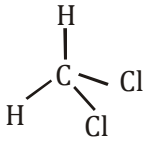
Geometrical Isomerism and Conformations

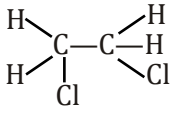
SOLUTIONS

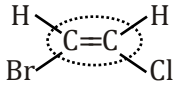
EXERCISE - O

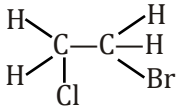
1. Ans. (C)

G.I

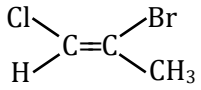
(A)  ×

(B)  ×

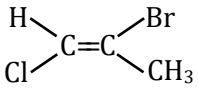
(C)  ✓

(D)  ×

2. Ans. (C)

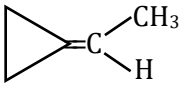

(II)

and


(IV)

→ Geometrical (isomers)

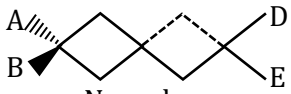
3. Ans. (C)



G.I. is absent

Identical groups

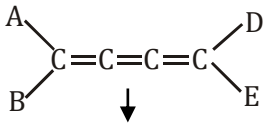
4. Ans. (B)



G.I. absent

Non-planar

5. Ans. (B)

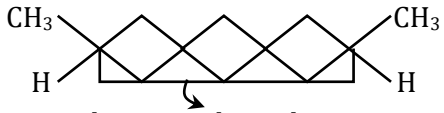


about this geometrical center

G.I. present

if A ≠ B, C ≠ D

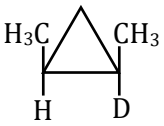
6. Ans. (B)



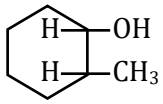
Plannar about this geometrical center

G.I. present

7. **Ans. (D)**



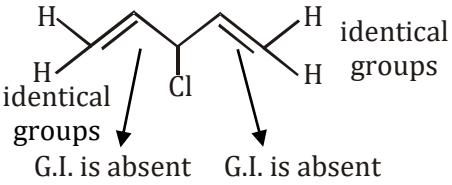
G.I. is present



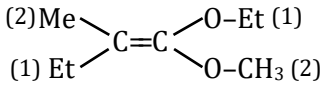
G.I. is present

$C_6H_5-CH=N-OH$
G.I. is present

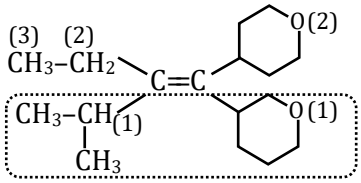
8. **Ans. (C)**



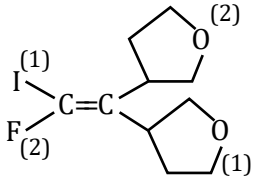
9. **Ans. (B)**

(A) 

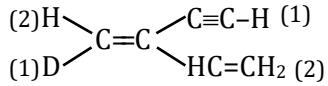
Same no. ⇒ opposite side ⇒ E

(B) 

Same No. ⇒ same side ⇒ Z

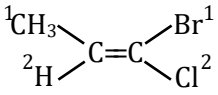
(C) 

(E)

(D) 

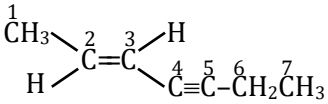
(E)

10. **Ans. (A)**



Higher priority groups on same side. So, Z.

11. **Ans. (D)**



Higher priority groups are opposite sides, So

Name is (E) –2 hepten-4-yne

12. **Ans. (A)**

Compound is unsymmetrical So number of G.I. is 2^n, n = 2

Total number of G.I. = $2^2 = 4$

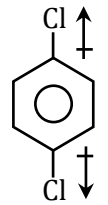
13. **Ans. (C)**

Geometrical isomer = 2^n (unsymmetrical molecule)

n = 2 G.I sites

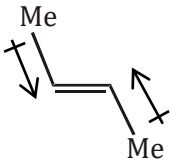
$= 2^2 = 4$

14. **Ans. (C)**



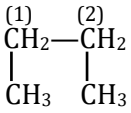
Dipoles cancel each other.

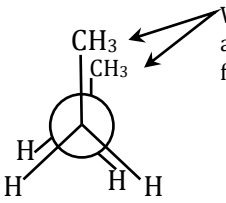
15. **Ans. (B)**



$\Rightarrow$ Dipoles cancel each other.

16. **Ans. (C)**

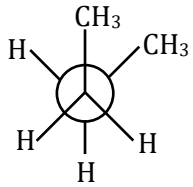




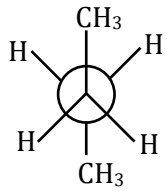
Wander wall strain as well as Tortional strain in eclipsed from

$\Downarrow$

Least stable



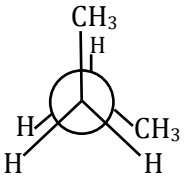
gauche form



Anti form

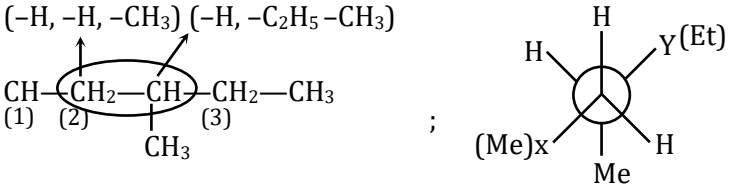
$\Downarrow$

most stable

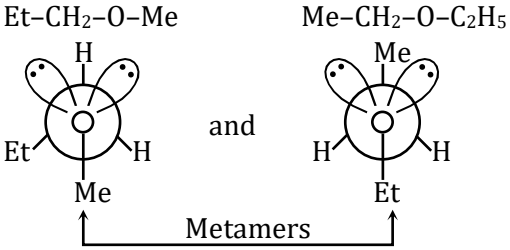


Partially eclipsed form

17. **Ans. (A)**



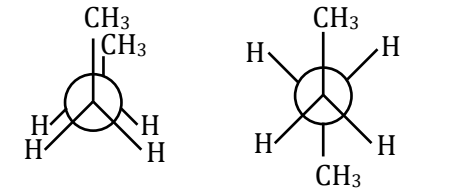
18. **Ans. (B)**



19. **Ans. (D)**

b, d, e, f can show conformational isomerism

20. **Ans. (B)**



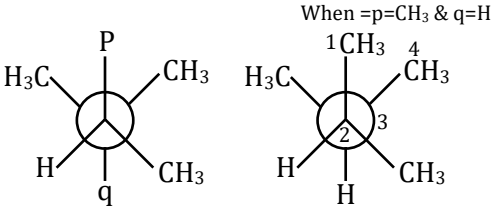
Dihedral angle=0° Dihedral angle=180°

180° is required to get most stable conformation from least stable conformation

21. **Ans. (B)**

Stereo isomers have same structural formula but have different arrangement of atoms / groups in space

22. **Ans. (C)**

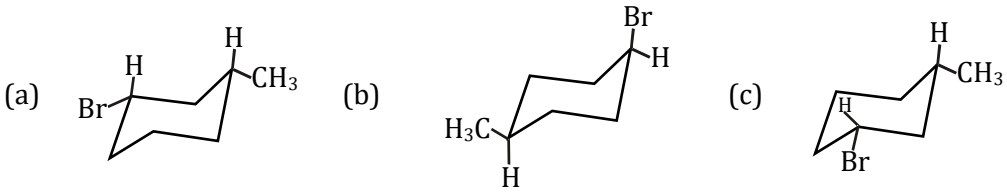


IUPAC name is 2,3–Dimethylbutane

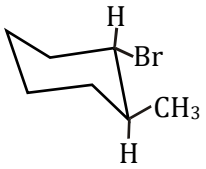
23. **Ans. (D)**

Infinite Conformers are possible for a compound at room temperature.

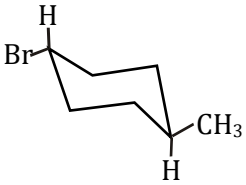
24. **Ans. (B)**



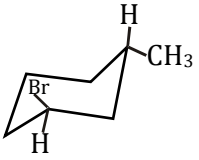
cis cis cis

(d) 

trans

(e) 

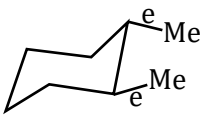
trans

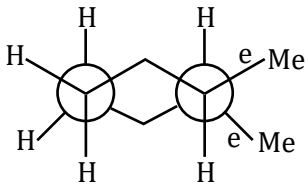
(f) 

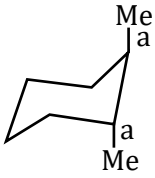
trans

25. Ans. (C)

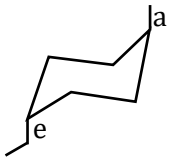
A & B are same only difference by projection, steric repulsion of Methyl at axial position is more than equatorial position

(a) 

(b) 

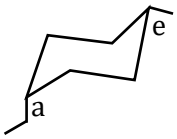
(c) 

26. Ans. (C)

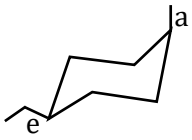


(I)

(II)

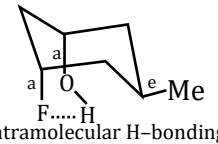


(III)



(IV)

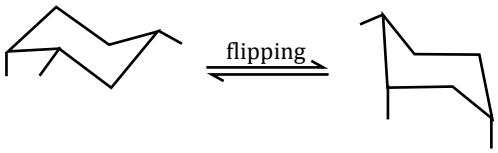
27. Ans. (B)



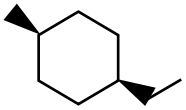
Intramolecular H–bonding
Chair conformation

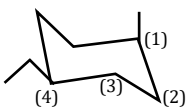
28. Ans. (B)

(B) During flipping a $\longleftrightarrow$ e, e $\longleftrightarrow$ a are inter convertible.



29. Ans. (B)


Cis–1, 4–disubstituted compound has a e configuration so 'Et' group is present at 'e' and 'Me' at 'a'



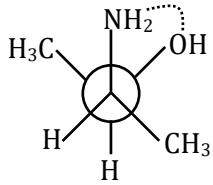
30. Ans. (A)

CH_3 group at equatorial position is more stable

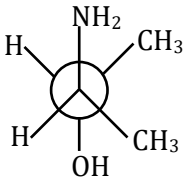
31. Ans. (A)

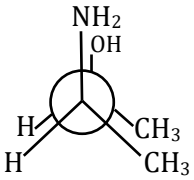
After ring flipping geometries remain same

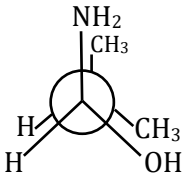
32. Ans. (A)

(A) 

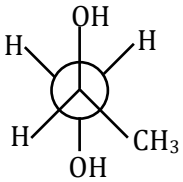
Due to intramolecular H–bonding

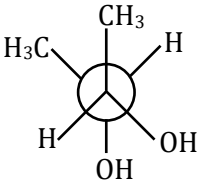
(B) 

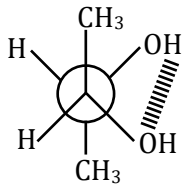
(C) 

(D) 

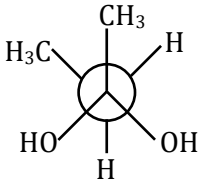
33. Ans. (C)

(A) 

(B) 

(C) 

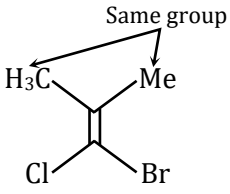
Due to Intramolecular H–Bonding

(D) 

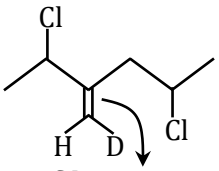
Potential energy $\propto \frac{1}{\text{Stability}}$

EXERCISE - S

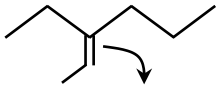
1. Ans. (9)

(I) 

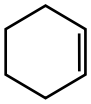
G.I. is absent

(II) 

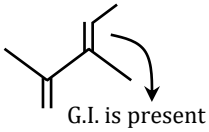
G.I. is present

(III) 

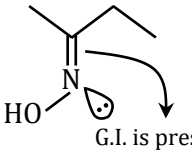
G.I. is present

(IV) 

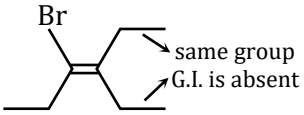
G.I. is absent

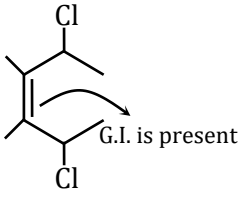
(V) 

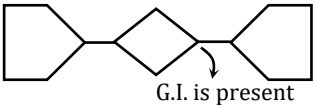
G.I. is present

(VI) 

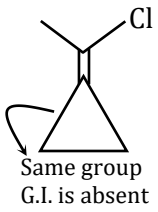
G.I. is present

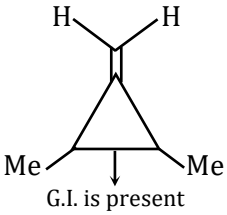
(VII) 

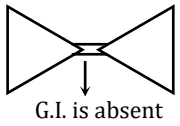
(VIII) 

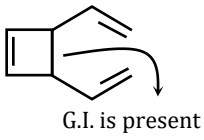
(IX) 

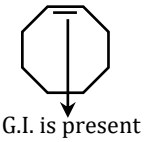
G.I. is present

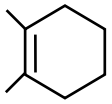
(X) 

(XI) 

(XII) 

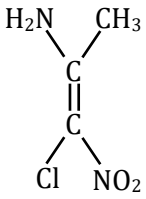
(XIII) 

(XIV) 

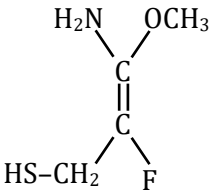
(XV) 

2. Ans. (5)

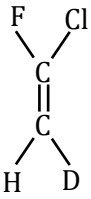
(i) Z ; (ii) Z ; (iii) Z ; (iv) E ; (v) E; (vi) E ; (vii) E ; (viii) E

(i) 

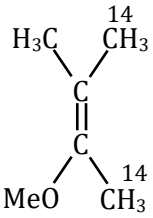
(Z)

(ii) 

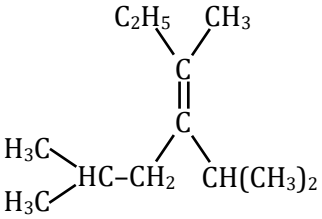
(Z)

(iii) 

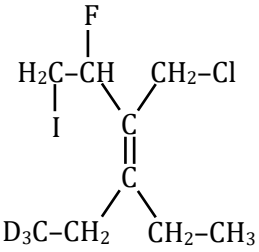
(Z)

(iv) 

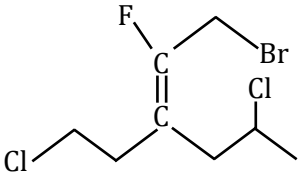
(E)

(v) 

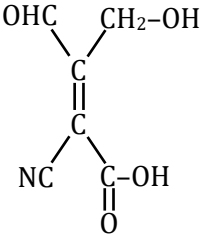
(E)

(vi) 

(E)

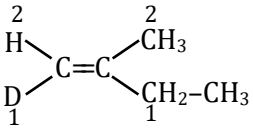
(vii) 

(E)

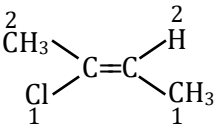
(viii) 

(E)

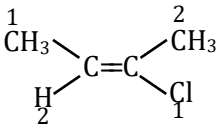
3. Ans. (3)

(i) 

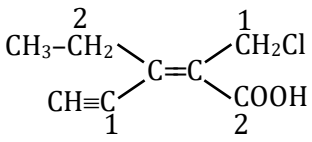
Z

(ii) 

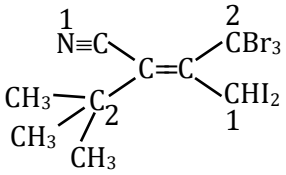
Z

(iii) 

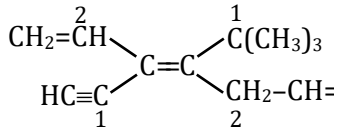
E

(iv) 

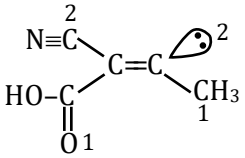
E

(v) 

E

(vi) 

E

(vii) 

Z

4. Ans. (23)

(i) $CH_3-\underset{\_\_\_\_\downarrow}{CH=CH}-CH_3$

One π-bond ⇒ 2 G.I

(ii) $CH_3-CH=CH-CH=CH_2$

one π bond, shows G.I. = 2

(iii) $CH_3-CH=CH-CH=NH$

Number of π-bonds showing G.I., n = 2

Number of G.I = $2^n = 2^2 = 4$

(iv) $CH_3-CH=CH-CH=CH-CH_3$

Symmetric , n = 2

number of G.I = $2^n - 2^{\frac{n}{2}-1} = 2^2 - 2^{\frac{2}{2}-1} = 4 - 2^\circ = 4 - 1 = 3$

(v) $CH_3-CH=CH-CH=CH-CH_2-Cl$

Number of π-bonds showing G.I., n = 2

Number of G.I = $2^n = 2^2 = 4$

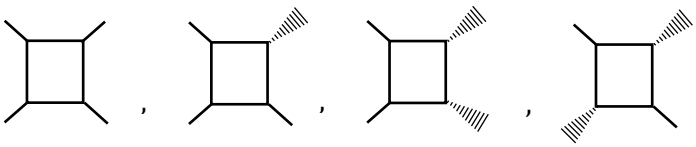
(vi) $CH_3-\underset{1}{\underbrace{CH=C=C=CH}}-\underset{2}{\underbrace{CH=CH}}-CH_2-\underset{3}{\underbrace{CH=NH}}$

n = 3

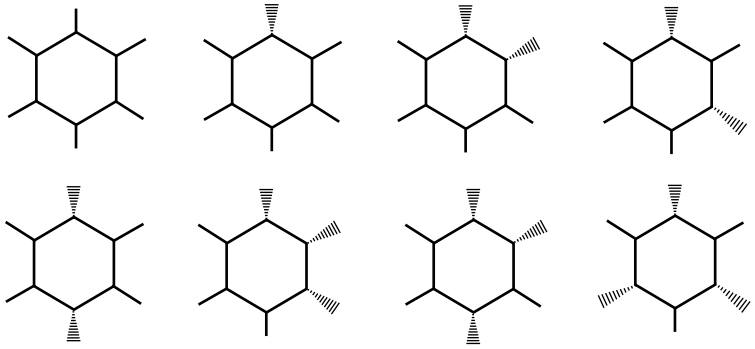
G.I = $2^n = 2^3 = 8$

Sum = 2 + 2 + 4 + 3 + 4 +8 = 23

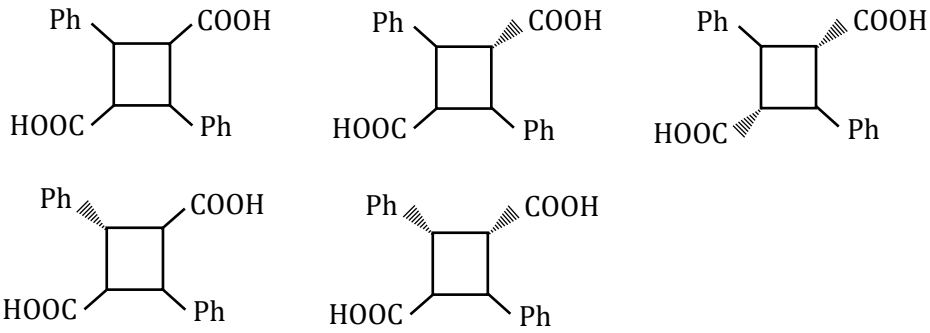
5. Ans. (4)



6. **Ans. (8)**



7. **Ans. (5)**



8. **Ans. (5.55)**

Unit = 1 = $\mu_A X_A + \mu_G X_G$

We know $\mu_A = 0$ μ_A : dipole moment of anti-form

Therefore $1 = \mu_G X_G$ μ_C : dipole moment of gauche-form

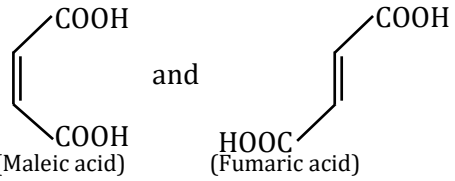
$1=\mu_G (1-X_A)$ X_AX_G : mole fraction of anti and gauche form, respectively

$=\mu_G (1-82)$

$$\mu_G = \frac{1}{18} = 5.5$$

EXERCISE - JEE (Mains) PYQ

1. Ans. (3)



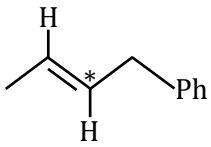
(Maleic acid) (Fumaric acid)

Geometrical isomers

2. Ans. (3)

More number of groups at equatorial positions, more stable will be the isomer.

3. Ans. (3)

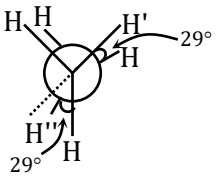


Shows G.I.

4. Ans. (2)

In 'I' identical groups are present on one side of double bond, so no geometrical isomerism.

5. Ans. (3)



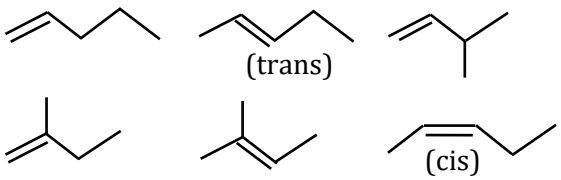
H'–C–C–H"

Hence angle between

H'—C–C–H" is

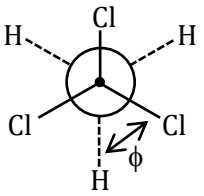
(120º + 29º) = 149º

6. Ans. (6)



7. Ans. (60)

1,1,1–Trichloro ethane [CCl_3–CH_3]



Dihedral angle (ϕ) = 60°

(Newman staggered form)

8. **Ans. (4)**

More stable less potential energy.

Stability order : I > III > IV > II

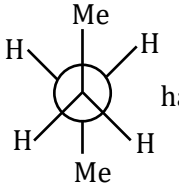
So Potential energy : II > IV > III > I

9. **Ans. (3)**

Dihedral angle : It's the angle b/w 2 specified groups ($-CH_3$ here)

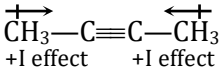
Staggered form is Given in option (C) & the angle is 180°

10. **Ans. (1)**

Conformation  has lowest vanderwaal and torsional strain. Hence it must be most stable.

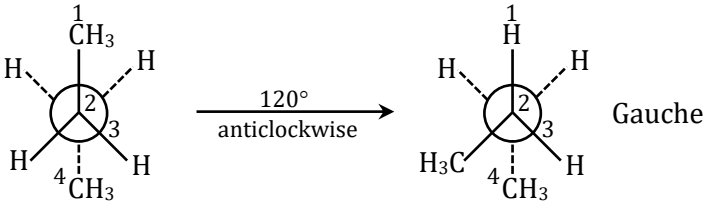
EXERCISE - JEE (Advanced) PYQ

1. **Ans. (B)**

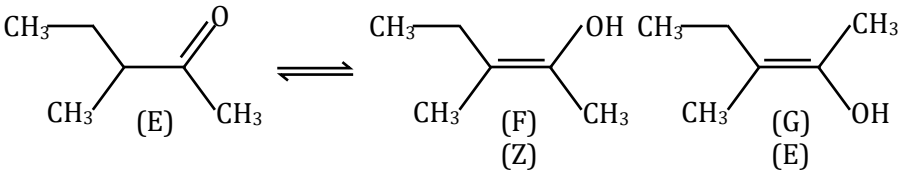


Net dipole moment is zero.

2. **Ans. (D)**



3. **Ans. (B,C,D)**



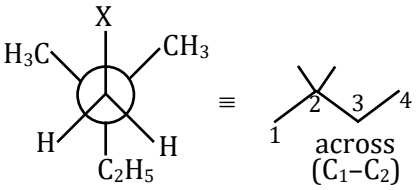
E, F and E, G are tautomers.

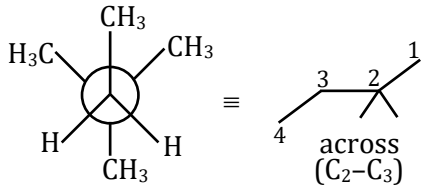
F and G are geometrical isomers and diastereomers.

4. **Ans. (C)**

Bond energy of a C–C single bond is approx = 100 kcal/mol

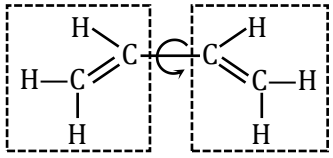
5. **Ans. (B,D)**





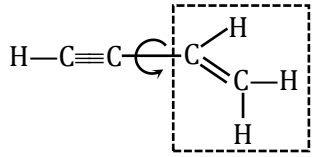
6. Ans. (B,C)

(A)



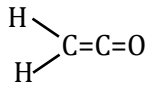
Both planes will not lie in same plane after rotation around (C–C) σ-bond.

(B)



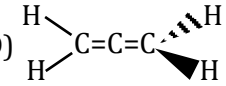
All atoms will remain in same plane despite rotation around (C–C) σ-bond.

(C)



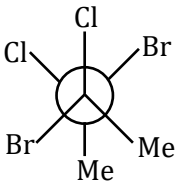
(all atoms lie in same plane)

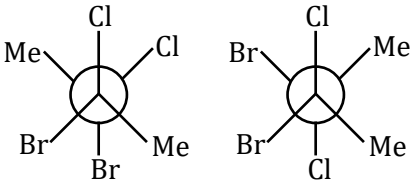
(D)



(Not all atoms are in same plane)

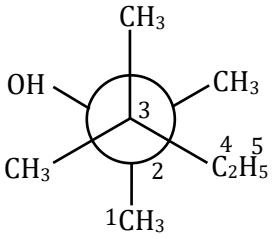
7. Ans. (3)



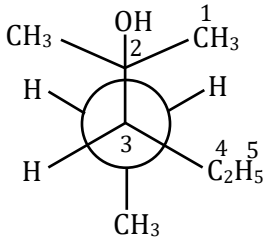


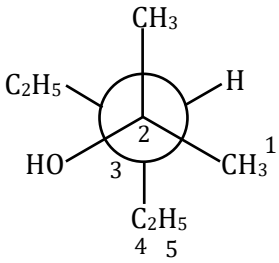
8. Ans. (C)

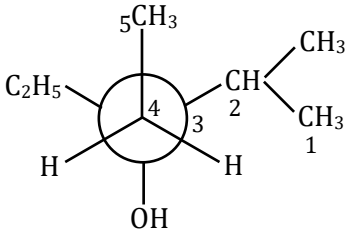
P.



2, 3, 3-trimethyl pentan-2-ol

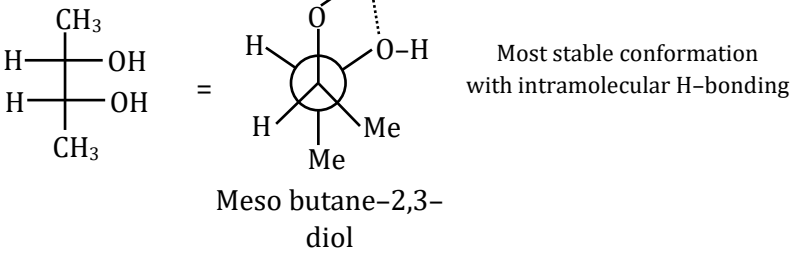
Q.  **3-**ethyl-2-methyl pentan-2-ol

R.  **3-**ethyl-2-methyl pentan-2-ol

S.  **3-**ethyl-2-methyl pentan-3-ol

Q and R is same.

9. Ans. (B)

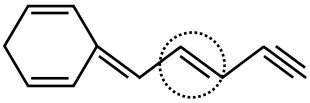


Meso butane–2,3–diol

JEE (Main) Practice Paper

SECTION-A

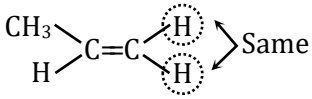
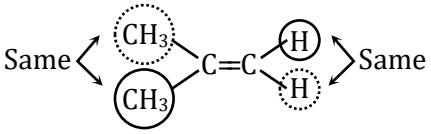
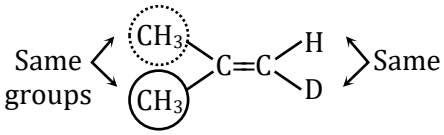
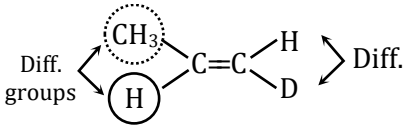
1. Ans. (1)



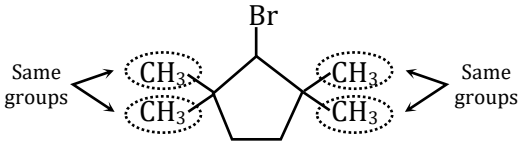
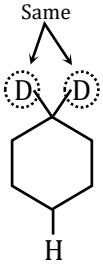
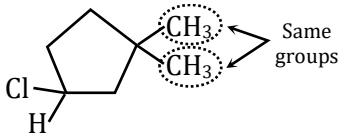
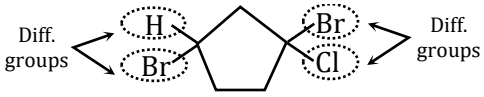
n = 1

Total G.I = $2^n = 2^1 = 2$

2. Ans. (4)

		G.I
(1)		×
(2)		×
(3)		×
(4)		✓

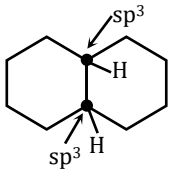
3. Ans. (4)

		G.I
(1)		×
(2)		×
(3)		×
(4)		✓

4. Ans. (2)

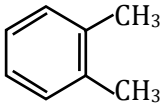
G.I

(1)  ×

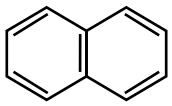
(2) 

✓

Bicyclo compound

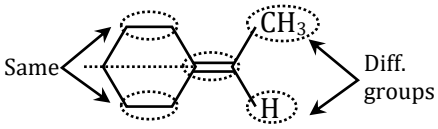
(3) 

×

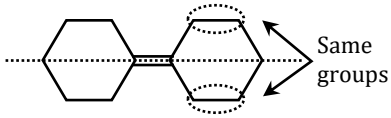
(4)  ×

5. Ans. (4)

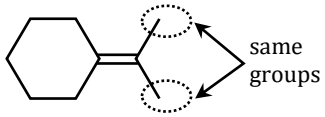
G.I

(1) 

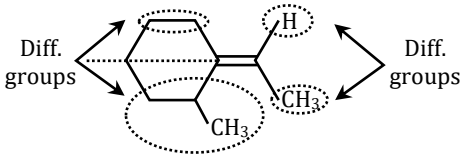
×

(2) 

×

(3) 

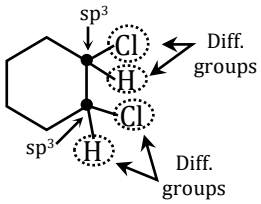
×

(4) 

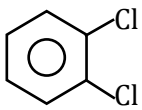
✓

6. Ans. (1)

G.I

(1) 

✓

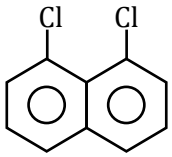
(2) 

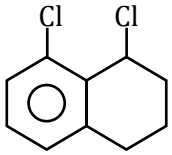
×

In 6 member Rings

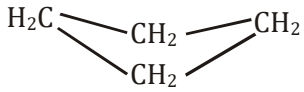
⇓

No. GI w.r.t (=)

(3)  ×

(4)  ×

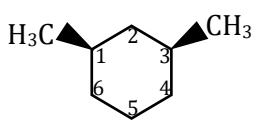
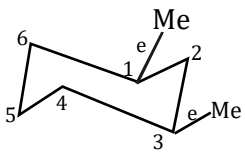
7. Ans. (1)

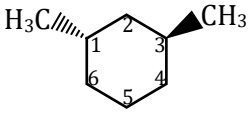
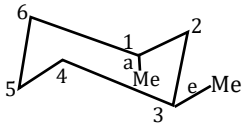
(1) 

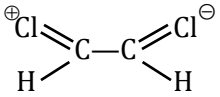
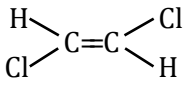
Cyclobutane is a non–planar compound

(2) In cyclo alkene

C ≥ 12 trans > cis ⇒ stability

(3)   ⇒ Both methyl groups at Equatorial so cis–form more stable

  ⇒ One of methyl groups at axial so trans–form relatively less stable

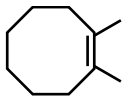
(4)  

⇓

Due electrostatic force of alteraction ⇒ cis effect

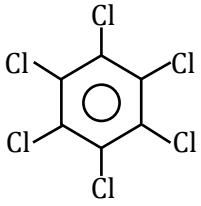
8. Ans. (2)

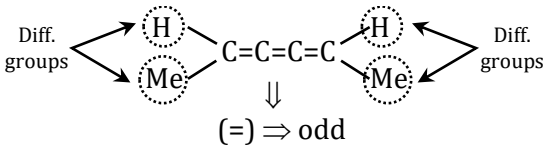
G.I

(1)  ✓

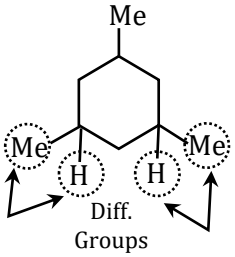
Cyclo ocfene

C ≥ 8 ⇒ G.I

(2)  ×

(3) 

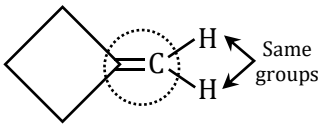
✓

(4) 

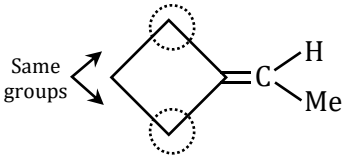
✓

9. Ans. (3)

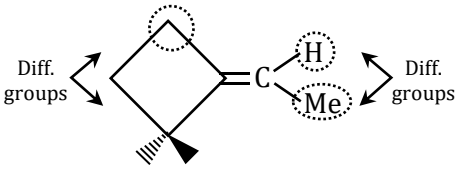
G.I

(1) 

✓

(2) 

×

(3) 

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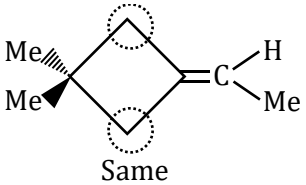
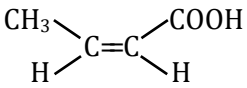
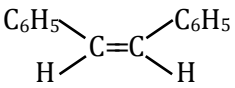
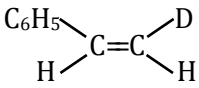
(4) 

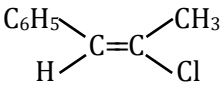
×

10. Ans. (4)

(1) 

(2) 

(3) 

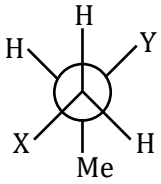
(4) 

⇒ for cis-trans nomenclature at least one group is same on both carbons of C=C

11. Ans. (1)

In (1) both groups are at equatorial position. So, least repulsion. Hence, more stable.

12. Ans. (1)



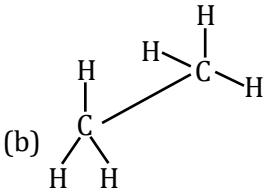
Newmann projection $CH_3-CH_2-\underset{\underset{CH_3}{|}}{CH}-CH_2-CH_2-CH_3$ about C_2-C_3 is

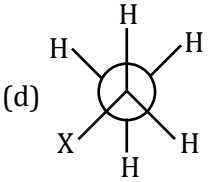
X & Y is

$X \rightarrow Me$

$Y \rightarrow Pr$

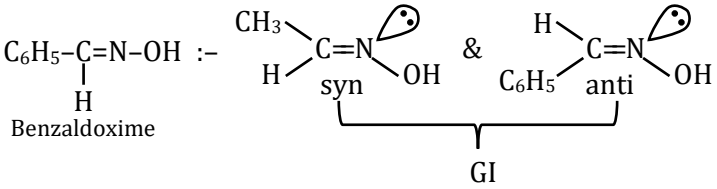
13. Ans. (3)



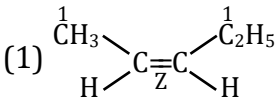


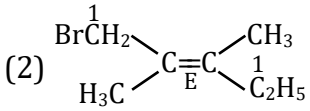
(b) and (d) both are staggered form

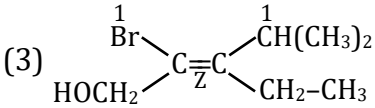
14. Ans. (4)

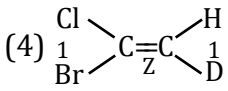


15. Ans. (2)



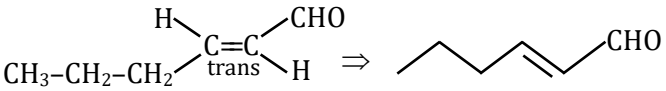




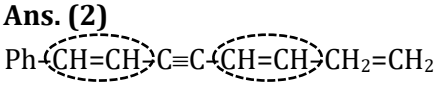


16. Ans. (2)

Trans-2-haxenal :-

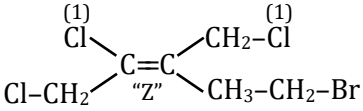


17. Ans. (2)



n = 2 G.I. = $2^n = 2^2 = 4$

18. Ans. (4)



Same group opposite side, so trans.

19. **Ans. (3)**

According to CIP rules, high priority group same side, so Z-form.

20. **Ans. (2)**

When number of double bonds are even with different ends formula is 2^n where n is the number of double bond, so $2^4 = 16$

SECTION-B

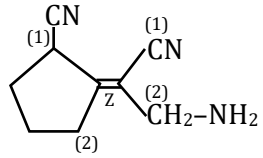
1. **Ans. (4)**

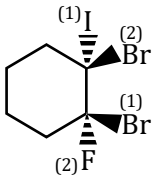
C_6H_{12}

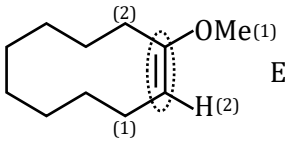
$CH_3-CH_2-CH_2-CH=CH-CH_3$, $CH_3-CH_2-CH=\underset{\displaystyle CH_3}{\underset{|}{C}}-CH_3$, $CH_3-CH_2-\underset{\displaystyle CH_3}{\underset{|}{C}}=CH-CH_3$,

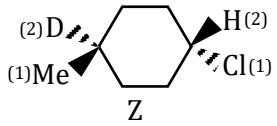
$CH_3-CH_2-CH=CH-CH-CH_3$

2. **Ans. (2112)**

(1) 

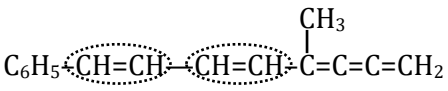
(2) 

(3) 

(4) 

ZEEZ $\Rightarrow$ 2112

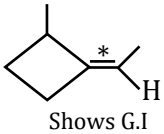
3. **Ans. (4)**



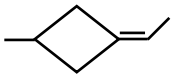
n = 2

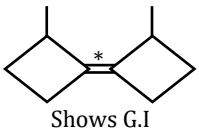
Total G.I. = $2^n = 2^2 = 4$

4. **Ans. (6)**

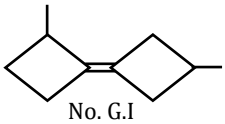
(a) 

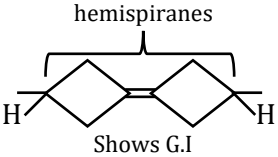
Shows G.I

(b) 
No. G.I

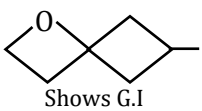
(c) 

Shows G.I

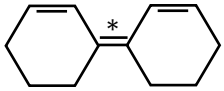
(d) 
No. G.I

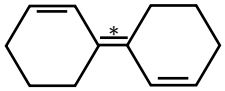
(e) 

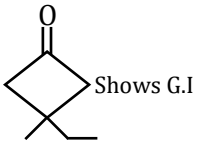
Shows G.I

(f) 

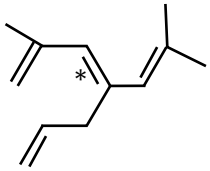
Shows G.I

(g) 
Shows G.I

(h) 
Shows G.I

(i) 
Shows G.I

5. Ans. (2)



$\Rightarrow$ n = 1

$\Rightarrow$ unsymmetrical

$\Rightarrow$ GI = $2^1 = 2$

6. Ans. (6)

symmetrical n = 3 (odd)

$\therefore\ 2^{n-1} + 2^{\frac{n-1}{2}} = \text{G.I.} = 6$

7. Ans. (3)

Bulky group is stable at equitorial position. So, most bulky group must be at equatorial.

So, ring flipping equilibrium constant is greater than 1 for (i), (ii) and (v)

8. Ans. (5)

All up $\rightarrow$ 1

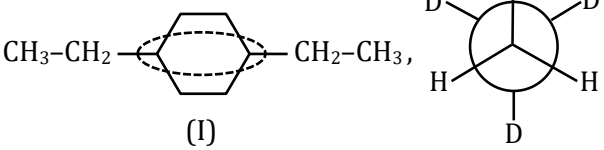
1 COOH up $\rightarrow$ 1

1 Ph up $\rightarrow$ 1

COOH, Ph up $\rightarrow$ 1

2 COOH up $\rightarrow$ 1

9. Ans. (3)


(I)

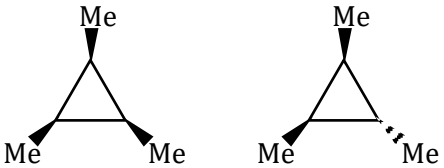
(II)

anti-form

G.I = 2 = p , q = 1

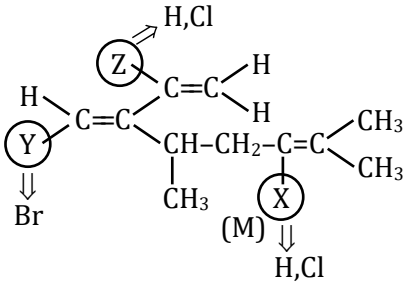
p + q = 2 + 1 = 3

10. Ans. (2)



JEE (Advanced) Practice Paper

1. Ans. (C)



(Z) and (X) containing alkene cannot show G.I. in which XYC = (CXY)

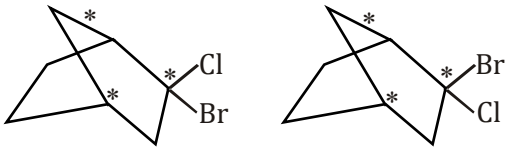
X, Y are same, only Y-containing alkene can show G.I. so w.r.t given question Y must Be, Br.

2. Ans. (D)

In (x) both $-CH_3$ are in anti-orientation while in (Y) both $-CH_3$ are in Gauche orientation.

so stable ; x > y (repulsion factor)

3. Ans. (C)



Way-1 : Stereo-isomers which aren't mirror image of each other, are diastereomers.

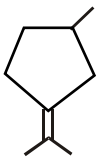
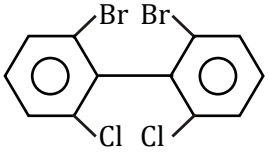
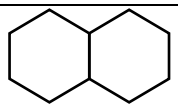
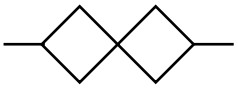
Way-2 : Out of 3 chiral centre, there is change in-configuration only 1 chiral centre. Rest two are rigid. So both compound are diastereomers.

4. Ans. (A)

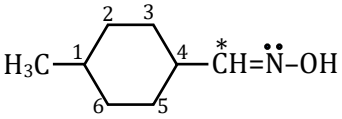
Stability order ⇒ Chair form > Twist boat form > Boat form > Half chair form

⇒ Due to least Torsional strain & Steric strain, chair form is most stable conformer of cyclohexane.

5. Ans. (C)

(A)		(B)	
	Optical isomerism		Optical isomerism
(C)		(D)	
	Cis & trans isomerism		Optical isomerism

6. Ans. (B)



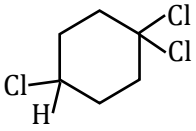
⇒ n = 2 (1,4, position & C= N)

⇒ unsymmetrical

⇒ GI = $2^n=2^2 = 4$

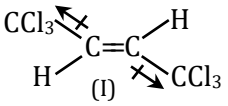
7. **Ans. (D)**

⇒ For GI in monocyclic compounds there should be two difference groups present on at least two difference sp^3-carbons of ring.

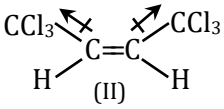


⇒ No GI

8. **Ans. (D)**



(I)
μ=0
trans



(II)
μ≠0
cis

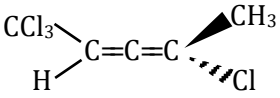
⇒ Dipole moment :- II > I

⇒ BP :- II > I

⇒ MP : - I > II

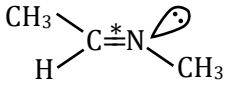
⇒ Stability : I > II

9. **Ans. (A)**

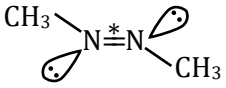
(A) 

⇒ Even number of C = C allene

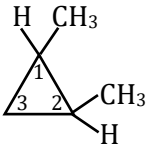
⇒ show OI not GI

(B) 

⇒ show GI

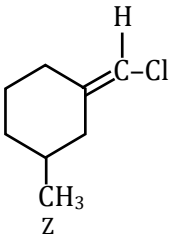
(C) 

⇒ show GI

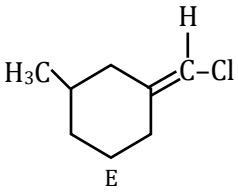
(D) 

⇒ show GI from (1, 2) position

10. **Ans. (D)**



Z

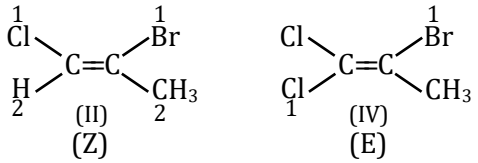


E

Geometrical isomers

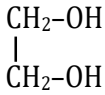
11. Ans. (C)

Pair of geometrical isomers

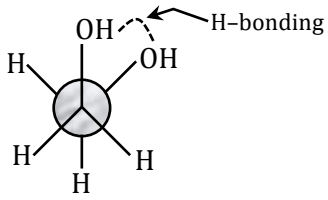


Option II & IV are geometrical isomers.

12. Ans. (C)

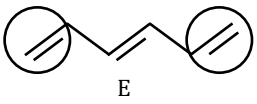


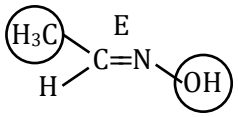
Most stable conformer of ethylene glycol

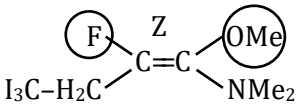


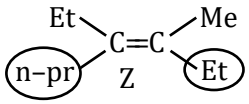
Gauche form is most stable due to presence of H-Bonding.

13. Ans. (A,B)

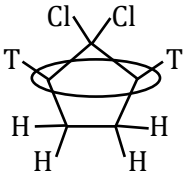
(A) 

(B) 

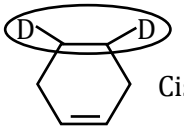
(C) 

(D) 

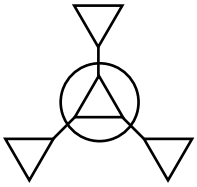
14. Ans. (A,B,C)

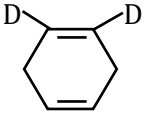
(A) 

Cis and Trans

(B) 

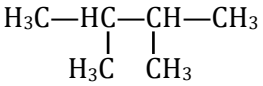
Cis and Trans

(C) 
Cis and Trans

(D) 

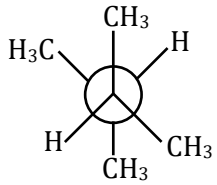
No. Geometrical isomerism is possible for the given compound

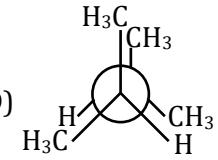
15. **Ans. (B, D)**



2, 3 – Dimethyl butane

Newman projection formula of 2,3–Dimethylbutane across C_2 and C_3 bond

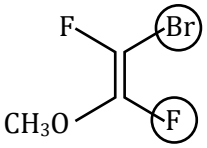
(C) 

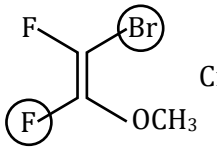
(D) 

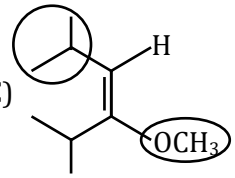
16. **Ans. (B,C)**

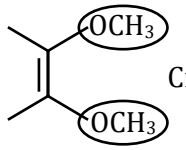
B and C have identical groups on one side of double bond. So, no geometrical isomerism.

17. **Ans. (A)**

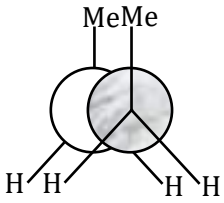
(A)  Trans, Z

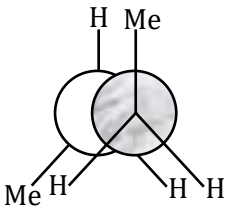
(B)  Cis, E

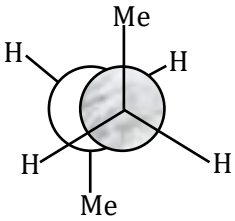
(C)  Cis, E

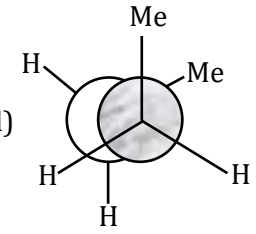
(D)  Cis, Z

18. **Ans. (C)**

(a)  Fully eclipsed form → (p)

(b)  Partially eclipsed form→ (q)

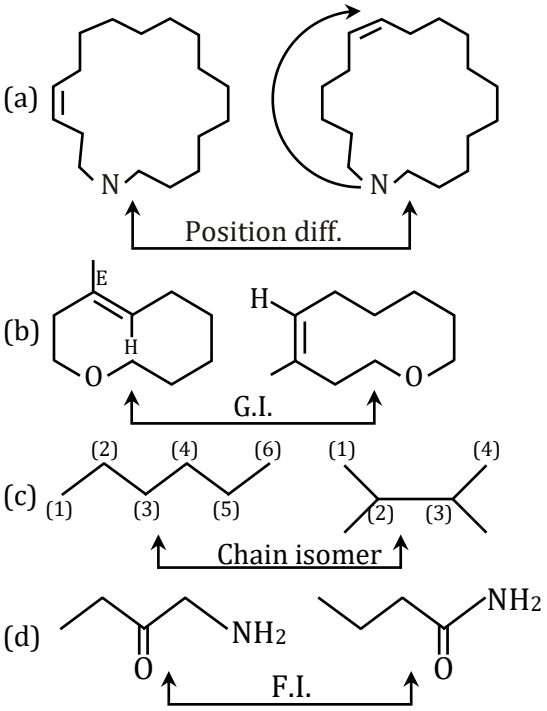
(c)  staggered form → (s)

(d) 

Gauche form → (r)

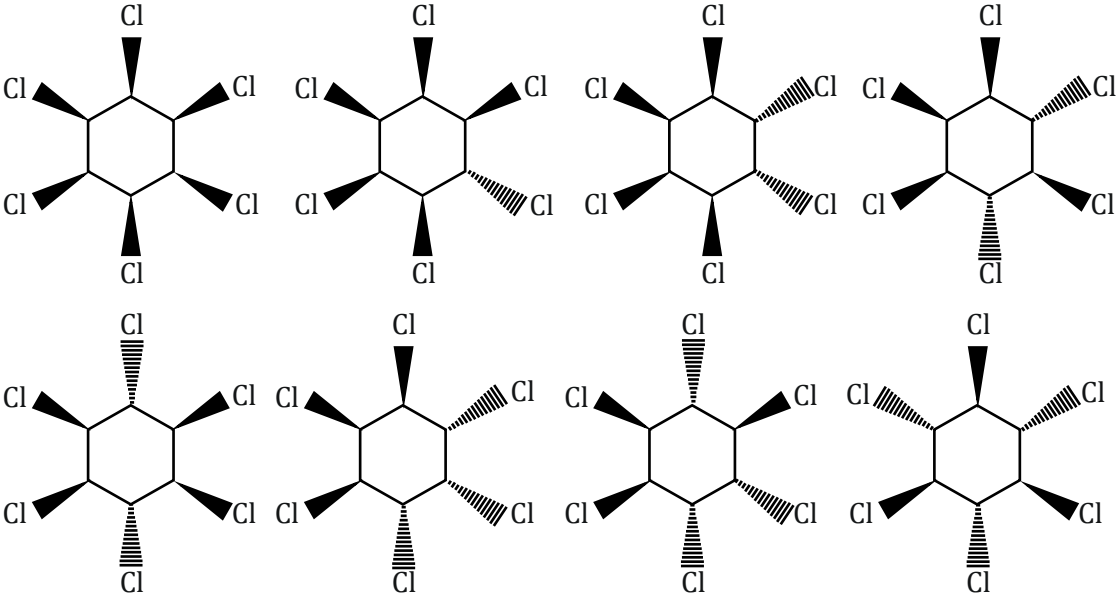
(a – p) (b – q) (c – s) (d – r)

19. Ans. (3124)



(a) 3 (b) 1 (c) 2 (d) 4

20. Ans. (8)



Total 8 geometrical isomers