Organic Chemistry

Valence Electrons

Valence $\bar{e}$ = outermost shell electrons

Valence $\bar{e}$ determine no. of covalent bonds
x

13th	14th	15th	16th	17th
3	4	5	6	7
x	x	x	x	x
B	C	N	O	F
Al	Si	P	S	Cl
Ga	Ge	As	Se	Br
In	Sn	Sb	Te	I
Tl	Pb	Bi	Po	At

Alkanes → C–C
↓
single bonds

C_nH_{2n+2}

n = no. of carbon atoms

n = 1

$C_1H_{2\times1+2} = CH_4$

n = 2

$C_2H_{2\times2+2} = C_2H_6$

n = 3

$C_3H_{2\times3+2} = C_3H_8$

Alkenes → C=C
↓
double bonds

C_nH_{2n}

n = 2 C_2H_4

n = 3 C_3H_6

n = 4 C_4H_8

Alkynes → C≡C
↓
triple bonds

C_nH_{2n-2}

n = 2 C_2H_2

n = 3 C_3H_4

n = 4 C_4H_6

Which of the following is an Alkane ?

(a) C_3H_6 (b) C_6H_{14}

(c) C_6H_{10} (d) None of these

How to count the number of Hydrogen atoms?

No. of H-atoms attached to Carbon

$= 4 - y$

y → no. of bonds already formed

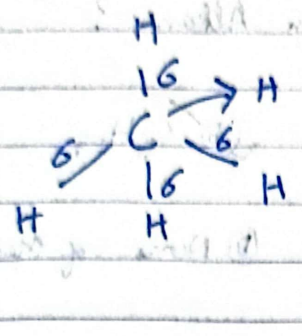
How to find Hybridisation and Count no. of sigma and pie bonds

Hybridisation (H)

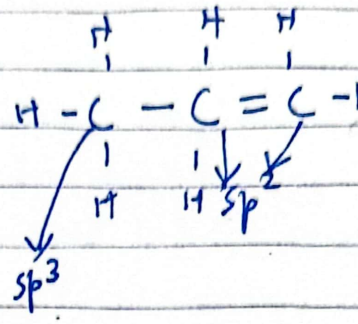
= no. of σ bonds + no. of L-P. = 4 ⇒ sp^3
" " " " " " " " = 3 ⇒ sp^2
" " " " " " " " = 2 ⇒ sp

Single bond b/w atoms = 1σ
double " " " = 1σ + 1π
triple " " " = 1σ + 2π

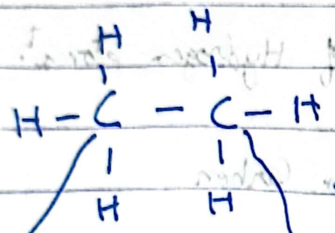
Q-



$H = 4 + 0 = 4 \Rightarrow sp^3$



Q-



$4+0=4 \Downarrow sp^3$

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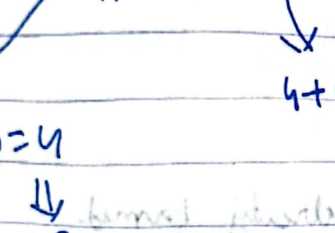
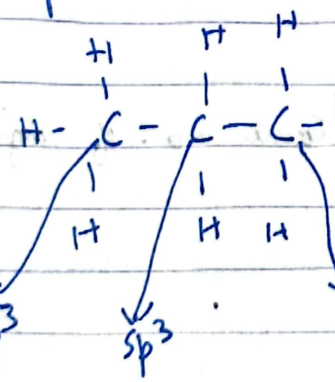
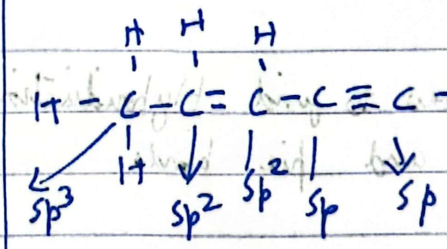


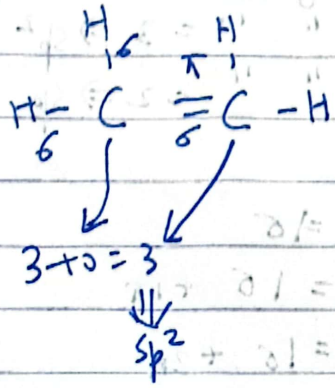
$2\sigma + 0\ L.P = 2 \Downarrow sp$

Q-





Q-



$3+0=3 \Downarrow sp^2$

Which of the following compounds contain all the carbon atoms in same hybridisation state?

(A) $\overset{sp}{H-C} \equiv \overset{sp}{C} - \overset{sp}{C} \equiv \overset{sp}{C} - H$

(B) $CH_3 - C \equiv C - CH_2$

(C) $\overset{sp^2}{CH_2} = \overset{sp^2}{C} = \overset{sp^2}{CH_2}$

(D) $\overset{sp^2}{CH_2} = \overset{sp^2}{CH} - \overset{sp^2}{CH} = \overset{sp^2}{CH_2}$

Assertion (A): All the carbon atoms in $\overset{sp^2}{H_2C} = \overset{sp}{C} = \overset{sp^2}{CH_2}$ are sp^2 hybridised ✗

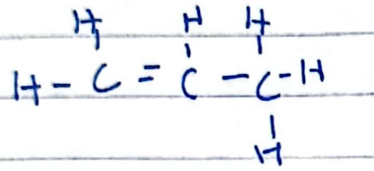
Reason: In this molecule all the carbon atoms are attached to each other by double bonds. ✓

A is not correct but R is correct

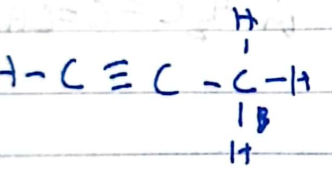
How to Represent an Organic Compound

→ Condensed Representation of Organic Compound

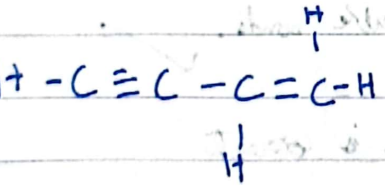
		Condensed
C_2H_6	→ Alkane	H_3CCH_3
C_3H_8	→ Propane	$H_3C{\cdot}CH_2CH_3$



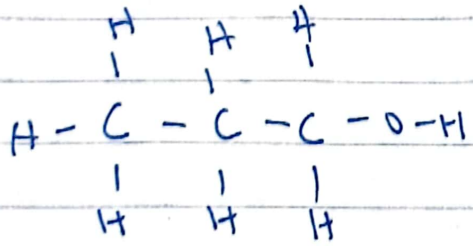
$H_2C{=}CHCH_3$



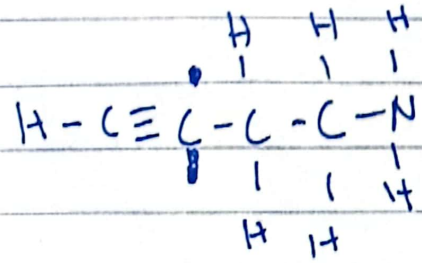
$HC{\equiv}CCH_3$



$HC{\equiv}CCH{=}CH_2$



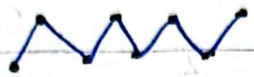
$H_3CCH_2CH_2OH$



$HC{\equiv}CCH_2CH_2NH_2$

→ Bond Line Representation

① Draw lines in Zig-Zag manner



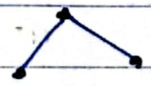
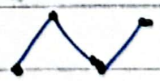
② No of corner = no. of C-atoms

③ — = single bond

= double bond

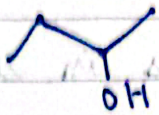
≡ = triple bond

④ H not written

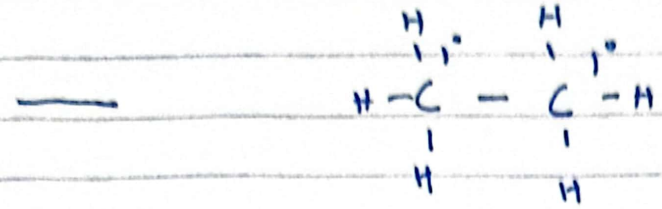
	Bond Line
H_3C-CH_3	—
$CH_3-CH_2-CH_3$	
$CH_3-CH_2-CH_2-CH_3$	
$CH_3CH=CH_2$	

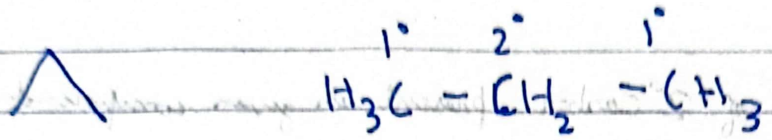
$CH_3CH=CHC\equiv CH$

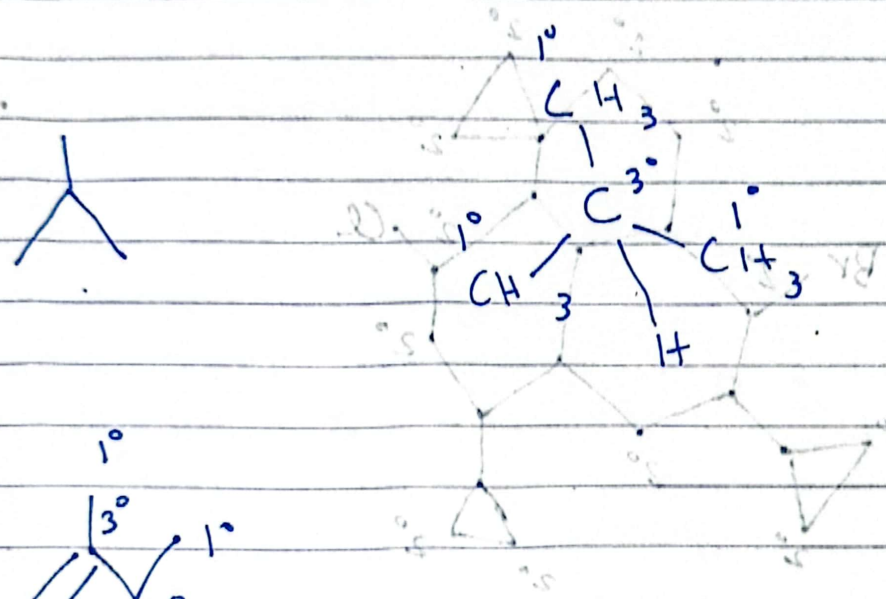
$CH_3CH_2\underset{OH}{\underset{|}{C}}HCH_3$

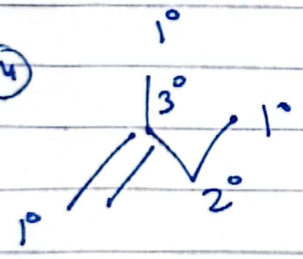


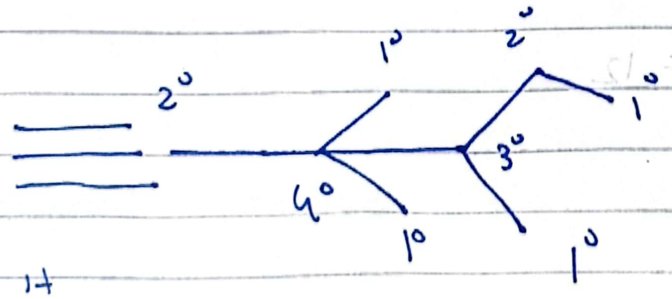
$\overset{1}{H_2C}=\overset{2}{C}H\overset{3}{C}\equiv\overset{4}{C}\overset{5}{C}H\overset{6}{C}H_3$
$\quad\quad\quad

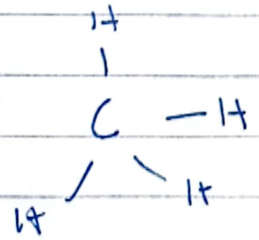
① 

② 

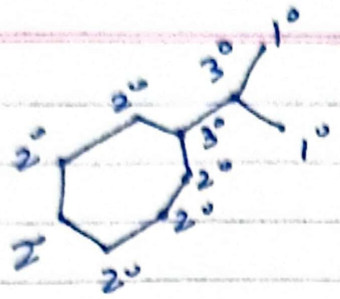
③ 

④ 

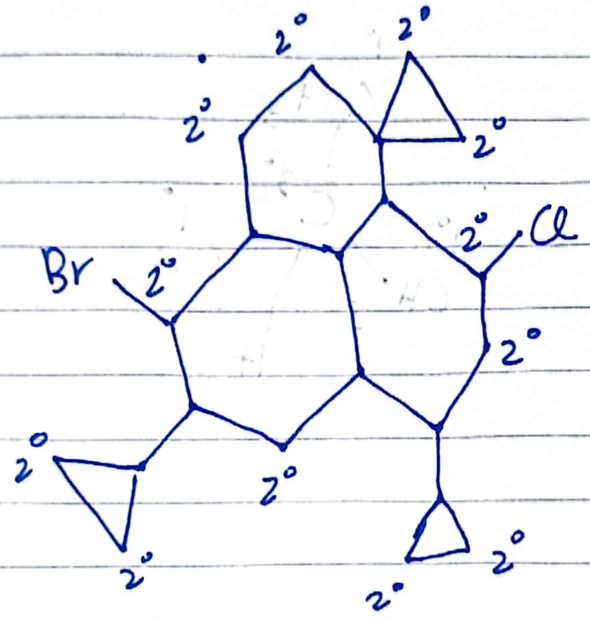
⑤ 

⑥  Super primary.

(2)



Q- Total no. of 2° carbon present in given compound



2° = 12

Degree of Hydrogen

Hydrogen attached to carbon

Find the numbers of 1°, 2° and 3° H-atoms in the following compounds.

	1°	2°	3°
(a) $CH_3-CH(CH_3)-CH_3$	9	0	1
(b) $CH_3-CH_2-CH_3$	6	2	0
(c) $CH_3-CH_2-CH_2-CH_3$	6	4	0

A compound with no tertiary hydrogen is :

(A) $(CH_3)_3CCH(CH_3)_2$

(B) $(CH_3)_3CCH_2CH_3$

(C) $(CH_3)_2CHCH_2CH_2CH_3$

(D) None of these

Degree of Carbon in Alkyl Halide

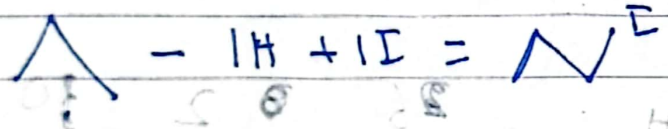
Alkyl Halide = Alkane − 1H + 1X

↓

Halogen (X) = (F, Cl, Br, I)

$CH_4 - 1H + 1Cl = CH_3Cl$

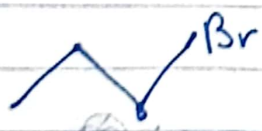
$C_2H_6 - 1H + 1Br = C_2H_5Br$

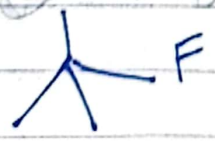


Halogen attached to carbon

↓

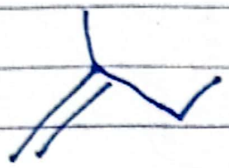
Degree of carbon = Degree of alkyl halide





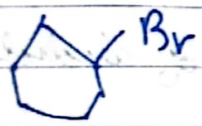
3°

2°

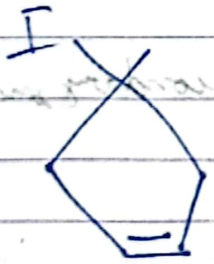


2°

1°



2°



3°

Degree of Carbon in Alcohol

Alkyl Alcohol = Alkane − 1H + 1OH

$CH_4 - 1H + 1OH = CH_3OH$

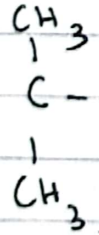
$C_2H_6 - 1H + 1OH = C_2H_5OH$

Alcohol (-OH) attached to carbon

↓

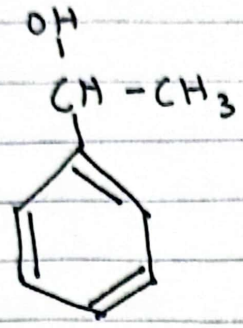
Degree of carbon = Degree of alcohol.

Q- Classify the following as primary, secondary and tertiary alcohols

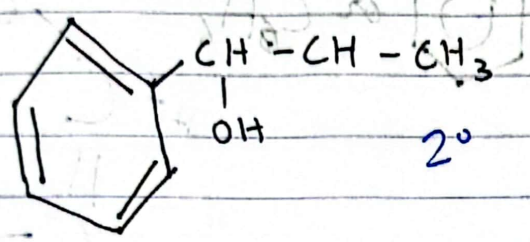
(1) 

(2) $H_2C=CH-CH_2OH$ 1°

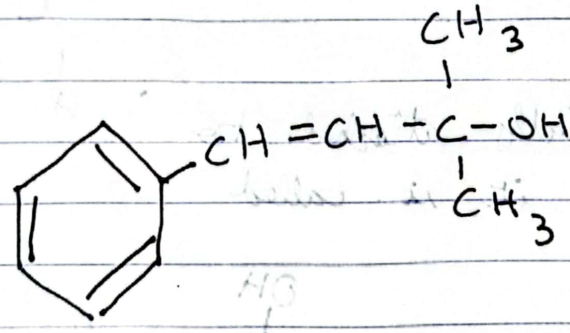
(3) $CH_3-CH_2-CH_2-OH$ 1°

(4) 

2°

(5) 

2°

(6) 

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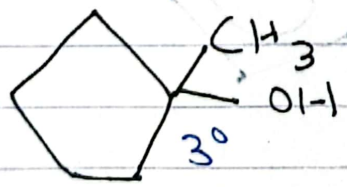
(7) 

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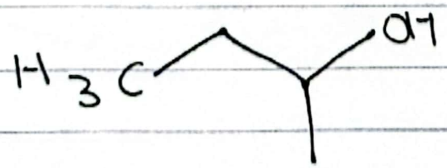
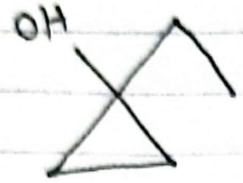
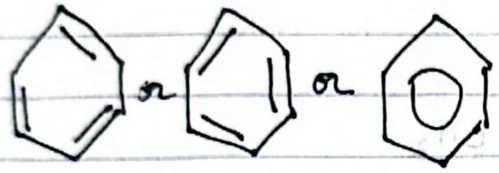
(8) 

2°

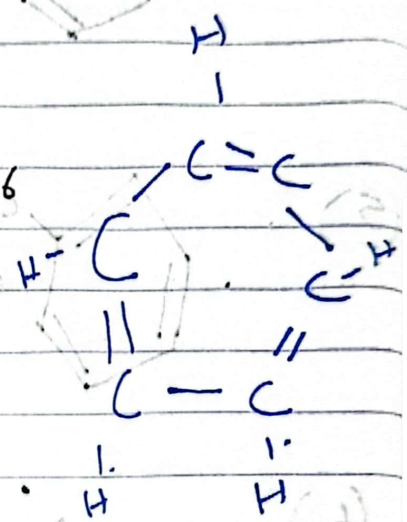
•) 

3°

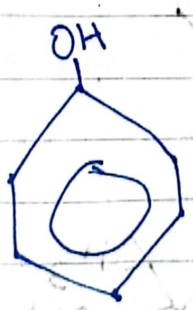


C_6H_6

Benzene



When -OH directly attached to benzene ring it is called phenol



Degree of Amines

Alkane - 1H + 1NH_2 = Alkyl Amine

$CH_4 - 1H + NH_2 = CH_3NH_2$

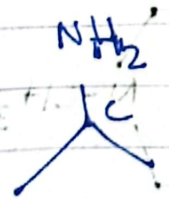
$C_2H_6 - 1H + 1NH_2 = C_2H_5NH_2$

If N of amine is attached to 1-C it is Primary or Pri or 1° amine

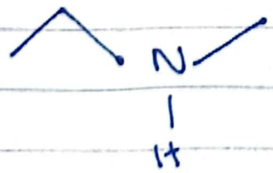
" " " " " " " 2-C " " Secondary or Sec or 2° amine

" " " " " " " " 3-C Tertiary or Ter or 3° amine

" " " " " " " " 4-C Quarternary or Que or 4° amine



1° amine



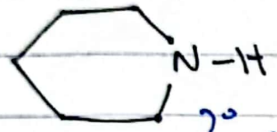
2° amine

3° amine

4° amine

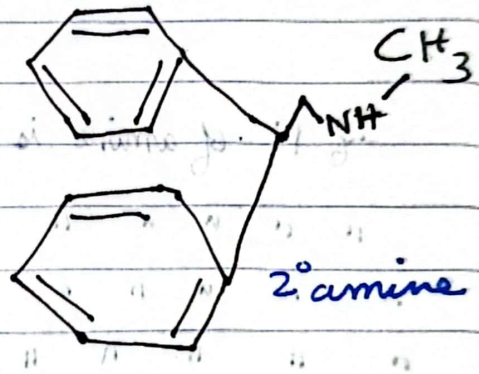
Indicate the following as 1°, 2° and 3° amines

(A)



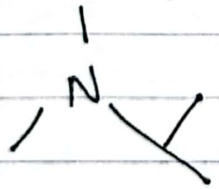
2° amine

(B)



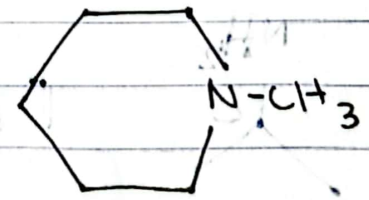
2° amine

(C)



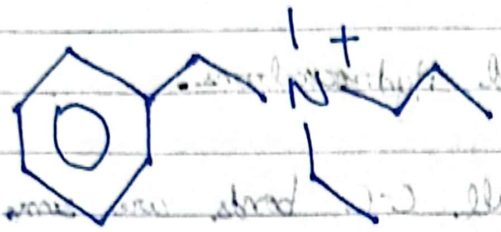
3° amine

(D)



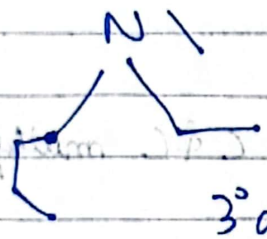
3° amine

(1)



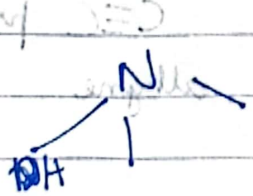
4° amine

(2)



3° amine

(3)



2° amine

Saturated and Unsaturated Hydrocarbons

Saturated hydrocarbon - all C-C bonds are ~~same~~ single

Eg. - Alkanes

Unsaturated hydrocarbon - atleast one C & C multiple bond present

C=C present
alkene

C≡C present
alkyne

Hydrogenation

$$\text{Unsaturated hydrocarbon} + H_2 \xrightarrow[\Delta]{Ni/Pt/Pd} \text{Alkane}$$

$$CH_2=CH_2 + 1H_2 \xrightarrow[\text{''}]{\text{''}} CH_3-CH_3 \text{ or } C_2H_6$$

$$H-C\equiv C-H + 2H_2 \xrightarrow[\text{''}]{\text{''}} H-C-C-H$$

Degree of Unsaturation (D.U.) or Double Bond Equivalents (D.B.E.) or Index of Hydrogen Deficiency (I.H.D.)

Max.^{m} no. of H-atoms that can be attached with carbon is given by formula C_nH_{2n+2}

		I.H.D
$C_2H_2 + 2H_2 \rightarrow C_2H_6$ (max. H_2)	2 H_2 deficient	2
$C_2H_4 + 1H_2 \rightarrow C_2H_6$		1
$C_3H_6 + 1H_2 \rightarrow C_3H_8$		1

① I.H.D is present due to π-bond or rings.

② I.H.D = 0 if neither π-bond nor ring present

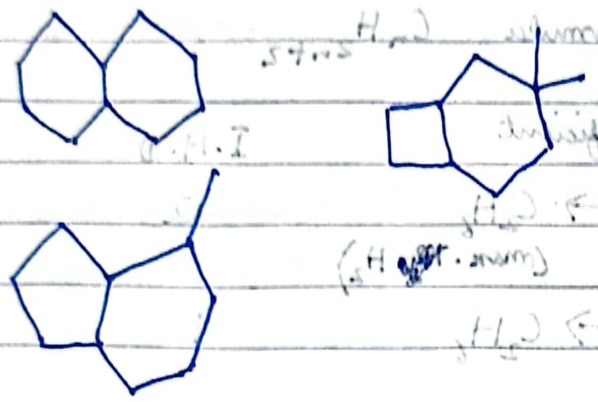
I.H.D = 1 if either π-bond or ring present.

I.H.D = 2 if either 2π-bonds
or
2 rings
or
1π-bond & 1 ring

$$C_{10}H_{18} + 2H_2 \longrightarrow C_{10}H_{22}$$

$\downarrow$

I.H.D = 2



How to find D.U. if formula is given?

$$I.H.D. = (C+1) - \frac{(H+X-N)}{2}$$

C = no. of C atoms

H = no. of H atoms

X = no. of Halogen atoms (any monovalent atom)

N = no. of Nitrogen atoms (any trivalent atom)

IHD

① C_3H_8 $\quad (3+1) - \frac{(8+0-0)}{2}$

$= 4-4 = 0$

② C_3H_6 $\quad (4+1) - \frac{(6+0-0)}{2}$

$= 4-3 = 1$

③ C_3H_4 $\quad (3+1) - \frac{(4+0-0)}{2}$

$= 4-2 = 2$

④ C_5H_{12} $\quad (5+1) - \frac{(12+0-0)}{2}$

$6-6=0$

⑤ $C_{10}H_8$ $\quad (10+1) - \frac{(8+0-0)}{2}$

$= 11-4$

$= 7$

I.H.D.

⑥ C_2H_5Cl $\quad (2+1) - \frac{(5+1-0)}{2}$

$= 3-3$

$= 0$

⑦ C_3H_6O $\quad (3+1) - \frac{(6+0-0)}{2}$

$= 4-3 = 1$

⑧ C_2H_7N $\quad (2+1) - \frac{(7+0-1)}{2}$

$= 3-3 = 0$

⑨ C_2H_6S $\quad (2+1) - \frac{(6+0-0)}{2}$

$= 0$

⑩ CH_3COOH $\quad (2+1) - \frac{(4+0-0)}{2}$

$= 1$

(11) CH_3COO^-

I.H.D.

$$3 - \frac{(3+0-0)}{2}$$

$$= 3 - \frac{3}{2}$$

$$= 1.5$$

(12) C_4H_8O

$$(4+1) - \frac{(8+0-0)}{2}$$

$$= 5 - 4 = 1$$

How to find D.U. if structure is given?

D.U. = 1 → 1π
→ 1 ring

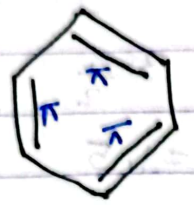
D.U. = 2 → 2π
→ 2 ring
→ 1π & 1 ring

1 ring = 1 D.U.

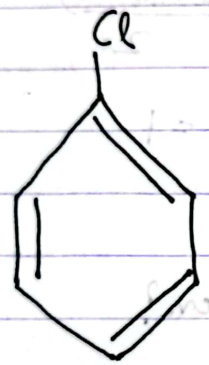
1 π-bond = 1 D.U.

No. of π-bond + No. of ring = I.H.D

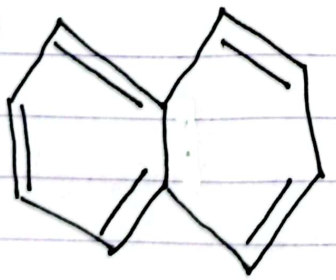
Calculate D.B.E value-

① 

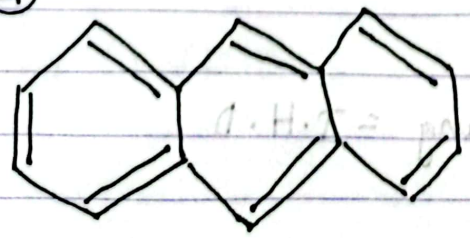
IHD = 1 ring + 3π bond = 4

② 

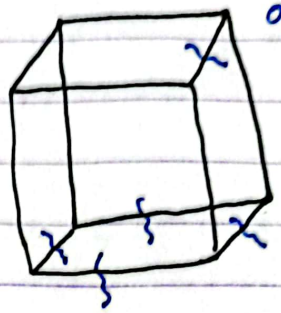
1+3 = 4

③ 

2 + 5 = 7

④ 

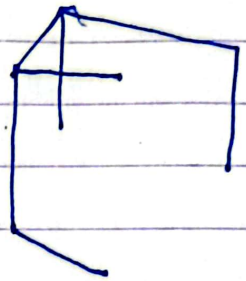
3 + 7 = 10

⑤ 

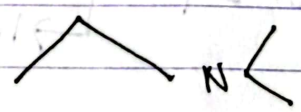
C_8H_8

$9 - \frac{(8+0-8)}{2}$

$= 5$

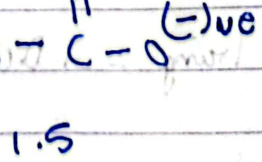


5

⑥ 

0

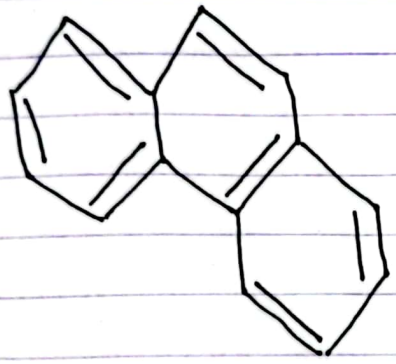
⑦ $HCOO^-$



1.5

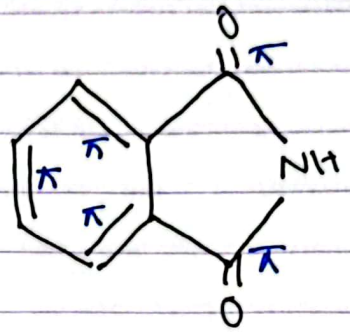
No. of σ or π bond broken to get open chain saturated Hydrocarbon determines I.H.D

(8)



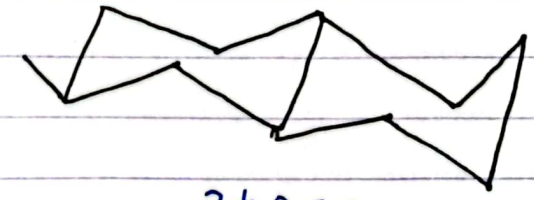
3+7
= 10

(10)



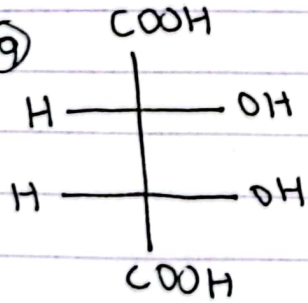
= 5+2 = 7

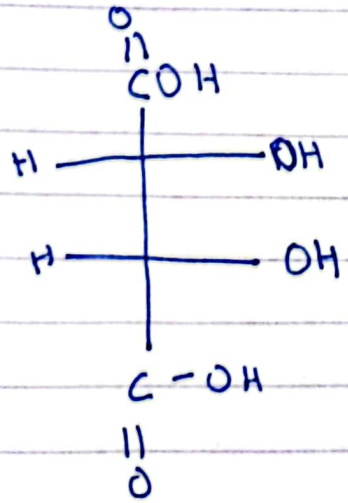
(11)



2+0 = 2

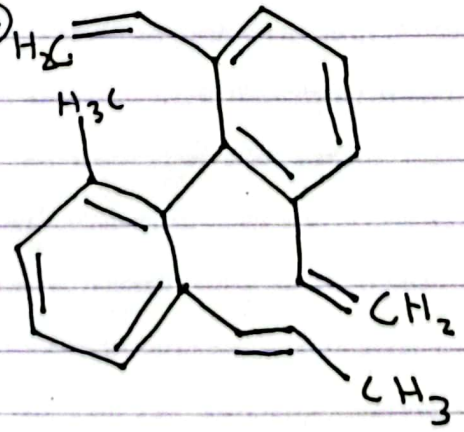
(9)





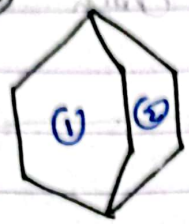
= 2

(12)



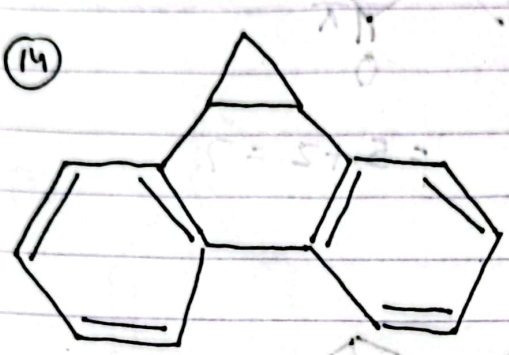
2+9 = 11

(13)



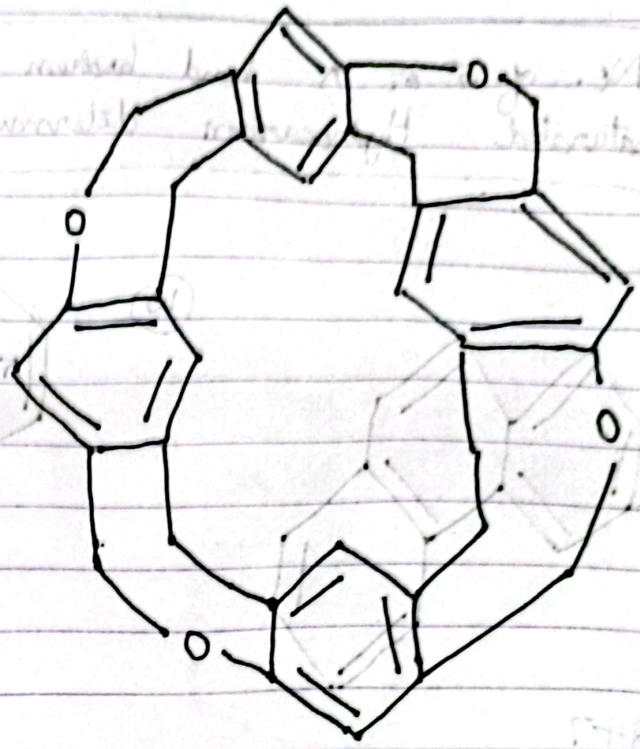
2

(14)



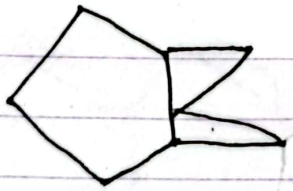
4 + 6 = 10

(17)



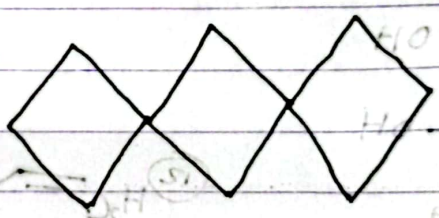
9 + 12 = 21

(15)



3

(18)

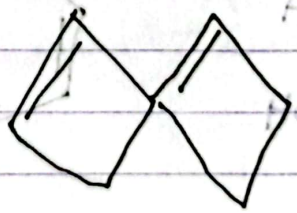


3

(16)

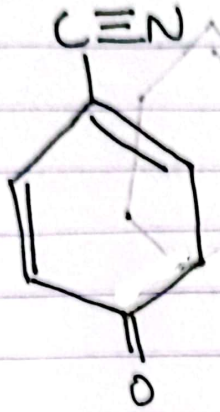
1 + 2 = 3

(19)



2 + 2 = 4

(20)

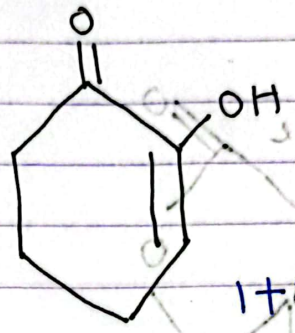


1+5= 6

(23)

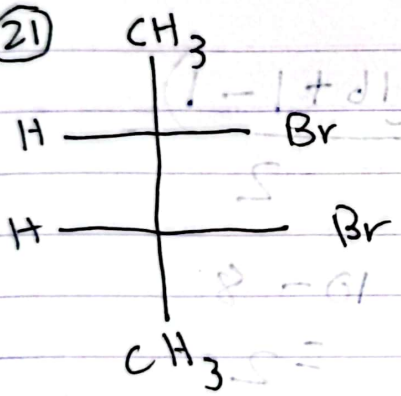
1+3=4

(24)



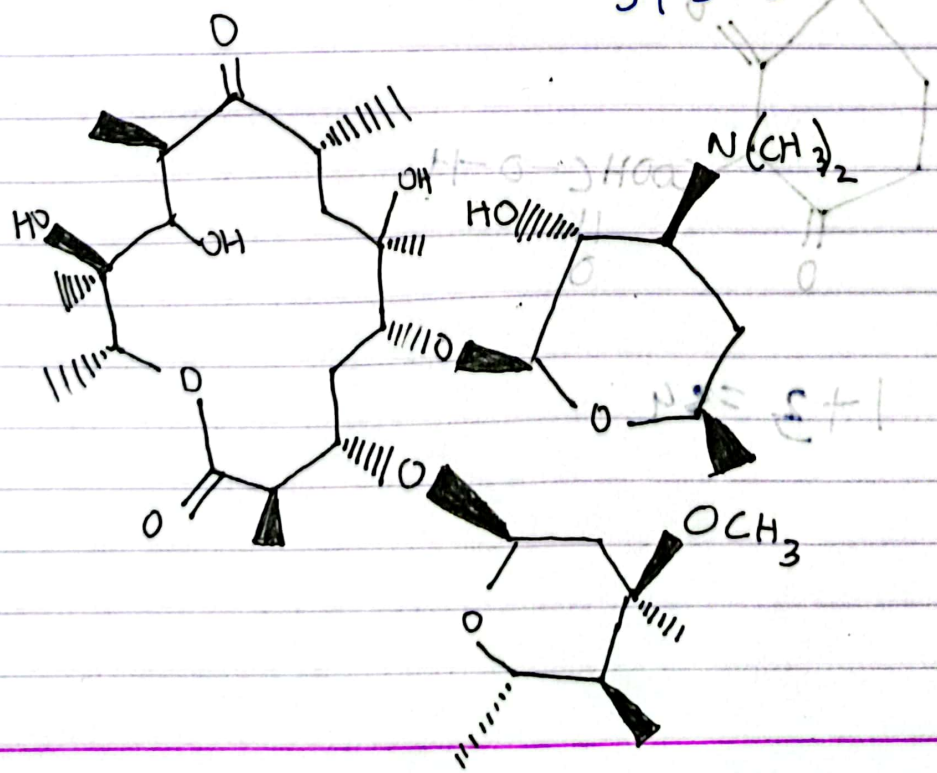
1+2=3

(21)



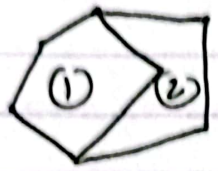
0

(22)



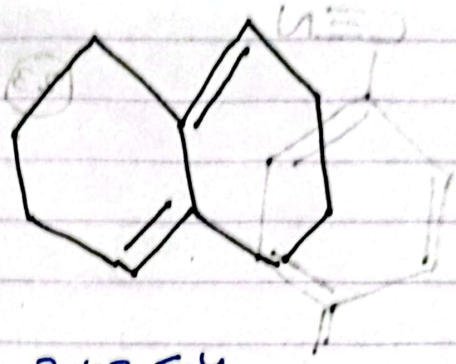
3+2=5

(25)



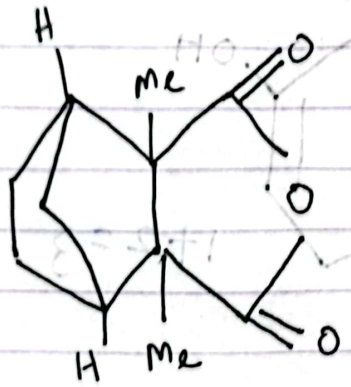
2

(28)



2+2=4

(26)



3+2=5

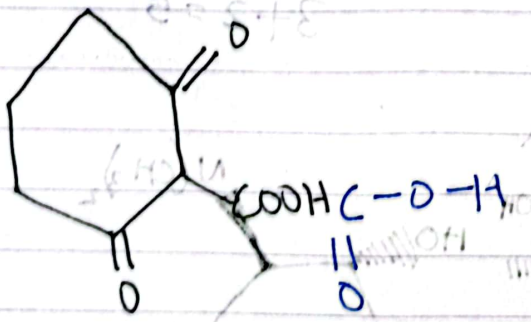
(29) $C_9H_{16}NOCl$

$$\frac{(9+1)-(16+1-1)}{2}$$

$$= 10-8$$

$$= 2$$

(27)



1+3 = 4.