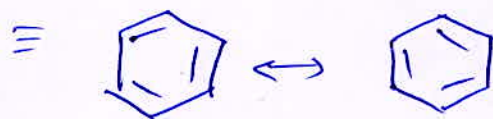
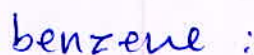
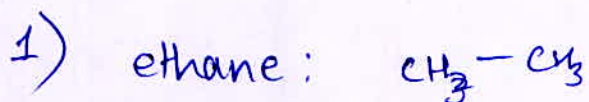


# GOC and Isomerism solutions

①

## Level 01

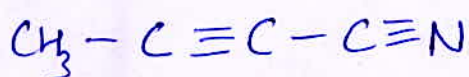


Ethane has a single bond. All others have double or triple bonds. Double or triple bonds are shorter than single bonds. Hence answer is (a)

Bond length order:

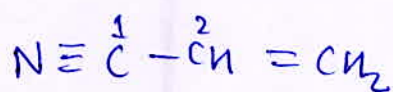


2)



In  $\equiv$ , there are  $2\pi$  bonds. Hence total  $\pi$  bonds in this molecule = 4. Hence (d)

3)



1 is  $sp$  hybrid

2 is  $sp^2$  hybrid

Hence bond b/w 1-2 is  $sp-sp^2$ . Hence (c)



7) Naphthalene

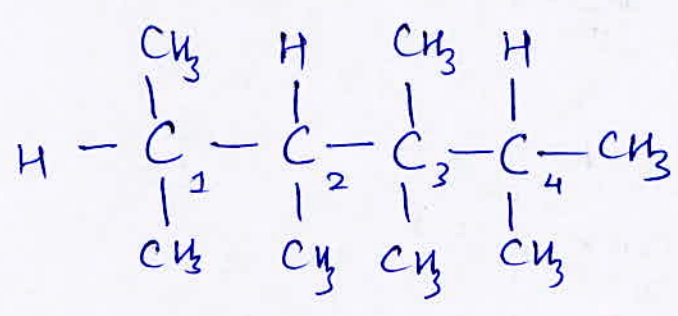


No. of  $\pi$  electrons =  $2 \times$  no. of  $\pi$  bonds  
 +  $2 \times$  (no. of lone pairs taking part in resonance)

=  $2 \times 5 + 2 \times 0$   
 = 10

Hence (a)

8)



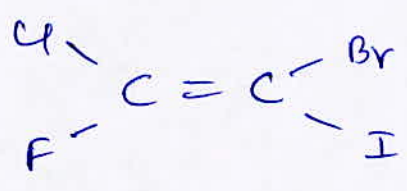
- 1  $\rightarrow$  connected to 3C  $\therefore 3^\circ$
- 2  $\rightarrow$  connected to 3C  $\therefore 3^\circ$
- 3  $\rightarrow$  connected to 4C  $\therefore 4^\circ$
- 4  $\rightarrow$  connected to 3C  $\therefore 3^\circ$

Hence no. of  $3^\circ = 3 \therefore (b)$

9)

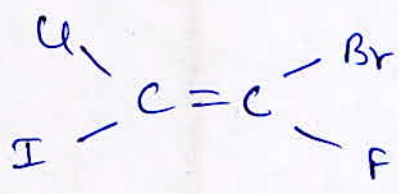


E & Z isomers of this possibility



E & Z isomers of this possibility

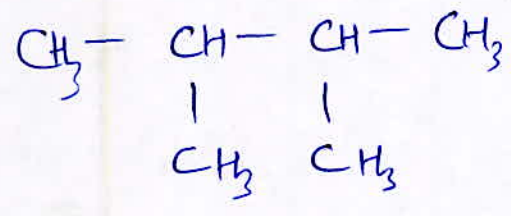
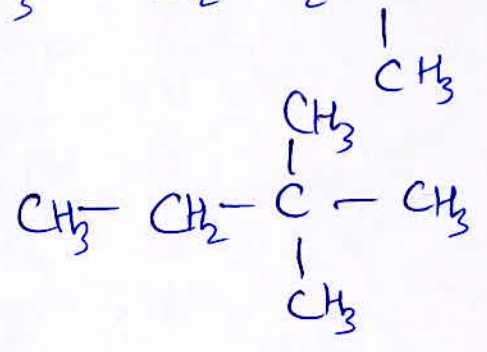
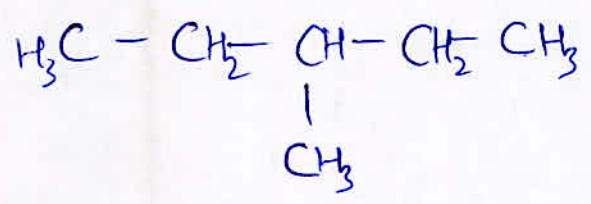
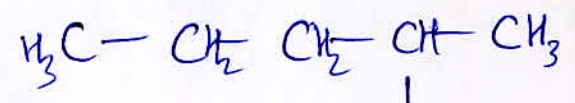
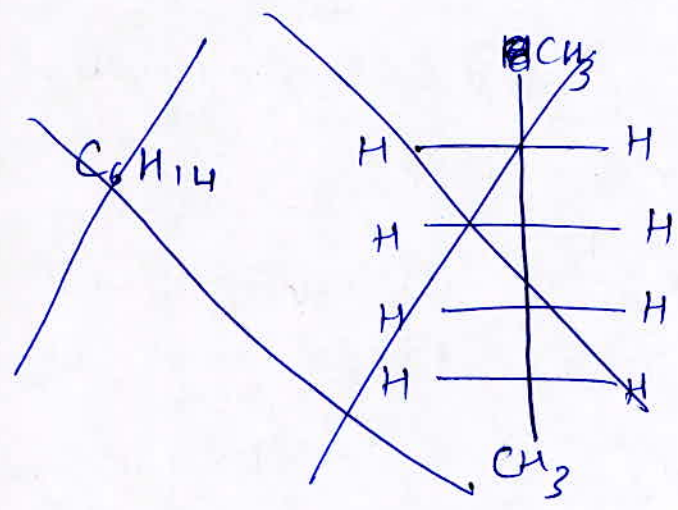




E & Z isomers of this.

∴ Total 6 isomers. (d)

10)



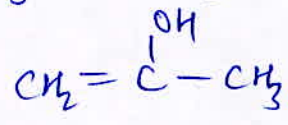
answer is (b)  
(Possibly wrong in the booklet answer key)

11)

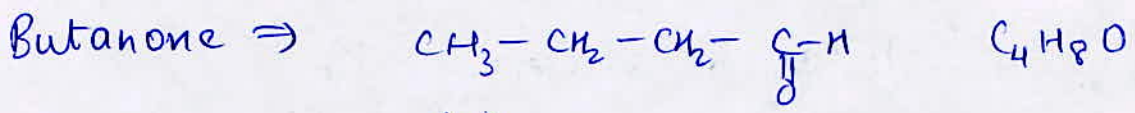
Acetone



Enolic form

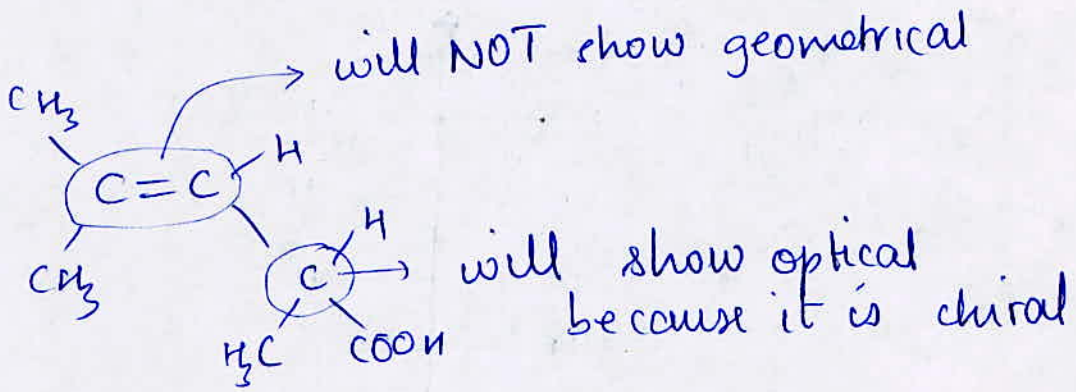


∴ 9σ bonds, 1π bond  
2 LP on O.  
∴ (a)



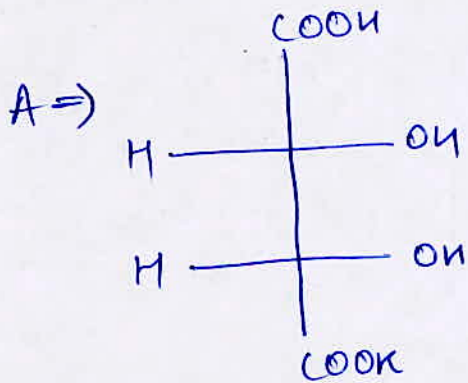
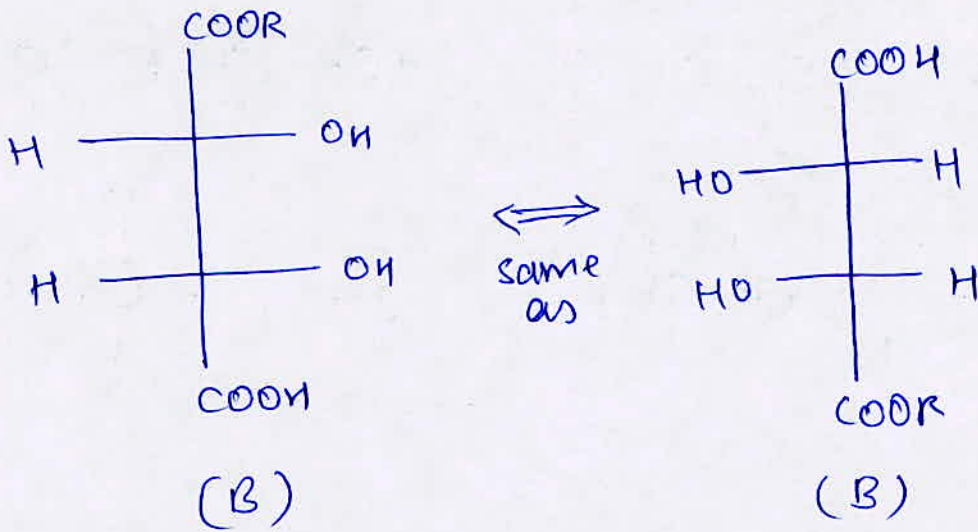
Hence (d)

13)



(b) is the answer

14)



Hence mirror image.

Hence (b)

15) (c)

16) (d)

17) (b)



19) ~~(a)~~ (b)

$3^\circ > 2^\circ > 1^\circ$  in inductive effect.

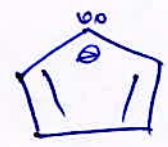
18)



$4\pi = 4n\pi$  where  $n=1$  electrons delocalized over ring. Anti aromatic. (d)

~~19)~~

20) (a)



$6\pi$  elec, completely delocalized over entire ring, in the same plane. Hence aromatic (a)

21) (c)

because  $\delta^+$  on C on  $\text{H}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$  is more

than  $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$  is more than

$\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$  (inductive effect of  $\text{CH}_3$  decreases  $\delta^+$ )

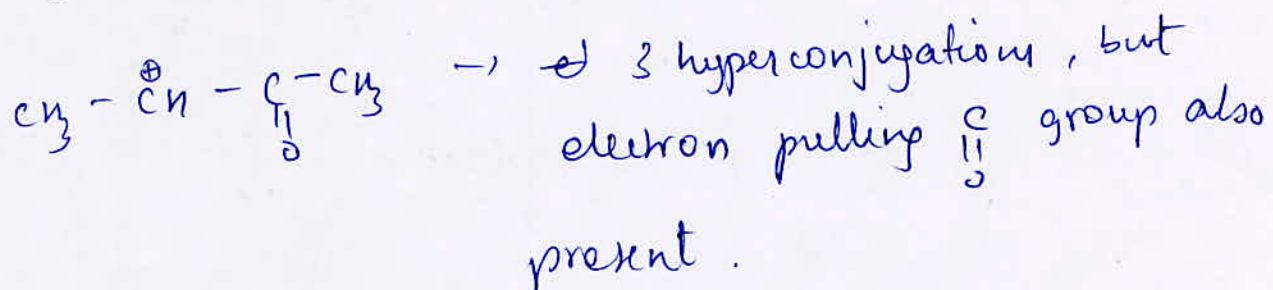
22) (c)



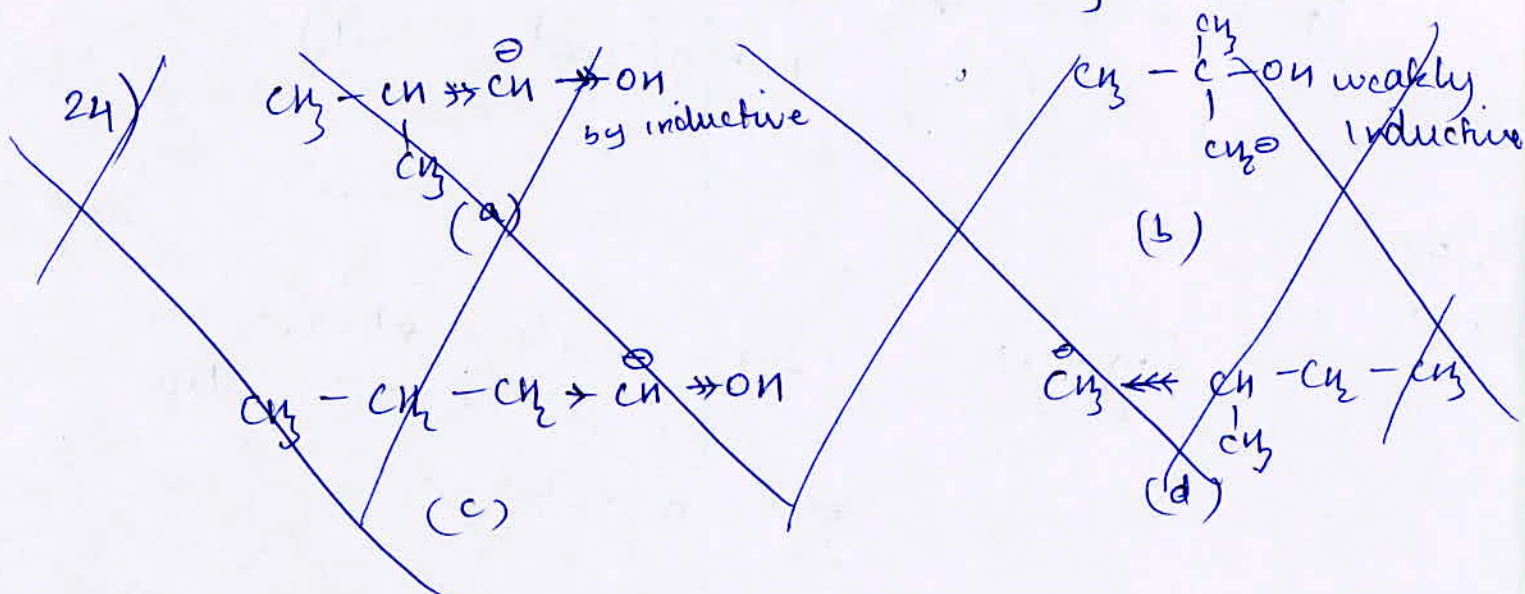
23)



⑦



$\therefore 2 > 1 > 3$  (Answer probably wrong in booklet)



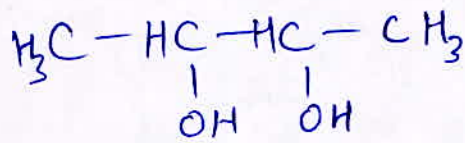
25) (c). Takes place by anti markownikoff's addition of Bromine.

26) (c) fact.

27) (a) fact.

15) 2,3 - butanediol

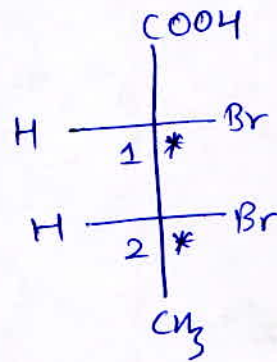
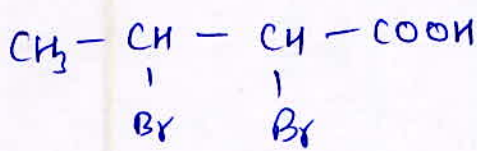
2



Possible optical isomers  $\Rightarrow$   
 d, d  
 l, l  
 d, l  $\rightarrow$  inactive

$\therefore$  2 optically active (b)

16)

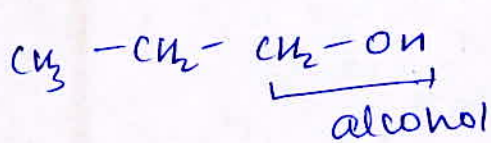


Possible optical isomers

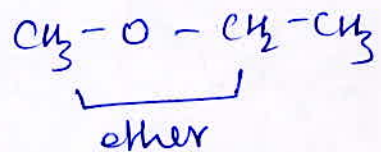
1	2
d	d
e	e
d	e
e	d

$\therefore$  4 possible  $\therefore$  (d)

17)



and



$\therefore$  functional (c)

18) (b) diastereomers by definition

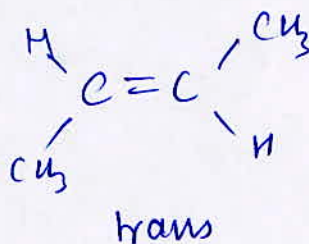
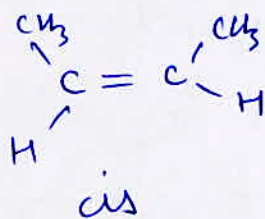
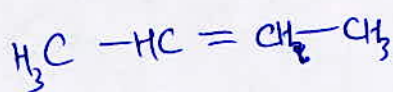




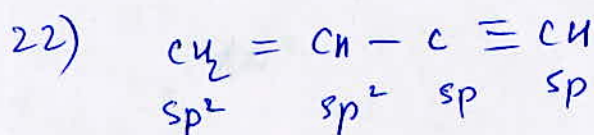
20) Heat of hydrogenation  $\propto$   $\frac{1}{\text{stability}}$  (a)

1,3 butadiene will have resonance stability, while others don't. Hence (d)

21)



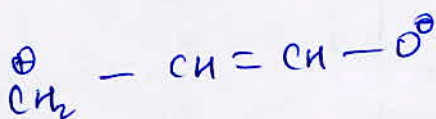
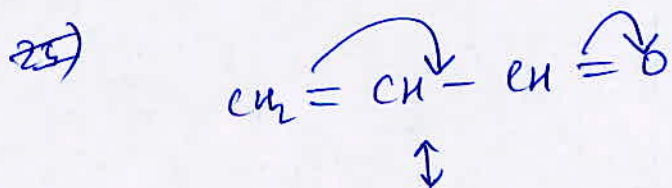
Hence (a)



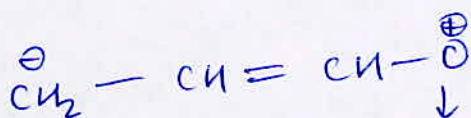
$\therefore$  (b)

23) (a) by definition

24) (b) or (d) (Mistake in booklet options)

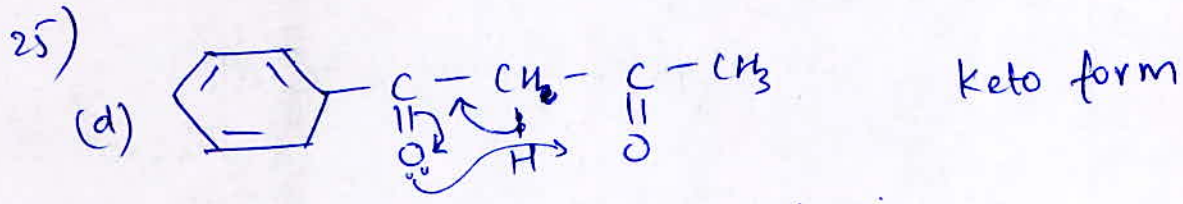


This will be stable as compared to

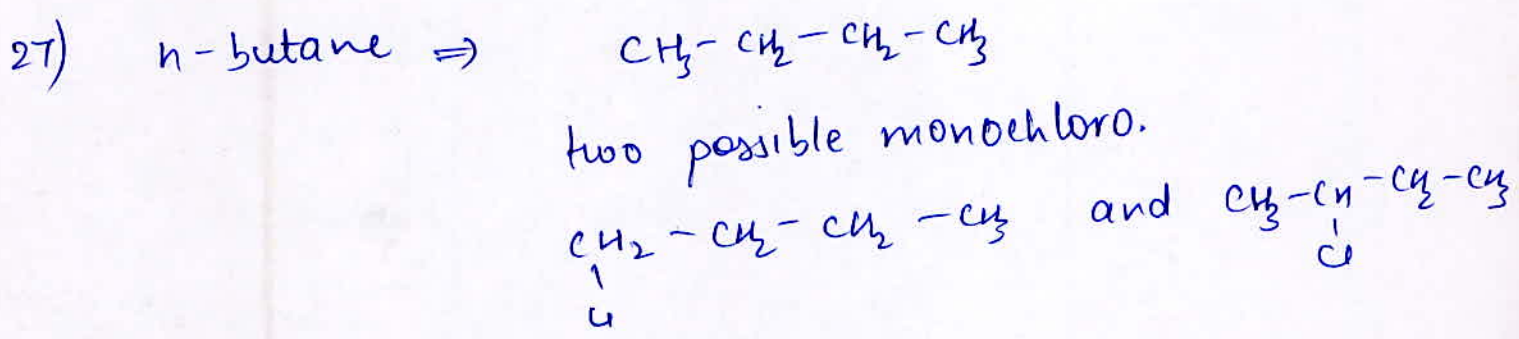
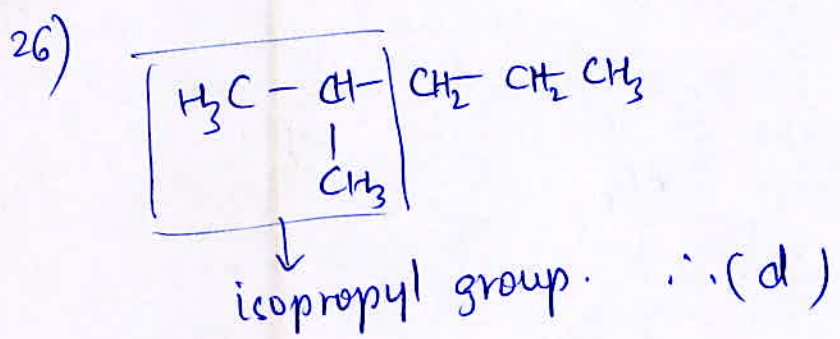
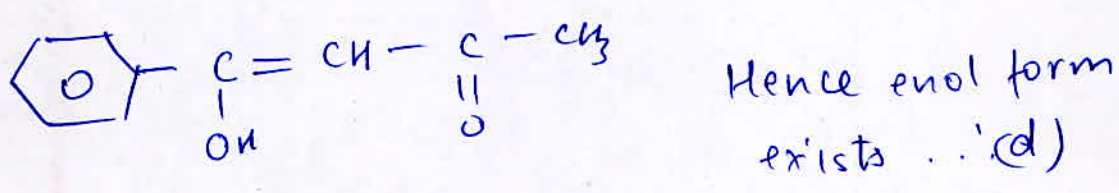


incomplete octet of O.  
Hence negligible contribution.

So.



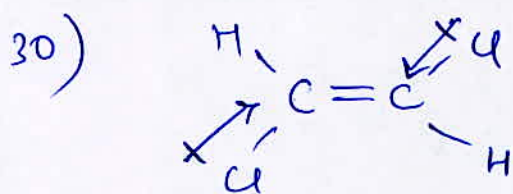
↓ by hyperconjugation



∴ (a)

28) F is most electronegative. Hence it will be most electron pulling, and hence will stabilize the carboxylate ion most. Hence (c)

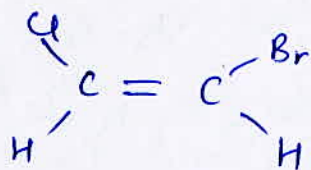
29) (c) by definition



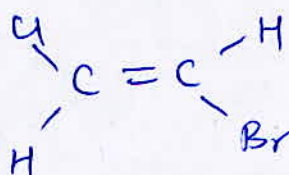
The dipoles cancel vectorially.  
Hence (c) (11)

31) (b) by definition

32) (c)

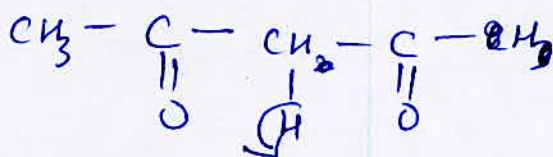


Z isomer

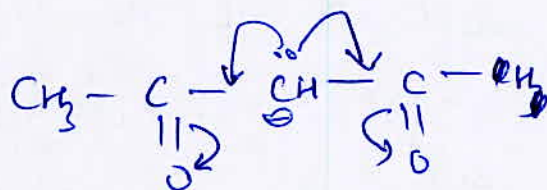


E isomer.

33) (d)

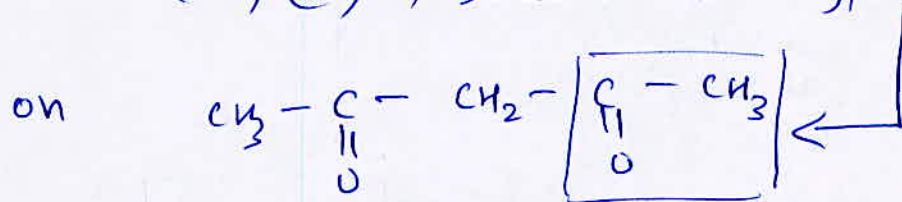


↓



2 possible  
resonating str.

∴ (d) (c), because ~~it~~ hyperconjugation



will decrease resonance  
from LP on C.

∴ (c)

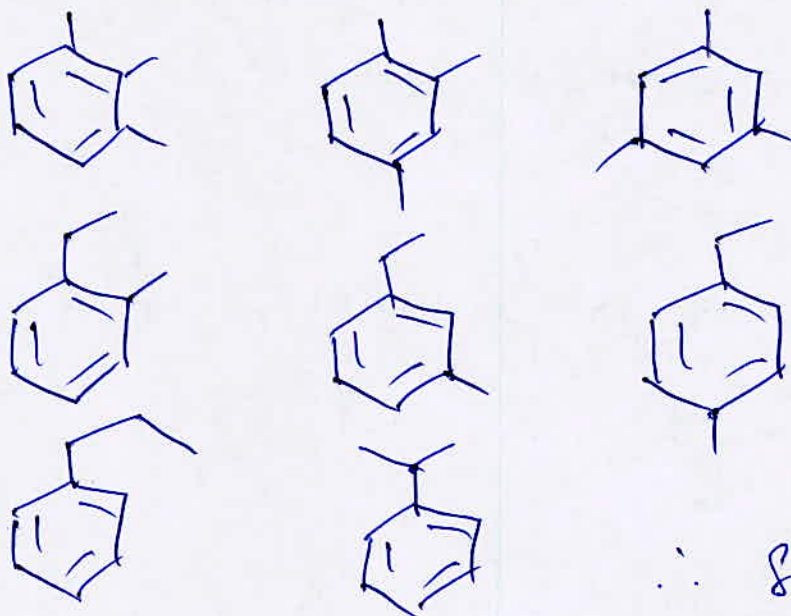




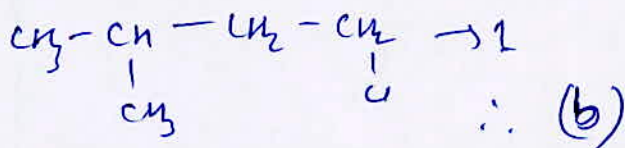
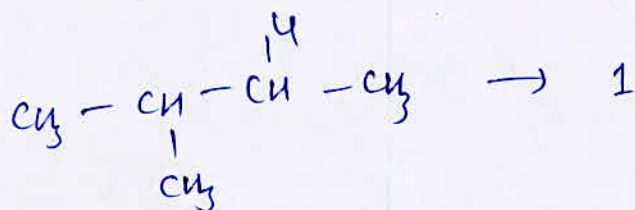
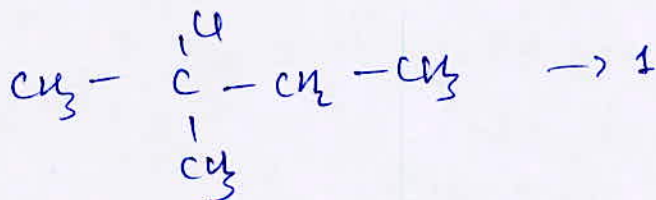
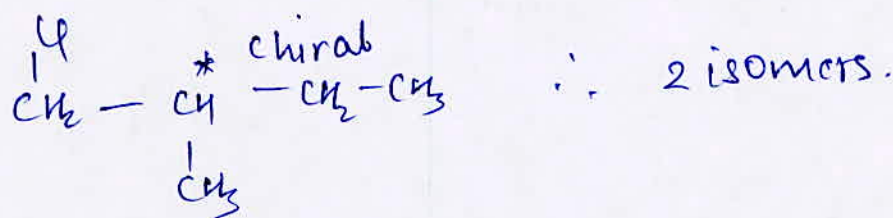
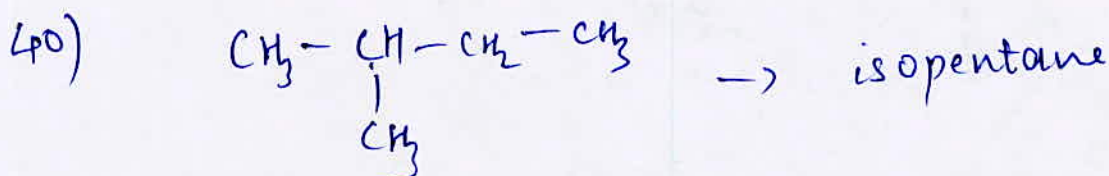
39) No. of  $\pi$  equivalents =  $\frac{(2 \times 9 + 2) - 12}{2} = 4$  (13)

One aromatic ring  $\therefore$  one benzene ring =  $4\pi$  eq.

$\therefore$  One benzene ring with ~~met~~ alkyl groups as substituents



$\therefore$  8 str. (d)

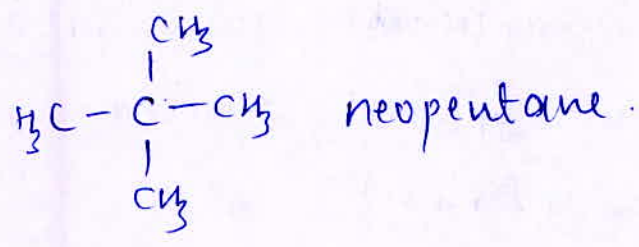


41) (a) from previous question

42) (a) by definition

43) (d) by definition

44)



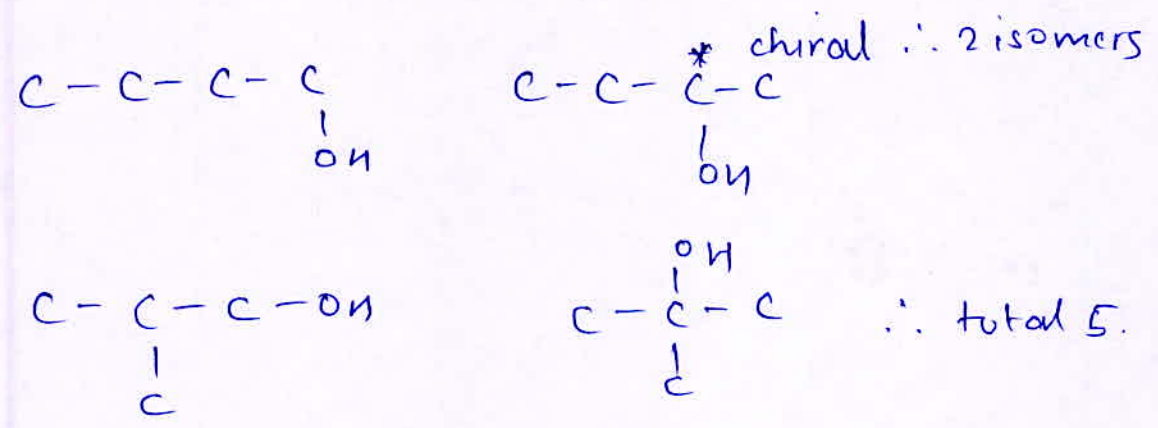
All e not in same plane, because central C is sp<sup>3</sup> hybrid, only 3 e are in plane at once.

45) (a) & (c) have electron pulling groups, so they destabilize the carbocation. Hence relatively unstable.

in comparing (b) & (d), (d) has electron donating group by LP resonance (Oxygen atom). Hence (d) is most stable.

46)  $\pi \text{ eq} = \frac{(4 \times 2 + 2) - 10}{2} = 0$

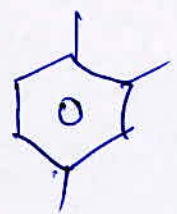
∴ no π bond or ring





47)

5



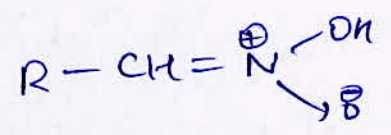
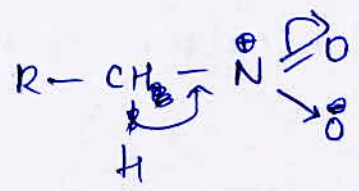
∴ 3 total

48) (c) . Whenever ~~an~~ optically active product is ~~from~~ formed from optically inactive reactant, racemic mixture is formed.

49) 3 stereo centres that are non identical

∴ total Geometrical isomers =  $2^3 = 8$

50)

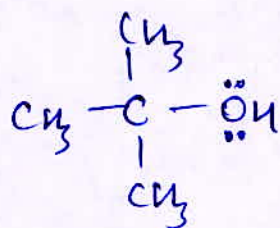


∴ (b) exhibit tautomerism.

# Level 02

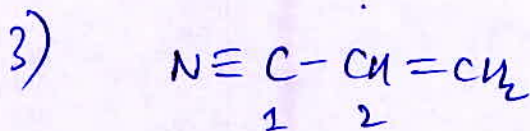
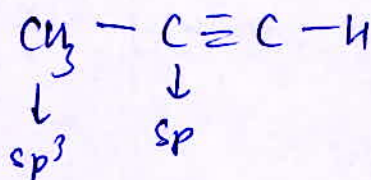
(6)

1) (c)

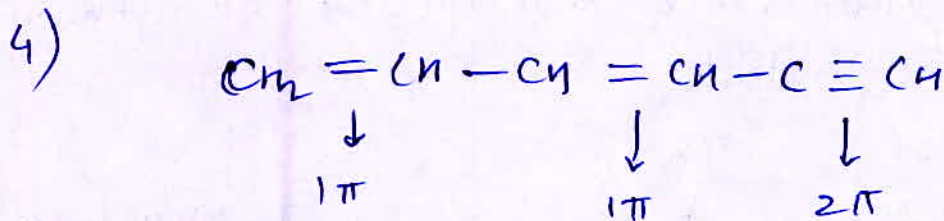


all atoms are  $sp^3$  hybrid.

2) (a)

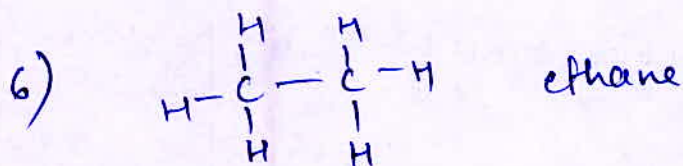


$\therefore$  (c)

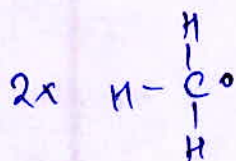


$\therefore$  total 4 (c)

5) (d)

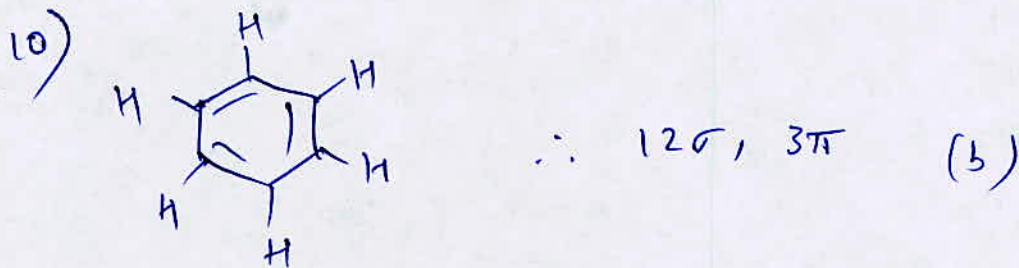
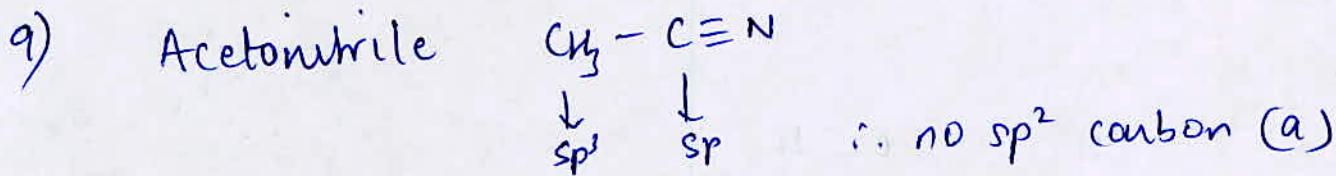
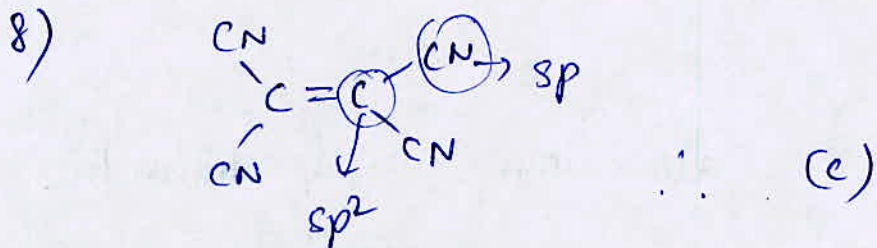


$\downarrow$  homolytic fission

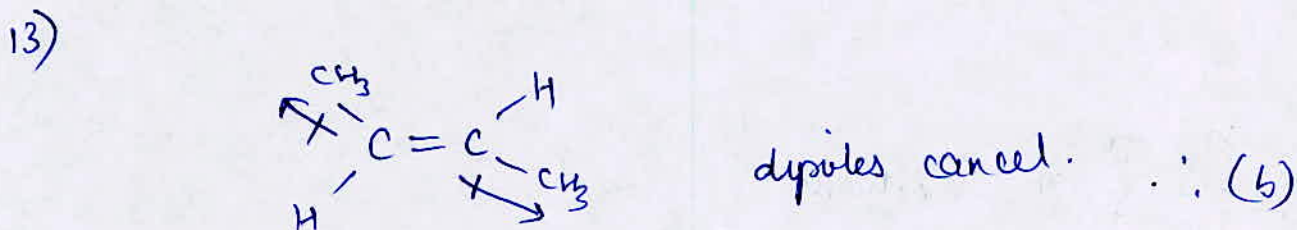
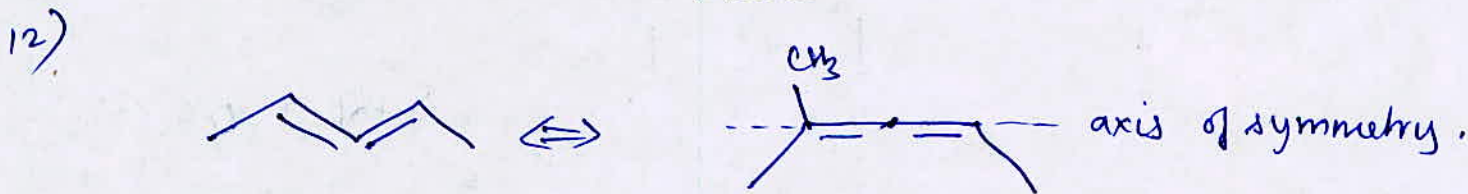


$sp^2$  hybrid. single electron won't take part in hybridization here.

7) (c)



11) (b)  $\text{sp}$  hybrid carbon more electronegative. Carbonion will be more stable.



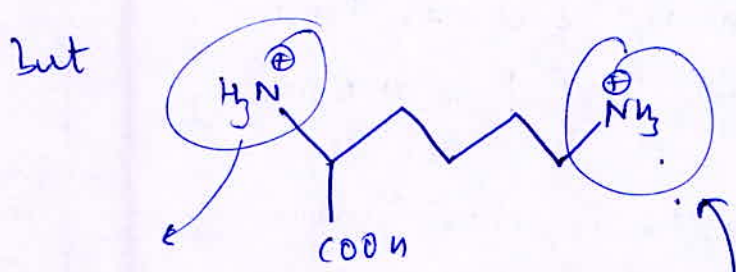
14) (d) fact.



28) (d) because inductive effect stabilizes the free radical.



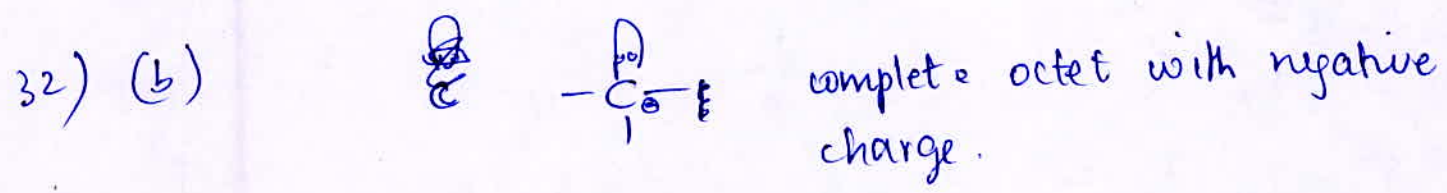
30)  $-COOH > -NH_3^+$  in acidity



this is more unstable than because of e withdrawing COOH group. Hence it will lose H+ more easily. ∴ X > Y > Z ∴ (b)

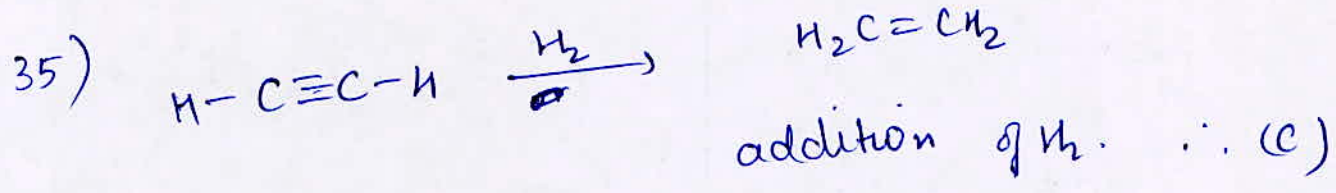
31) Heterolytic cleavage is easier for pair of atoms having high difference in electronegativity.

∴ (d)



33) (d). Because Cl- from SbCl5 will attack Cl in Cc1ccccc1Cl in SN2 reaction and cause racemisation.

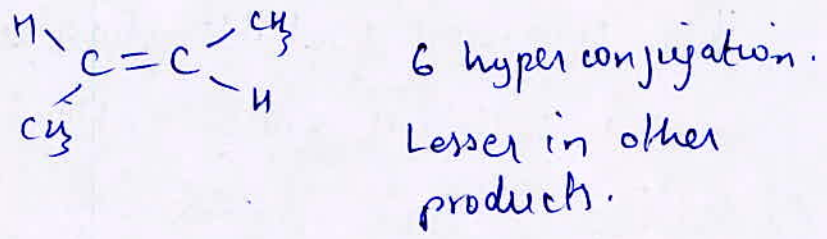
34) (c) Fact.



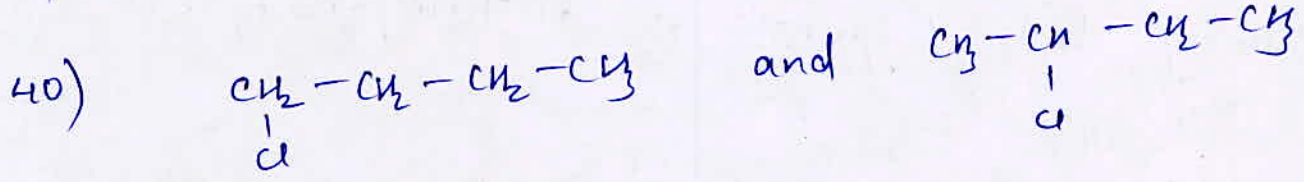
36) (a)

37) Fastest when X is a better leaving group,  $\therefore$   $\text{X}^\ominus$  should be a relatively weaker base  
 $\therefore$   $\text{Cl}^\ominus$  is the weakest base among given. (a)

38) (b), because 2-butene is more stable

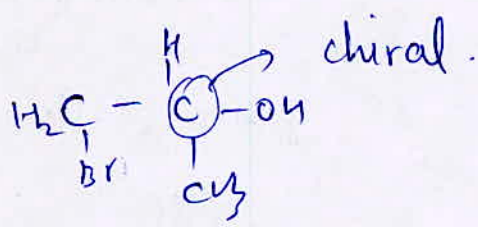


39) (b) by definition



$\therefore$  (a)

41) (d)



42) (e) Achiral = symmetric

43) (c) ortho, meta and para products are the three isomers.

44) (b) d & l Lactic acid is  $\text{HOOC}-\overset{\text{H}}{\underset{\text{CH}_3}{\text{C}}}-\text{OH}$

45) (a)  $\text{HC}-\text{HC}-\text{CH}_2-\text{CH}_3$  n butane

$\text{CH}_3-\underset{\text{CH}_3}{\text{CH}}-\text{CH}_2-\text{CH}_3$  isobutane

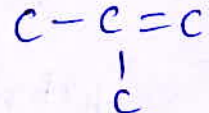
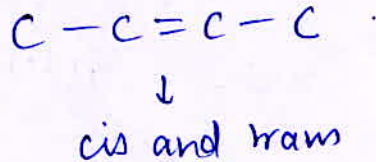
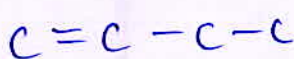
46) (d)  $\text{CH}_3-\underset{\text{OH}}{\overset{\text{CH}_3}{\text{C}}}-\text{CH}_2-\text{CH}_3$  chiral

47) (b) difference in location of functional group (ene)

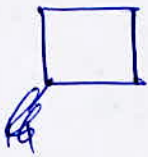
48) (a)

~~$\text{CH}=\text{CH}$~~   $\begin{matrix} \text{CH}_3 \\ \diagdown \\ \text{C}=\text{C} \\ \diagup \\ \text{H} \end{matrix} \begin{matrix} \text{CH}_3 \\ \diagup \\ \text{C} \\ \diagdown \\ \text{H} \end{matrix}$  2 butene shows cis trans isomerism.

49)  $\text{C}_4\text{H}_8 \rightarrow 1 \pi \text{ eq.} \therefore 1 \pi \text{ bond or 1 ring.}$





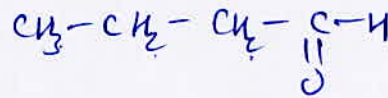


∴ Total 6 isomers. (d)

(2)

50) (d)  $C_2H_5 - O - C_2H_5$  diethyl ether.

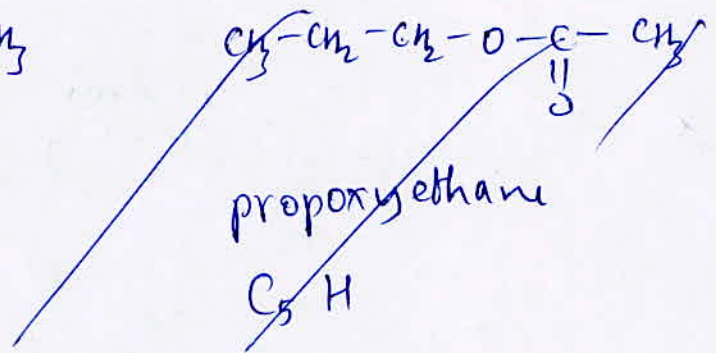
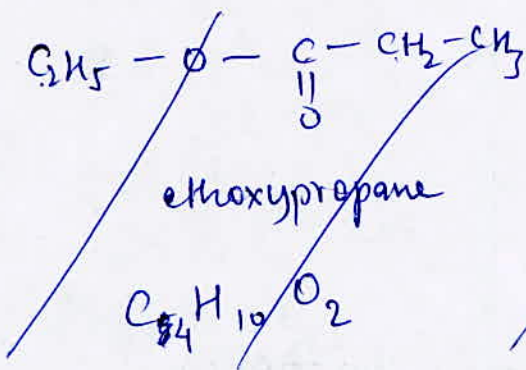
butanone is not an isomer, because formula of butanone is  $\Rightarrow$



$C_4H_8O$  and formula of diethyl ether is  $C_4H_{10}O$ .

51) (b) ether and alcohol.

52)



m.

methoxy methane  
 $C_2H_4O_2$

methanol  
 $C_2H_6O$

∴ not isomeric ∴ (d)

53)



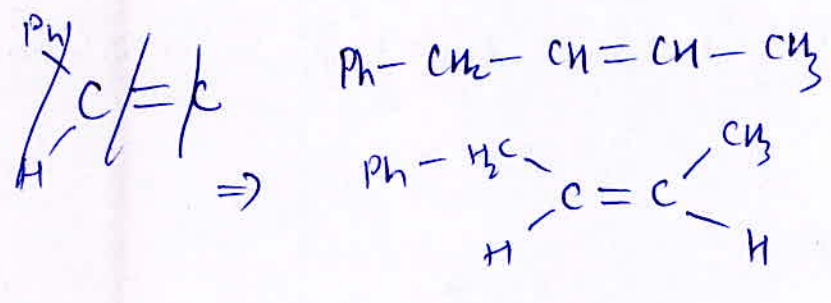
ketone



aldehyde.

∴ (a)

54)



shows E & Z isomerism (geometrical)

(a) is the answer.

55) (b)

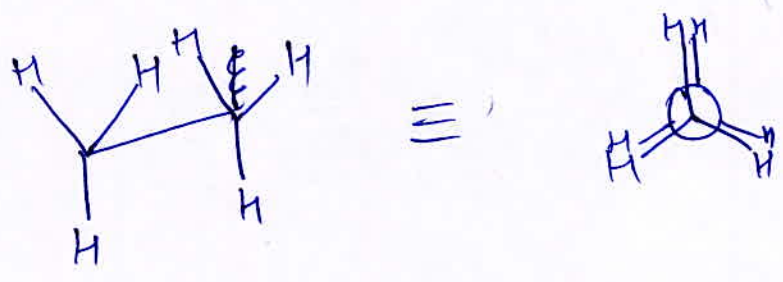
56) (d) Fact

57) Triple bonds will get attacked first. Because of poisoned Pd, double bonds will not get attacked by  $\text{H}_2$ , hence all the atoms will remain achiral.  
(b).

58) (d).  $-\text{OH}$  of  $-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$  is removed. Optical activity of alcohol part will be retained.

59) (c) Fact.

60) (b)



61) (c)

62) (b) because of electron donating by resonance 23  
O atom.

63) (b)



single  
 $\sigma$  bond



partial  $\pi$   
bonds



Full  $\pi$  bond



Full triple bond.

## Assertion and reason

20

1) (b) Because catenation is because of the ~~2 empty~~ 1 empty orbital, and overall four empty spaces where electrons can be filled. (Reason) is the consequence of the above fact.

~~2) (a) Since olefins have only <sup>one double</sup> ~~a single~~ bond between two carbon atoms, and the no. of  $\pi$  eq. given by  $x=n, y=2n+1 \Rightarrow \frac{2n+2-2n-1}{2}$~~

2) Olefins have general formula  $C_nH_{2n}$   
 $\pi$  equivalents =  $\frac{2n+2-2n}{2} = 1$ .  $\therefore$  There has to be 1  $\pi$  bond.  $\therefore$  (e)

3) A: true

R: true

But R is not the reason of A.  $\therefore$  (b)

4) A: true

R: true But R is not the reason of A. (b)



5) (a) Self explanatory

25

6) (b) A: true. It is the definition.

R: true.

7) (a) A: false. reactivity is in the order  $1^\circ > 2^\circ > 3^\circ$   
because  $1^\circ$  is ~~the~~ least stable, followed by  $2^\circ$  &  $3^\circ$ .

R: false. In a carbonium ion / carbocation, carbon is in  $sp^2$  hybrid state.

8) (b) A: True

R: True. They're short lived and unstable because their octet is incomplete.

9) (b) A: True R: True

It is  $sp^2$  hybrid because it has 3  $\sigma$  bonds.

10) (a) A: True R: True.

The  $\alpha$  hydrogen present causes keto enol tautomerism to happen, and results in formation of  $C=C-OH$  from  $\begin{array}{c} \diagdown \\ C-CH_2 \\ \diagup \\ || \end{array}$

11) (e) A: False. Reverse is true.

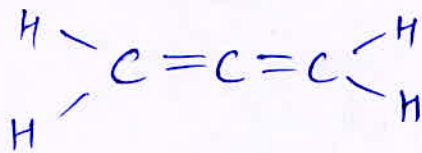
R: true.

12) (b) A: True R: true

R is the definition of cis trans, not the reason. The reason is that dihedral repulsion in cis form.

13) (e)

A: false



All four substituents

should be different.

R: True.

14) (b) Structure of lactic acid already given

A: true

R: true. But R is not the reason.

15) (e) A: False. Same no. of Lone Pairs ~~on~~ are not present

R: true.

16) (b) A: true, because of two equivalent resonating structure, so same amount of double bond character with both C=O bonds.



R: true.

17) (a) A: True. Definition

R: True

18) (b) A: True

R: true

But R is not the only condition. Another required condition is that the two groups attached on each carbon should be distinct.

19) (a) A: True R: True

20) (c) A: True R: False

In larger alkanes, all carbon atoms aren't in the same plane, because they're  $sp^3$  hybrid.

21) (c) A: True R: False

Alcohols don't show intramolecular hydrogen bonding

22) (a) Self explanatory

23) (a) Self explanatory

24) (d) Self explanatory.

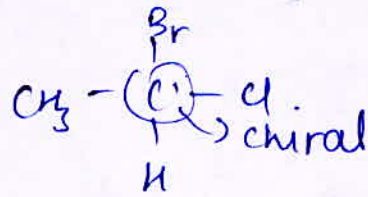
25) (a) Self explanatory.



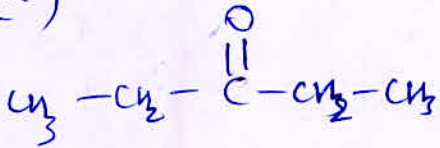
# Previous Years Questions

28

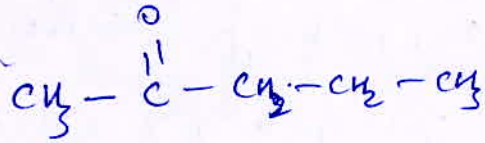
1) (b)



2) (a)

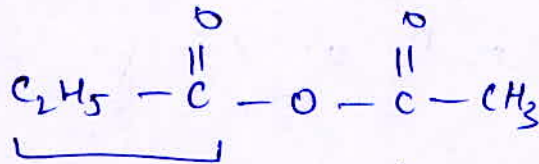


diethyl ketone



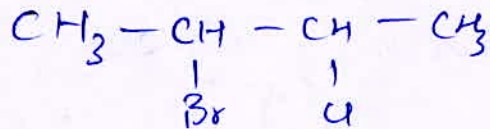
methyl propyl ketone

3) (d)



shows tautomerism.

4) (c)



2 distinct chiral C

$$\therefore \text{total number} = 2^2 = 4$$

5) (c)

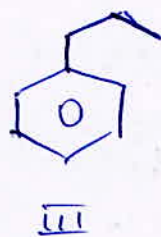
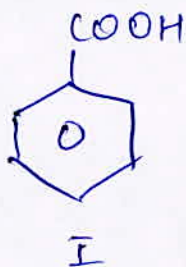


6) (a)

For m directing group, it should be an electron pulling group.  $-\text{COOH}$  is electron pulling by resonance.



7) (d)



29

actual order  $\Rightarrow$  II > III > I

8) (c)

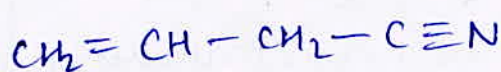
• order of electronegativity

$sp > sp^2 > sp^3$ . More electronegative the C, more stable is the negative charge on it.

9) (d) The structure is of benzene. All C are  $sp^2$  hybrid.  $\therefore$  All bond angles are  $120^\circ$ .

10) (a)

Allyl Cyanide



11) (d)

Order of acidic strength:

alcohol > alkyne > alkane.

12) (c)

Acetophenone



Dipole moment increased because of resonance and hyperconjugation.

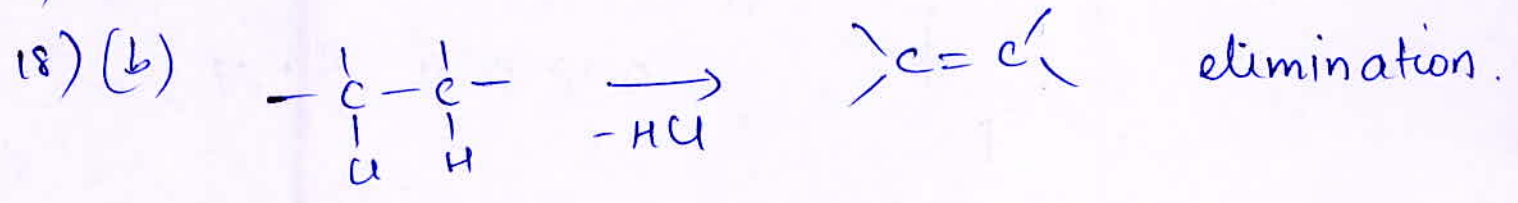
13) (a) Definition.

14) (a) Most number of resonating structures as compared to others.

15) (b) Most activated.

16) (d) NaCl is not a Lewis acid.

17) (d)  $\text{NO}_2^+$  acts as an electrophile.

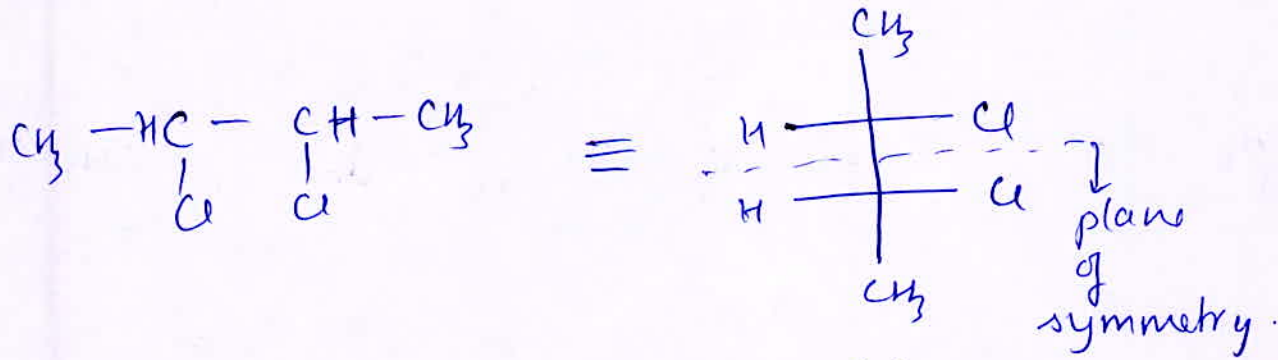


19) (d)

20) (d) Phenol will be activated by electron donating -OH group.

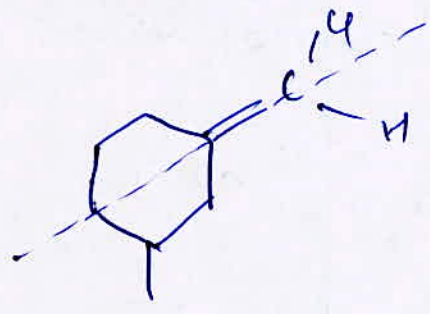
21) (d) because C-Cl bond is stronger due to partial double bond character and  $\pi$  electron cloud of  $\pi$  bond will repel the nucleophile. Hence will decrease the reactivity.

22) (b)



23) (d) Ideal gases have same density at same temp and press if the molecular masses are same.  $\rho = \frac{PM}{RT}$ .

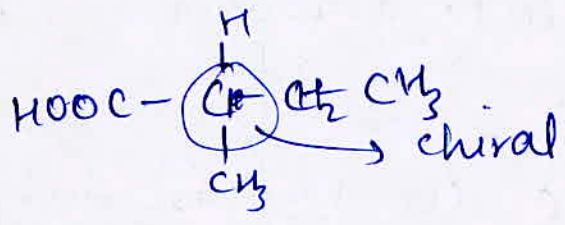
24) (d) For geometrical isomerism in rings, the ring should be asymmetrical as seen from the double bond



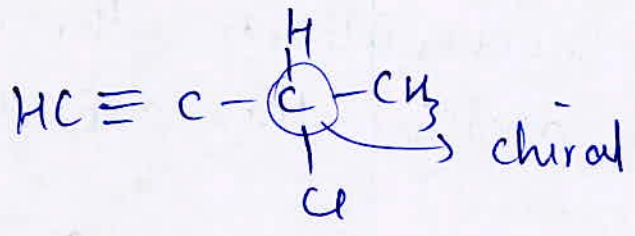
asymmetrical ring

25) (a)

26) (d)



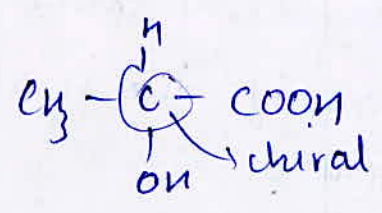
27) (b)



28) (c)



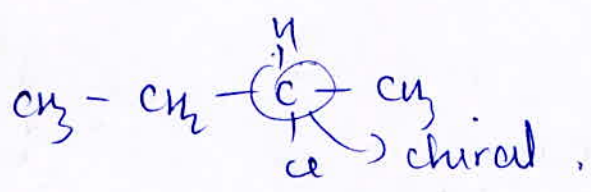
29) (b)



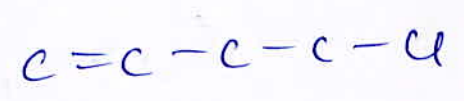
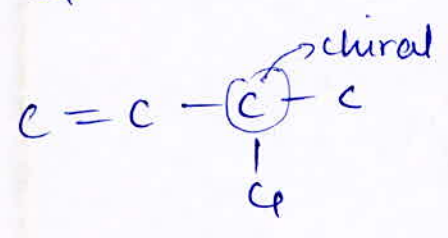
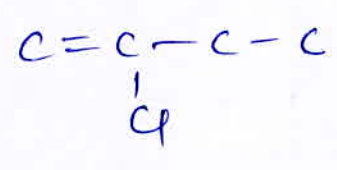
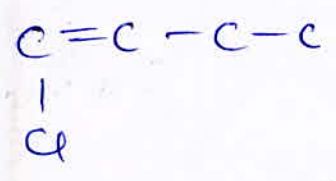
no possibility of Geometrical isomerism.



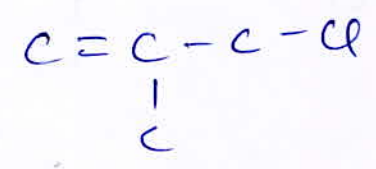
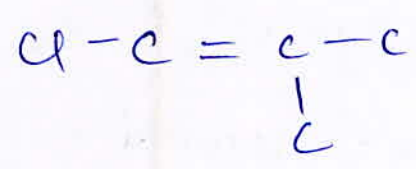
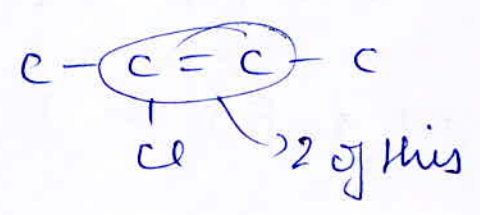
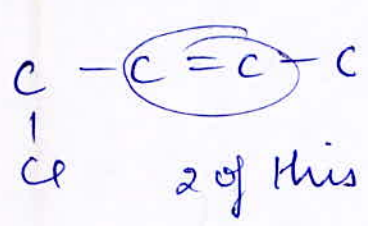
30) (a)



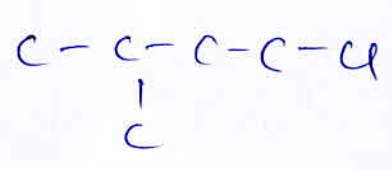
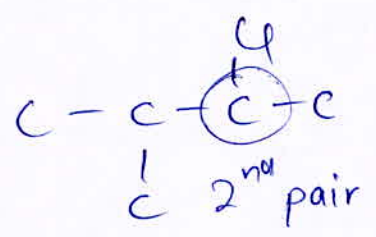
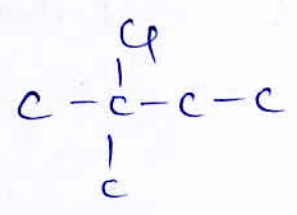
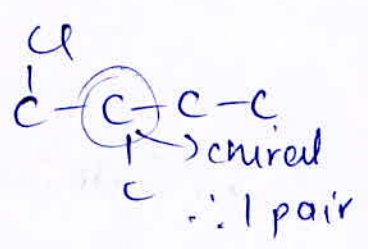
31) (a)



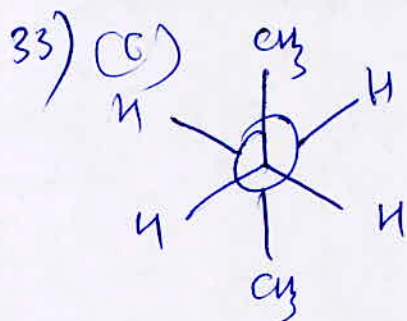
∴ 2 of this



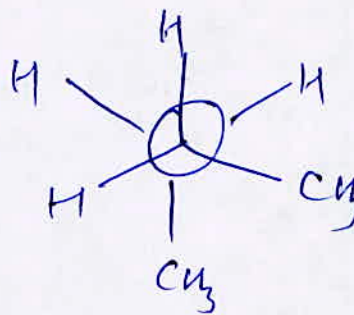
32) (b)  
(d)





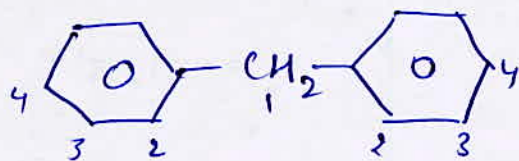


rotate  
by  $120^\circ$



Gauche.

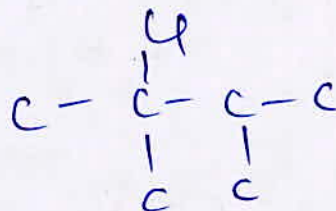
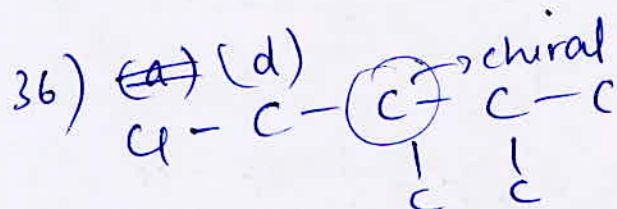
34) (d)



ortho chlorine can be replaced on 1, 2, 3 or 4

Hence 4 structures.

35) (a) fastest on  $1^\circ$  carbon.



$\therefore$  ~~two~~ <sup>one</sup> enantiomeric pairs obtained,  
because both one chiral carbon  
possible.

37) (a)  $3^\circ$  carbocation formed as intermediate when  
dehydration occurs.

38) (d) Ionic salt.

39) (c) No. of possible optical isomers =  $2^{\text{no. of distinct chiral C}}$

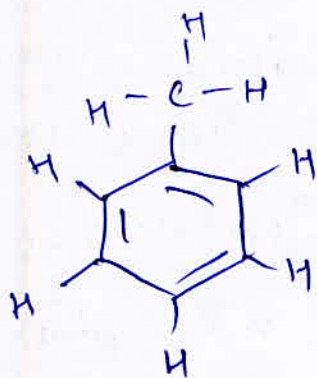
$$\therefore 2^3 = 8$$

40) (a)  $2\pi$  electrons =  $4n+2$  where  $n=0$ .

41) (c) Most number of resonating structures.

42) (b) Most number of hyper conjugative structures.

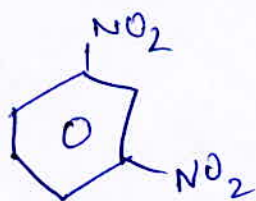
43) (d)



15 $\sigma$ , 3 $\pi$

44) (b) Most number of hyper conjugative structures.

45) ~~(a)~~ (b) Resonance is decreased at meta position



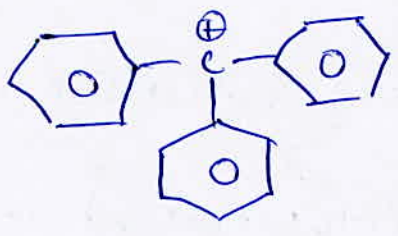
Hence ring will be more reactive than other disubstituted rings, -NO<sub>2</sub> is deactivating group.

46) (a)  $n$  has to be a whole number in  $4n+2$  formula.

47) (b) SO<sub>2</sub> has vacant d orbitals. Hence acts as an electrophile.

48) (d) Chlorine is electron donating by resonance. Hence it is an ortho para directing group.

49) (b)

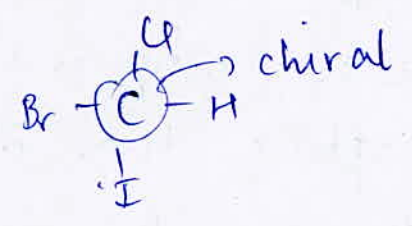


because of large number of resonating structures.

50) (a) S is the least electronegative element amongst all others given. Hence it has a higher tendency to donate electrons, and hence it is the strongest nucleophile.

51) (d) Chlorobenzene can undergo nucleophilic substitution by  $SN^2_{Ar}$  mechanism when heated with nucleophile.

52) (d)



53) (a). Numbering the substituents according to atomic weight, and then looking from the opposite side of lowest numbered carbon atom

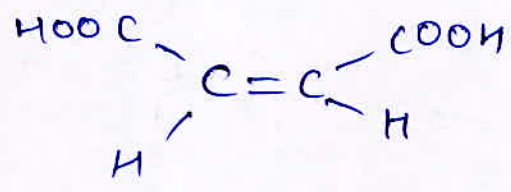
$Br > Cl > C > H$   $\therefore$   $Br \rightarrow 1$   
 $Cl \rightarrow 2$   
 $C \rightarrow 3$   
 $H \rightarrow 4$



Anticlockwise arrangement, hence R.

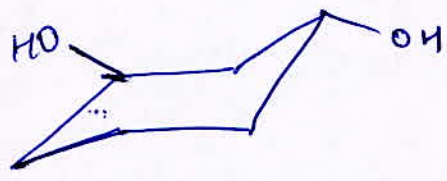
54) (d)

55) (c)



shows cis trans isomerism.

56) (d)

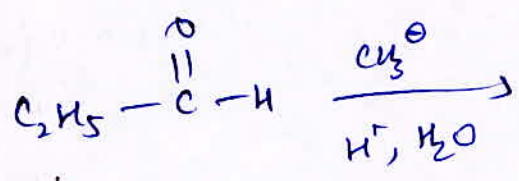


both equatorial, trans form

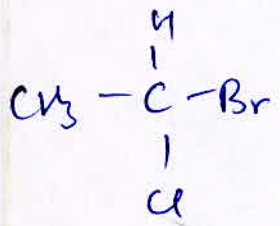
57) (c)



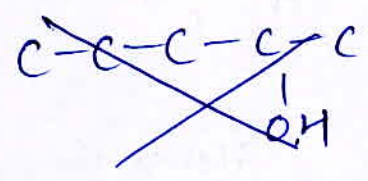
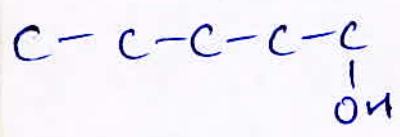
58) (b)



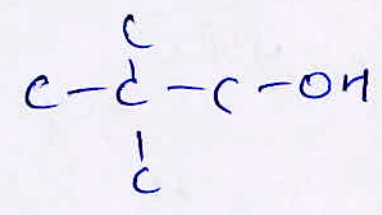
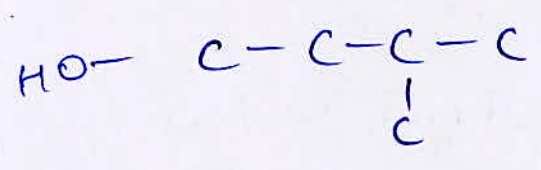
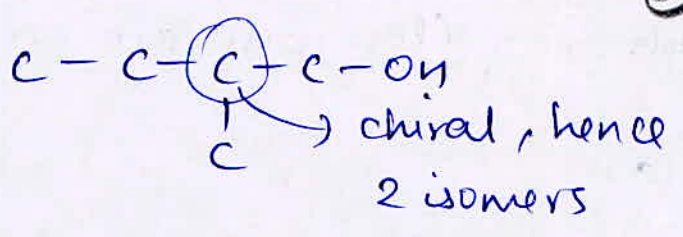
59) (b)



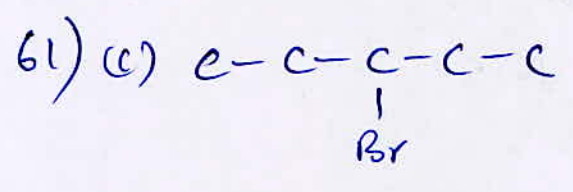
60) (c)



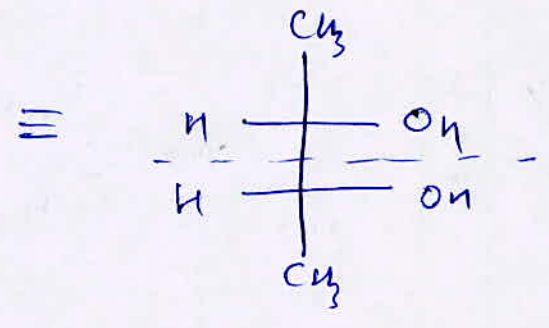
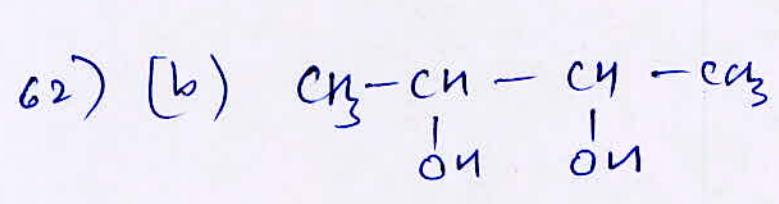




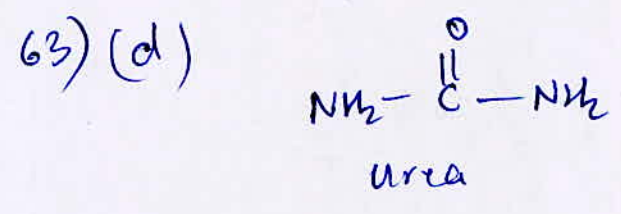
∴ total 5.



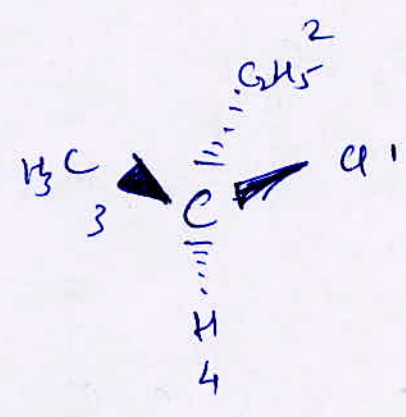
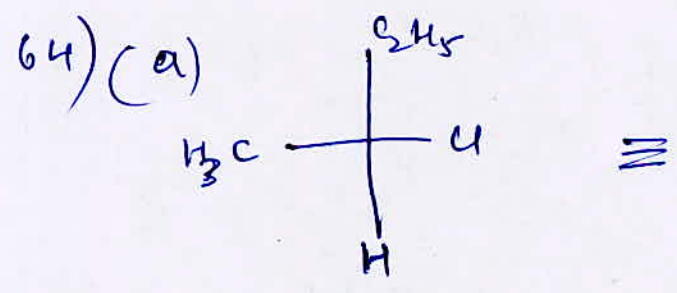
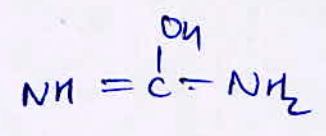
Hence not chiral.



meso form.



⇌  
tautomerism



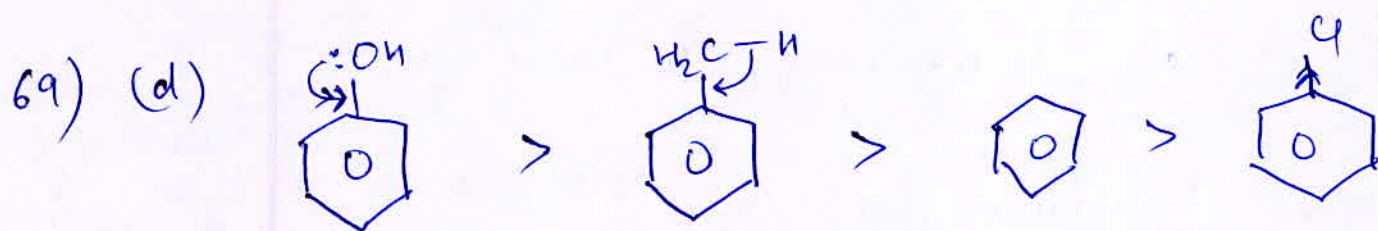
Hence R.

65) (d) Racemic mixture has d & l forms in equal amount. Hence, there is no net optical rotation.

66) (d) Order of electronegativity  $F > Cl > Br$   
More electronegative the atom, more it will stabilize the carboxylate anion, and more acidic will it be.

67) (a)  $I^- > Br^- > Cl^-$

68) (d) II has electron donating O by resonance  
III has electron withdrawing  $\text{C}=\text{O}$  by induction



70) (d) More stable the enol, more will it form.



71) (a) Draw structure and check.

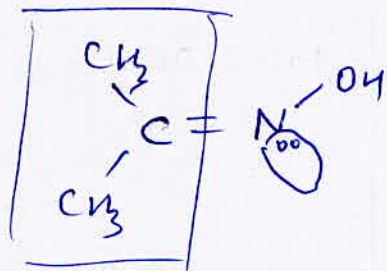
72) (a) II > III because II is aromatic while III is not

I > II because  $sp$  hybrid carbon is more electronegative than  $sp^2$

73) (c) Electron donating O by resonance activates the ring most, compared to the other options.

74) (a)

75) (d)

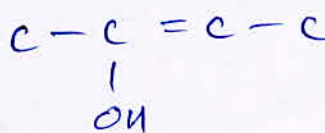
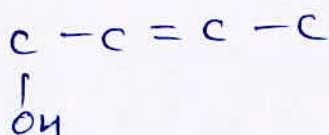
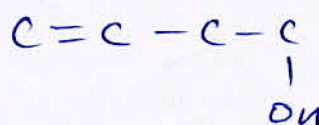
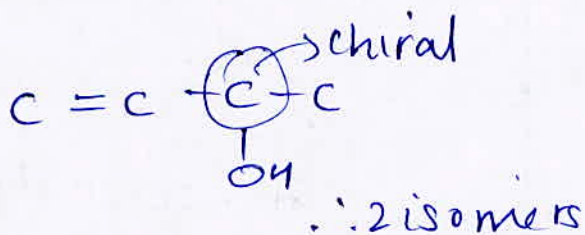
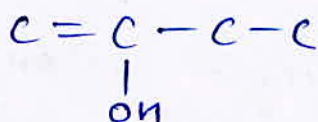
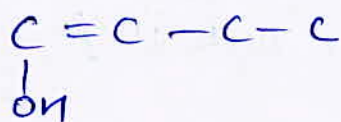


should have two distinct groups.

76) (d) Alcohol > Alkyne > Alkene, acidic strength order.

77) (a) Cl substituted by OH in R-Cl.

78) (d) 1π equivalent



will not show geometrical isomerism because will form keto by tautomerism

Total 7



79) (c) Anti conformer is most stable due to least ~~to~~ dihedral repulsion.

80) (b) Order of acidic strength. To be remembered.

81) (a)  $\text{Cl}$  is overall electron withdrawing. Increases  $\delta^+$  on ~~the~~ connected C atom.

82) (d) Hyperconjugation

83) (b) ~~Can~~ tertiary  $\bullet$  carbocation formed in III, while secondary formed in IV.

$\text{SN}^1$  is ~~more~~ more easily done than  $\text{SN}^2$  ar.

But  $\text{II} > \text{I}$  because electron withdrawing groups increase  $\delta^+$  on carbon atom on which attack of nucleophile takes place.

84) (c) because of electron donating OH group by resonance, and electron donating  $\text{CH}_3$  group by hyperconjugation.

85) (d) By ~~def~~ definition.

86) (b) The middle two sp hybrid C make the entire molecule linear.



87)(b) A  $\Rightarrow$  more thermally stable product 41  
will be formed

B  $\Rightarrow$  Addition will take place according  
to Markovnikov's rule.

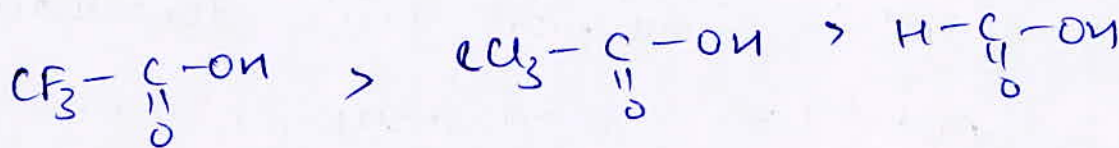
Questions asked in 2012, 13, 14

1) (c)



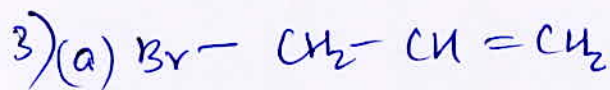
-CH<sub>3</sub> group is electron donating  
by hyperconjugation, increases  
reactivity of benzene ring.

2) (a)



$\downarrow$   
F is electron withdrawing  
&  $F > \text{Cl}$  in electronegativity

$\downarrow$   
 $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$   
 $\text{CH}_3$  is electron  
donating by  
hyperconjugation



3-bromopropene

4) (a) Exhibits geometrical isomerism.

5) (d) First  $\text{NH}_2\text{-NH}_2$  acts as nucleophile, adds to the molecule, then  $\text{H}_2\text{O}$  gets eliminated. (42)

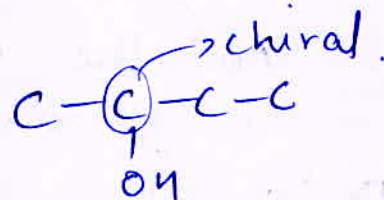
6) (d) By definition

7) (c) self explanatory

8) (a)

9) (d)

10) (d) (b)

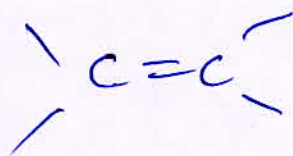


11) missing

12) (b)

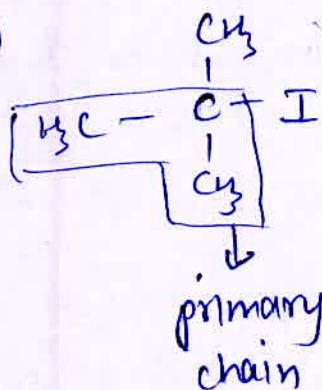
13) (b)

14) (b)



shows geometrical

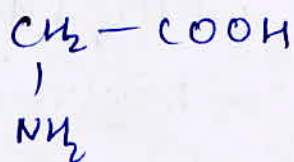
15) (d)



$\Rightarrow$

2-iodo-2-Methyl propane.

16) (d)



glycine

(13)

17) (d)



All C have p orbitals.

∴ 7 p orbitals.

Total no. of unpaired e = 7

And the compound is aromatic, because Huckel's rules satisfy the phenyl ring.

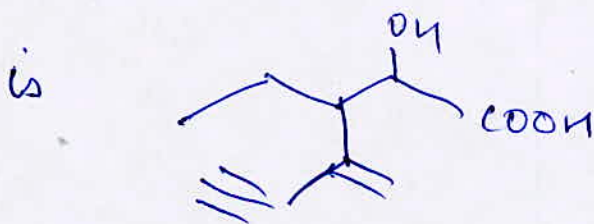
18) ~~(b)~~ (e)  $3 > 2 > 1$

because of hyperconjugation.

19) (b) By definition, iso butyl is  $\begin{array}{c} \text{CH}_3 - \text{CH} - \text{CH}_2 - \\ | \\ \text{CH}_3 \end{array}$

20) (c) By IUPAC rules

3-Ethyl-2-hydroxy-4-methyl hex-3-en-5-ynoic acid

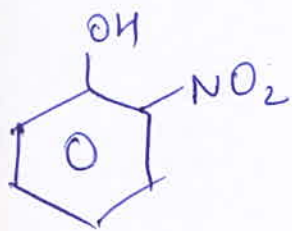




21) Soluble in  $\text{NaHCO}_3 \Rightarrow$  more acidic than  $\text{H}_2\text{CO}_3$

42

(a)



Because of intramolecular hydrogen bonding, H of OH will be less acidic.