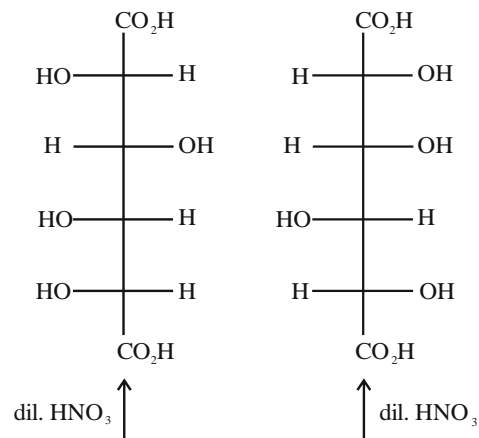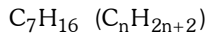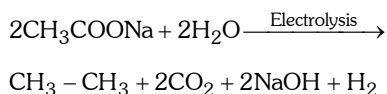
Q.4 (3)

Q.5 (4)

In gemdihalide both the halogen atoms are present on the same carbon atom while in vicdihalide both the halogen atoms are present on adjacent carbon atoms.

$$\underset{\text{Gemdihalide}}{CH_3 - CHBr_2} \qquad \underset{\substack{| \quad | \\ Br \quad Br \\ vic-dihalide}}{CH_2 - CH_2}$$

Q.6 (2)

Q.7 (2)

$$\underset{\substack{| \\ CH_3}}{H_3C - CH - CH_2 - CH_3} + Br_2 \longrightarrow$$

Q.8 (4)

Alkene gives anti addition reactions with bromine trans alkane gives meso in tramaddition.

Q.9 (4)

(4) $C_2H_5I + alc.KOH \rightarrow C_2H_4 + KI + H_2O$

Q.10 (2)

Q.11 (3)

(3)

$$R - CH = CH - R \xrightarrow[\text{room temp.}]{\text{dil. aqueous } KMnO_4} \underset{\substack{| \quad | \\ OH \quad OH \\ (Alcohol)}}{R - CH - CH - R}$$

$$R - CH = CH - R \xrightarrow[\text{heat}]{\text{Conc.} KMnO_4} R - COOH + R - COOH$$

Q.12 (2)

$$(2)\ CH_2 = \underset{\substack{| \\ CH_3}}{C} - CH_3 + HCl \rightarrow CH_3 - \underset{\substack{| \\ CH_3}}{\overset{\substack{Cl \\ |}}{C}} - CH_3$$

2-chloro-2-methyl propane

Q.13 (2)

$$\underset{\substack{2 \\ OH \\ 2Methyl-2-hydroxypropane}}{\underset{\substack{| \\ CH_3}}{CH_3 - \overset{\substack{CH_3 \\ |}}{C} - CH_3}} \xrightarrow[\text{Dehydration}]{H_2SO_4} \underset{\text{Isobutene}}{CH_3 - \overset{\substack{CH_3 \\ |}}{C} = CH_2} + H_2O$$
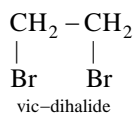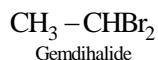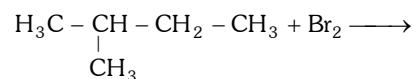
Q.14 (1)

$(1)\ \overset{sp^2}{CH_2} = \overset{sp^2}{CH} - \overset{sp}{C} \equiv \overset{sp}{CH}$
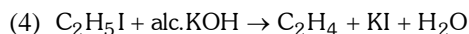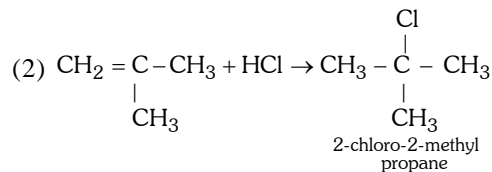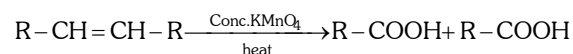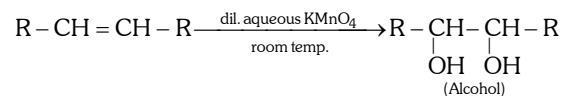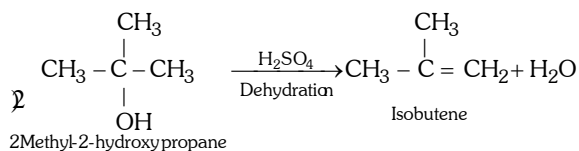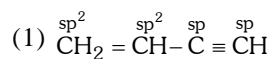
Q.15 (2)

(2) Markownikoff's rule can not be applied for symmetrical alkene.

Q.16 (1)

$(1)\ CH_3 - CH_2 - Cl + C_6H_6$

$\xrightarrow{\text{anhy.} AlCl_3} C_6H_5CH_2CH_3$

Q.17 (4)

$CH_3CH_2 - OH \xrightarrow[433K]{Conc.H_2SO_4} \underset{\text{(Intramolecular dehydration)}}{CH_2 = CH_2}$

Q.18 (1)

$(1)\ 3CH \equiv CH \xrightarrow[\text{Fe tube}]{\text{Red hot}}$

Benzene
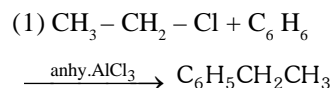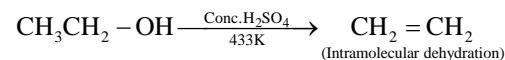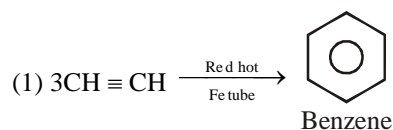
Q.19 (1)

Q.20 (1)

(1) $HC \equiv CH$ one sigma and two π bond

Q.21 **(3)**

(3) $Mg_2C_3 + 4H_2O \rightarrow CH_3C \equiv CH + 2Mg(OH)_2$
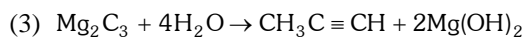
Q.22 **(2)**

$CH \equiv CH$ Hydrogen connected to carbon in sp hybridization is acidic Hydrogen.

$CH_2 = CH_2$ less acidic.

So order will be $\rightarrow CH \equiv CH > CH_2 \equiv CH_2 > CH_3 - CH_3$.

Q.23 **(1)**

JEE-MAIN
OBJECTIVE QUESTIONS

Q.1 **(2)**

Q.2 **(1)**

Mech

Q.3 **(3)**

Q.4 **(2)**

Q.5 **(1)**

Mech

Q.6 **(3)**

$CH_3 - CH_2 - CH_2 - CH_2 - CH_3 \xrightarrow[h\nu]{Cl_2} CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - Cl$

$+$

$CH_3 - CH_2 - \overset{\displaystyle \overset{\bigstar R/S}{|}}{\underset{\displaystyle \underset{Cl}{|}}{CH_2-CH}} - CH_3$

$+$

$CH_3 - \underset{\displaystyle \underset{Cl}{|}}{CH_2-CH} - CH_2 - CH_3$

Q.7 **(3)**

$CH_3 - \underset{\displaystyle \underset{CH_3}{|}}{CH} - CH_2CH_2 - CH_3 \xrightarrow[F.R.S]{Cl_2/h\nu} CH_3 - \underset{\displaystyle \underset{CH_3}{|}}{CH} - CH_2 - CH_2 - CH_2 - Cl$

$+$

$CH_3 - \underset{\displaystyle \underset{CH_3}{|}}{CH} - CH_2 - \overset{\displaystyle \overset{\bigstar R/S}{|}}{\underset{\displaystyle \underset{Cl}{|}}{CH}} - CH_3$

$+$

$CH_3 - \underset{\displaystyle \underset{CH_3}{|}}{CH} - \overset{\displaystyle \overset{\bigstar R/S}{|}}{\underset{\displaystyle \underset{Cl}{|}}{CH}} - CH_2 - CH_3$

$+$

$CH_3 - \underset{\displaystyle \underset{CH_3}{|}}{\overset{\displaystyle \overset{Cl}{|}}{C}} - CH_2 - CH_2 - CH_3$

$+$

17
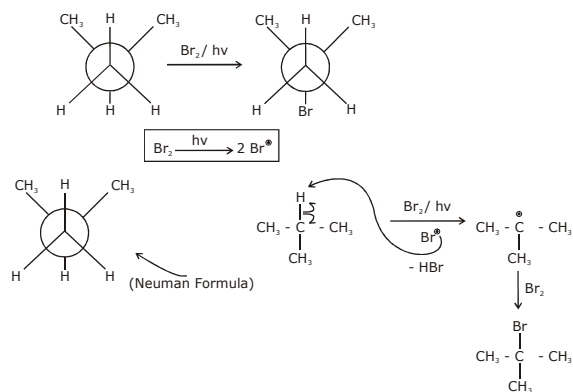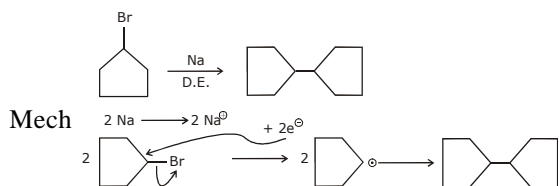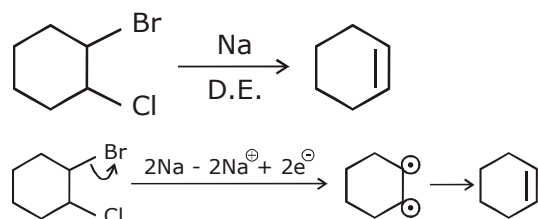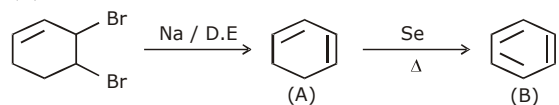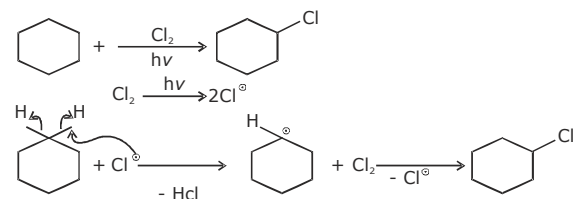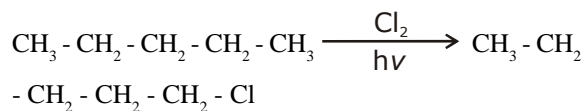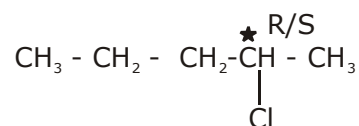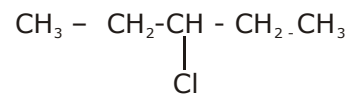
$$CL - CH_2 - \overset{\overset{H}{|}}{\underset{\underset{CH_3}{|}}{C}} \star R/S - CH_2 - CH_2 - CH_3$$
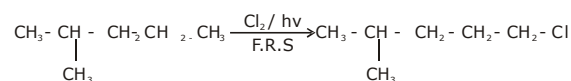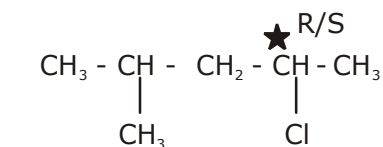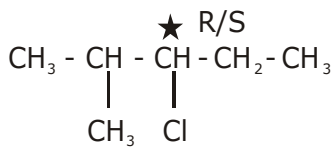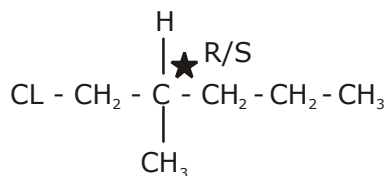
Total no of monochloro product = 8

Q.8 **(4)**

$$\text{(structure)} \xrightarrow[\underset{-NaCl}{Na \longrightarrow Na^{\oplus} + e^{\ominus}}]{Na\ /D.E} \text{(diradical)} \longrightarrow \text{(dimethylcyclopentane)}$$

Q.9 **(4)**

$$CH_3 - Cl + CH_3 - CH_2 - Cl \xrightarrow[D.E]{Na} CH_3 - CH_3 + CH_3 - CH_2 - CH_2 - CH_3$$
$$+ CH_3 - CH_2 - CH_3$$

Q.10 **(3)**

$$\text{(1,2-dichlorocyclohexane)} \xrightarrow[D.E]{2Na \quad 2Na^{\oplus}+2e^{\ominus}} \text{(diradical)} \longrightarrow \text{(cyclohexene)} + 2Nacl$$

Q.11 **(3)**

$$\text{(methylcyclohexane)} \xrightarrow[\underset{-H\ Br}{Br^{\ominus}}]{Br_2\ /\ hv} \text{(radical)} \xrightarrow[Br - Br]{Br_2} \text{(1-bromo-1-methylcyclohexane)} + Br^{\ominus}$$

Q.12 **(2)**

$$\text{(structure)} \xrightarrow[\underset{-H\ Br}{Br^{\ominus}}]{Br_2\ /\ Hv} \text{(structure)} \xrightarrow[DMF]{Na} \text{(dimer structure)}$$

or

(radical structure)

Q.13 **(4)**

$$\text{(chlorocyclohexene)} \xrightarrow[Na \rightarrow Na^{\oplus} + e^{\ominus}]{Na\ /\ D.E} \left[\text{(radical)} \overset{R.S}{\longleftrightarrow} \text{(radical)} \right]$$

(dimer products)

Q.14 **(3)**

Reactivity of Alkyl Halide for Wurtz Rxn

R - I > R - Br > R - Cl > R - F

Q.15 **(4)**

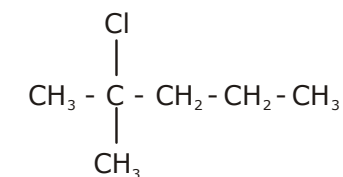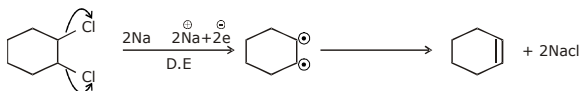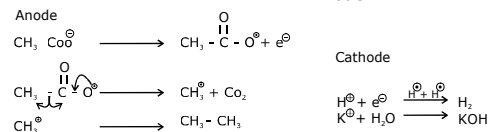$$\begin{array}{c} CH_3\ Coo^{\ominus}\ K^{\oplus} \\ + \\ Et - Coo^{\ominus}\ K^{\oplus} \end{array} \xrightarrow{Eletrolysis} \begin{array}{c} CH_3 - C_2H_5 \\ + \\ C_2H_5 - C_2H_5 \\ + \\ CH_3 - CH_3 \end{array} + 2Co_2 + \underline{KoH + H_2}_{\text{Cathode}}$$

Anode

$$CH_3\ Coo^{\ominus} \longrightarrow CH_3 - \overset{O}{\overset{||}{C}} - O^{\circledast} + e^{\ominus}$$

$$CH_3 - \overset{O}{\overset{||}{C}} - O^{\circledast} \longrightarrow CH_3^{\circledast} + Co_2$$

$$CH_3^{\circledast} \longrightarrow CH_3 - CH_3$$

Cathode

$$H^{\oplus} + e^{\ominus} \xrightarrow{H^{\oplus} + H^{\oplus}} H_2$$
$$K^{\oplus} + H_2O \longrightarrow KOH$$

Q.16 **(2)**

$$\text{(isobutyrate anion)} \xrightarrow{Eletrolysis} \text{(radical)} + e^{\ominus}$$

$$\downarrow$$

$$2\ \text{(isopropyl radical)}^{\circ} + Co_2$$

$$\downarrow$$

$$\text{(2,3-dimethylbutane)}$$

2,3 dimethyl butane

Q.17 **(1)**

(Newman projection I) (Newman projection II)

(I)   (II)

$$\updownarrow$$ $$\updownarrow$$

$$CH_3 - \overset{}{\underset{\underset{CH_3}{|}}{CH}} - CH_3$$ $$CH_3 - CH_3$$

$$\downarrow Br_2/\ hv$$ $$\downarrow Br_2/\ hv$$

$$\overset{Br}{\underset{\underset{CH_3}{|}}{|}}$$
$$CH_3 - \overset{|}{\underset{\underset{CH_3}{|}}{C}} - CH_3$$ $$CH_3 - CH_2 - Br$$

(III)

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

$\downarrow Br_2/ hv$

$$CH_3 - \underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}} - \underset{\underset{Br}{|}}{CH} - CH_3$$

[Most stable free radical is formed as intermidiate]

Order of Bromination $= I > III > II >$

Q.18   (4)

electrolysis

+ 2Na

Anode   Cathod

$- e^{\ominus}$ $Na^{\oplus}$

$H \frown OH + NaOH$

$H^{\oplus} e^{\ominus}$

$H^{\circ} \underset{H_2}{\overset{H^{\circ}}{\frown}}$

Co_2

(2-butyne)
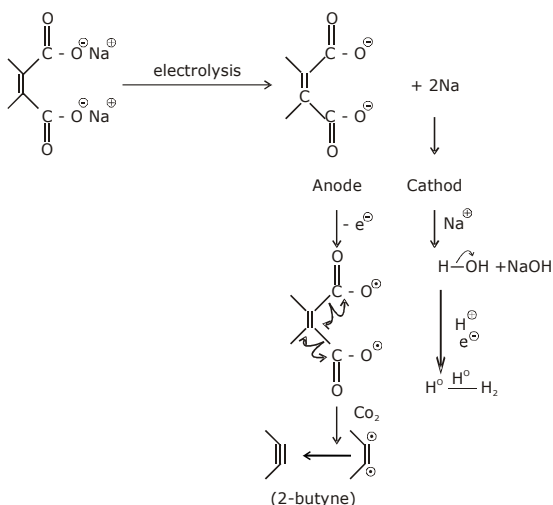
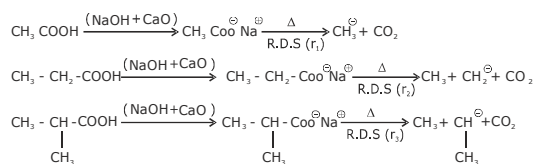**Q.19   (1)**

in Kolbe's eledrolysis process. NaOH / KOH is Formed at cathod so PH increases and PO^H decrease

At cathod $= Na^{\oplus} + H_2o \longrightarrow NaoH + \frac{1}{2}H_{2(}g)$

Q.20   (1)

$CH_3 COOH \xrightarrow{(NaOH+CaO)} CH_3 Coo^{\ominus} Na^{\oplus} \xrightarrow[R.D.S\ (r_1)]{\Delta} CH_3^{\ominus} + CO_2$

$CH_3 - CH_2 - COOH \xrightarrow{(NaOH+CaO)} CH_3 - CH_2 - Coo^{\ominus} Na^{\oplus} \xrightarrow[R.D.S\ (r_2)]{\Delta} CH_3 + CH_2^{\ominus} + CO_2$

$CH_3 - \underset{\underset{CH_3}{|}}{CH} - COOH \xrightarrow{(NaOH+CaO)} CH_3 - \underset{\underset{CH_3}{|}}{CH} - Coo^{\ominus} Na^{\oplus} \xrightarrow[R.D.S\ (r_3)]{\Delta} CH_3 + \underset{\underset{CH_3}{|}}{CH}^{\ominus} + CO_2$
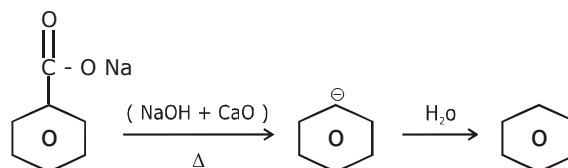
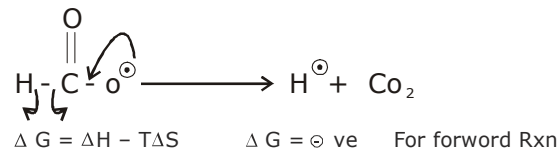[rater of decorboxylation $\propto$ stability of corbanion]

rate of decorboxylation $= r_1 > r_2 > r_3$

Q.21   (1)

$\xrightarrow[\Delta]{(NaOH + CaO)}$

$\xrightarrow{H_2o}$

Q.22   (1)

$H - \overset{\overset{O}{||}}{C} - o^{\odot} \longrightarrow H^{\odot} + Co_2$

$\Delta G = \Delta H - T\Delta S$ $\Delta G = \odot$ ve   For forword Rxn

$\Delta H = \ominus$ve $\Delta S = \oplus$ve

Q.23   (B)

$e^{\ominus} + CH_3 - Cl \longrightarrow$

$\odot C \begin{smallmatrix} H \\ H \end{smallmatrix} H + Cl^{\ominus}$

Q.24   (B)

(i)

$CH_3 - CH_2 - CH_2 - CH_2 - CH_3 \xrightarrow[Hv]{Cl_2} CH_3 - CH_2 - CH_2 - \overset{\bigstar}{CH} - CH_3 \quad R/s$, $\underset{Cl}{|}$

(ii)

Cl_2/ Hv

$Cl^{\ominus}$

Reaction 3

Reaction 4

$\Box \xrightarrow{Cl_2 / Hv}$ $\quad + $

$CH_3 - \underset{\underset{O\ CH_3}{|}}{CH} - CH_3 \xrightarrow{Cl_2/ Hv} CH_3 - \underset{\underset{O\ CH_3}{|}}{CH} - \overset{\bigstar}{CH_2} - Cl \quad R/s$

$+ CH_3 - \underset{\underset{O\ CH_3}{|}}{\overset{\overset{Cl}{|}}{C}} - CH_3$
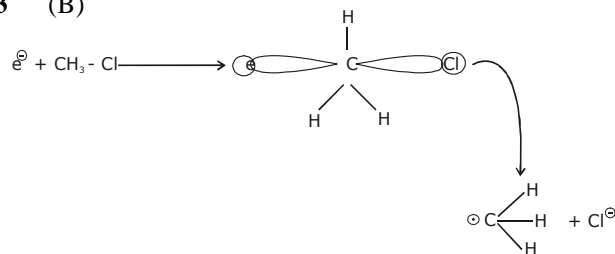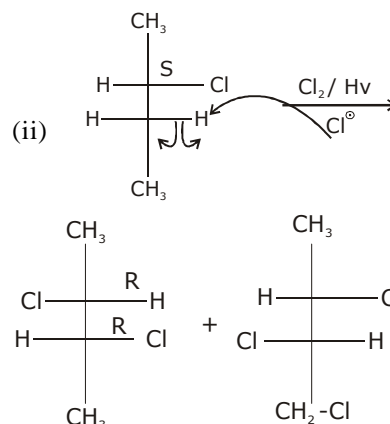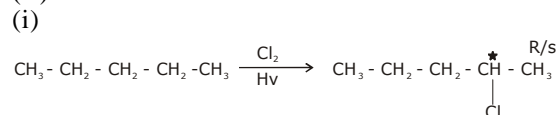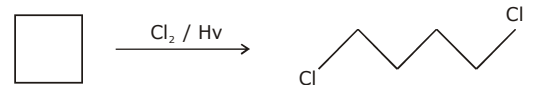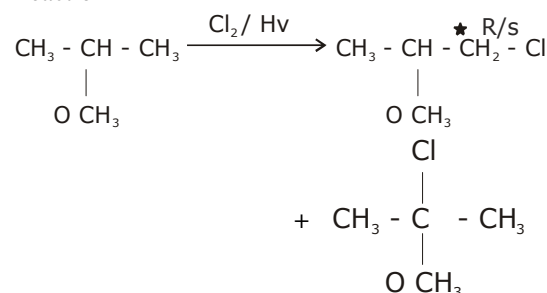
Q.25 **(1)**
Stability depends on hyperconjugation which further depends on total number of αH.

Q.26 **(3)**
Dipole moment is a vector quantity.In trans 1,2-Dichloroethene ,all the vector cancell each other

Q.27 **(4)**
Heat of hydrogenation α

$$\frac{1}{\text{Stability of alkene or crowding across } \pi \text{ bond}}$$

Q.28 **(4)**
Stability depends on hyperconjugation which further depends on total number of αH.
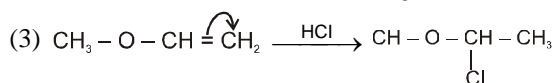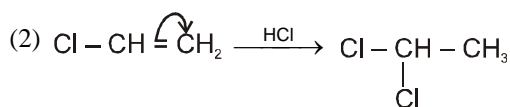
Q.29 **(3)**
Electron releasing group and stability of carbocation will decide rate of reaction in electrophilic addition reaction.

Q.30 **(3)**
Electron releasing group and stability of carbocation will decide rate of reaction in electrophilic addition reaction.

Q.31 **(1)**
Electron releasing group and stability of carbocation will decide rate of reaction in electrophilic addition reaction.
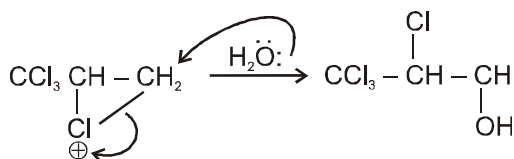
Q.32 **(4)**
No rearrangement in oxymercuration Demercuration.

Q.33 **(1)**

(1) $CF_3 - CH = CH_2 \xrightarrow{H^+Cl^-} CF_3 - CH_2 - CH_2 - Cl$

(2) $Cl - CH = CH_2 \xrightarrow{HCl} Cl - CH - CH_3$ with Cl substituent

(3) $CH_3 - O - CH = CH_2 \xrightarrow{HCl} CH - O - CH - CH_3$ with Cl substituent

Q.34 **(2)**
In anti addition, cis reactant will give enantiomers.

Q.35 **(2)**

$CCl_3CH = CH_2 \xrightarrow{Cl_2 + H_2O}$

$CCl_3 CH - CH_2 \xrightarrow[H_2\ddot{O}:]{} CCl_3 - CH - CH$

with Cl substituents, giving $CCl_3 - CH - CH$ with Cl and OH

Q.36 **(2)**
$CH_3 - CH = CH_2$ (Free radical substitution reaction)

Q.37 **(2)**

$CH_2 = CH - CH_2 - CH = CH_2 \xrightarrow{NBS} CH_2 = CH - \underset{\bullet}{CH} - CH = CH_2$

$\updownarrow$ Resonance

$CH_2 = CH - CH = CH - CH_2 - Br \xleftarrow{NBS} CH_2 = CH - CH = CH - \underset{\bullet}{CH_2}$
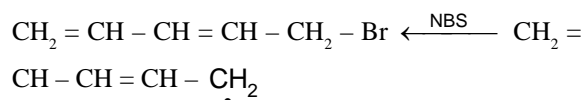
Q.38 **(3)**
Conceptual

Q.39 **(1)**

$CH = CH$ (bridged with Br, $\oplus$) has more strain due to sp^2 hydridised carbon.

Q.40 **(4)**

$CH_3 - C \equiv CH \xrightarrow{HBr} CH_3 - C = CH_2$ with Br

$\xrightarrow{HBr} CH_3 - \underset{Br}{\overset{Br}{C}} - CH_3$

$CH_3 - C = CH_2$ with Br $\xrightarrow{HBr} CH_3 - \underset{Br}{\overset{Br}{C}} - CH_3$

Q.41 **(1)**

Ph$-C \equiv CH \xrightarrow[HOBr]{\ominus \quad \oplus}$ Ph$-C = CH$ with Br, OH

$\xrightarrow[HOBr]{\ominus \quad \oplus}$ Ph$-\underset{OH}{\overset{OH}{C}} - CH \underset{Br}{\overset{Br}{<}} \xrightarrow{-H_2O}$ Ph$-\underset{O}{\overset{\|}{C}} - CHBr_2$

Q.42 **(1)**

Q.43 **(1)**

$\overset{1}{Ph}-\overset{2}{CH}=\overset{3}{CH}-\overset{4}{CH}=CH-Ph \xrightarrow{HBr}$

$Ph-CH_2-\overset{\oplus}{CH}=CH=CH-Ph \xrightarrow{Br}$

$Ph-CH_2-CH=CH-\underset{Br}{CH}-Ph$
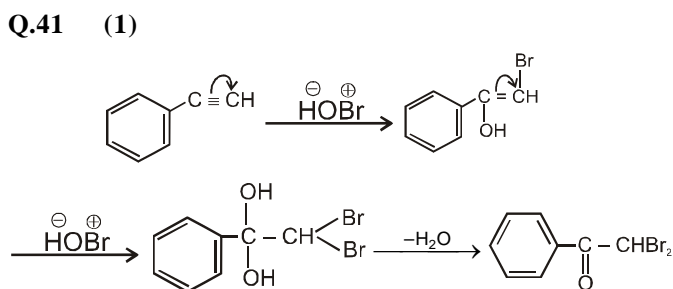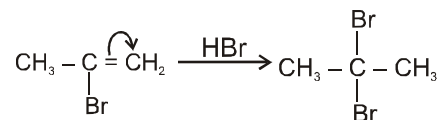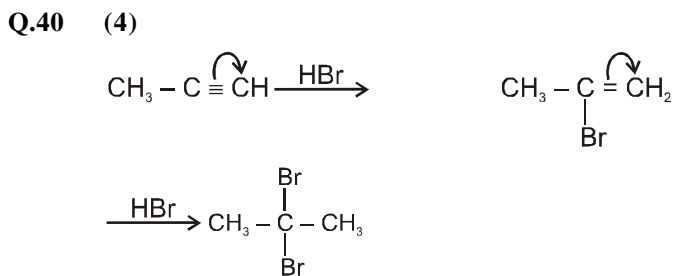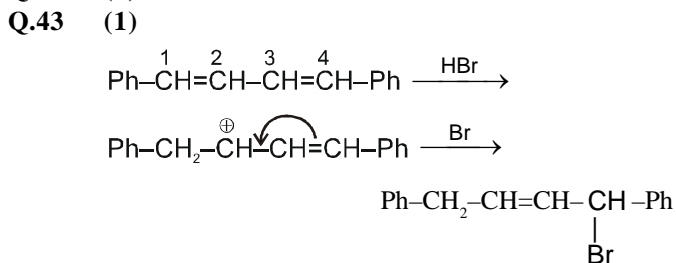
Q.44 **(2)**

When double bond and triple bond is in the conjugation then triple bond is more reactive due to more stable carbocation.
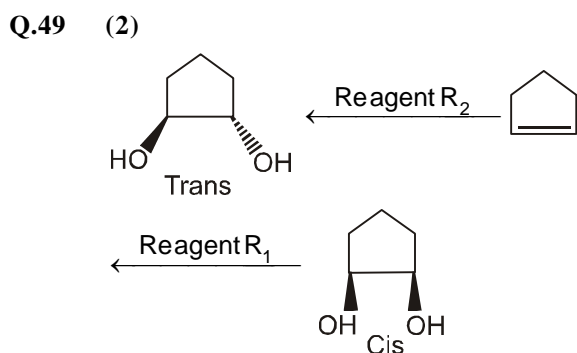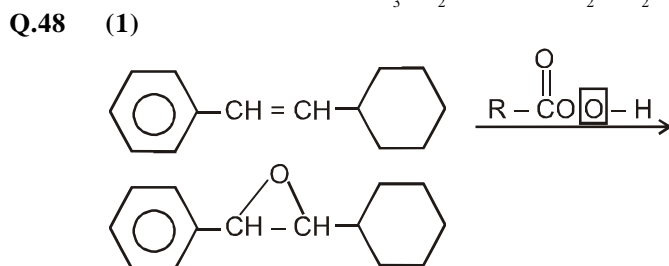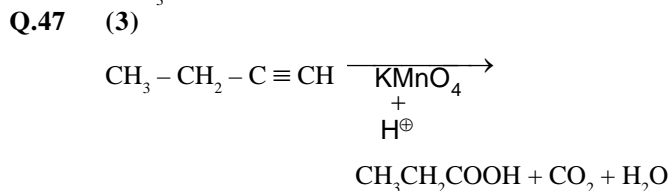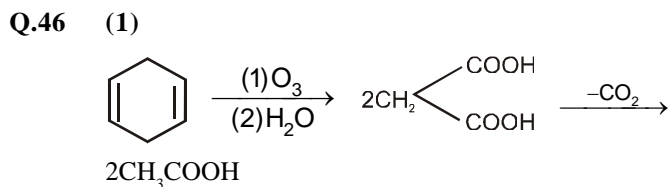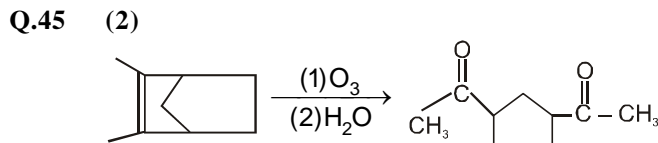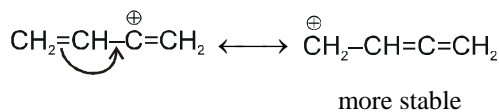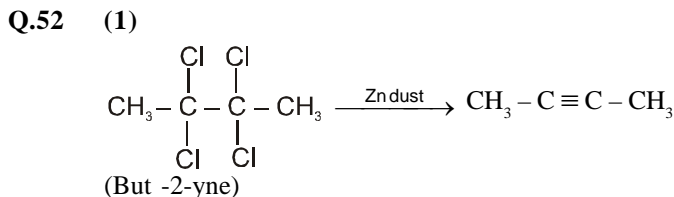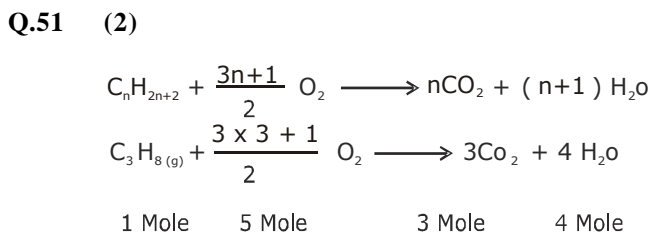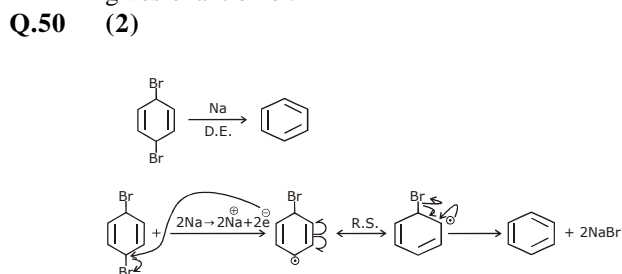
$$CH_2=CH-\overset{\oplus}{C}=CH_2 \longleftrightarrow \overset{\oplus}{C}H_2-CH=C=CH_2$$

more stable

Q.45 **(2)**

Q.46 **(1)**

$2CH_3COOH$

Q.47 **(3)**

$$CH_3-CH_2-C\equiv CH \xrightarrow[\underset{H^\oplus}{+}]{KMnO_4}$$

$$CH_3CH_2COOH + CO_2 + H_2O$$

Q.48 **(1)**

Q.49 **(2)**

Syn addition with Baeyer's Reagent, So cis will form meso compound however peroxy acid in anti addition gives enantiomer.

Q.50 **(2)**

Q.51 **(2)**

$$C_nH_{2n+2} + \frac{3n+1}{2} O_2 \longrightarrow nCO_2 + (n+1) H_2O$$

$$C_3H_{8(g)} + \frac{3 \times 3 + 1}{2} O_2 \longrightarrow 3CO_2 + 4 H_2O$$

| 1 Mole | 5 Mole | 3 Mole | 4 Mole |

Q.52 **(1)**

(But -2-yne)

Q.53 **(3)**
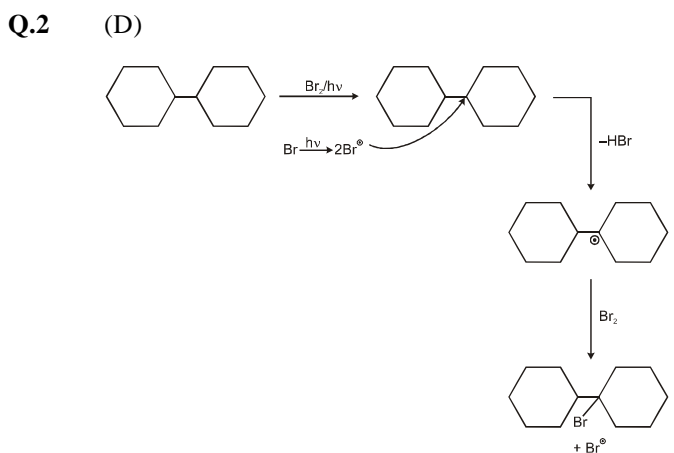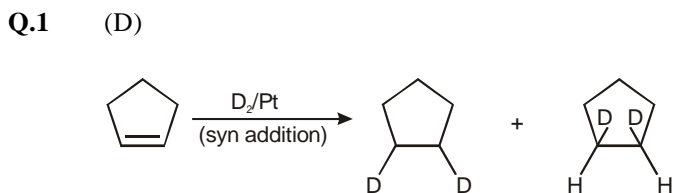

$+ 2H_2O$

Q.54 **(4)**
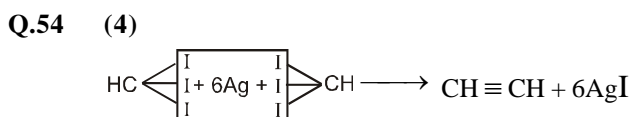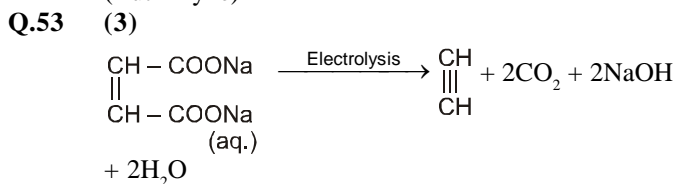
Q.55 **(3)**

sp Hybridisation of alkyne and also intermediate form is less stable.

Q.56 **(1)**

$$CaC_2 + H_3O^+ \longrightarrow Ca(OH)_2 + C_2H_2 \text{ (Acetylene)}$$
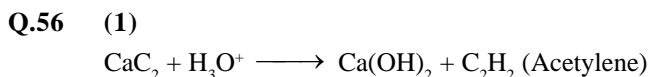
Q.57 **(2)**

Conceptual

JEE-ADVANCED

OBJECTIVE QUESTIONS

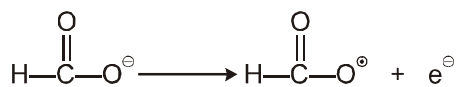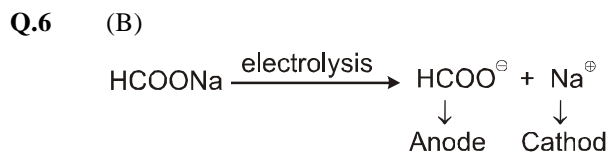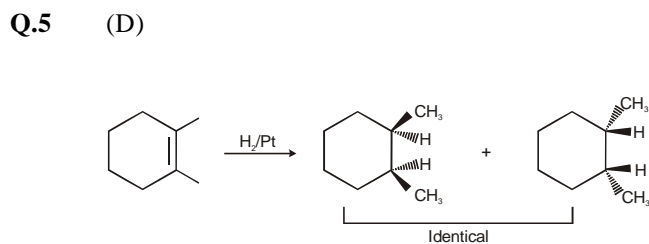**Q.1** (D)

Q.2 (D)

Q.3 (A)

$$HO-O-H \xrightarrow{h\nu} 2HO^{\ominus}$$

$$HO^{\ominus} + HBr \longrightarrow H_2O + Br^{\ominus}$$

3° F.R.
(More Stable)   2° F.R.

Q.4 (C)

Diastereomer

Q.5 (D)

Identical

Q.6 (B)

$$HCOONa \xrightarrow{electrolysis} HCOO^{\ominus} + Na^{\oplus}$$

↓   ↓
Anode   Cathod

Anode :

$$H^{\circ} + H^{\circ} \longrightarrow H_2(g)$$

Cathod :

$$H^{\oplus} + e^{\ominus} \longrightarrow \frac{1}{2} H_2(g)$$

$$Na^{\oplus} + H_2O \longrightarrow NaOH$$

Q7 (B)

Q.8 (A)

Rate of Hydrogenation $\propto$

$$\frac{1}{\text{crowding across } \pi \text{ bond}}$$

(Hydrogenation follow syn addition)

Q.9 (A)

$$CH_3 - CH - \underset{\underset{Br}{|}}{\overset{\overset{CH_3}{|}}{C}} - CH_2 - CH_3 \xrightarrow{Zn/\Delta}$$

(with Br on the CH)

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

$$\xrightarrow{Red P + HI} CH_3 - CH_2 - \underset{}{\overset{\overset{CH_3}{|}}{C}} - CH_2 - CH_3$$

Q.10 (D)

$$\begin{array}{l} CH_3 - CH - COOH \\ | \\ CH_3 - CH - COOH \end{array} \xrightarrow{Electrolysis} \begin{array}{l} CH_3 - CH \\ || \\ CH_3 - CH \end{array} +$$

$$2CO_2 + H_2 + 2NaOH$$

Q.11 (C)

$$Ph - CH_2 - \overset{\oplus}{CH} - CH_3 \xrightarrow{1, 2H^- \text{ shift}} Ph - \overset{\oplus}{CH} -$$

$$CH_2 - CH_3 \xrightarrow{H_2\overset{..}{O}:} Ph - \underset{\underset{OH}{|}}{CH} - CH_2 - CH_3$$
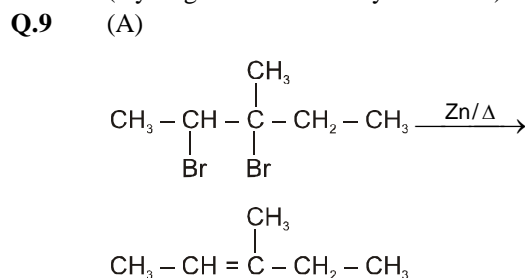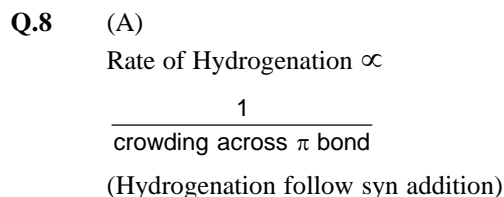
Q.12 (C)

Q.13 (C)

X = Hydrobroation oxidation, Y = oxymercuration & demercuration, Z = Simple hydration reaction

Q.14 (B)

$$CH_3CH=CH_2 \xrightarrow{BD_3/ THF} (CH_3CHCH_2)_3B$$
(with D)

$$\xrightarrow{H_2O_2/OH^-} CH_3CHCH_2OH$$
(with D)

Q.15 (B)
In anti addition, cis reactant will give enantiomers.

Q.16 (C)

Trans + Br$_2$ ⟶ Meso
Cis + Br$_2$ ⟶ d + l (enantiomer)

But-1-ene + Br$_2$ ⟶ $CH_3 - CH_2 - \overset{*}{C}H - CH_2Br$
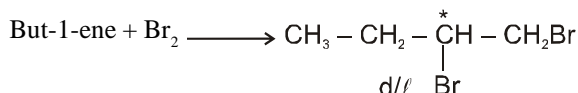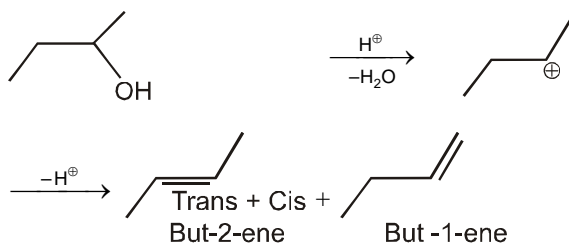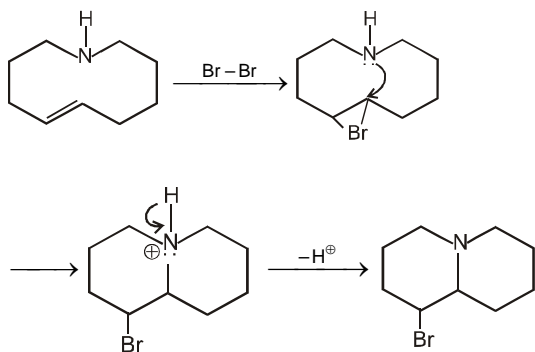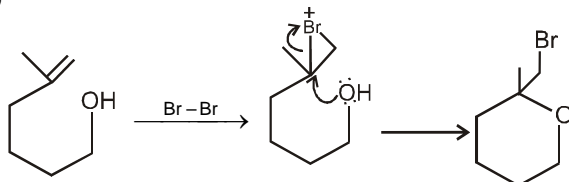   d/l   Br
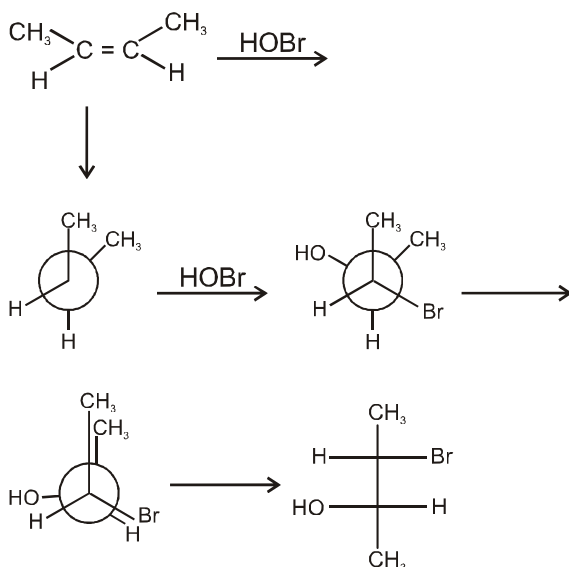
Q.17 (D)

Q.18 (B)

Q.19 (B)

Q.20 (A)
In the presence of peroxide, HBr undergoes free radical addition and HCl undergoes electrophilic addition.

Q.21 (B)
After addition of HBr, we get two chiral centres, so total isomers will be four.

Q.22 (A)

Q.23 (A)

$CH_2 - OH$
$CH \equiv CH \xrightarrow[2.P]{1.NaNH_2} CH \equiv C - CH_2 - CH_2 - OH$
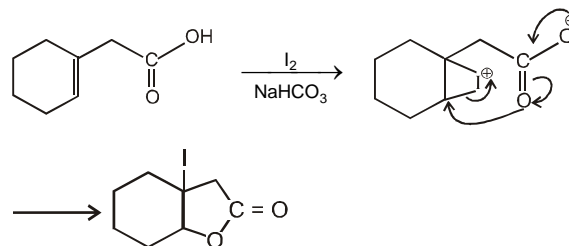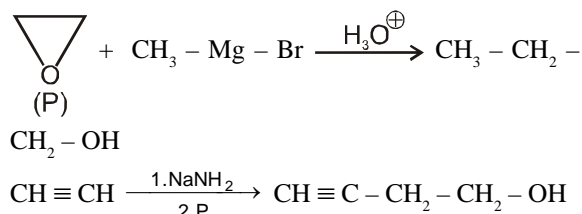
Q.24 (C)
Since cis form in syn addition gives only one steresisomer i.e. meso ∴ it is 100 percent stereoselective and 100 percent stereoselective reaction is also called stereospecific reaction.

Q.25 (B)

Q.26 (B)

Q.27 (C)

Q.28 (C)

CH₃–C(=CH–CH₃)–CH=C(CH₃)–CH₃ (with CH–CH₃ substituent) $\xrightarrow{(1)O_3}{(2)H_2O}$

$$CH_3COOH + CH_3-\overset{O}{\overset{\|}{C}}-CH_3 +$$

$$CH_3-\overset{O}{\overset{\|}{C}}-COOH$$

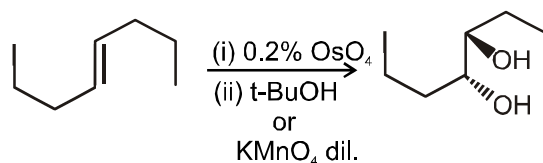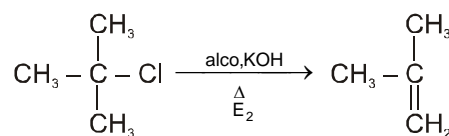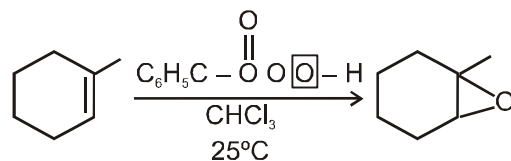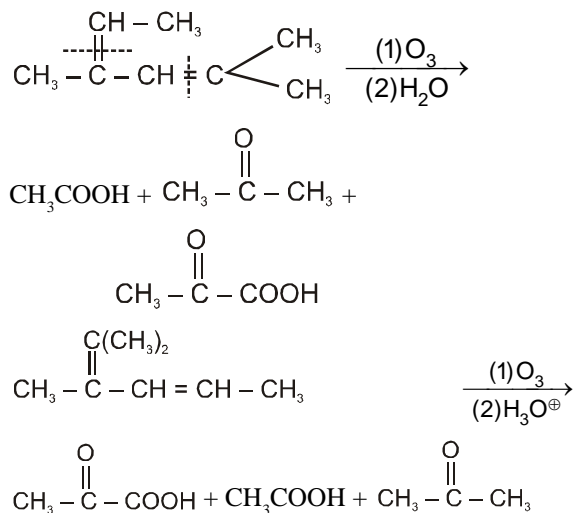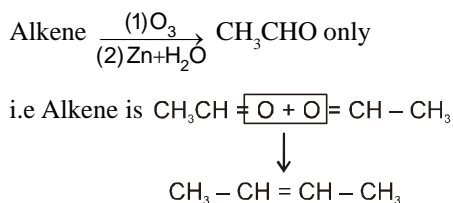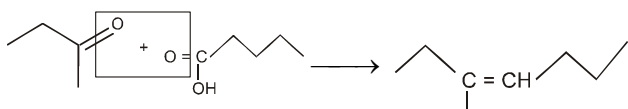$$CH_3-\overset{C(CH_3)_2}{\overset{|}{C}}=CH-CH=CH-CH_3 \xrightarrow{(1)O_3}{(2)H_3O^\oplus}$$

$$CH_3-\overset{O}{\overset{\|}{C}}-COOH + CH_3COOH + CH_3-\overset{O}{\overset{\|}{C}}-CH_3$$

Q.29 (A)

Alkene $\xrightarrow{(1)O_3}{(2)Zn+H_2O}$ CH₃CHO only

i.e Alkene is $CH_3CH=\boxed{O+O}=CH-CH_3$

$$\downarrow$$

$$CH_3-CH=CH-CH_3$$

Q.30 (A)

Q.31 (D)

$KMnO_4$, $H^\oplus$ →

(products with COOH groups)

Q.32 (A)

$$CH_3-C(CH_3)=CH-\overset{CH_3}{\underset{CH_3}{\overset{|}{\underset{|}{C}}}}-CH_3 \xrightarrow{NaIO_4}{KMnO_4}$$

$$CH_3-\overset{O}{\overset{\|}{C}}-CH_3 + (CH_3)_3C.COOH$$

Q.33 (D)

$R-C\equiv C-R \xrightarrow[\text{P—2—catalyst}]{H_2 + Pd (CaCO_3 + Qunoline)}$ Cis Alkene
Raney Ni

Q.34 (D)

$CH_2=CH_2 \xrightarrow{\text{alkaline KMnO}_4}$ (Pink Colour) → $\underset{OH}{CH_2}-\underset{OH}{CH_2}$ + MnO → Coloursless

Q.35 (B)

alc. KOH, Δ (E₂ elimination) → 1-butene + Cis-2-butene + Trans-2-butene (Major)

Q.36 (A)

$\xrightarrow[\text{Peroxide}]{HCl}$

Q.37 (C)

Q.38 (C)

$\xrightarrow{H_2/Pd–C}$

Q.39 (B)

$+Br_2 \longrightarrow$ (Major) +

Q.40　(C)

Q.41　(A)

Q.42　(D)

$$CH_3—CH \overset{\cdot\cdot}{\underset{\cdot\cdot}{=}} C \overset{\cdot\cdot}{\underset{\cdot\cdot}{=}} CH_2 \xrightarrow{O_3/Zn/H_2O} CH_3—CHO + HCHO + CO_2$$

Q.43　(D)

Q.44　(D)

$$H_2C=CH—CH_2—C\equiv CH + Br_2 \xrightarrow{-80°}$$

1–Penten–4–yne

(4–5 Dibromopentyne)

Q.45　(B)

Anti-Markownikoff's addition of HBr is operate at unsymmetrical Alkene so but-2-ene are symmetrical Alkene not operate Anti Markownikoff's addition of HBr.

Q.46　(B)

(A) 　2-Methyl-2-butene

(B)

(C) $CH_3—CH_2—CH=CH_2 \xrightarrow[\Delta]{KMnO_4} CH_3—CH_2—COOH + HCOOH$

(D) $CH_3—CH_2=CH—CH_2 \xrightarrow[\Delta]{KMnO_4} 2CH_3—COOH$
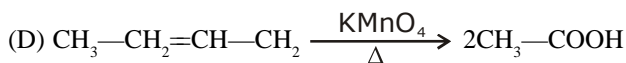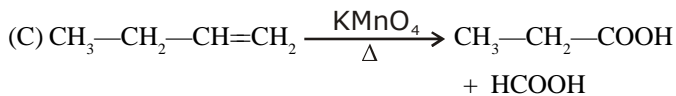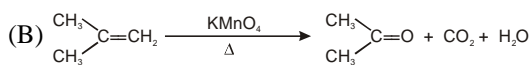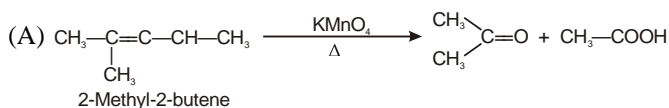
Q.47　(A)

Q.48　(C)

Q.49　(A)

Q.50　(C)

Q.51　(D)

Q.52　(A)

25

Q.53 (B)

$$C_4H_{10}O \xrightarrow[\Delta]{\text{Con. } H_2SO_4} CH_3-C=CH_2 \xrightarrow{\text{dil } H_2SO_4} C_4H_{10}O$$

Q.54 (A)

(A)

(2 Methyl Propanole)

(2 Methyl 2-Propanole)
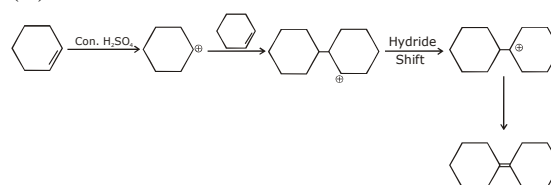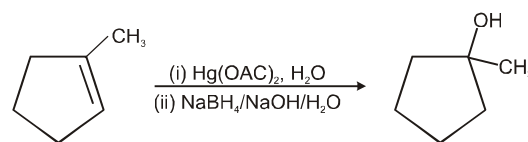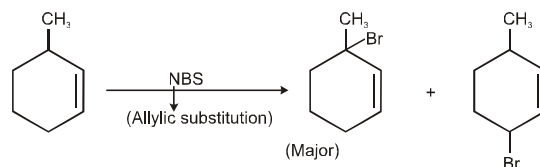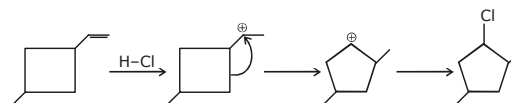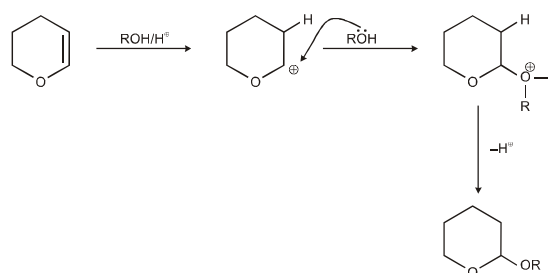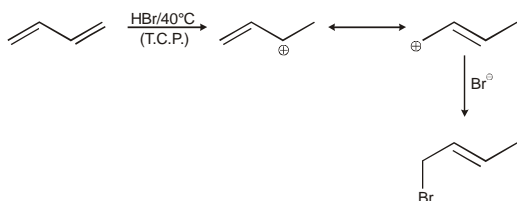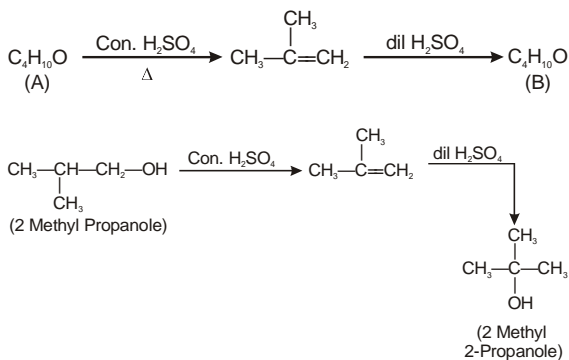
(A, B are positional isomers)

Q.55 (C)

Diastereomer

Q.56 (B)

HBr

+M

Br$^\ominus$

Q.57 (C)

(A) Trans-2-butene $\xrightarrow[\text{Anti}]{Br_2/CCl_4}$ Meso comp.

(B) Cis-2-butene $\xrightarrow[\text{syn}]{\text{Cold KMnO}_4}$ Meso comp.

(C)

(D)

Q.58 (B)

Tran-2-butene $\xrightarrow[\text{Anti addition}]{Br_2 \; CCl_4}$ Meso Comp

Q.59 (B)

$\xrightarrow{Br_2/CCl_4}$ + enantiomers

Q.60 (D)

$\xrightarrow[\text{(Syn addition)}]{\text{Cold KMnO}_4}$ +

Q.61 (A)

Tran-2-pentene $\xrightarrow[\text{(anti addition)}]{Br_2/CCl_4}$ Racemic Mixture
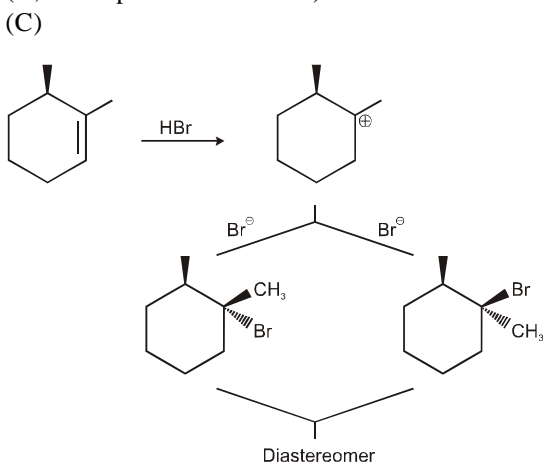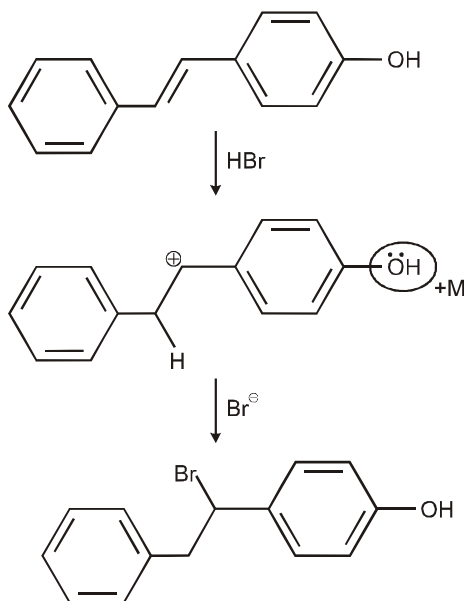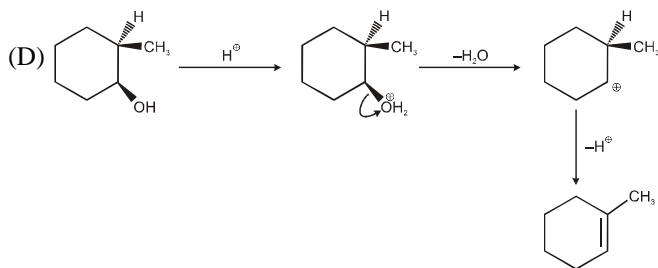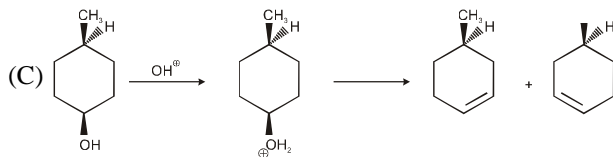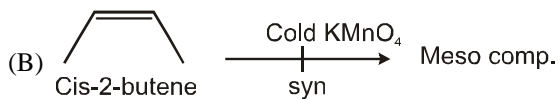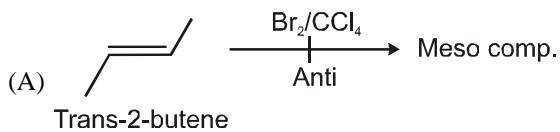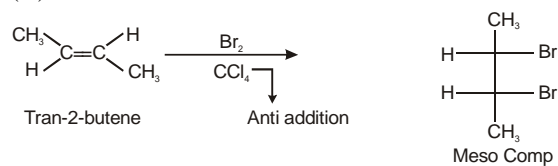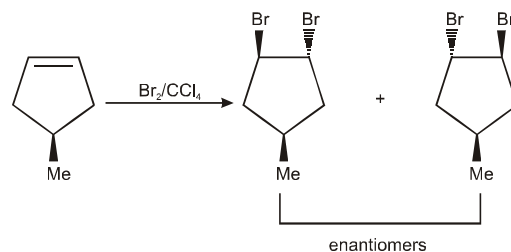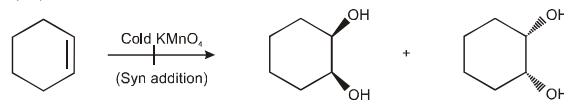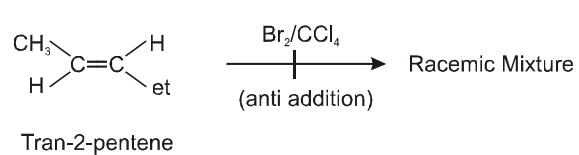
Always unsymmetrical Alkene react with Br_2/CCl_4 and gives Racemic Mixture.

Q.62 (A)

$$CH_3-CH=CH_2 \xrightarrow{\text{dil } H_2SO_4} CH_3-\overset{\oplus}{CH}-CH_3$$

$$\downarrow H_2\ddot{O}$$

$$CH_3-CH-CH_3$$

$$CH_3 \atop CH_3 \Big\rangle CH-OH \xleftarrow{-H^{\oplus}} \overset{\oplus}{\underset{H}{O}}$$

Q.63 (C)

Q.64 (A)

$$Me-CH-CH=CH-Ph \xrightarrow{HCl} Me-CH-CH_2-\overset{\oplus}{CH}-Ph$$
$$Et \phantom{-CH=CH-Ph \xrightarrow{HCl} Me-CH-CH_2-}Et$$

$$\downarrow Cl^{\ominus}$$

$$Me-CH-CH_2-CH-PH$$
$$Et Cl$$

Q.65 (C)

Triozonide

Q.66 (C)

Diastereomers
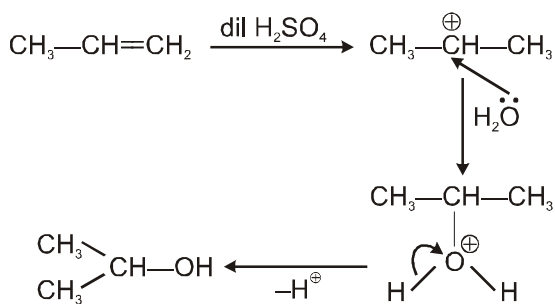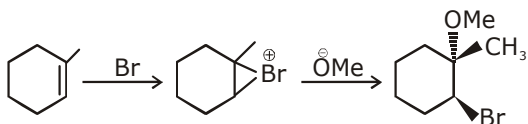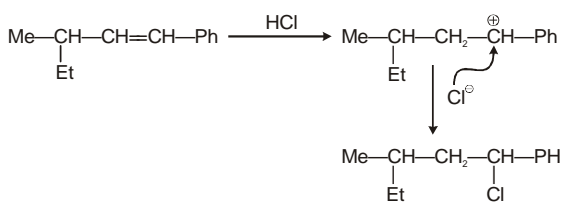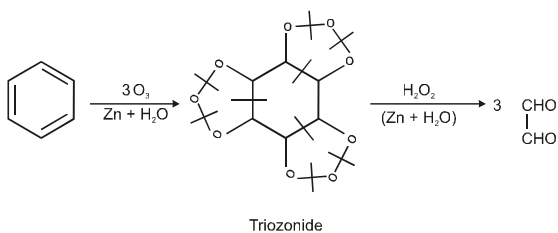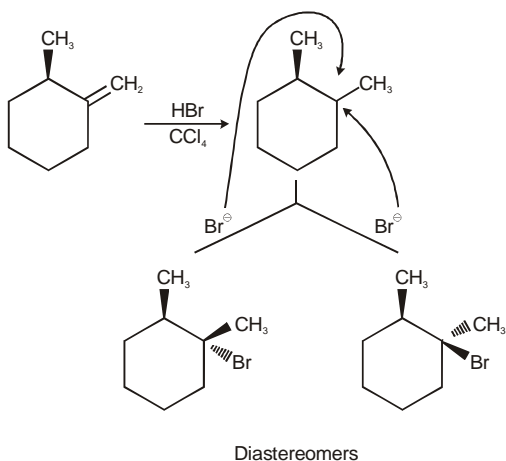
Q.67 (C)
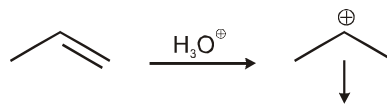
Shape of carbo cation ⟶ (Trigonal planner) as intermidiate

Q.68 (B)

Q.69 (C)

Q.70 (A)

$$CH(Br_2)-C(Br_2)-CH_3 \xrightarrow[\Delta]{\text{Zn Powder}} CH_3-$$

$$C\equiv CH$$
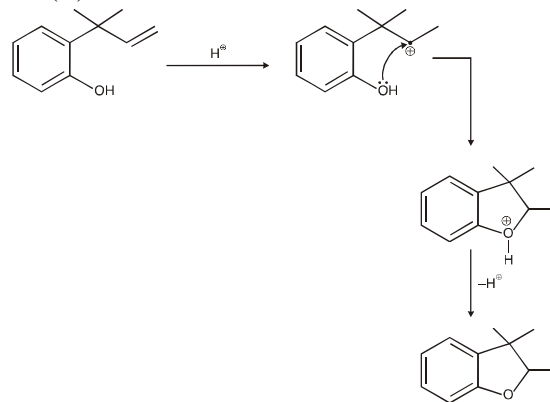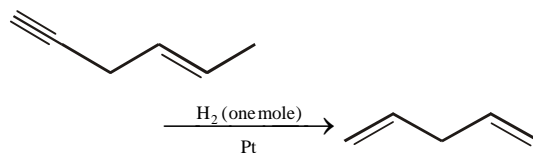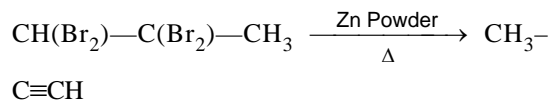
Q.71 (A)
$NaNH_2$ is dehydrohalogenating agent (removes HBr)

Q.72 (D)
Since base is bulky, we get Hoffmann's product as a major product

Q.73 (D)

$$CH_3-CH_2-C\equiv C-CH_3 \xrightarrow[NH_3]{NaNH_2} CH_3\text{-}CH_2\text{-}$$

$$CH_2\text{-}C\equiv CH \xrightarrow{\text{Basic medium}}$$

$$CH_3-CH_2-CH_2-C\equiv \overset{\ominus}{C}$$

Non terminal alkyne   Terminal alkyne

$$\text{Product} \xleftarrow[S_N2]{PhCH_2I}$$

Q.74 (C)

$$CH \equiv C - CH_2 - CH_2 - CH_3$$

BH₃ THF/H₂O₂– OH⁻ (left) | HgSO₄/H₂SO₄ (right)

Left:
$$CH = CH - CH_2 - CH_2 - CH_3$$
$$\overset{|}{OH}$$
Tautomerise
$$\overset{||}{\underset{O}{C}}H - CH_2 - CH_2 - CH_2 - CH_3$$
silver mirror test
But no iodoform test

Right:
$$CH_2 = C - CH_2 - CH_2 - CH_3$$
$$\overset{|}{OH}$$
Tautomerise
$$CH_3 - \overset{||}{\underset{O}{C}} - CH_2 - CH_2 - CH_3$$
No silver mirror test
But go for iodoform test

Q.75 (A)

$$\text{(cyclohexyl)} - \overset{|}{\underset{OH}{C}} = CH_2 \xleftarrow[\text{HgSO}_4]{\text{H}_2\text{O,H}_2\text{SO}_4}$$

$$\text{(cyclohexyl)} - C \equiv CH \xrightarrow[\text{HgSO}_4]{\text{D}_2\text{O,D}_2\text{SO}_4} \text{(cyclohexyl)} - \overset{|}{\underset{OD}{C}} = CHD$$

Left branch: Tautomerisation

Right branch: BH₃/THF, H₂O₂/OH⁻ → Tautomerisation

$$\text{(cyclohexyl)} - \overset{||}{\underset{O}{C}} = CH_2$$
(B)

$$\text{(cyclohexyl)} - CH = CH$$
$$\overset{|}{OH}$$

$$\text{(cyclohexyl)} - \overset{||}{\underset{O}{C}} = CHD_2$$
(A)

Tautomerisation

$$\text{(cyclohexyl)} - CH_2 - CH = O$$
(C)

Q.76 (A)

$$CH_3 - CH_2 - CH_2 - C \equiv CH \xrightarrow[(2)\text{H}_2\text{O}_2/\text{OH}^-]{(1)\text{BH}_3 - \text{THF}}$$

$$CH_3 - CH_2 - CH_2 - CH = \overset{|}{\underset{}{C}}H$$
$$\overset{|}{OH}$$

Tautomerisation

$$CH_3 - CH_2 - CH_2 - CH_2 - CHO$$

Q.77 (C)

$$CH_3 - C \equiv CH \xrightarrow[\text{HgSO}_4 /\text{H}^\oplus]{\text{C}_2\text{H}_5\ddot{\text{O}}\text{H}} CH_3 - \underset{\oplus}{C} = CH_2$$

$$\xrightarrow{\text{C}_2\text{H}_5\ddot{\text{O}}\text{H}} CH_3 - \overset{|}{\underset{OC_2H_5}{C}} = CH_2$$

Q.78 (A)

(I) $$CH_2 = C = CH_2 \xrightarrow{\text{H}_2\text{O}} CH_2 = \overset{|}{\underset{OH}{C}} - CH_3$$

$$\underset{\text{Tauto}}{\rightleftharpoons} CH_3 - \overset{||}{\underset{O}{C}} - CH_3$$

(II) $$CH_3 - C \equiv CH \xrightarrow[\text{HgSO}_4]{\text{H}_2\text{SO}_4} CH_3 - \overset{|}{\underset{OH}{C}} = CH_2$$

$$\underset{\text{Tauto}}{\rightleftharpoons} CH_3 - \overset{||}{\underset{O}{C}} - CH_3$$

(III) $$CH_3 - C \equiv CH \xrightarrow[\text{H}_2\text{O}_2/\text{OH}^-]{\text{BH}_3.\text{THF}} CH_3 - CH = \overset{|}{\underset{OH}{C}}H$$

$$\underset{\text{Tauto}}{\rightleftharpoons} CH_3 - CH_2 - CHO$$

Q.79 (C)

$$CH_3 - CH_2 - C \equiv CH \xrightarrow[(2)\text{CH}_3\text{COOD}]{(1)\text{BH}_3.\text{THF}}$$

$$CH_3 - CH_2 - \underset{\overset{|}{H}}{C}H = C\overset{H}{\underset{D}{\diagup}}$$

Q.80 (B)

$$\xrightarrow[\text{Anti addition}]{\text{Br}_2} (d\ell) - 2, 3 \text{ dibromo butane}$$

$$\xrightarrow[\text{Syn addition}]{\text{H}_2/\text{Pd}}$$

Q.81 (C) (dℓ) -2, 3 -dibromo butane

$$CH_3 - C \equiv C - CH_3 \xrightarrow[\text{Birch reduction}]{\text{Li/NH}_3(\ell)} CH_3 - \underset{\overset{|}{\underset{\text{Trans } H}{}}}{C} = C - CH_3$$

$$\xrightarrow[\text{Anti addition}]{\text{Br}_2}$$

Fischer projection:
$$\begin{array}{c} CH_3 \\ H - \!\!\!\!|\!\!\!\! - Br \\ H - \!\!\!\!|\!\!\!\! - Br \\ CH_3 \end{array} \text{ (Meso)}$$

Q.82 (C)

$$Ph-C\equiv C-CH_2CH_3 + Na^+ O^- -S(=O)_2- \text{—} CH_3$$

Q.83 (A)

CH_3-

$C\equiv CH \xrightarrow{Na/liq.NH_3}$

$$CH_3-C\equiv \overset{\ominus}{C} Na^+ \quad CH_3-CH_2-CH_2-CH=O$$

$$CH_3-C\equiv C-\overset{\overset{\displaystyle O^{\ominus}}{|}}{CH}-CH_2-CH_2-CH_3$$

$\downarrow NH_2-H$

$$CH_3-C\equiv C-\overset{\overset{\displaystyle OH}{|}}{CH}-CH_2-CH_2-CH_3$$

Q.84 (A)

$$CH_3-\overset{\overset{\displaystyle CH_3}{|}}{CH}-C\equiv C-CH_3 \xrightarrow[(2)H_3O^+]{(1)O_3}$$

$$CH_3-\overset{\overset{\displaystyle CH_3}{|}}{CH}-COOH + CH_3COOH$$

(Oxidative ozonolysis)

Q.85 (C)

$$CH_3-\overset{\overset{\displaystyle CH_3}{|}}{CH}-\boxed{COOH + HOOC}-CH_2-CH_3$$

$$\longrightarrow CH_3-\overset{\overset{\displaystyle CH_3}{|}}{CH}-C\equiv C-CH_2-CH_3$$

Q.86 (A)

CH₃—C≡C—CH₃ →(H₂/pd-BaSO₄) Cis-2-butene

(Syn addition) ← Cold KMnO₄ → Meso Comp.

Q.87 (B)

CH₃—C C—CH₃ →(Na/liq. NH₃) (Tran-2-butene)

↓ Cold KMnO₄(Syn)

Racemic Mixture

Q.88 (B)

CH₃—C≡C—CH₃ →(Pd/BaSO₄) Cis-2-butene

↓ Br₂/CCl₄ (Anti addition)

(Racemic Mixture)

Q.89 (D)

$$CH_3-\underset{(a)}{C\equiv C}-CH_2-\underset{(b)}{CH=CH}-CH_2-\underset{(c)}{\overset{\overset{\displaystyle O}{||}}{C}}-Cl$$

more collision probablity having triple bond than double bond. Reactivity order of catalytic hydrogenation c > a > b

Q.90 (B)

$CH_3-C\equiv C-CH_2-CH=CH_2$
Reactivity toward E.A.R b>a

Q.91 (D)

CH₃—C≡C—CH₃ →(Na/liq. NH₃, Li/leq. NH₃, Li/et OH) (Trans-2-butene)

Q.92 (D)

→(Na/liq. NH₃)

Birch reduction

CH₃—C≡C—CH₃ →(Na/liq. NH₃)

CH₃—C≡C—H →(Na/liq. NH₃) CH₃—CH=CH₂

Q.93 (B)

→(Li°,C₂H₅NH₂, −78°C)

E-3-hexene

Q.94 (B)

→(Li/Liq. NH₃)

2-butyne ↓ Tran-2-butene

Metal dissolved reduction

Q.95 (A)
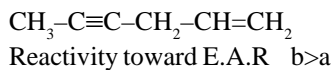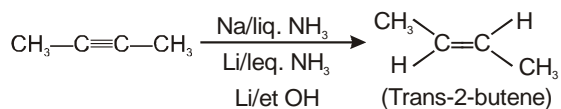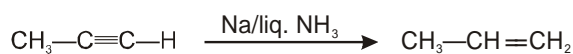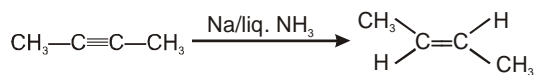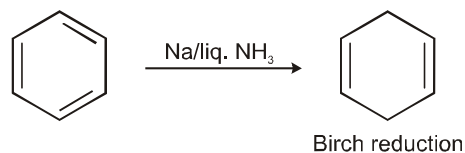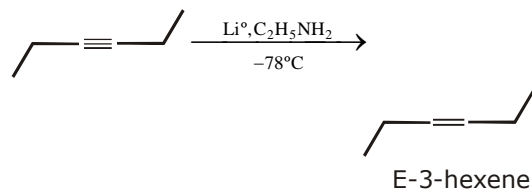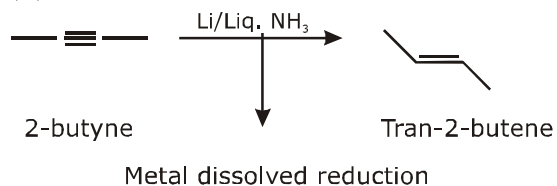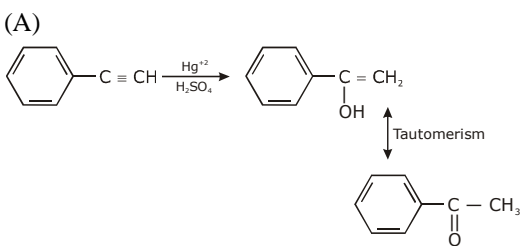
Q.96 (B)
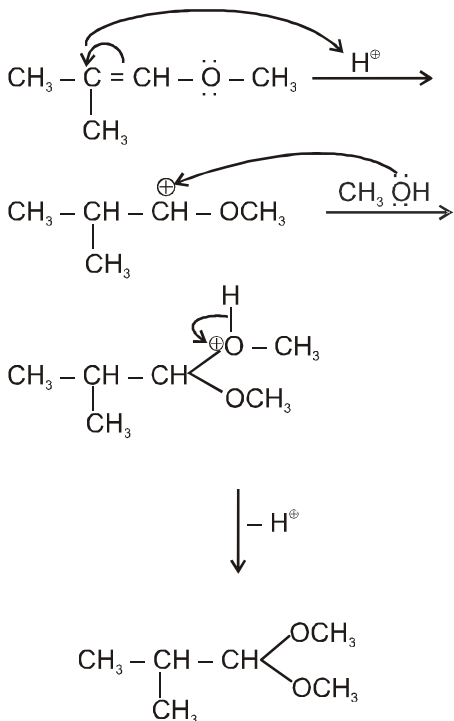
Q.97 (B)

Correct reactivity order towards photochemical chlorination depend upon reactivity of hydrogen.

reactivity of hydrogen = 3° H > 2° H > 1° H

Q.98 (B)
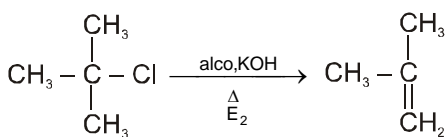
Q.99
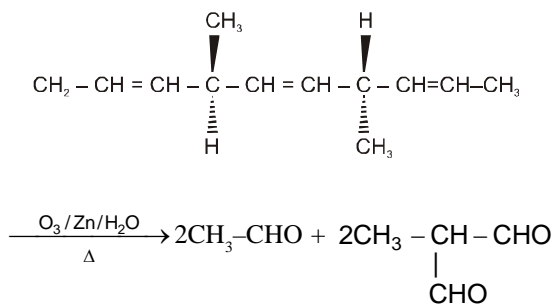
All optically inactive products

Q.100 (C)
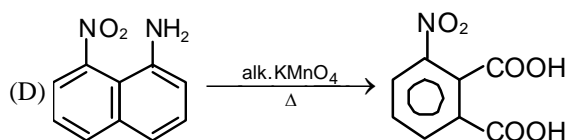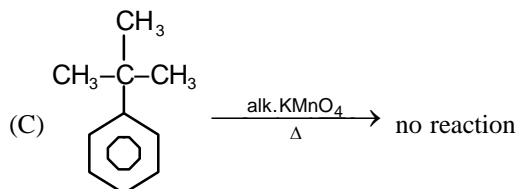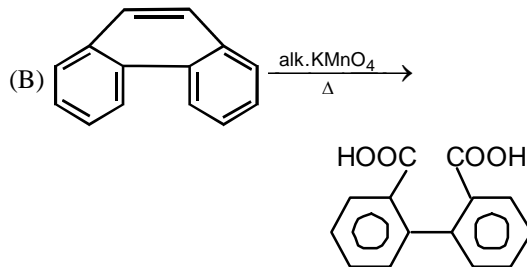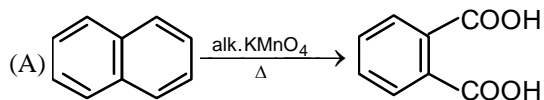
Q.101 (D)
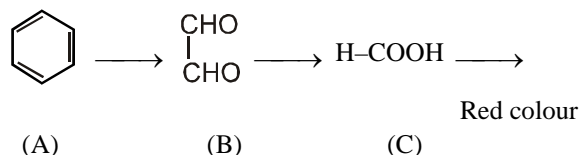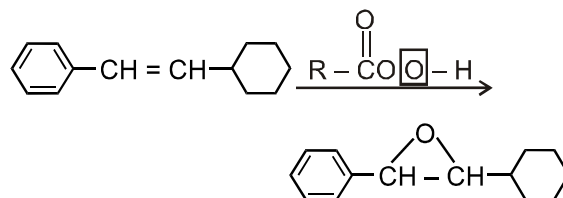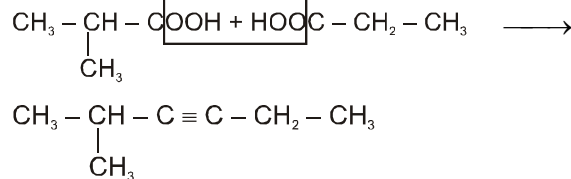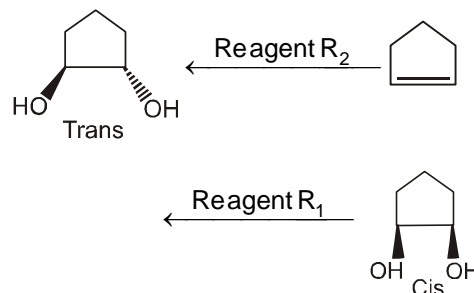
Red colour

   (A)   (B)   (C)

Q.102 (A)

Q.103 (D)

Q.104 (C)

$$CH_3 - CH - C \equiv C - CH_2 - CH_3$$
$$\qquad\quad |$$
$$\qquad\quad CH_3$$

Q.105 (B)

30

Syn addition with Baeyer's Reagent, So cis will form meso compound however peroxy acid in anti addition gives enantiomer.

Q.106 (D)

Syn addition of H_2 on double bond and racemic mixture obtained

Q.107 (A)

It is birch reduction

Q.108 (B)

Q.109 (B)

It is birch reduction.

Q.110 (B)

Reduction with Wilkinson's catalyst is homogeneous

Q.111 (D)
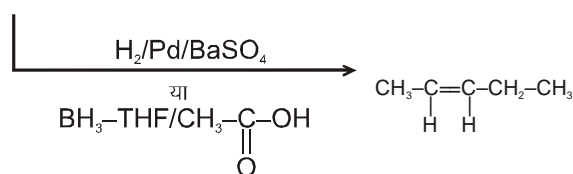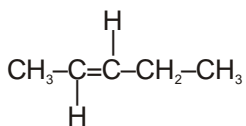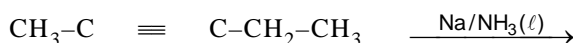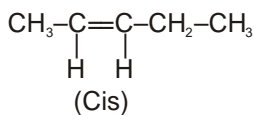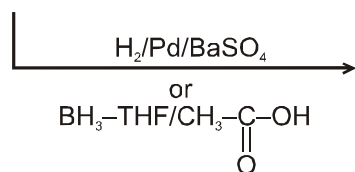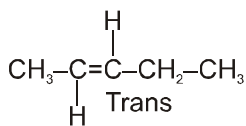
JEE-ADVANCED

MCQ/COMPREHENSION/COLUMN MATCHING

Q.1 (CD)

(A)

(B)

(C)

(D)

Q.2 (AB)

Q.3 (ACD)

Q.4 (ABC)

(i)

(ii)

(iii)

31

(iv)

$$CH_2-CH_2-COOH \atop CH_2-CH_2-COOH \xrightarrow{NaOH} {CH_2-CH_2-COONa \atop CH_2-CH_2-COONa} \xrightarrow{electrolysis} \square$$
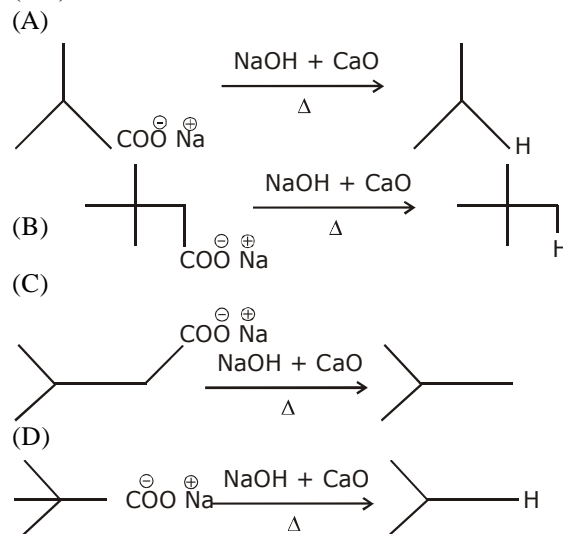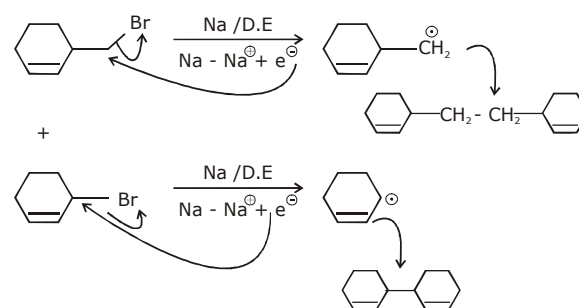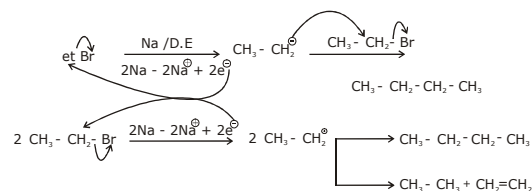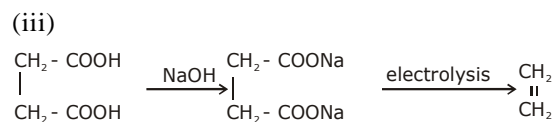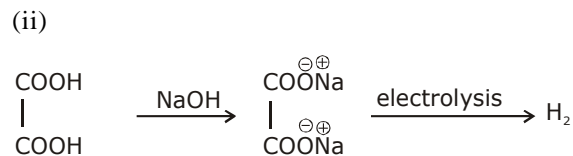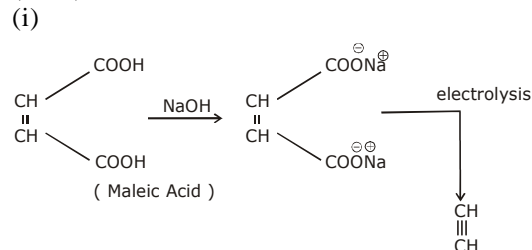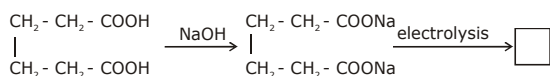
Q.5 (ABCD)
(A) and (B) product of dehydrohalogenation.
(C) Product of dehalogenation.
(D) Kolbe's Electrolysis process.

Q.6 (ABC)
X is Birch Reducing agent and Y is lindlar's cotalyst.

Q.7 (ACD)
A, C, D gives alkenes by cyclic T.S. on heating.

Q.8 (ABC)
A, B, C will undergo free radical subsitution reaction however D will perform free radical addition reaction.

Q.9 (ABCD)

(A)

$$\text{cyclopentyl}-CH=CH_2 \xrightarrow{H^\oplus}$$

$$\text{cyclopentyl}-\overset{\oplus}{C}H-CH_2 \xrightarrow{\text{Ring expansion}} \text{(cyclohexyl cation)}$$

$$\xrightarrow{1,2H\ shift} \text{(cyclohexyl cation)}$$

$$\text{cyclohexyl}-OH$$

$$\xleftarrow{H_2\ddot{O}:}$$
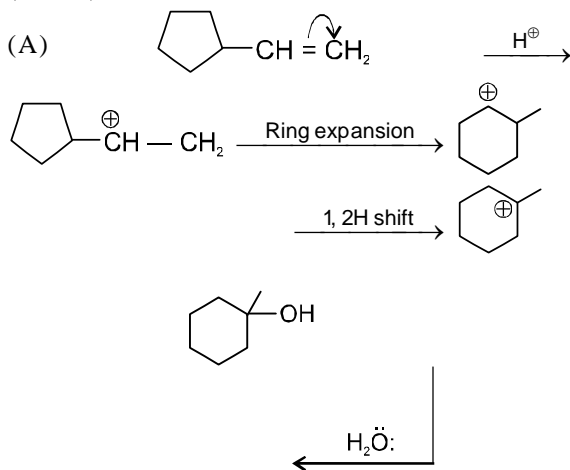
(B), (C) and (D) also depends on stability of carbocation.

Q.10 (AC)

$$H_3C \equiv CH \xrightarrow[HgSO_4]{H_2SO_4} CH_3-\overset{OH}{\underset{}{C}}=CH_2$$

$$\xrightarrow{Tautomerise} CH_3-\overset{O}{\overset{\|}{C}}=CH_3$$

$$(CH_3)C=C(CH_3)_2 \xrightarrow[\Delta]{KMnO_4} 2(CH_3)_2C=O$$
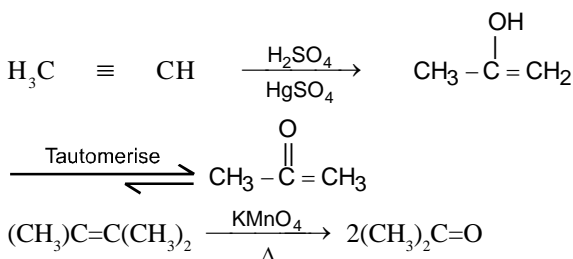
Q.11 (ABC)
(A) when H+ add to the Buta-1, 3-diene in the r.d.s., an allylic carbocation is formed, however from But-1-ene, an 2° carbocation will form which will be less stable.
(B) At room temperature, product will be TCP.

(C) $CH_2=CH-C\equiv CH \longleftrightarrow$

$$\overset{\oplus}{C}H_2-CH=C=\overset{\ominus}{C}H \xrightarrow{H^\oplus}$$

$$\overset{\oplus}{C}H_2-CH=C=CH_2$$
(carbocation as more stable)
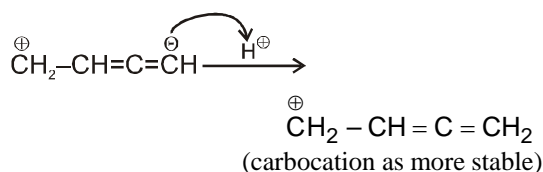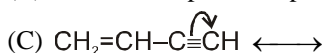
Q.12 (ABC)
See mechanism of ozonolysis of alkene and alkyne.

Q.13 (AB)
$$CH_3-CH_2-HC\dot{\div}CH-CH_2-CH_2-CH_2-CH_3$$

$$\xrightarrow{[O]} CH_3-CH_2COOH + CH_3(CH_2)_3-COOH$$
cis / trans
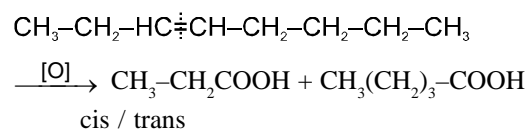
Q.14 (BC)
(B) Base is bulky so Hoffmann's alkens.
(C) Product of Hoffmann's reaction.

Q.15 (ABCD)
(A)

$$Ph-\underset{CH_3}{\overset{CH_3}{\underset{|}{C}}}-CH=CH_2 \xrightarrow{H_2O} Ph-\underset{CH_3}{\overset{CH_3}{\underset{|}{C}}}-\overset{\oplus}{C}H-CH_3$$

$$\xrightarrow{Migration\ of\ CH_3} Ph-\underset{CH_3\ CH_3}{\overset{\oplus}{C}}-CH-CH_3$$

$$\downarrow$$

$$Ph-\underset{CH_3\ CH_3}{\overset{OH}{\underset{|}{C}}}-CH-CH_3$$

(B) $$Ph-CH-\underset{CH_3}{\overset{CH_3}{\underset{|}{C}}}=CH_2 \longrightarrow$$

$$Ph-\underset{}{\overset{CH_3}{\underset{|}{C}}}H-\overset{\oplus}{C}-CH_3 \xrightarrow{H^-\ shift} \atop CH_3$$

$$Ph-\underset{\oplus\ CH_3}{\overset{CH_3}{\underset{|}{C}}}-CH-CH_3 \rightarrow Ph-\underset{OH\ CH_3}{\overset{CH_3}{\underset{|}{C}}}-CH-CH_3$$

(C) $$\underset{Ph}{\overset{CH_3}{\diagdown}}C=C\underset{CH_3}{\overset{CH_3}{\diagup}} \xrightarrow{H_2O/H^+}$$

$$\underset{Ph}{\overset{CH_3}{\diagdown}}\overset{\oplus}{C}-CH\underset{CH_3}{\overset{CH_3}{\diagup}} \xrightarrow{\overset{-}{O}H}$$

$$Ph-\underset{CH_3\ CH_3}{\overset{OH}{\underset{|}{C}}}-CH-CH_3$$

$$Ph-C(CH_3)(CH(CH_3)_2)=CH_2 \xrightarrow{H_2O/H^+}$$

(D)

$$Ph-\overset{\oplus}{C}(CH_3)(CH(CH_3)_2)-CH_3 \xrightarrow{\overset{-}{OH}} Ph-C(CH_3)(CH(CH_3)_2)-C(CH_3)(OH)$$
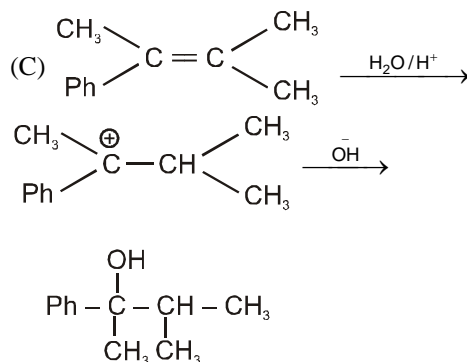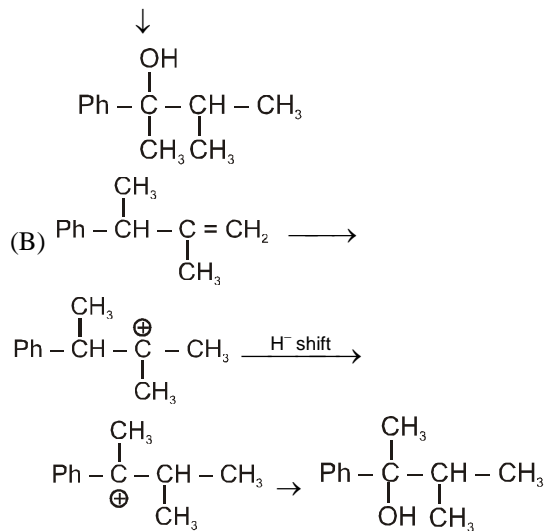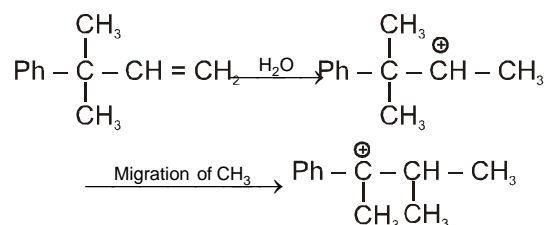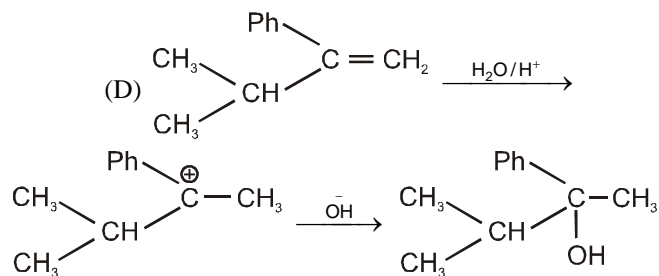
Q.16 (ABD)

The more stable carbocation of alkene gives the major product in electrophilic addition reactions.

Q.17 (BCD)

Q.18 (ABC)

See mechanism of ozonolysis of alkene and alkyne.

Q.19 (ABC)

Q.20 (BC)

Bromination is anti and H_2O adds giving by enols which tautomerised to give product.

Q.21 (ABC)

Conceptual

Q.22 (AC)

Conceptual

Q.23

$$H-C \equiv C-H + H_2O \xrightarrow{H_2SO_4, HgSO_4}$$

$$CH_2 = \overset{OH}{\underset{|}{CH}} \underset{\longleftarrow}{\overset{Tautomerise}{\longrightarrow}} CH_3CH=O \xrightarrow{[O]} CH_3-COOH$$
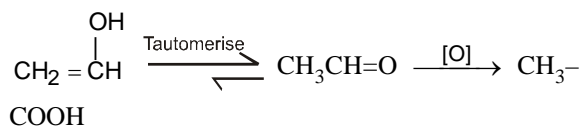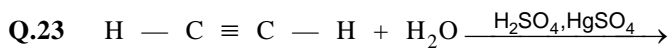
Q.24 (C)

Addition of H_2O by Markownikov's Rule and by anti-Markownikov's Rule. (Hydroboration oxidation).

Q.25 (C)

Addition of H_2O by Markownikov's Rule (By oxymercuration demercuration).

Q.26 (D)

$$\text{(cyclopentene)} \xrightarrow[Zn + H_2O]{O_3} OHC-(CH_2)_3-CHO$$

Q.27 (A)

$$(CH_3)_2C \equiv C(CH_3)_2 \xrightarrow[Zn + H_2O]{O_3} 2(CH_3)_2C=O$$

Q.28 (A)

$$CH_3-CH \equiv CH-\underset{\underset{CH_3}{|}}{CH}-CH_3 \xrightarrow[Zn + H_2O]{O_3}$$

$$CH_3CHO + CH_3-\underset{\underset{CH_3}{|}}{CH}-CHO$$
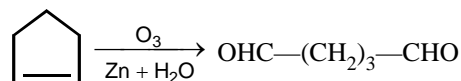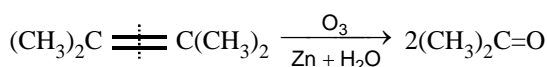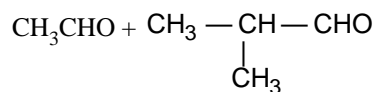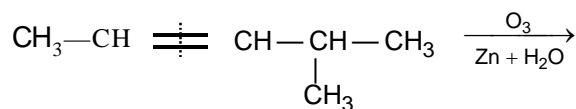
Q.29 (B)

Solution by reverse synthesis: W must be terminal alkyne, since it gives white Precipitate with Tollen's Reagent

$$CH_3-CH_2-C \equiv CH \xleftarrow{NaNH_2}$$
$$\text{(W)}$$

$$CH_3-CH_2-\underset{\underset{Br}{|}}{CH}-\underset{\underset{Br}{|}}{CH_2} \xrightarrow{Br_2}$$
$$\text{(Z)}$$

$$CH_3-CH_2-CH=CH_2$$
$$\text{(Y)}$$

$$\uparrow alco.KOH$$

$$CH_3-CH_2-CH_2-CH_2-Br$$
$$\text{(C}_4\text{H}_9\text{Br)}$$
$$\text{(X)}$$

Q.30 (B)

$$CH_3-CH_2-CH=CH_2 \xrightarrow[Ozonolysis]{Reductive}$$

$$CH_3CH_2-CHO + CH_2O$$

Q.31 (C)

$$CH_3-CH_2-C \equiv CH \xrightarrow{Lindlar's Catalyst}$$
$$\text{(W)}$$
$$CH_3-CH_2-HC=CH_2$$
$$\text{(Y)}$$
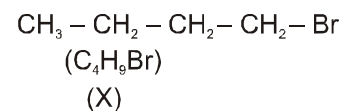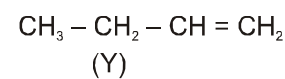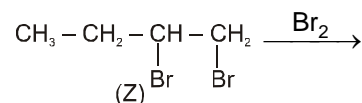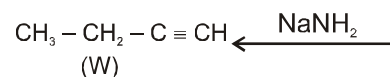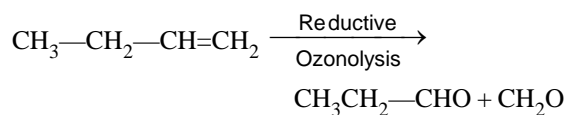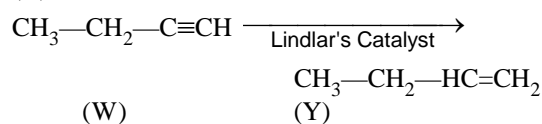
Q.32 (B)

Q.33 (B)

(39 - 40)

$$\text{(X)} \xrightarrow{(O)} \text{m- chlorobenzoic acid}$$

$\therefore$ X must be (m-chlorostyrene, $CH=CH_2$ with Cl)

(reaction scheme showing conversions to (Y), (Z), (W))

33
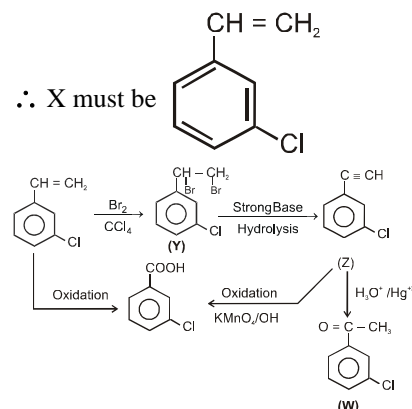
Q.34 (D)

Q.35 (B)
(34 & 35)

Q.36 (A) - (s) ; (B) - q ; (C) - s ; (D) - s ; (E) - s ; (F) - q ; (g) - p

(A) $CaC_2 + H_2O \longrightarrow Ca(OH)_2 + CH \equiv CH$

(B) $Mg_2C_3 + H_2O \longrightarrow Mg(OH)_2 + CH_3 - C \equiv CH$

(C)

(D)

(E) $2HCI_3 + 6Ag \longrightarrow$

(F)

Br_2

(G)
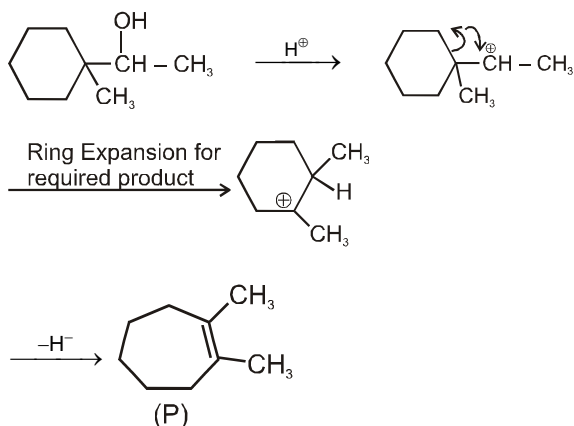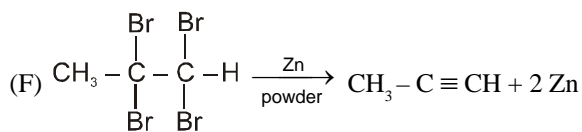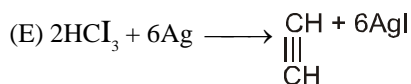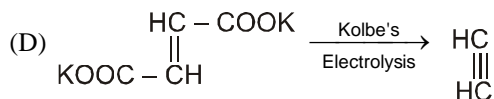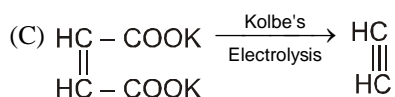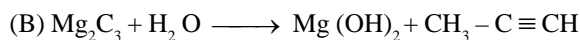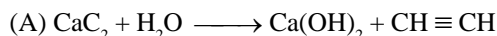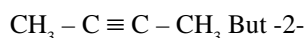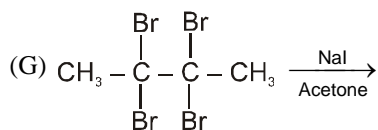
$CH_3 - C \equiv C - CH_3$ But -2-yne

Q.37 (X) - (ii) ; (Y) - (i), (iv), (v) ; (Z) - (iii)
$C_5H_{12}O$; DU. = O May be either alcohol or ether .
Since oxidation will give ketone, hence $C_5H_{12}O$ must be 2° alcohol
Y must be 1° alcohol since it oxidised & gives aldehyde & then acid
Z must be 3° alcohol; since it does not oxidised

$$X = \begin{array}{c} CH_3 \\ | \\ CH_3 - CH - CH - CH_3 \\ | \\ OH \end{array} \qquad \text{2° alcohol}$$
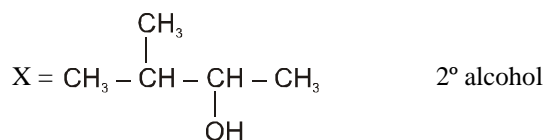
Y = must be 1° alcohol; Z = must be 3° alcohol

Q.38 (A) - (r) ; (B) - (q, r) ; (C) - (p, r) ; (D) - (r, s)
Regioselectivity : → Out of two positional isomers, one isomer is preferred.
Stereoselectivity : → When one stereoisomer of the reactant has selected one stereoisomer of the products
Chemoselectivity : → The reagent selects only one functional group /multiple bond/ substituents
Rearrangement : → For increasing the stability carbocation undergo for rearrangement.

Q.39 A

(A)

(B)

(C) $CH_3 - C \equiv C - CH_3 \xrightarrow{NaNH_2 / \Delta} CH_3 - CH_2 - C \equiv CH$ (1-butyne)

(D) $CH_3 - CH_2 - C \equiv CH \xrightarrow{alc\ KOH / \Delta} CH_3 - C \equiv C - CH_3$ (2-butyne)
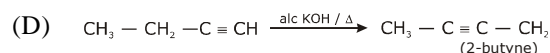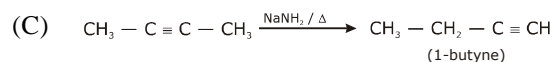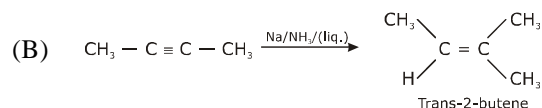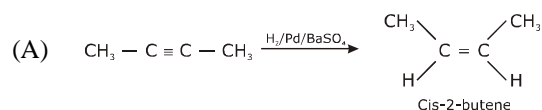
NUMERICAL VALUE BASED
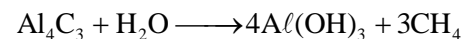
Q.1 [3]
$$Al_4C_3 + H_2O \longrightarrow 4Al(OH)_3 + 3CH_4$$
So, moles of CH_4 formed = 3 mole

Q.2 [5]
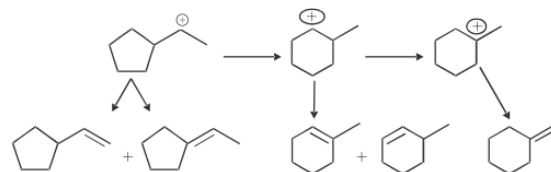
Q.3 [2]
Q.4 [2]

Q.5 [2]
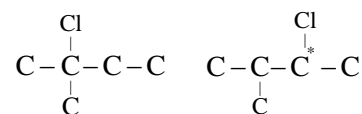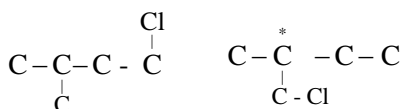
Only two products contain chiral carbon atom. Hence no. of possible enantiomeric pairs are 2.

Q.6 [3]

This indicates that loss of proton is not occurring is rate determining step so mechanism may either be E1 or E_1C_B.

Q.7 [4]

(i) (A) gives monobromoalkane (B) $\longrightarrow$ (A) is alkene

(ii)
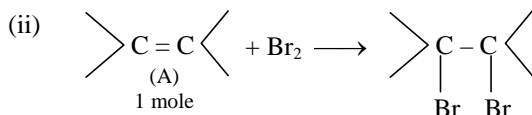
Since 2 gm Br_2 reacts completely with = 0.70 g of (A)

$\therefore$ 160 gm Br_2 reacts completely with = $\dfrac{0.70 \times 160}{2}$

= 56 gm of (A)

$\therefore$ Molecular weight = 56

$C_nH_{2n} = 56$

(since compound is alkene)

12n + 2n = 56

n = 4

Q.8 [1]

No. of meso Isomers – 1

No. of d and l Isomers – 0

Hence number of optical isomers = 1

Q.9 [4]

C_xH_y (organic compound, A) $\xrightarrow[\text{(monobromination)}]{Br_2, h\nu}$ Product (Enantiomeric)

$A \xrightarrow{Br_2, CCl_4}$ no reaction.

$A \xrightarrow{Br_2, Fe}$ mono Bromo derivative product
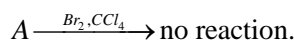
Q.10 [3]

Only except cyclopentane alkane are not hydrogenated.

KVPY

PREVIOUS YEAR'S

Q.1 (B)

Q.2 (A,B)

Q.3 (B)

Q.4 (A)

$CH_2 = CHBr \xrightarrow[-HBr]{NaNH_2} CH \equiv CH$

Q.5 (B)

$PhC \equiv CH \xrightarrow{NaNH_2/NH_3} PhC \equiv C^- \xrightarrow{CH_3I}$

$PhC \equiv C-CH_3 \xrightarrow{H_2, Pb/C} PhCH = CH-CH_3$

Q.6 (B)

Q.7 (C)

Q.8 (A)

Q.9 (D)

$CH_3 - CH = CH - CH_3$

$\downarrow$ Alkaline $KMnO_4$ (Baeyer's reagent)

Syn Addition

$CH_3 - CH - CH - CH_3$

OH   OH   Syndiol

Q.10 (A)

$CaO + C \xrightarrow{\Delta} CaC_2$ (Calcium carbide)

$\downarrow$ H_2O

Hydrolysis

$Ca(OH)_2 + CH \equiv CH$ (Acetylene)

$\downarrow$ Red hot iron

(Trimerisation)

 Benzene

35

Q.11 (A)

$$\text{(alkene)} \xrightarrow{H^{\oplus}} \text{(cation)} \xrightarrow{H_2O}$$

$$\text{(} \overset{\oplus}{O}H_2 \text{)} \xrightarrow{-H^{\oplus}} \text{(} OH \text{)}$$

Q.12 (D)

$$CH_3 - CH = CH - CH_3 \xrightarrow[\text{Oxidi sing agent}]{KMnO_4} CH_3COOH$$

Q.13 (A)

$$\xrightarrow{H^+/H_2O} \quad \overset{OH}{\text{(product)}}$$

$$\uparrow -H^{\oplus}$$

RDS $\Big|\overset{H^{\oplus}}{}$

$$\longrightarrow \text{(} \overset{\oplus}{} \text{)} \xrightarrow{H_2O} \text{(} \overset{\oplus}{O}H_2 \text{)}$$
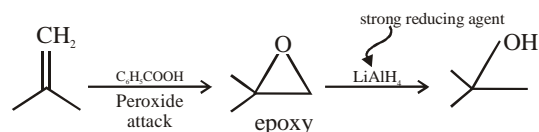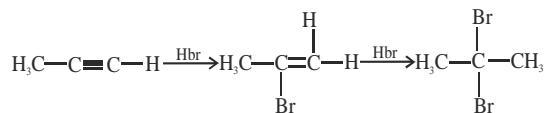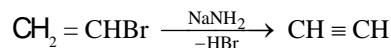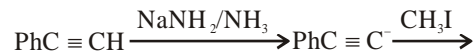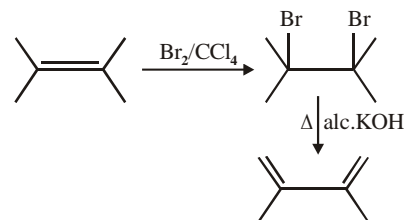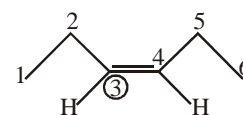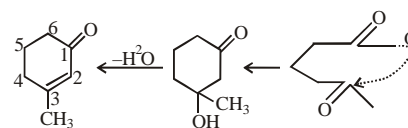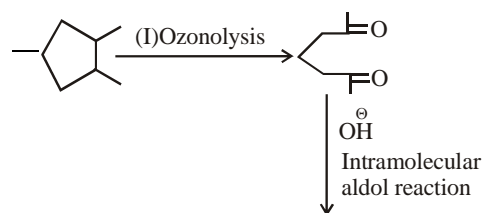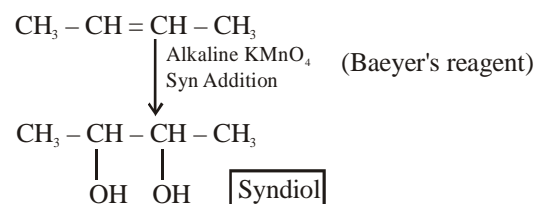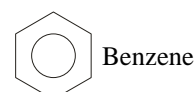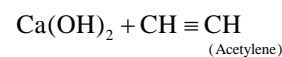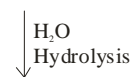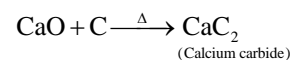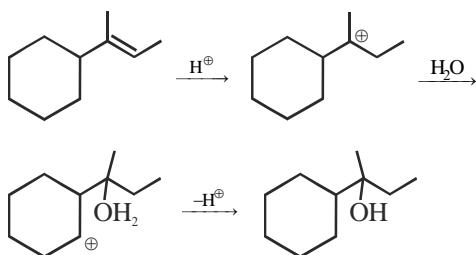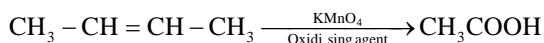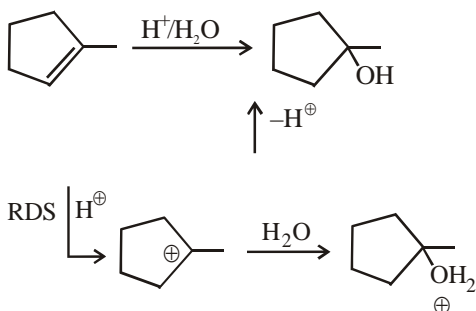
Q.14 (B)

This is example of Reductive Ozonolysis

$$CH_3 - CH = CH - CH_3$$
$$\Big\downarrow O_3$$

$$CH_3 - CH \overset{O}{\underset{O-O}{\diagdown\diagup}} CH - CH_3 \xrightarrow{Zn|H_2O} 2CH_3 - \underset{O}{\overset{\|}{C}} - H$$

Q.15 (D)

$$CH \equiv CH \xrightarrow{\text{Alkaline KMNO}_4} \underset{H-O \quad\quad O-H}{\overset{H-O \quad\quad O-H}{HC - CH}}$$

$$\underset{H-C=O}{HO-C=O} \xleftarrow{(O)} \underset{H-C=O}{HO-C=O}$$
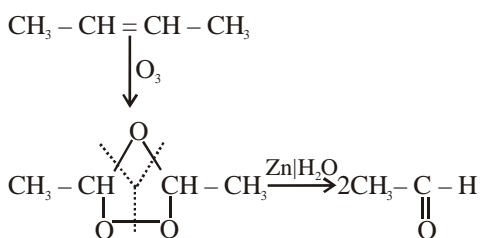
Oxalic acid
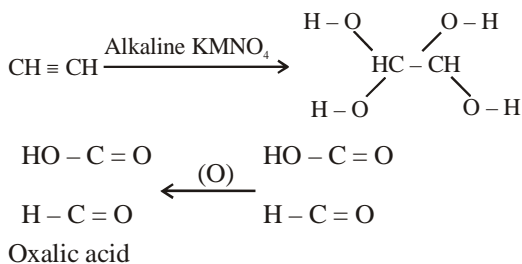
Q.16 (B)

This is example of Dehydrohalogenation

$$CH_3 - \underset{Br}{\overset{Br}{CH}} - \underset{Br}{\overset{Br}{CH}} - CH_3 \xrightarrow[\text{KOH–HBr}]{\text{Alcoholic}} CH_3 - CH = C - CH_3$$

$$-HBr \Big\downarrow NaNH_2$$

$$CH_3 - C \equiv C - CH_3$$

$$CH_3 - \underset{Br}{\overset{Br}{CH}} - \underset{Br}{\overset{Br}{CH}} - CH_3 \, Br \longrightarrow CH_3 - CH = C - CH_3$$

Q.17 (C)

$$CH_2 - CH - CH_3 \xrightarrow[-\text{AlCl}_3\text{Br}]{\text{AlCl}_3} \overset{\oplus}{CH_2} - CH - CH_3$$
$$\underset{Br \quad\ CH_3}{} \qquad\qquad \underset{CH_3}{}$$

$$\Big\downarrow \text{hydride shift}$$

Toluene $+ \overset{\oplus}{CH_2} - \underset{CH_3}{\overset{|}{C}} - CH_3 \qquad CH_3 - \overset{\oplus}{\underset{CH_3}{\overset{|}{C}}} - CH_3$

[Act As a $E^{\oplus}$]

[subs.] $\diagdown\diagup$ $[E^{\oplus}]$

$$H_3C - \text{(} \text{)} - \underset{CH_3}{\overset{CH_3}{\overset{|}{\underset{|}{C}}}} - CH_3$$

[Rxn is fridel crafts alkylatn]

Q.18 (B)

$$\xrightarrow[H_2O_2/NaOH]{B_2H_6} \overset{OH}{X} \xrightarrow{CrO_3/H_2SO_4}$$

$$\overset{COOH}{Y}$$

Q.19 (C)

$$H_3C - C \equiv C - H \xrightarrow[\substack{2.\ x \\ 3.\ y}]{1.\ \text{NaNH}_2,\ \Delta} \underset{CH_3}{\overset{CH}{\diagup}} \underset{CH}{\overset{CH_3}{\diagup}}$$

(Trans alkene)

Q.20 (C)

$$\xrightarrow{H_2/Ni} \quad \text{(optically active)}$$

$$\xrightarrow{H_2/Ni} \quad \text{(optically active)}$$

Q.21 (A)

$$\xrightarrow{HBr} \quad + \quad$$

mixture of Diastereomers

Q.22 (C)

Q.23 **(C)**

Given

$$\text{Moles} = \frac{420 \times 10^{-3}}{210}$$

Let Moles of R produced $= \dfrac{0.4 \times 420 \times 10^{-3}}{210}$

Wt. of R produced $= \dfrac{0.4 \times 420 \times 10^{-3}}{210} \times 106g = 84.8$ mg

Mole of Q produced $= \dfrac{0.4 \times 420 \times 10^{-3}}{210}$

Wt. of Q produced $= \dfrac{0.4 \times 420 \times 10^{-3}}{210} \times 136g = 108.8$ mg
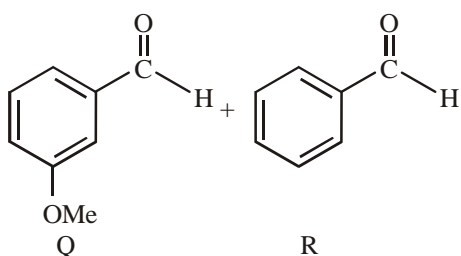
JEE-MAINS
PREVIOUS YEAR'S

Q.1 (2)
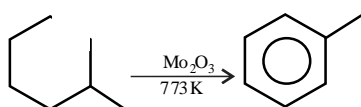
It is catalytic reforming (Aromatisation) of alkanes. n-heptane gives toluene in this process.

Q.2 (3)
Q.3 (1)
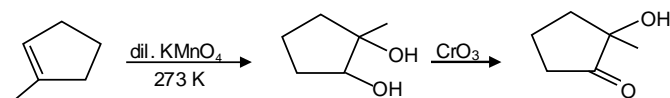
Q.4 [7]
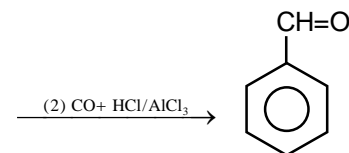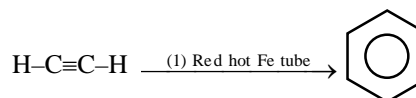
Q.5 (2)

Q.6 (2) (a) Alcoholic potassium hydroxide → used for β-elimination
(b) Pd/ $BaSO_4$ → Lindlar's catalyst
(c) BHC (Benzene hexachloride) → Obtained by addition reactions
(d) Polyacetylene → Electrodes in batteries

Q.7 (1)
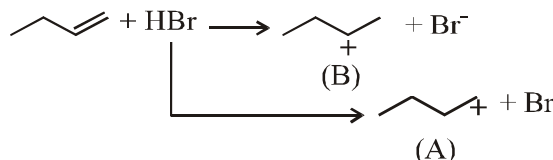
This is more stable due to secondary cation formation and formed with faster rate due to low activation energy.

Q.8 (3) Alkane are very less reactive, tertiary hydrogen can oxidise to alcohal with $KMnO_4$.

2-methyl-butane
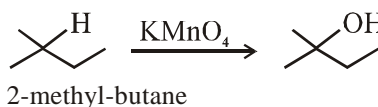
Q.9 (4) Partially deactivated palladised charcoal (H_2/pd/$CaCO_3$) is lindlar catalyst.

Q.10 (4)
Q.11 (4)

Q.12 (1)

Q.13 (4)

Q.14 (4)

Q.15 (1)

Q.16 (4)

Q.17 (3)

Q.18 (3)

Q.19 (4)

Q.20 (2)

Q.21 (2)

JEE ADVANCED
PREVIOUS YEAR'S

Q.7 1.62

$$Mg_2C_3 + 4H_2O \rightarrow 2Mg(OH)_2 + CH_3C \equiv CH$$

$$CH_3C \equiv CH \xrightarrow{NaMe_2} CH_3 - C \equiv C^-Na^+$$

$$\downarrow MeI$$

$$CH_3 - C \equiv C - CH_3 \text{(0.075 mmol)}$$
$$(Q)$$

$$3CH_3 - C \equiv C - CH_3 \xrightarrow[\substack{\text{iron tube} \\ 873 \text{ K}}]{\text{red hot}}$$
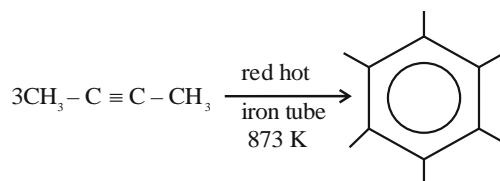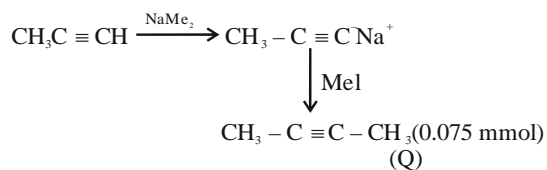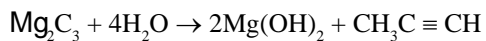
(0.075 × 0.4) ×
= 0.01 mole
The value of x = 162 × 0.01 = 1.62 gm

Q.8 3.2

$$(P)_{(0.1) \text{ mole}} \xrightarrow[\substack{333K,100\% \\ \text{Kucherov} \\ \text{reaction}}]{Hg^{2+}/H^+} CH_3 - \overset{O}{\overset{\|}{C}} - CH_3 \text{ (0.01) mole}$$

$$\downarrow Ba(OH)_2/\Delta$$

$$\overset{H_3C}{\underset{H_3C}{}}C = CH - C - CH_3 \left(0.1 \times \frac{82}{100} \times \frac{1}{2}\right)$$

$$\downarrow$$

$$\overset{H_3C}{\underset{H_3C}{}}C = CH - \overset{O}{\underset{\|}{C}} - OH + CHCl_3$$
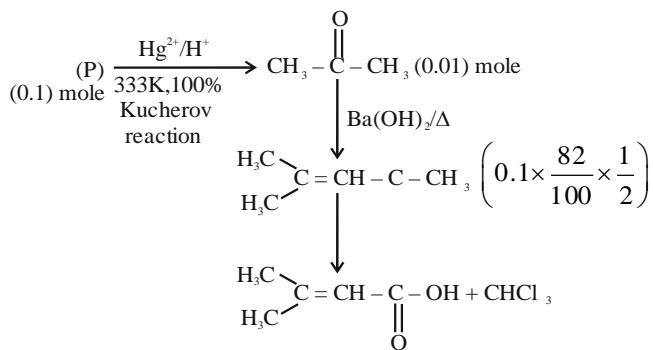
$$\left(0.04 \times \frac{80}{100}\right) = 0.032 \text{mole}$$

60 + 32 + 8 = 100
The value of Y = 0.032 × 100 = 3.2

Q.9 (B)

$$\equiv\!\!\diagdown\!\!\diagup\!\!\diagdown\!\!\diagup\!\!\diagdown\!\!\diagup \xrightarrow[\text{Nalip.NH}_3]{\text{NaNH}_2} \equiv\!\!\diagdown\!\!\diagup\!\!\diagdown\!\!\diagup\!\!\diagdown\!\!\diagup$$
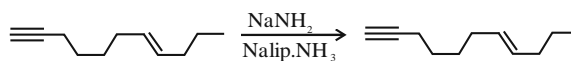
Q.10 (D)

Practical Organic Chemistry

<div align="center">

EXERCISES

</div>

ELEMENTARY

Q.1 (2)

Q.2 (1)

Q.3 (3)

Q.4 (1)

Q.5 (4)

Q.6 (4)

JEE-MAIN
OBJECTIVE QUESTIONS

Q.1 (4)

boiling point depends on H-bonding more than on dipole moment so order is w > z > x > y.

Q.2 (3)

Greater the mol. wt., greater will be boiling point hence I > II > III > IV.

Q.3 (2)

boiling point $\propto$ molecular weight

189º > (156º) > (132º) > (85º)
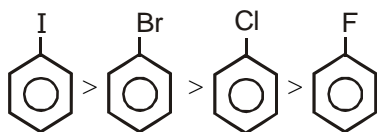
Q.4 (4)

boiling point $\propto$ molecular weight.

Q.5 (3)

Melting point depends on molecular wt. Greater the mol. wt. greater will be melting point.

Q.6 (3)

Melting point depends on symmetry so p-dibromobenzene has highest melting point.

Q.7 (2)

Melting point depends on H-bonding.

Q.8 (3)

Parahydroxyphenol is more symmetrical with presence of intermolecular H-bond.

Q.9 (4)

Phenyl group decreases the extent of H-bonding so solubility decreases.

Q.10 (3)

Solubility depends on Hydrogen bonding and dipole moment. Greater the H-bonding and dipole moment, greater the solubility of molecule in water.

Q.11 (1)

Solubility depend on extent of H-bonding. Lower the molecular wt. of alcohol greater the H-bonding and greater is the solubility.

Q.12 (3)

Alcohol have H-bonding.

Q.13 (2)

aniline is base so form salt with HCl .

Q.14 (3)

carboxylic acid form salt with $NaHCO_3$.

Q.15 (1)

Lower alcohol are soluble in water.

Q.16 (1)

anisol does not form salt with NaOH.

Q.17 (1)

benzene is non-polar so cannot form salt with any of these reagents.

Q.18 (4)

Terminal alkyne form white ppt. with Tollen's reagent.

Q.19 (2)

3º alcohol gives instant turbidity with lucas reagent.

Q.20 (1)

3º alcohol gives instant turbidity with lucas reagent.

Q.21 (3)

aldehydes gives black or silver ppt. with tollen's reagent.

Q.22 (3)

$\left(CH_3-\overset{\displaystyle O}{\underset{\displaystyle \|}{C}} \right)$ group gives positive iodoform test.

Q.23 (1)

amide gives smell of NH_3 with conc. NaOH.

Q.24 (1)

Secondary amine does not give +ve test with $CHCl_3$/ KOH.

Q.25 (1)

Glycosidic linkage is an acetal linkage as it connects two (hemiacetal) monosaccharide units.

Q.26 (3)

Sucrose $\longrightarrow$ Gulose +

Fructose

+ 65° + 52.5°

− 90°

the product mixture is overall laevorotatary

Q.27 (2)

Hydrolysis of sucrose (dextrorotatory) into (+) glucose and (−) fructose gives overall levorotatory mixture of products, hence the process is known as "inversion of sugar".

Q.28 (3)

α and β methyl glucosides are formed because glucose contains a ring structure and the reaction with CH_3OH passes through a carbanion.

Q.29 (2)

Aqueous solution of starch give blue colour with iodine solution.

Q.30 (4)

I, II & IV have 2 DU.

Q.31 (3)

D is relative configuration, assigned to D − glyceraldehyde.

Q.32 (3)

Cellulose on hydrolysis yields β − D − glucose, because β − D − glucose units are polymerised in cellulose.

Q.33 (2)

Inverted sugar is 1 : 1 mixture of glucose and fructose.

Q.34 (2)

α − D glucose and β − D − glucose differ in configuration at C − 1.

Q.35 (4)

In fructose total no. of chiral centres = 3. Hence total no. of stereo isomers = 2^3 = 8

Q.36 (3)

Aldose sugars are always present in the form of hemiacetal.

Q.37 (2)

Given carbohydrate contains six carbons and a aldehydic group, thus is an aldohexose.
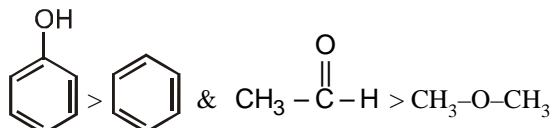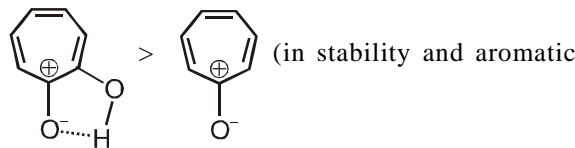
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OBJECTIVE QUESTIONS

Q.1 (C)

The lowest boiling point is due to intramolecular hydrogen bonding in 'C'.

All other have intermolecular H-bonding.
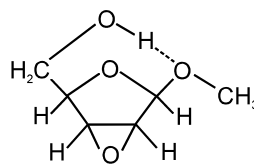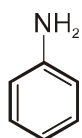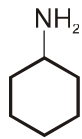
Q.2 (D)

Boiling points depends on molecular weight.

Q.3 (A)

Boiling point ∝ molecular weight.

Q.4 (B)

Boiling point ∝ molecular weight.

Q.5 (C)

Boiling point ∝ molecular weight.

Q.6 (A)

Melting point depends H-bonding which is dependent on surface area. Lower the surface area, more extent of the H-bonding.

Q.7 (D)

is more symmetrical.
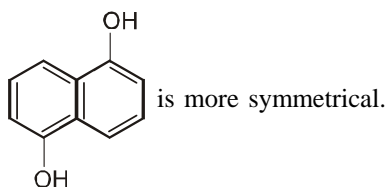
Q.8 (A)

Melting point depends on symmetry of molecule.

Q.9 (B)

Melting point depends on symmetry of molecule.

Q.10 (D)

D has highest molecular weight so have maximum melting point.

Q.11 (C)

& $CH_3 - \overset{\displaystyle O}{\overset{\|}{C}} - H > CH_3 - O - CH_3$

Q.12 (B)

 (in stability and aromatic character).

Q.13 (B)

I and II have aromatic character, III has more polarity due to resonance.

Q.14 (A)

Malonic acid is having smaller alkyl part so more soluble in water.

Q.15 (D)

Pentan-1-ol has larger alkyl group which decreases H-bonding so least soluble in water.

Q.16 (A)

Acids dissolves in $NaHCO_3$ but phenols are insoluble.
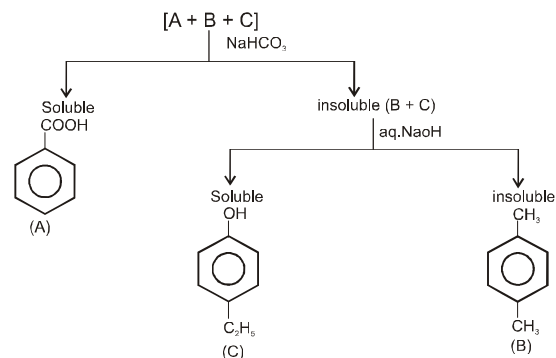
Q.17 (C)

 on reaction with $NaNO_2$ / HCl then β-napthol

form red dye but do not.

Q.18 (C)

II is soluble in $NaHCO_3$, I is soluble in NaOH and III is soluble in HCl.

Q.19 (B)

Hydrazine ($H_2N–NH_2$) do not have carbon so no CN^- formation occur with Na extract.

Q.20 (A)

Fractional distillation is used to separate compounds which differ in boiling point.

Q.21 (B)

For $C_xH_yO_zX_aN_b$, $Du = \dfrac{2x+2-y-a+b}{2}$

∴ for $C_{20}H_{24}N_2O_2$ $Du = 10 = 6db + 4$ ring.

Q.22 (B)

Compound have acidic H.

Q.23 (A)

Q.24 (D)

Q.25 (B)

$C_4H_{10}O$

(i) Na metal → No H_2 gas evolved ⇒ absence of acidic H

(ii) $Cl_2/h\nu$ → 3-monochloro products ⇒ absence of alcohol

(iii) Lucas reagent → –Ve test

Q.26 (C)

Ph – C = C – Ph
    | |
   CH₃ CH₃ $\xrightarrow{\text{ozonolysis}}$

Ph – C = O $\xrightarrow{\text{iodoform test}}$ Ph –COO⁻
    |
   CH₃
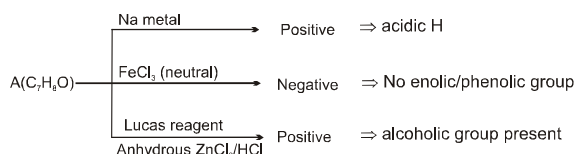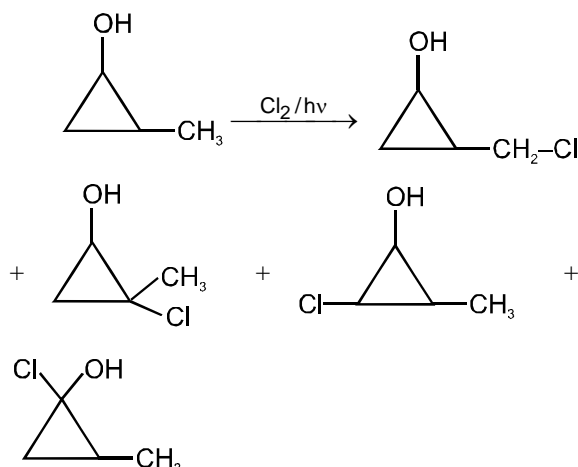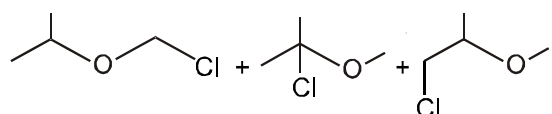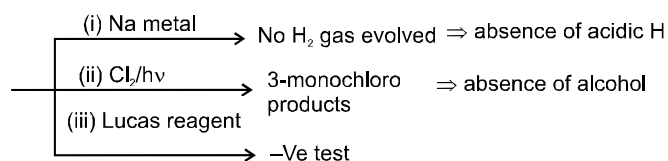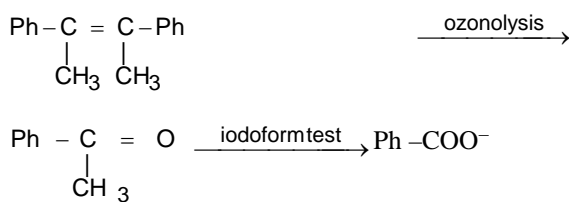
Q.27 (D)

It contains no C =C bond, C=O bond & acidic H.

Q.28 (A)

(i) Na metal → ⇒ acidic H

(ii) $NaHCO_3$ → ⇒ carboxylic acid group

(iii) 2,4-DNP → ⇒ aldehyde or ketone group

(iv) Lucas reagent → ⇒ alcoholic group

Q.29 (C)

$CH_3 - O - C \equiv C - H$
(II)

Na → +ve test due to acidic hydrogen

Tollens reagent → + ve test due to terminal alkyne

Lucas reagent → – ve test (no alcoholic – OH group)

2, 4-DNP → –ve test No. (– C – group)
                      ‖
                      O
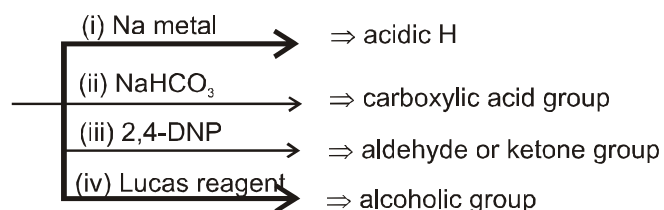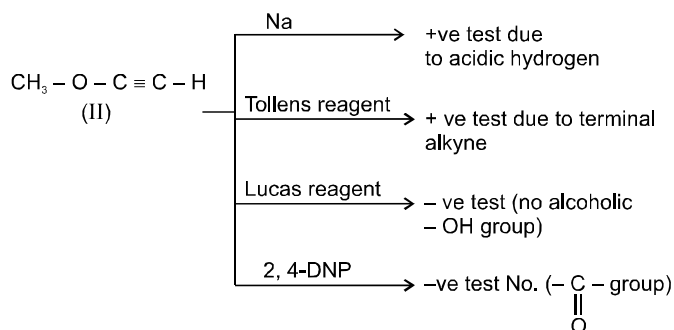
Q.30 (B)

Two compounds have alcoholic and phenolic group present.

Q.31 (A)

Fructose on enolisation remains in the equilibrium with mannose and glucose hence reduces tollens reagent.

Fructose $\underset{}{\overset{OH^{\ominus}}{\rightleftharpoons}}$ Mannose $\rightleftharpoons$ Glucose

Q.32 (A)
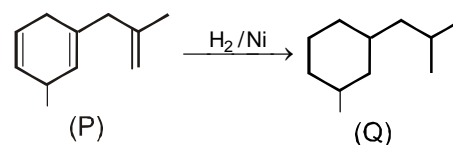
Q.33 (C)

Due to unsaturation pink colour of Baeyer's reagent

decolourises

Q.34 (B)
Q.35 (D)
Q.36 (A)

$CH_3 - \overset{\overset{\displaystyle Br}{\|}}{C} - CH_3 \xrightarrow[\text{Iodoform reaction}]{I_2/Na_2CO_3} CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - \overset{\oplus}{O}\overset{\ominus}{Na} + H - C - I$

(A) Iodoform

$H - C - I \xrightarrow[2:1]{\text{Ag Powder}} H - C \equiv CH$

(A)

$$\xrightarrow[\text{H}_2\text{SO}_4]{\text{Hg}^{++}} \text{H}-\text{C}=\text{C}-\text{H} \rightleftharpoons \text{H}_3\text{C}-\overset{\text{O}}{\overset{||}{\text{C}}}-\text{H}$$

(with H–O–H group above)
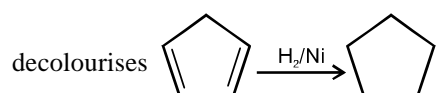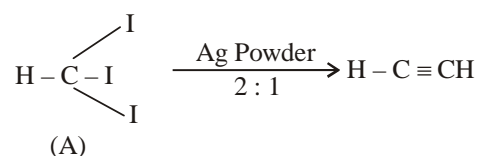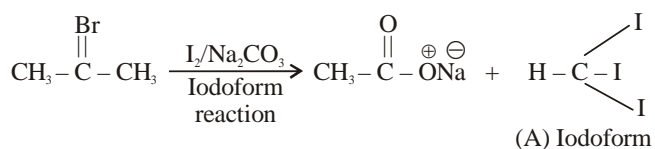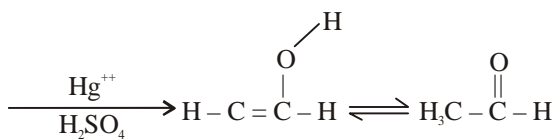
Q.37 (B)

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MCQ/COMPREHENSION/COLUMN MATCHING

Q.1 (ABC)

△—OH form H-bond, ⟩=O has more dipole

moment, (OH—CH₂—CH₂—OH) form more H-bond.

Q.2 (ACD)

↗O↗ do not form H-bond so has lower melting point.

↗↗OH form H-bond so has higher melting point.

↗↗Cl has dipole moment so higher melting point.

Q.3 (ABCD)

(ring structures) has polarity so solubility in water.

Q.4 (B,D)

(p-chlorotoluene) is more symmetrical with maximum dipole.
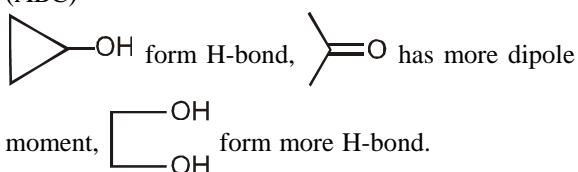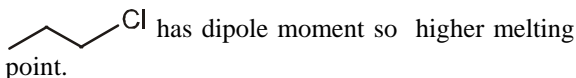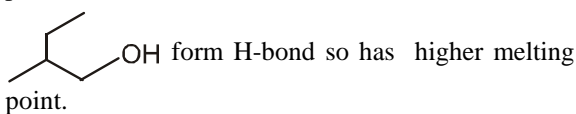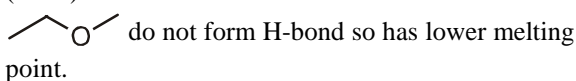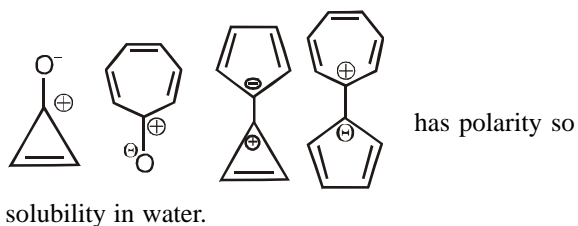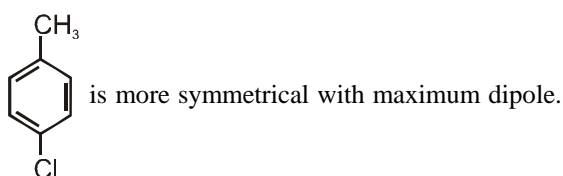
Q.5 (C,D)

(A) Surface area decreases, solubility increases, so A is wrong order.

(B) (salicylic acid structure)
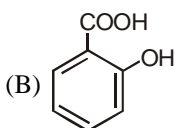
In it, due to the presence of intramolecular H – bonding the solubility is decrease, so B is wrong order.

(C) (two chlorobenzene structures) <
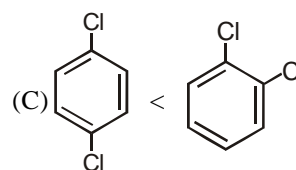
μ = 0   μ ≠ 0

Like dissolve like so it is correct.

(D) (structures I and II)
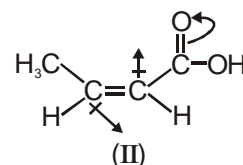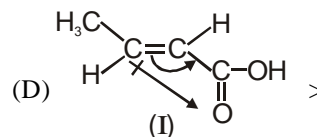
dipole moment of I is greater than II. Greater the dipole moment greater its solubility.

Q.6 (AB)

Ammonical AgNO₃ give white ppt. with first and second gives this (aniline NH₂OH structure)
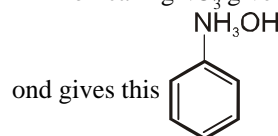
Q.7 (ABCD)

Self explanatory.

Q.8 (ABC)

Presence of enolic/phenolic group.

Q.9 (ACD)

CH₃CO–R group without electron withdrawing group at b position of – C=O will give idoform test.

Q.10 (ABCD)

(OH-benzene-COOH) + ROH ⟶ (OH-benzene-COOR) (Sweet smelling compound)
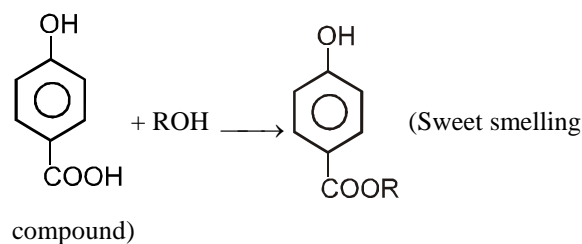
Q.11 (ABCD)

It has 3 acidic H.

43

Q.12 (BCD)

$\left(CH_3-\underset{\underset{O}{\|}}{C}\right)$, $\left(CH_3-\underset{\underset{OH}{|}}{C}\right)$ groups gives positive iodo-form test.

Q.13 (B, C)
Glucose and fructose can reduce Tollen's reagent.

Q.14 (A,B,C)
Glycerine, glycerol and propane-1,2,3-triol and of compound are purified by vacuum distillation. Therefore option (A), (B) and (C) are correct.

Q.15 (A,B,C)
Factual

Q.16 (A,B,C)
Kjeldahl's method is suitable for estimating nitrogen in those organic compounds in which nitrogen is linked to carbon and hydrogen.
The method is not used in the case of nitro, azo and azoxy compounds.
So option (A), (B) and (C) are correct.

Q.17 (A,B,D)

Element of atom		Relative number Simplest ratio
C	$\frac{6}{12} = .5$	$\frac{.5}{.5} = 1$
H	$\frac{1}{1} = 1$	$\frac{1}{.5} = 2$
O	$\frac{8}{16} = .5$	$\frac{.5}{.5} = 1$

Therefore the empirical formula of molecule is CH_2O and
molecular formula = $n(CH_2O)$ n = 1, 2, 3, ...
So option (A), (B) and (D) are correct.

Q.18 (A,C)
Benzene and aniline are both liquids have their boiling points wide apart(about 40°).
So it may be separated by using distillation.
The mixture also spearated by dil HCl by dil HCl
Therefore option (A) and (C) are correct.

Q.19 (B,D)
The empirical formula of a compound is CH_2. The hydrocarbon series belong alkenes and cycloalkenes.
So therefore option (B) and (D) are correct.

Q.20 (A,D)
The desiccants used for absorbing cuter during Liebigs method are anhyd $CaCl_2$ and $Mg\,(ClO_4)_2$.
Therefore option (A) and (B) are correct.

Q.21 (B,C)
If N and S both are present in the organic compound. They may combine to form sodium thiocyanate.

$Na + C + S + N \xrightarrow{\Delta} NaSCN$
Sod. Thiocynate

This when heated with ferrous sulphate produces a blood red colouration due to ferric thiocyanate
$Fe^{3+} + 3NaSCN \rightarrow Fe(SCN)_3 + 3Na^+$
Ferric thiocyanate
(Blood red colouration)

Q.22 (C,D)
Absolute alcohol can be prepared form rectified spirit by
* azeotropic distillation with benzene
* keeping over fresh CaO for few hours and then distilling.
Therefore option (A) and (C) are correct.

Q.23 (A)
Boiling point μ Extent of H-bonding.

Q.24 (A)
Boiling point μ Surface area.

Q.25 (D)
Boiling point μ Molecular weight.

Q.26 (C)
$-NH_2$ containing compound form salt with HCl.

Q.27 (A)
$-COOH$ group form salt with $NaHCO_3$.

Q.28 (D)
Naphthalene does not form salt with HCl, $NaHCO_3$ and NaOH.

Q.29 (C)
R & S are geometrical isomers which have different physical properties but on ozonolysis give same products.

Q.30 (C)
R have lower boiling point because it vaporize earlier.

Q.31 (C)
$CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$ have 3 types of chemically different H.

Q.32 (A) - p, s ; (B) - p, q ; (C) q, r, s ; (D) r
Due to unsaturation brown colour of $Br_2/\,H_2O$ decolourises. Carboxylic acid gives CO_2 gas with $NaHCO_3$. Aldehydes gives black or silver ppt. with tollen's reagent and terminal alkyne gives white ppt. with tollen's reagent. $>C = O$ group gives positive 2,4-DNP test.

Q.33 (A) - p ; (B) - s ; (C) - q ; (D) - r

Benzene is non-polar, phenol has –OH group so slightly soluble, p-hydroxyphenol has 2–OH group so

more soluble on water,

COONa

COONa

is salt so is most

soluble in water.
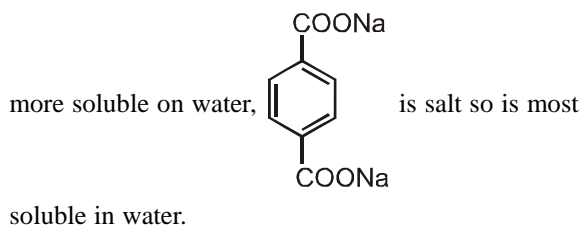
Q.34 (A) - r ; (B) - r ; (C) - p ; (D) - r

Melting point and boiling point depend on H-bonding in molecule while dipole moment depends on direction of electron flow.

Q.35 (A) - q ; (B) - s ; (C) - r ; (D) - p

(A) H—C(COOH)(CH₃)—CH₂OH has lower moleculer weight along
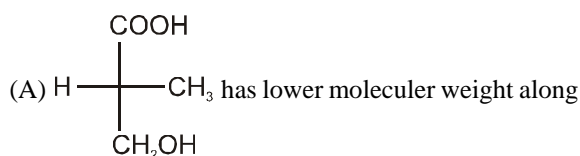
with H-bond with water, so easily separated.

(B) H—C(COOH)(CH₃)—C₆H₅ is a acid which can be separated

by weak base, $NaHCO_3$.

(C) p-OH-C_6H_4—CH(CH₃)(Et)—H is weak acid so can be separated

by NaOH.

(D) p-NH₂-C_6H_4—CH(CH₃)(Et)—H is a base so can be separated by
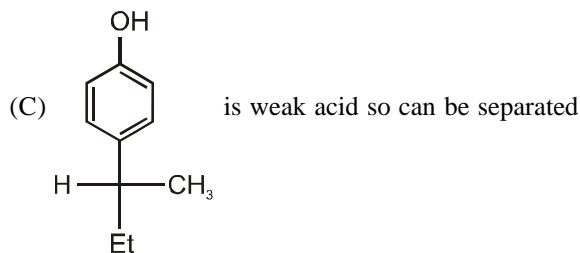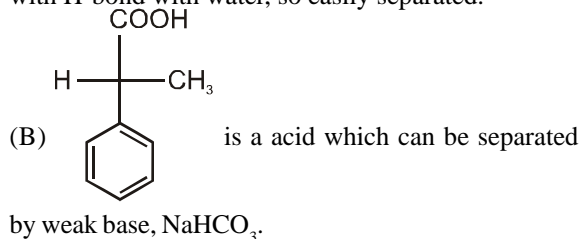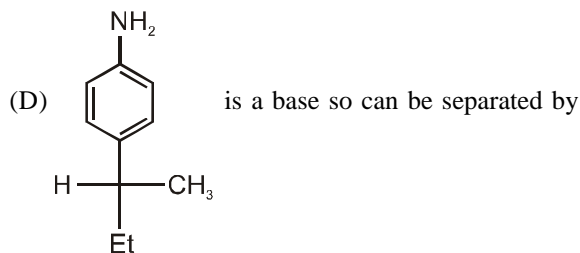
HCl because it form salt.

Q.36 (A) – p,q,t ; (B) – s ; (C) – r,t ; (D) q,r,s.

(A) CH_3–C≡C–H gives white ppt. with T.R and
(I)
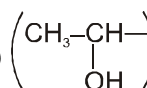
CH_3–CH=O black or silver ppt. with tollen's reagent.
(II)

CH_3–CH=O group gives positive iodoform test,
(II)

C=O group gives positive 2,4-DNP test.

(B) Phenol gives positive test with neutral $FeCl_3$.

(C) 2° alcohol gives turbidity in 5 – 10 min. with lucas

reagent, C=O group gives positive 2,4-DNP test.

(D) $\left(CH_3-CH- \atop OH \right)$ group gives positive iodoform test,

phenol gives positive test with neutral $FeCl_3$ and alcohol give positive test with lucas reagent.

Q.37 (A) - s ; (B) - t ; (C) - p ; (D) - q ; (E) - r

Q.38 (A) - s ; (B) - t ; (C) - p ; (D) - q ; (E) - r

Q.39 (A) - r, s ; (B) - p, q ; (C) - p, q, r ; (D) - p

NUMERICAL VALUE BASED

Q.1 [0012]

$P_1 = 756$ mm Hg

$P_2 = 760$

$V_1 = 48.6$ ml $\qquad V_2 = ?$

$T_1 = 300$ K

$T_2 = 273$ K

Applying general gas equation $\dfrac{P_1 V_1}{T_1} = \dfrac{P_2 V_2}{T_2}$

$V_2 = \dfrac{P_1 V_1 T_2}{T_1 P_2} = \dfrac{756 \times 48.6}{300} \times \dfrac{273}{760} = 44 \, ml$

Mass of organic compound=0.45 g

$\% \text{ of } N_2 = \dfrac{28}{22400} \times V_2 \times \dfrac{1}{0.145} \times 100$

$= \dfrac{28}{22400} \times 44 \times \dfrac{1}{0.45} \times 100 = 12.22 \approx 12$

Q.2 [5]

Alkene, Alkyne, phenol and aniline decolorise Br_2 water solution.

Q.3 [4]

$$CH_3—CH_2—CH_2—CH_2—\overset{\overset{\displaystyle O}{\|}}{C}—CH_3$$

$$CH_3—\underset{\underset{\displaystyle CH_3}{|}}{CH}—CH_2—\overset{\overset{\displaystyle O}{\|}}{C}—CH_3$$

$$CH_3—CH_2—\underset{\underset{\displaystyle CH_3}{|}}{CH}—\overset{\overset{\displaystyle O}{\|}}{C}—CH_3$$

$$CH_3—\underset{\underset{\displaystyle CH_3}{|}}{\overset{\overset{\displaystyle CH_3}{|}}{C}}—\overset{\overset{\displaystyle O}{\|}}{C}—CH_3$$
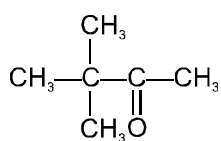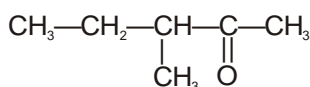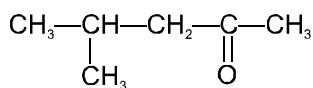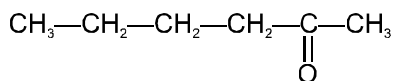
Q.4 [4]

Except aromatic aldehyde all other aldehyde react with Fehling's solution.

Q.5 [2]

112 ml of H_2 is obtained from 0.45 g

22400 ml of H_2 is obtained from $\dfrac{0.45 \times 22400}{112} = 90$ g

90 g compound give one mole H_2 gas
i.e. 2H obtained from 1 mole of compound.

Ans.   No. of active H = 2

Q.6 [81]

Compound Y is $\Rightarrow$ NaSCN

Molecular mass of NaSCN = 23 + 32 + 12 + 14 = 81

KVPY
PREVIOUS YEAR'S

Q.1 (B)

$$CH_3–CH_2–OH$$
$$(C_2H_{60})$$
Alcohol
$$(C_nH_{2n+2}O)$$

$$\xrightarrow{K_2Cr_2O_7/H_2SO_4} \quad CH_3–\overset{\overset{\displaystyle O}{\|}}{C}–O–H$$
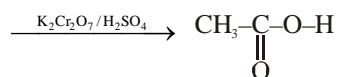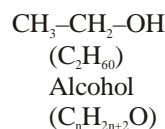
Carboxylic acid
Total wt = 60
C = 24 (40% carbon)
O = 32 (53.3%)
H = 4 (6.7%)

Q.2 (B)

Aniline is purified by distillation method.

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Q.1 (3)

Q.2 (3)

Q.3 [0.4]

retarding factor = $\dfrac{2}{5} = 0.4$

Q.4 (4)

For detection of NO_2^- the following test is used.

$$NO_2^- + CH_3COOH \rightarrow HNO_2 + CH_3COO–$$

(Sulphanilic acid solution)

Diazotized acid

1-napthyl amine

(Red azo dye)
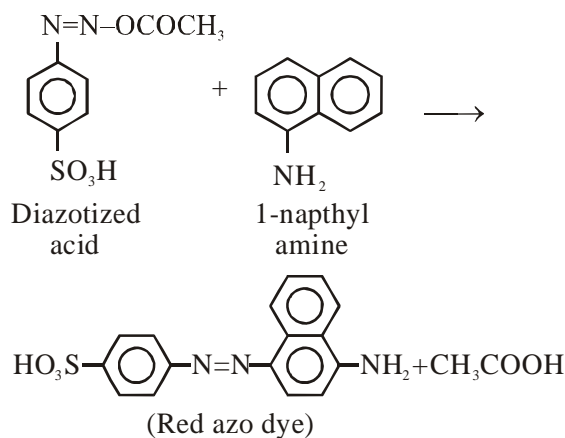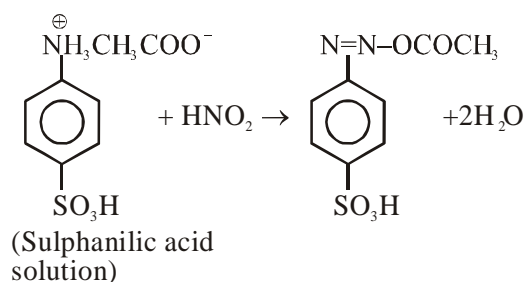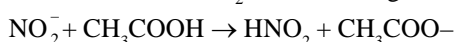
Q.5 (2)

Kjeldahl method is not applicable to compounds containing nitrogen in nitrogroup, Azo groups and nitrogen present in the ring (e.g Pyridine) as nitrogen of these compounds does not change to Ammonium sulphate under these conditions

Q.6 (3)
Match list :-

(a) Lassaigne's Test	(iii) N, S, P and Halogen
(b) Cu(II) oxide	(i) Carbon
(c) AgNO$_3$	(iv) Halogen Specifically
(d) Sodium fusion extract given black precipitate with acetic acid and lead acetate (CH$_3$COOH/(CH$_3$COO)$_2$Pb)	(ii) Sulphur

Option-(a)-(iii) ; (b)-(i) ; (c)-(iv) ; (d)-(ii)

Q.7 (4)
In chromotography technique, the purification of a compound is independent of the physical state of the pure compound.

Q.8 (3)
R$_f$ = retardation factor

$$R_f = \frac{\text{Distance travelled by the substance from reference line (c.m)}}{\text{Distance travelled by the solvent from reference line (c.m)}}$$

Note : R$_f$ value of different compounds are different.

Q.9 [19]
In Duma's method of estimation of Nitrogen. 0.1840 gm of organic compound gave 30 mL of nitrogen which is collected at 287 K & 758 mm of Hg.
Given ;
Aqueous tension at 287 K = 14 mm of Hg.
Hence actual pressure = (758 − 14)
$\qquad$ = 744 mm of Hg.

Volume of nitrogen at STP = $\dfrac{273 \times 744 \times 30}{287 \times 760}$

V = 27.935 mL
∵ 22400 mL of N$_2$ at STP weighs = 28 gm.
∵ 27.94 mL of N$_2$ at STP weighs =

$$\left(\frac{28}{22400} \times 27.94 \right) \text{gm}$$

$\qquad$ = 0.0349 gm

Hence % of Nitrogen = $\left(\dfrac{0.0349}{0.1840} \times 100 \right)$

$\qquad$ = 18.97 %
Rond off. Answer = 19 %

Q.10 (3)
Q.11 (2)
Q.12 (1)
Q.13 (4)
Q.14 (1)
Q.15 (2)

Environmental Chemistry

EXERCISES

JEE-MAIN
OBJECTIVE QUESTIONS

Q.1   (C)

Q.2   (A)

Q.3   (B)

Q.4   (C)

Q.5   (C)

Q.6   (C)

Q.7   (B)

Q.8   (C)

Q.9   (D)

Q.10   (C)

Q.11   (C)

Q.12   (A)

Q.13   (C)

Q.14   (D)

Q.15   (B)

Q.16   (C)

Q.17   (B)

Q.18   (A)

Q.19   (B)

Q.20   (A)

Q.21   (D)

Q.22   (A)

Q.23   (B)

Q.24   (D)

Q.25   (A)

Q.26   (D)

Q.27   (A)

Q.28   (B)

Q.29   (A)

Q.30   (C)

Q.31   (A)

Q.32   (A)

Q.33   (A)

Q.34   (A)

Q.35   (A)

Q.36   (D)

Q.37   (A)

Q.38   (B)

Q.39   (D)

Q.40   (A)

Q.41   (A)

Q.42   (B)

Q.43   (D)

Q.44   (C)

Q.45   (C)

Q.46   (C)

Q.47   (A)

Q.48   (D)

Q.49   (C)

Q.50   (A)

Q.51   (A)

Q.52   (B)

Q.53   (A)

Q.54   (A)

Q.55   (C)

Q.56   (B)

Q.57   (B)

Q.58   (C)

Q.59   (C)

Q.60   (A)

Q.61   (A)

Q.62   (D)

Q.63   (C)

Q.64   (B)

Q.65   (C)

Q.66   (B)
Q.67   (C)

Q.68   (A)

Q.69   (B)

Q.70   (C)

Q.71   (C)

Q.72   (1)

Q.73   (3)

Q.74   (4)

JEE-ADVANCED
MCQ/COMPREHENSION/COLUMN MATCHING

Q.1   (ACD)
Q.2   (CD)

Q.3   (ABC)

Q.4   (AC)

Q.5   (AD)

Q.6   (ABC)

Q.7   (ABC)

Q.8   (ABCD)

Q.9   (D)

Q.10   (D)

Q.11   (D)

Q.12   (D)

Q.13   (D)

Q.14   (D)

Q.15   (A) pq (B) r (C) pt (D) s
Q.16   (A) p (B) q (C) rst (D) pq

Q.17   (A) r (B) s (C) p (D) q

Q.18   (3)

Q.19   (4)
        DDT is a non-biodegradable pollutant.

Q.20   (1)
        ethyl isocyanate $CH_3 - N = C = O$ (MIC gas) (Fact)

Q.21   (3)
        Concentration of nitrate is maximum.

Q.22   (3)
        CH_4 is not present in stratosphere.

Q.23 (a) N_2 Molecule has minimum role in the formatin of photochemical smog. While $CH_2 = O$, O_3 and NO has major role. When fossil fuels are burnt, a variety of pollutants are emitted. Two of them are hydrocarbons (unburnt) and NO. When these pollutants build upto high levels, a chain reaction occurs from their interaction with sunlight. The reactions involved in the formation of photochemical smog are as follows:

$NO_2(g) \xrightarrow{\text{hv}} NO(g) + O(g)$

$O(g) + O_2(g) \rightleftharpoons O_3(g)$

$NO(g) + O_3 + O_3(g) \rightarrow NO_2(g) O_2(g)$

O_3 reats with unburnt hydrocarbons to produce chemicals such as formaldehyde, acrolein and PAN.

$3CH_4 + 2O_3 \rightarrow 3CH_2 = O + 3H_2O$

$+\underset{\text{Acrolein}}{CH_2 = CCH = O} + CH_3COONO_2$
$\underset{\underset{\text{(PAN)}}{O}}{||}$

Q.24 (C)
SO_2 gas causes stiffness of flower buds ?

Q.25 (A)
In ozone layer the wavelength of U.V radiation is 300 – 340 nm.

Q.26 (A)
O_3 is not common component of London and Los Angeles smog. It is present only in Los Angeles smog

Q.27 (B)
Acid rain reacts with marble. Hence, the Taj Mahal which is made up of marble is discoloured.

Q.28 (1)
The upper stratosphere conists of ozone (O_3), which protect us from harmful ultraviolet (UV) radiations coming from sun.
Correct option : (1)

Q.29 Correct option : (3)

Q.30 (4)
Excessive release of CO_2 into the atmosphere results in global warming.

Q.31 (4)
Nitrogen oxides and hydrocarbons (unburnt fuel) are primary pollutant that leads to photochemical smog.

Q.32 (3)
It's a fact, the layer of atmosphere between 10km to 50km above sea level is called as stratosphere.

Q.33 (3)
Troposphere is the lowest region of atmosphere bounded by Earth beneath and the stratosphere above where most\ of the clouds form and where life form exists.

Q.34 (1)
Photochemical smog occurs in warm (sunlight) and has high concentration of oxidising agent there fore it is called photochemical smog/oxidising smog.

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Q.1 (2)

Q.2 (3)

Q.3 (4)

Q.4 (1)
The gas CH_4 evolved due to anaerobic degradation of vegetation which causes global warming and caner.

Q.5 (4)
Non-biodegradable wastes are generated by the thermal power plants which produces fly ash. Detergents which are biodegradable causes problem called eutrophication which kills animal life by deprieving it of oxygen.

Q.6 (1)
Methane leads to both global warming & photochemical smog.
Methane is generated in large amounts from paddy fields.
CO_2 can be absorbed by photosynthesis, or by formation of acid rain etc., while no such activities are there for methane.
Hence methane is stronger global warming gas than CH_4.
Methane is not a part of reducing smog.

Q.7 (3)
The green house gases are CO_2, $H_2O_{(vapour)}$ & CH_4.

Q.8 (2)
In presence of ozone(O_3), oxidising smog gets increased during the day time because automobiles and factories produce main components of the photochemcial smog (oxidising smog) results from the action of sunlight on unsaturated hydrocarbon and nitrogen oxide.
Ozone is strong oxidising agent and can react with the unburnt hydrocarbons in the polluted air to produce chemicals.

Q.9 **(2)**

Reducing or classical smog is the combination of smoke, fog and SO_2.

Q.10 **(4)**

The process in which nutrient enriched water bodies support a dense plant population which kills animal life by depriving it of oxygen and results in subsequent loss of biodiversity is known as eutrophication.

Q.11 **(1)**

Cation exchanger contains $-SO_3H$ or $-COOH$ groups while anion exchanger contains basic groups like $-NH_2$.

Q.12 (4)

Q.13 (2)

Q.14 (3)

Q.15 (1)

Q.16 (4)

Q.17 (4)

Q.18 **(3)**

Q.19 **(3)**

Q.20 (3)

Q.21 **(2)**

Q.22 (4)