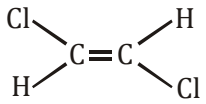
Optical Isomerism

SOLUTIONS

EXERCISE - O

1. **Ans. (A)**

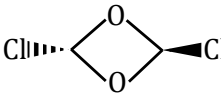


$\Rightarrow$ Planar and contain COS

2. **Ans. (C)**

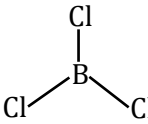
It has both POS and COS

3. **Ans. (C)**



have both POS and COS present

4. **Ans. (D)**



has both C_2 & C_3 AOS :

5. **Ans. (C)**

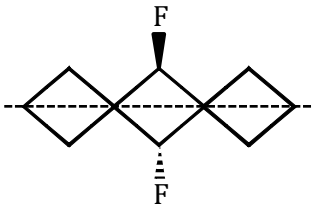
It has 7 POS

6. **Ans. (D)**

At equal distance and opposite direction, we meet identical groups from centre.

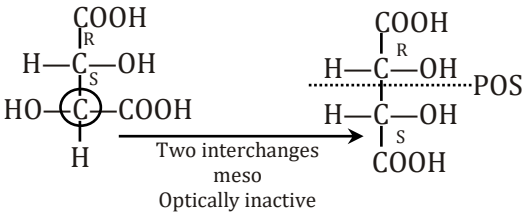
7. **Ans. (B)**

Contains both POS and COS

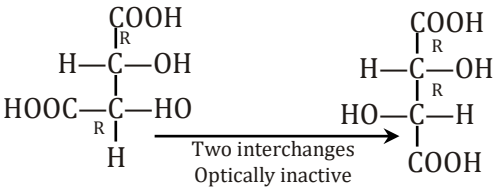


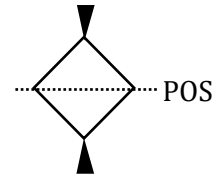
8. **Ans. (D)**

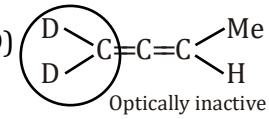
(A)



(B)



(C) 

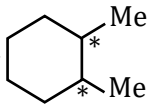
(D) 

Optically inactive

9. Ans. (A)

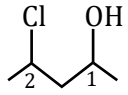
In 'A' there is no chiral carbon present.

10. Ans. (D)

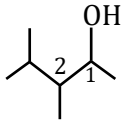
x → 

2, y and z has no chiral carbon

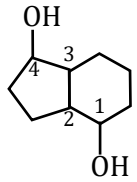
11. Ans. (C)

A → 

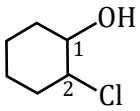
→ 2 Chiral centre

B → 

→ 2 Chiral centre

C → 

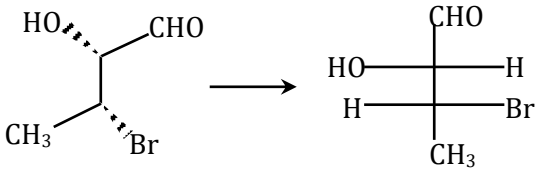
→ 4 maximum number of chiral centre

D → 

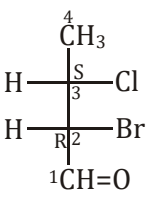
→ 2 chiral centre

12. Ans. (A)

The correct Fischer projection is



13. Ans. (C)



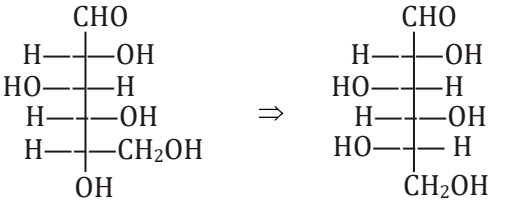
14. Ans. (C)

(II) and (IV) have R – configuration

15. Ans. (B)

In B, the two identical substituents are on different sides.

16. Ans. (B)

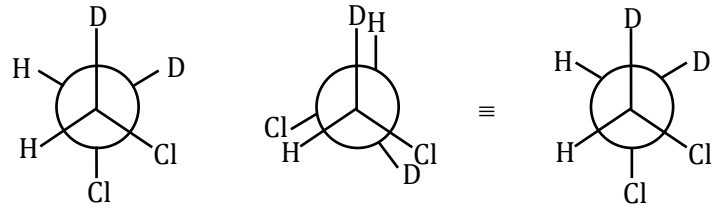


L configuration

17. Ans. (D)

B & D have same configuration and are identical

18. Ans. (D)



(I) (III) (III)

⇒ Both identical

19. Ans. (B)

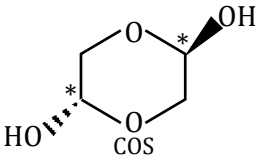
$\theta_d = +9°$ $\theta_\ell = -1°$ θ α conc.

optical purity = $\frac{|d-\ell|}{d+\ell}\times 100$ d = conc. of dextro

l = conc. of leavo

$= \frac{9-1}{9+1}\times 100 = 80\%$

20. Ans. (C)

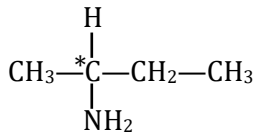


θ=O°

Optically inactive

21. Ans. (D)

(A)	$CH_3–NH_2$	⇒ No chiral centre ⇒ Optically inactive
(B)	$CH_3–\overset{*}{N}H–CH_2CH_3$	⇒ Chiral–N ⇒ Optically inactive due to amine flipping
(C)	$CH_3CH_2CH_2–\overset{*}{N}(CH_3)(C_2H_5)$	⇒ Chiral–N ⇒ Optically inactive due to amine flipping

(D)	 Sec–butylamine	⇒ One chiral centre ⇒ Optically active

22. Ans. (D)

For n= even and symmetric compound, number of stereoisomers $=2^{n-1} + 2^{\frac{n}{2}-1}$

23. Ans. (C)

$HOCH_2–CH(OH)–CH(OH)–CH(OH)–CHO$,n = 3(asymmetric)

Total optically active isomers = $2^n = 2^3 = 8$

24. Ans. (A,B,C,D)

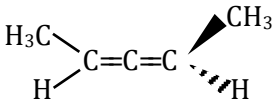
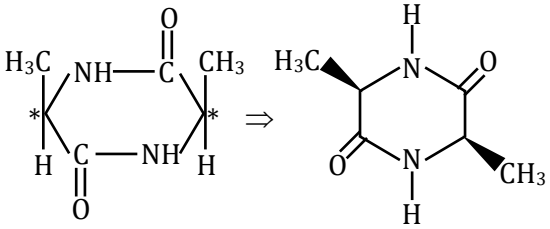
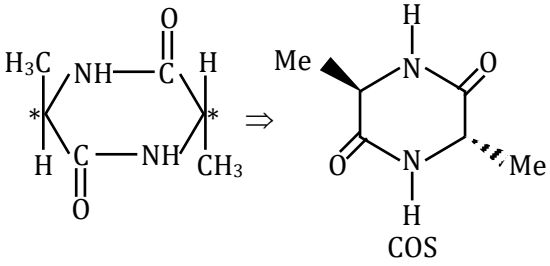
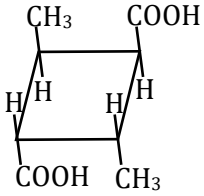
$C_n = \frac{360^\circ}{\theta}$ at $\theta = 180^\circ$ we receive identical orientation of molecule.

25. Ans. (A,C,D)

A, C and D contains plane of symmetry.

26. Ans. (C,D)

Optically inactive compounds are not resolvable.

(A)		⇒ Optically active ⇒ Resolvable
(B)		⇒ no POS and COS ⇒ resolvable
(C)		⇒ Not resolvable
(D)		⇒ COS ⇒ Not resolvable

27. Ans. (D)

Molar mass of MSG is 169 gm

Now, concentration is 169/845 (gm/ml)

Length is 200 mm = 2 dm

Observed angle = + 9.6

Specific rotation of (+) MSG = $\frac{\text{Observedrotation}}{C \times \ell}$

$= \frac{9.6}{\frac{169}{845} \times 2}$

$= \frac{9.6}{0.2 \times 2} = \frac{9.6}{0.4} = 24$

It is +24 for (+) MSG and –24 for (–) MSG.

(D) None of these

As correct answer is –24

28. Ans. (C)

Percentage composition of mixture of (+) MSG and (–) MSG.

Optically purity = $\frac{\text{Observedrotation}}{\text{Specification}}$

Sp. $\theta = -24°$

Abs $\theta = -20°$

Optical purity = $\frac{20}{24}$ = 83.33% of (–) MSG.

Now, 100– optical purity = Racemic mixture

100–83.33 = 16.66% % R.M

Racemic mixture contains 50% (+) and 50% (–) form

Thus, 8.33 % (+) MSG and 8.33 % (–) MSG.

Then total % of (–) MSG will be

83.33 % + 8.33 % = 91.6 %

O.P. from R.M.

29. Ans. (C)

When the two solutions are mixed then their volumes are added thus total volume is 338 ml + 169 ml = 507 ml.

Now, 16.9 gm of (–) MSG will cancel the rotation of 16.9 gm of (+) MSG form 33.8 gm of (+) MSG.

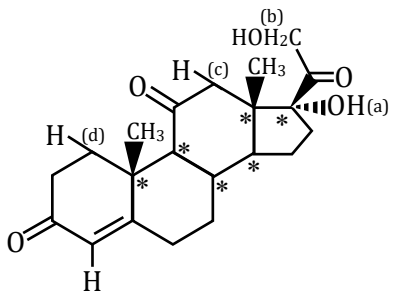
So, net amount of (+) MSG causing of rotation will be 16.9 gm in 507 ml.

Thus concentration 16.9/507 gm/ml

Length 400 mm = 4 dm.

and sp. rotation we already have 24 hence in 24 = $\frac{\theta}{\frac{16.9}{507} \times 4} = 3.2^{\circ}$ and as it of (+) MSG.

30. Ans. (C)



31. **Ans. (B)**

Total number of possible stereoisomers = 2^n where n → number of chiral atom

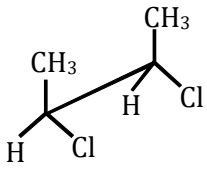
$2^6 = 64$

EXERCISE - S

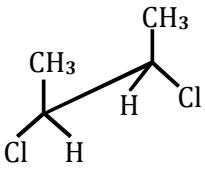
1. **Ans. (1)**

As compound is planar, so it has POS through plane of molecule only.

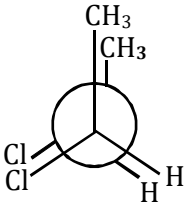
2. **Ans. (3)**

1. 

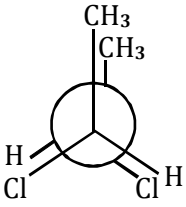
POS present

2. 

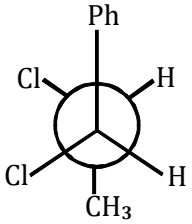
No POS

3. 

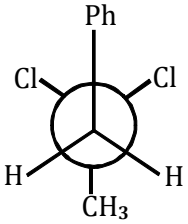
POS present

4. 

No POS

5. 

No POS

6. 

POS present

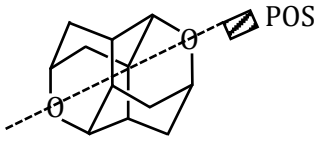
3. **Ans. (7)**

Optically inactive : a, d, g, k, m, n, q

4. **Ans. (8)**

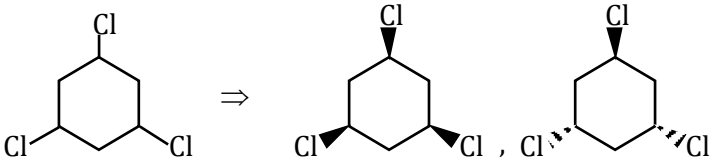
(a), (b): within plane POS present

(b)

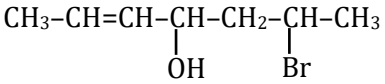


Optically active c, d, e, f, g, i, j, k

5. **Ans. (2)**



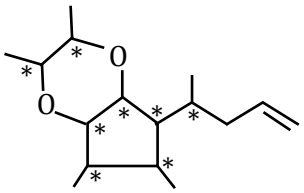
6. **Ans. (8)**



⇒ n = 3 & unsymmetrical

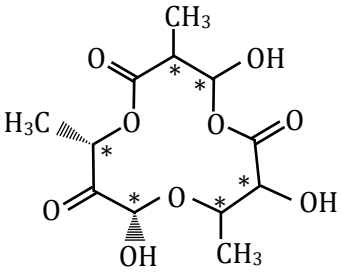
⇒ Total stereoisomers = $2^n = 2^3 = 8$

7. Ans. (8)



Stereocentre = 8

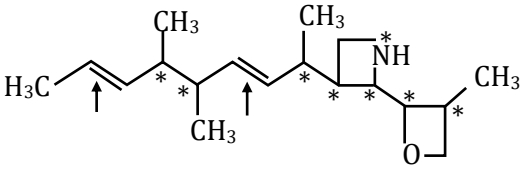
8. Ans. (64)



Total stereoisomers
$=2^n = 2^6 = 64$

Asymmetric compound

9. Ans. (1024)

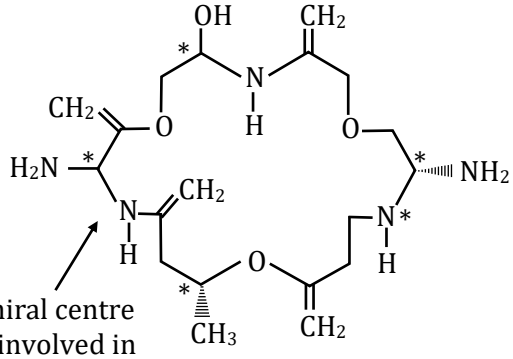


[Asymmetric compound]

Total stereo genic centre = 10 (including chiral centre and GI centre)

So, stereoisomer = $2^n = 2^{10}$

10. Ans. (32)



Not chiral centre as LP involved in resonance, making it sp^2
Stereoisomers $=2^5$

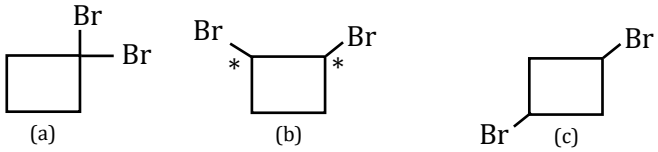
11. Ans. (8)

Chiral centre = 3

Stereoisomers $=2^3$

12. Ans. (6)

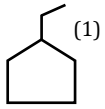
$[C_4H_6Br_2]$

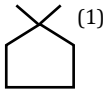


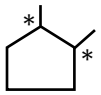
O. I	×	✓	×
G. I	×	✓	✓

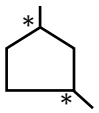
13. Ans. (8)

$[C_7H_{14}]$

(1) 

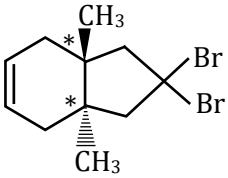
(2) 

(3) 

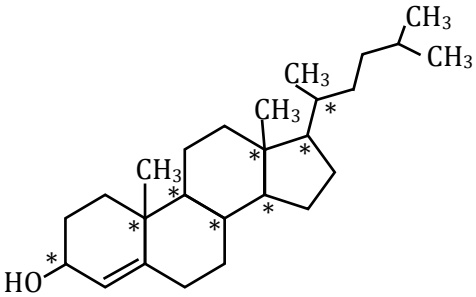
(4) 

S.I = 3 (symmetrical) S.I = 3

14. Ans. (2)

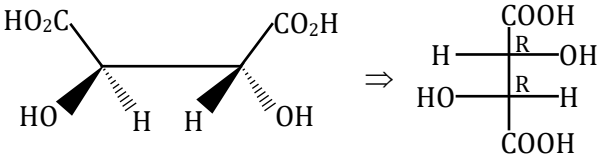


15. Ans. (8)



EXERCISE - JEE (Main) PYQ

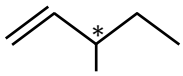
1. Ans. (2)



2. Ans. (1)

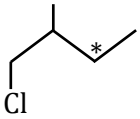
(i) cis	R
(ii) cis	S
(iii) trans	R
(iv) trans	S

3. Ans. (4)

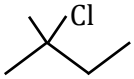


(Presence of C.C)

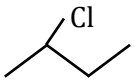
4. Ans. (4)



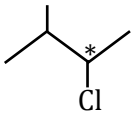
× 2 (2-chiral molecules)



(Achiral molecule)

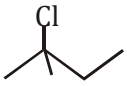


(Achiral molecule)



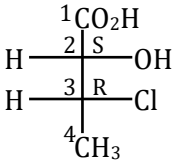
× 2 (2-chiral molecules)

5. Ans. (3)

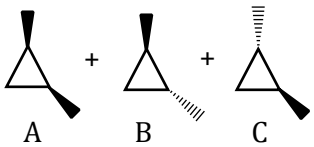


It achiral ∴ optically inactive

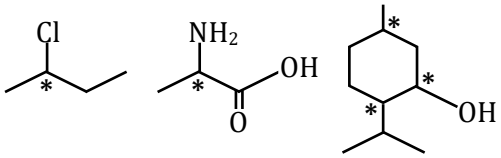
6. Ans. (3)



7. Ans. (4)

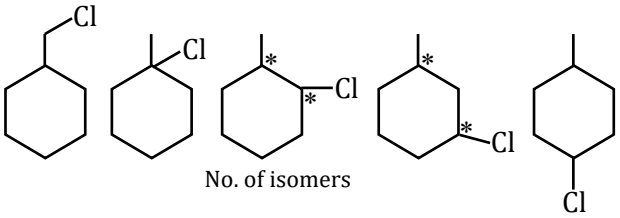


8. Ans. (3)



Number of compounds containing asymmetric carbons are three.

9. Ans. (12)



No. of isomers

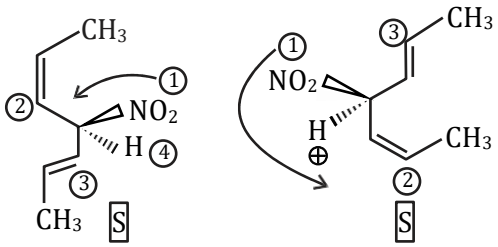
(1) (1) (4) (4) (2)

10. Ans. (42)

$$\% \text{ optical purity} = \frac{\text{observed rotation of mixture} \times 100}{\text{rotation of pure enantiomer}}$$

$$= \frac{+12.6^\circ}{+30^\circ} \times 100 = 42$$

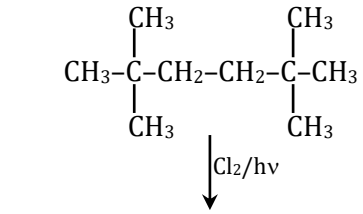
11. Ans. (3)

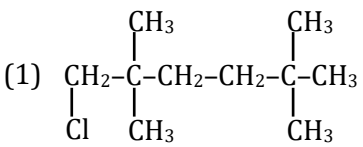


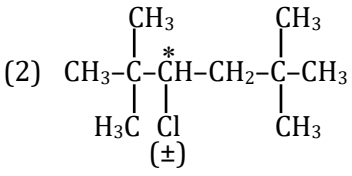
(A) (B)

Having same configuration.

12. Ans. (3)

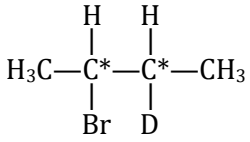




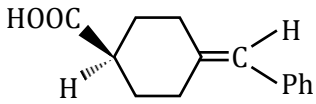


Total numbers of isomer = 03

13. Ans. (3)

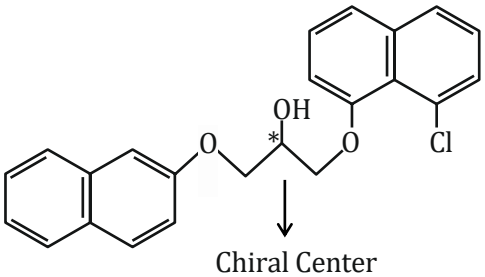


14. Ans. (2)

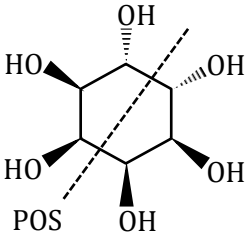


No POS, COS

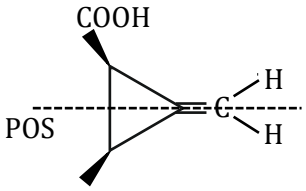
(Chiral)



Chiral Center
No POS, COS
(Chiral)

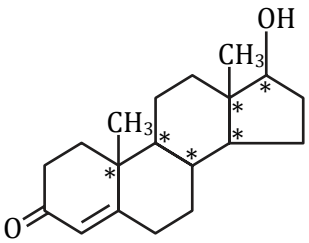


(Achiral)



(Achiral)

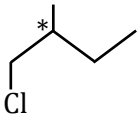
15. Ans. (6)



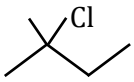
Testosterone

EXERCISE - JEE (Advanced) PYQ

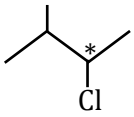
1. Ans. (A)



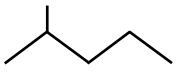
× 2 chiral molecules



(Achiral molecule)



× 2 chiral molecules

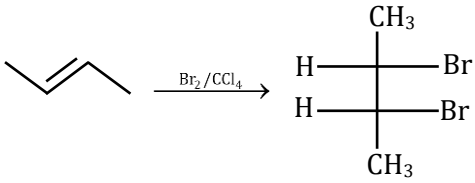


Total isomers = 6

Total no. of fractions obtained

After fractional distillation = 4

2. Ans. (A)



Trans-2-butene Meso compound

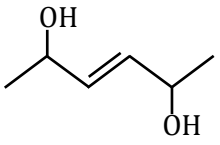
3. Ans. (C)

Chiral molecule has non-superimposable mirror image. However, the presence of chiral centres is not a necessary condition for chirality.

4. Ans. (A,D)

C_2– axis of symmetry is present.

5. Ans. (A,D)



(Symmetric structure)

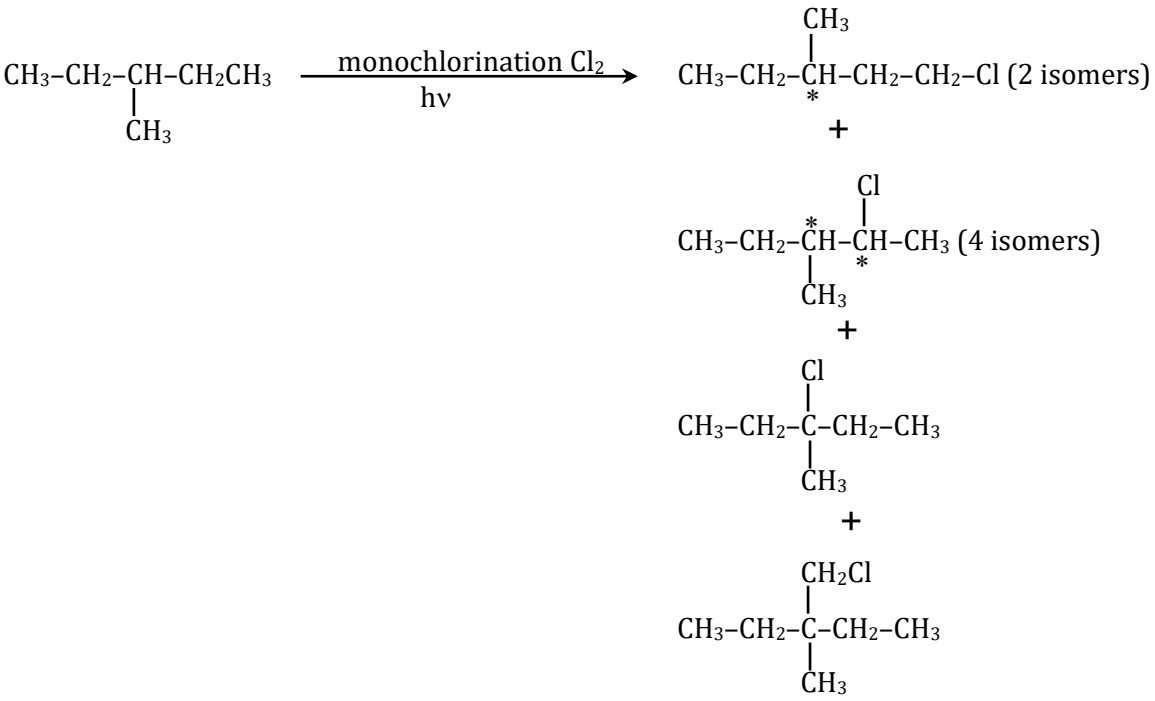
R cis R]
R cis S] ±

R cis S] Meso

R trans R]
S trans S] ±

R trans S] Meso

6. Ans. (8)



7. Ans. (A,B,C)

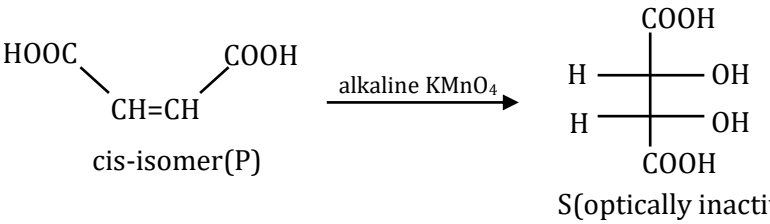
M and N are non-mirror images and are non-super imposable → A

M and O are identical → B

M and P are Enantiomers

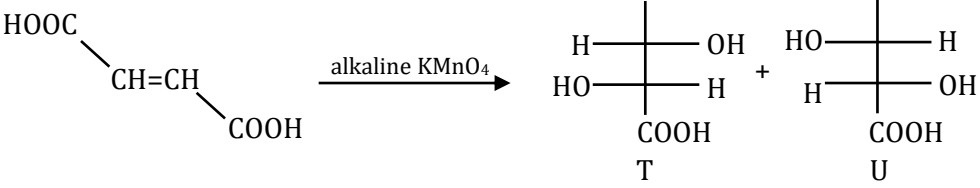
M and Q are diastereomers

8. Ans. (B)



cis-isomer(P)

S(optically inactive)



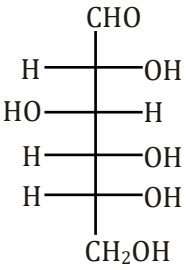
trans-isomer(Q)

T U

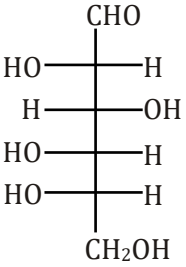
(optically inactive pair)

9. **Ans. (A)**

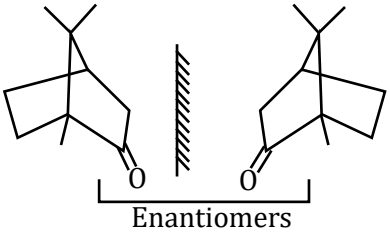
The structure of D(+) glucose is



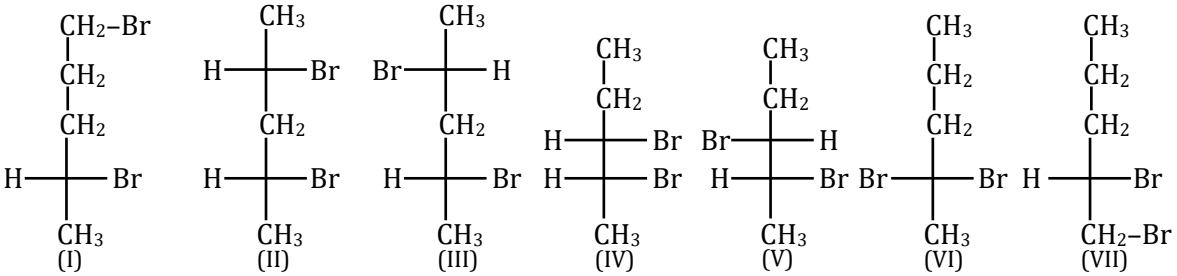
The structure of L(–) glucose which is enantiomer of D(+)-glucose is



10. **Ans. (2)**



11. **Ans. (5)**



All are chiral molecules except II and VI.

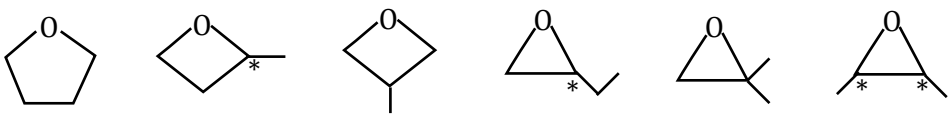
12. **Ans. (7)**

Number of stereoisomers = 2^n, (where n is number of variable stereocentres)

= 2^3 = 8 stereoisomers

But one of them is meso and all others are optically active or chiral molecules.

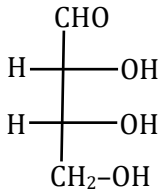
13. **Ans. (10)**



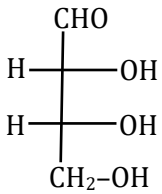
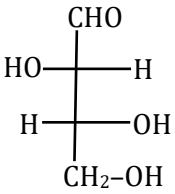
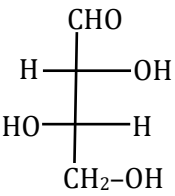
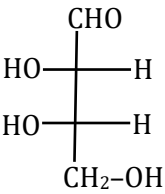
(2–isomers) (2–isomers) (3–isomers)

So, total number of cyclic ethers possible for C_4H_8O is ten.

14. Ans. (C)



D–Erythrose

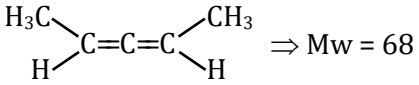
Compound P		It is Identical	P–2
Compound Q		It is Diastereomer	Q–1
Compound R		It is Diastereomer	R–1
Compound S		It is Enantiomer	S–3

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

JEE (Main) Practice Paper

SECTION-A

1. Ans. (3)



⇒ Mw = 68

⇓

Pos × cos ×

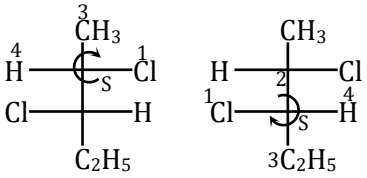
⇓

Optically active

⇓

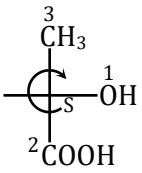
It will show optical isomerism.

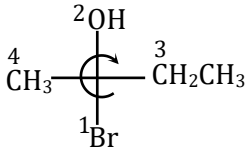
2. Ans. (2)

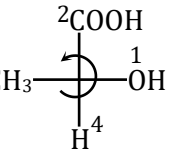


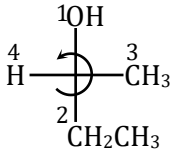
2S, 3S

3. Ans. (4)

(1)


(2)


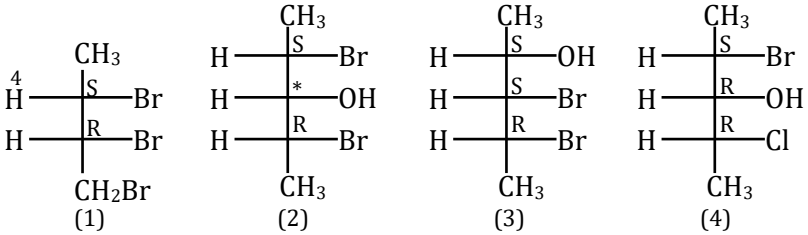
(3)


(4)


4. Ans. (2)

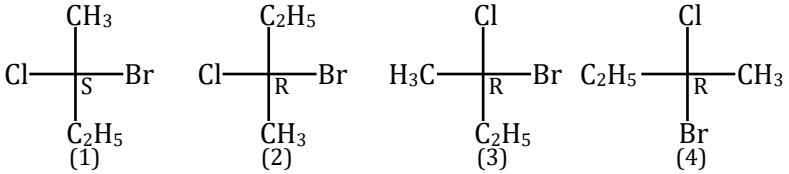
A molecule is said to be chiral, only if it is non-superimposable on its mirror image.

5. Ans. (2)



⇒ Pseudo-asymmetric centre :- A centre with two structurally same but of different configuration.

6. Ans. (4)



⇒ (2) & (4) are not enantiomers, they are identical.

7. **Ans. (2)**

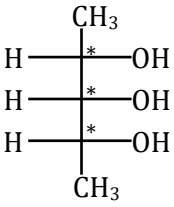
2,3,4–pentanetrial

$\Rightarrow$ n = 3 (odd)

$\Rightarrow$ symmetrical

$\Rightarrow$ $P = \frac{n+1}{2} = \frac{3+1}{2} = 2$

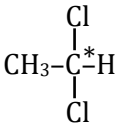
$\Rightarrow$ Meso isomer = $2^{p-1} = 2^{2-1} = 2$



8. **Ans. (4)**

All three compounds have COS

9. **Ans. (2)**



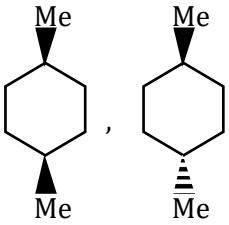
This compound is optically active. So, it will rotate the plane polarized light at room temperature

10. **Ans. (2)**

Chiral carbons in i = 1, ii = 2, iii = 1, iv = 2

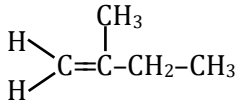
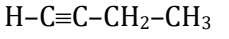
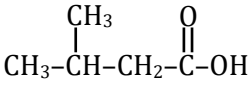
Total = 1 + 2 + 1 + 2 = 6

11. **Ans. (1)**



both have POS so optically inactive.

12. **Ans. (4)**

		S.I.
(1)		(×)
(2)		(×)
(3)		(×)

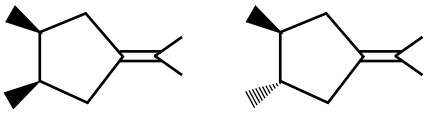
(4)	$CH_3-CH_2-\underset{*}{\underset{\vert}{C}}H-\overset{\overset{O}{\Vert}}{C}-OH$ (with H_3C and O substituents on the starred carbon) (R/S) Chiral carbon ⇓ Optical isomerism ✓ ⇓ Stereo isomerism ✓	(✓)

13. Ans. (2)

(I), (IV) have centre of symmetry and (iii) have plane of symmetry.

(II) have no plane of symmetry, no centre of symmetry and no alternate axis of symmetry.

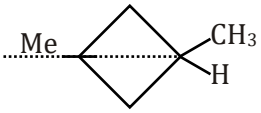
14. Ans. (3)



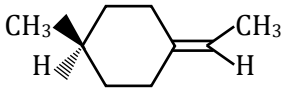
Cis Trans (Optically active)

trans have no POS, COS and AAOS

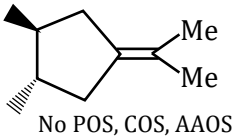
15. Ans. (4)



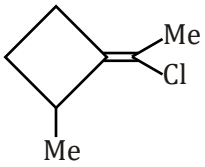
POS is present.

(A) 

No POS, COS, AAOS

(B) 

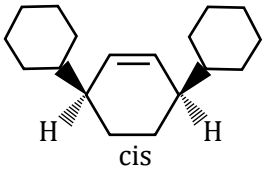
No POS, COS, AAOS

(C) 

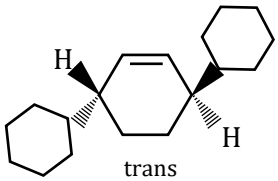
No POS, COS, AAOS

16. Ans. (3)

(3) can show both G.I. and optical isomer.



cis



trans (Optically active)

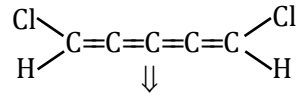
17. Ans. (1)

(1) 

⇒ (=) ⇒ odd.

(i) chiral atom is absent

(ii) always POS (it is molecular plane) is there because molecule is planar. It will not show O.I.



(=) ⇒ even

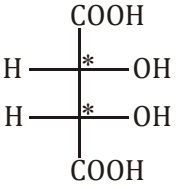
POS, COSX

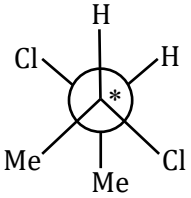
⇓

Optically active compound

(2) ⇓

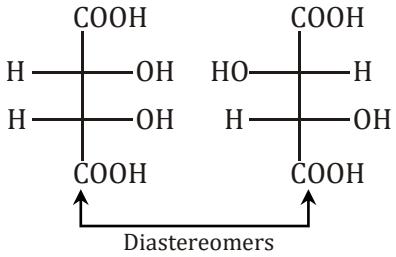
It will show optical isomerism.

(3)  → chiral centre is there, it will show optical isomerism.

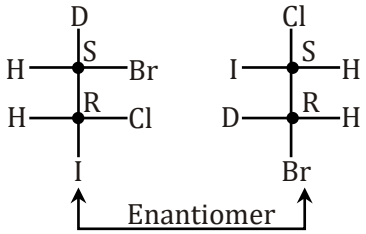
(4)  → chiral centre is there, it will show optical isomerism.

(1) is correct

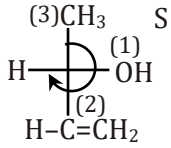
18. Ans. (3)

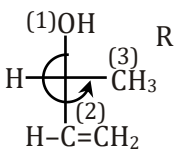


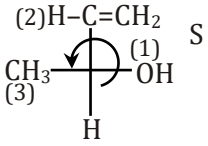
19. Ans. (1)

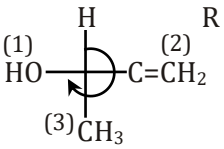


20. Ans. (3)


(I)

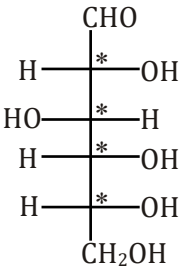

(II)


(III)


(IV)

SECTION-B

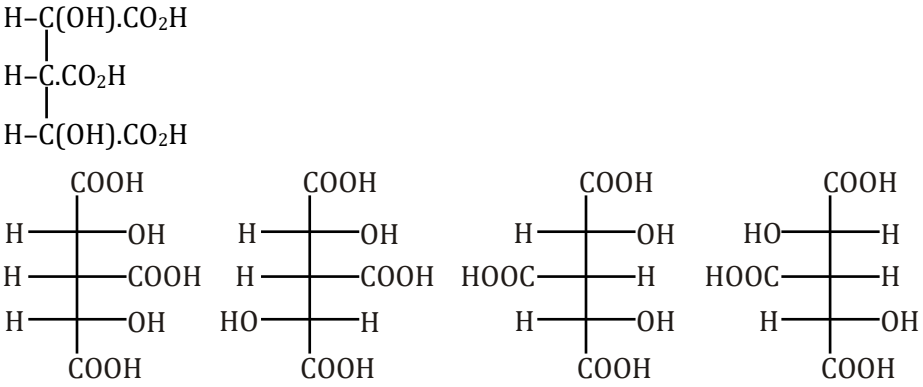
1. Ans. (16)



n = 4, total S.I. = $2^n = 2^4 = 16$

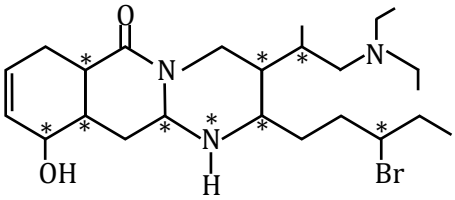
(C) is correct

2. Ans. (4)

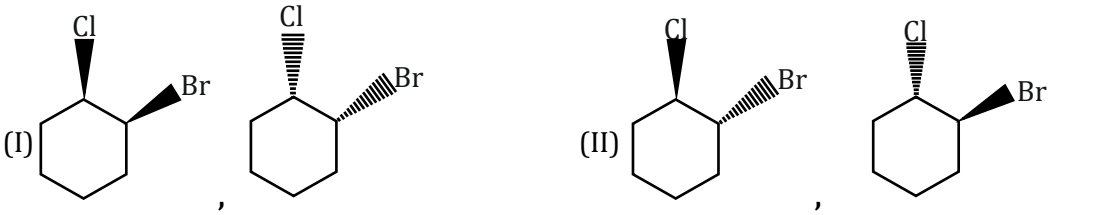


Total isomer $\Rightarrow$ 4.

3. Ans. (9)



4. Ans. (2)

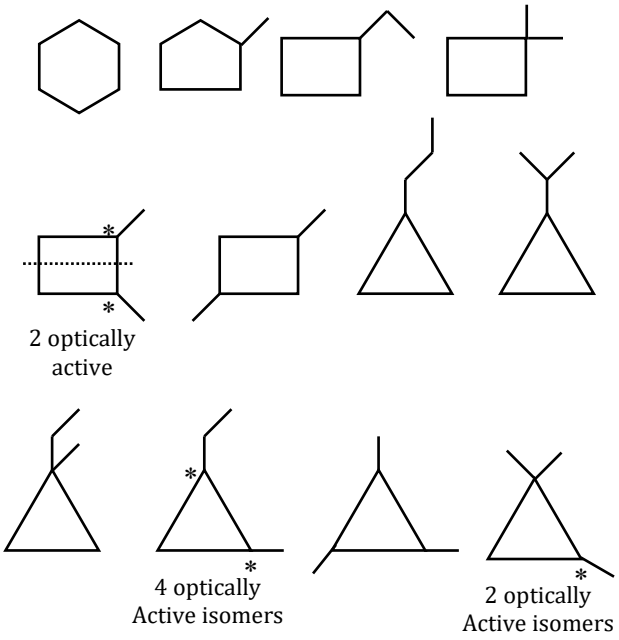


Enantiomer pair **Enantiomer pair**

5. Ans. (8)

C_6H_{12}

$DU = \frac{1}{2} \times (2 \times 6 + 2 - 12) = 1$



2 + 2 + 4 = 8 optically active isomers

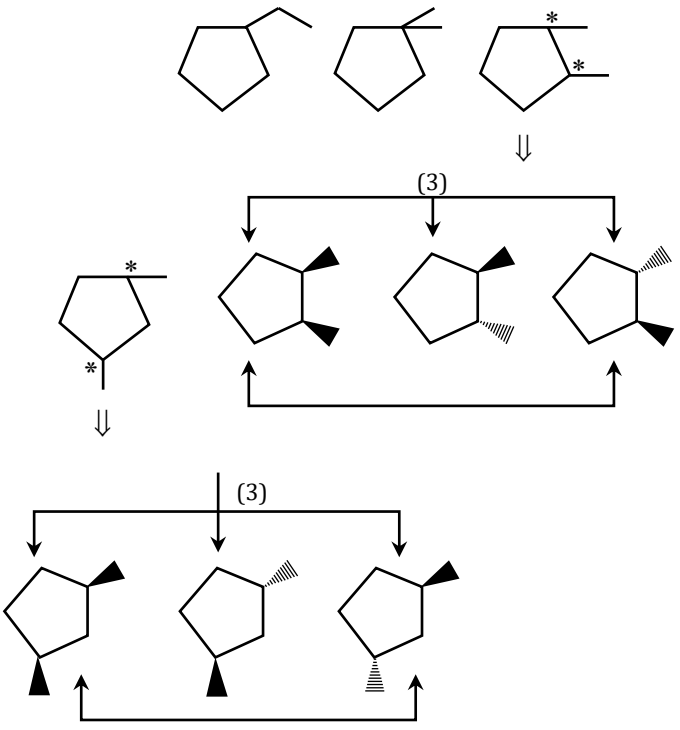
6. Ans. (6)

I, II, VI, VII, VIII, IX are chiral compounds.

7. Ans. (8)

C_7H_{14}

$DU = \frac{1}{2}(7 \times 2 + 2 - 14) = 1$



8. **Ans. (6)**

$$O.P = \frac{|d-l|}{d+l} \times 100 = \frac{53-47}{53+47} \times 100 = 6\ \%$$

9. **Ans. (4)**

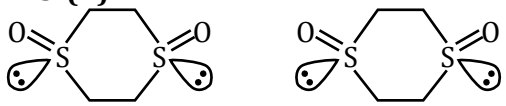
here n = 2 So total isomers = 2^2 =4

10. **Ans. (4)**

Number of pair of enantiomers possible for 1-bromo- 2-chlorocyclohexane = 2 = X.
Number of pair of enantiomers possible for 1-chloro- 2-fluorocyclobutane = 2 = Y.
X + Y = 2 + 2 = 4

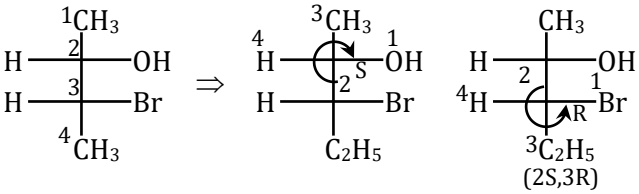
JEE (Advanced) Practice Paper

1. **Ans. (A)**

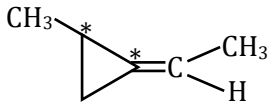


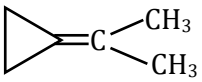
Geometrical isomer

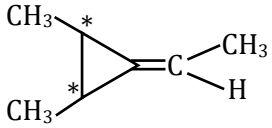
2. **Ans. (B)**

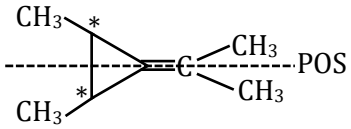


3. **Ans. (B)**

(A)  ⇒ show both OI & GI

(B)  ⇒ Don't show O.I. & G.I.

(C) 
⇒ No POS & COS in transform
⇒ Show O.I.
⇒ also show G.I.

(D)  ⇒ Show O.I. and G.I.

4. **Ans. (B)**

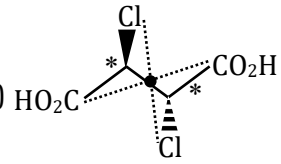
C_4H_9Br

$$DU = \frac{1}{2}(2 \times 4 + 2 - 10) = 0$$

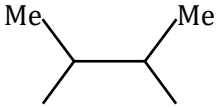
C–C–C–C–Br
(R/S)
C–C*–C–C
Br (Active)
⇓
2

total optically active isomer ⇒ (2).

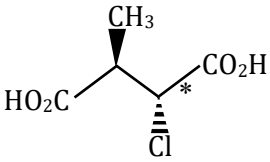
5. Ans. (A)

(A) 

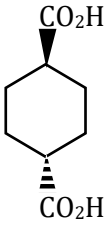
Chiral atoms ✓
COS
⇓
Inactive
⇓
meso ✓

(B) 

Chiral atoms ✗
meso ✗

(C) 

COS ×, POS ×
⇓
active
⇓
meso ✓

(D) 

Chiral atoms ×
COS ✓ POS ✓
Optically inactive
⇓
But meso ×

6. Ans. (B)

ℓ = 10 dm

c = 20 gm/200 ml

$\alpha = 30°$

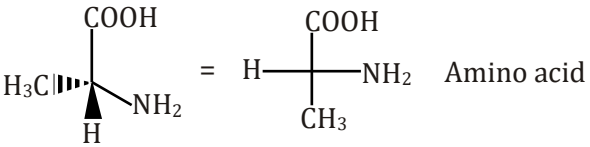
$$[\alpha]_{specific} = \frac{\alpha_{obs}}{c.l} = \frac{30}{\frac{20}{200}\times 10} \Rightarrow 30°$$

$\alpha_{obs.}$ after dilution

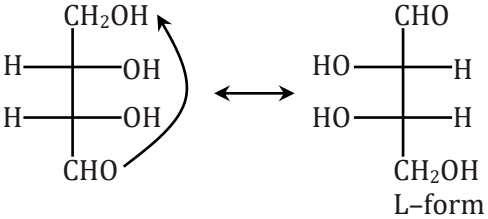
$\alpha_{obs} = \alpha_{sp}$ c.p.

$$\alpha_{obs} = 30\times\frac{20}{1000}\times 10 \Rightarrow 6°$$

7. Ans. (C)

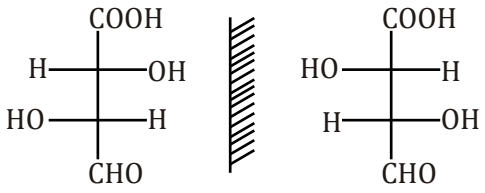


Amino acid



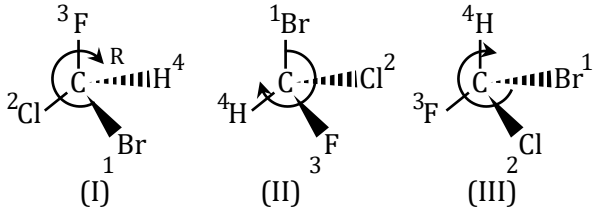
L–form

8. **Ans. (A)**

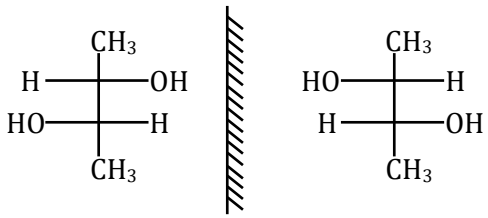


Mirror image → enantiomer

9. **Ans. (A)**

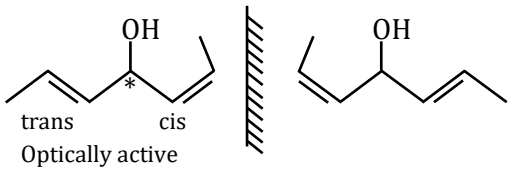


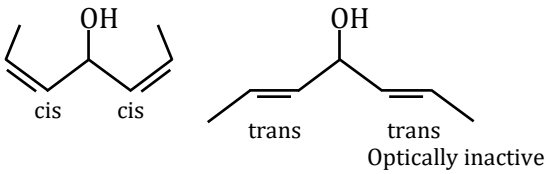
10. **Ans. (A)**



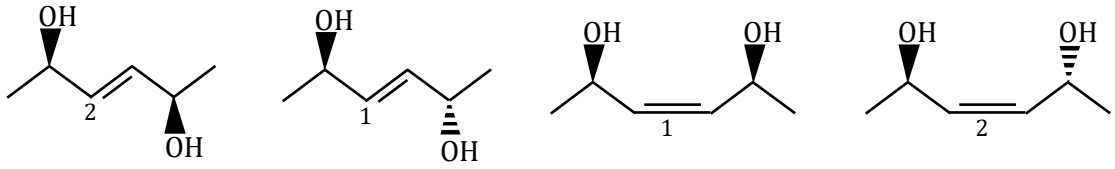
Non-super imposable minor image

11. **Ans. (A)**





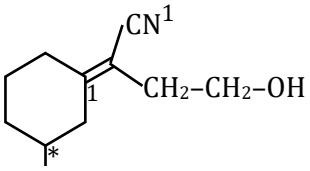
4 isomers



Optically Active | Optically Inactive | Optically Inactive | Optically Active

6 isomers

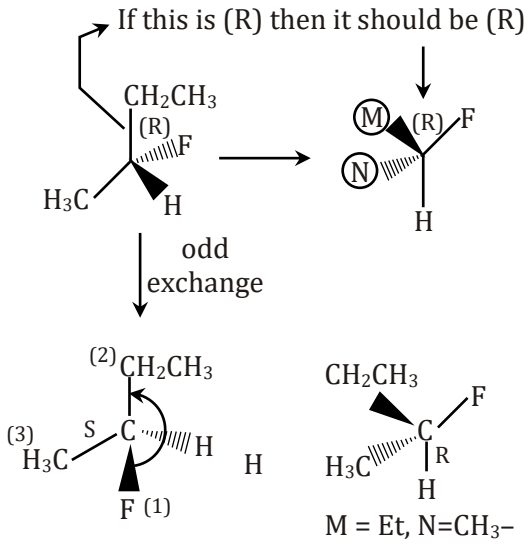
12. **Ans. (A)**



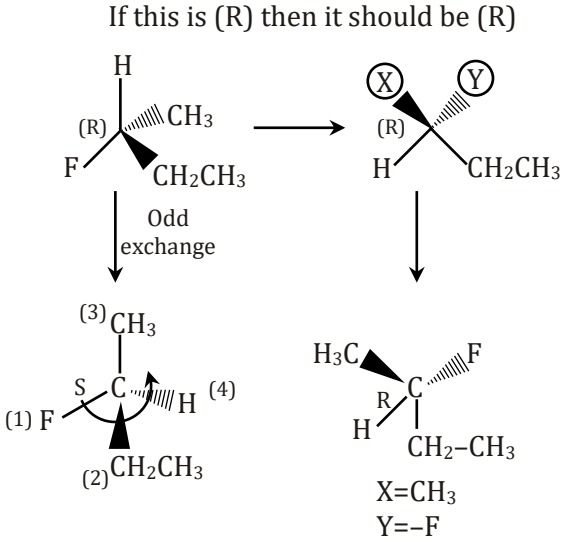
* Configuration at double bond E.
* Only one chiral centre
* Compound will show optical isomerism
* It will show geometrical isomerism

13. Ans. (A,B)

(A)

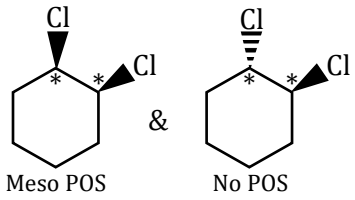


(B)

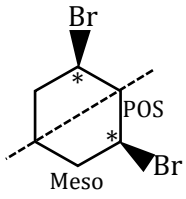


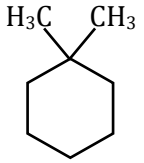
14. Ans. (A, B)

(a)

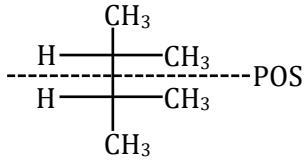


(b)



(c) 

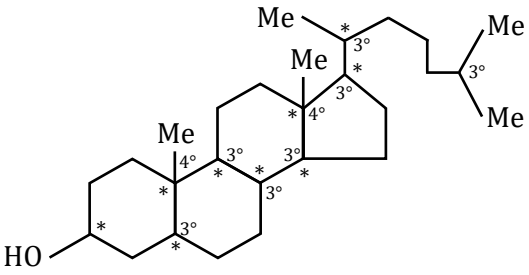
⇒ No chiral centre ⇒ Not meso

(d) 

No chiral center

(c) & (d) so no meso compound

15. Ans. (A,C,D)



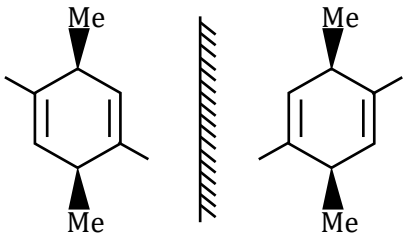
(a) 9- chiral centres

(b) It is tetra-cyclic compound

(c) 2–4°C present

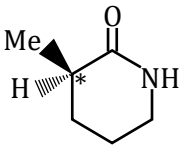
(d) 7–3°C present

16. Ans. (A, B)

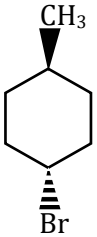


No plane of symmetry
no center of symmetry
chiral molecule

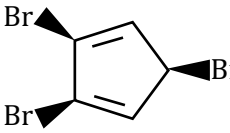
Non superimposable
mirror image



I chiral centre optically active

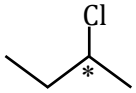


POS is present optically inactive compound.



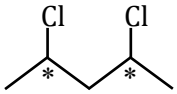
POS is present optically inactive

17. Ans. (A)

(1) 

(RIS)

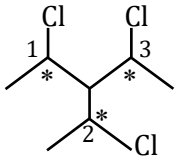
Total Stereo isomers = 2

(2) 

(Symmetrical)

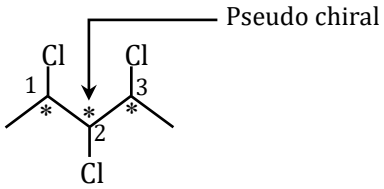
R R
S S
R S
S R
Same

; Total stereoisomers =3

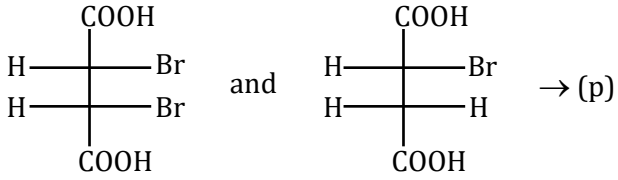
(3) 

R R R
S S S
R S R
R S S

(4) cases
⇓
Total stereo Isomers =4

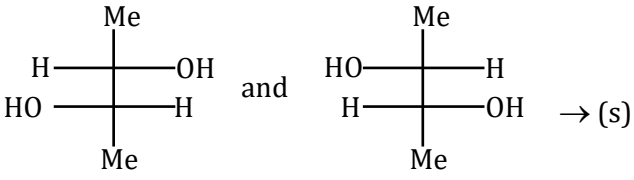
(4) 

18. Ans. (D)

(a) 

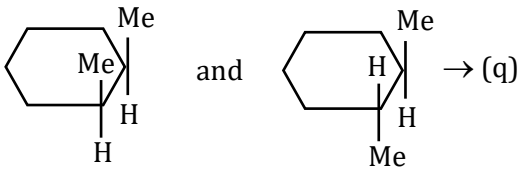
→ (p)

Diastereomers

(b) 

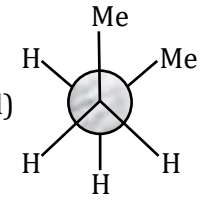
→ (s)

Non–super impossible mirror image enantiomers

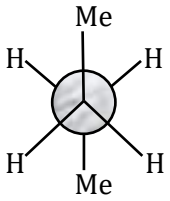
(c) 

→ (q)

Diastereomers

(d) 

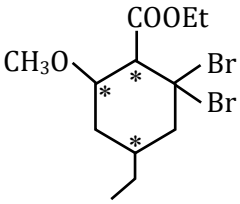
Gauch form

and 

Anti-form

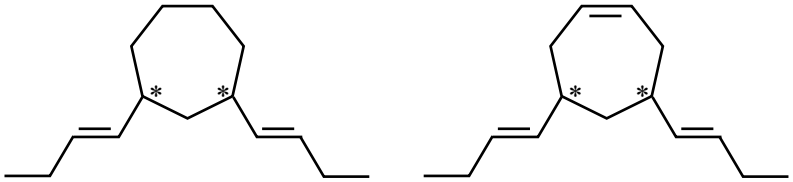
conformations

19. Ans. (3)



3 chiral centres

20. Ans. (16)

(i) 

Two π-bond and two chiral centres.

Total 4-stereoisomerism generating units.

No. of stereoisomers = $2^4 = 16$