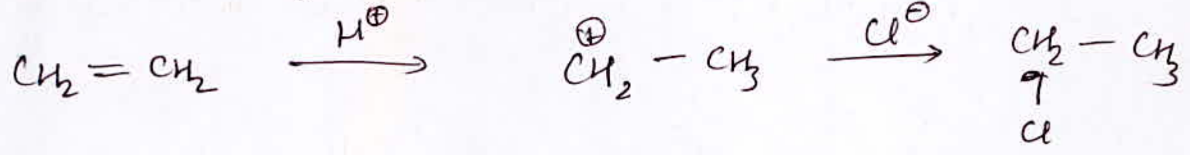
Hydrocarbons Solutions

Level 01

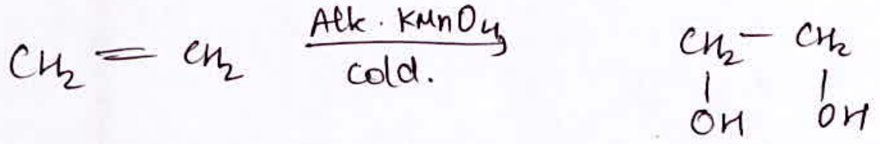
1) (4) Simple addition of HCl reaction.



$$CH_2=CH_2 \xrightarrow{H^{\oplus}} \overset{\oplus}{C}H_2-CH_3 \xrightarrow{Cl^{\ominus}} \underset{Cl}{CH_2}-CH_3$$

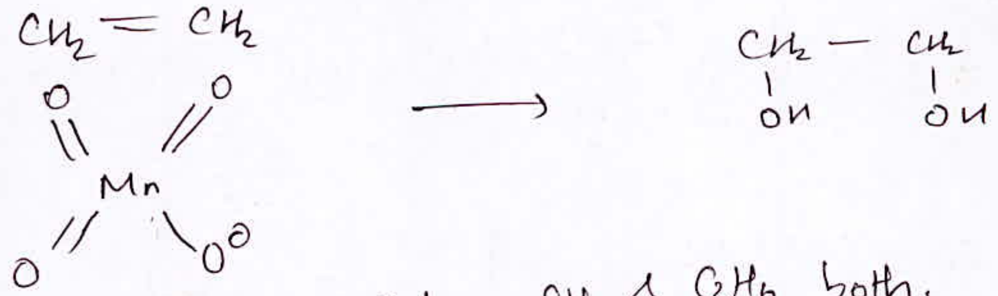
2) (2) = has more $\pi\ e^-$ density (per unit volume) as compared to ≡. Hence it is more reactive.

3) (3)



$$CH_2=CH_2 \xrightarrow[\text{cold.}]{\text{Alk. }KMnO_4} \underset{OH}{CH_2}-\underset{OH}{CH_2}$$

Baeyer's reagent is a mild oxidizing reagent. Syn product is formed as, both O atoms approach from same side.



4) (3) Cracking of petrol yeilds CH_4 & C_3H_6 both.

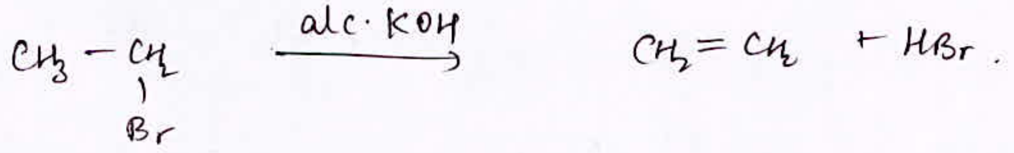
5) (3) $CH_2=CH-CH_3 \xrightarrow[\text{peroxide}]{HBr} Br-CH_2-CH_2-CH_3$

Anti markownikoff's addition of HBr in presence of peroxide

6) (3) As stated earlier, both O approach from same side. ∴ cis product will be formed.

7) (3) In photochemical chlorination, reaction takes place by homolytic fission. Hence homolysis.

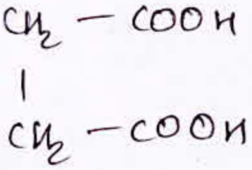
8) (2) Reaction of alkyl halide with α hydrogen with alcoholic KOH + heat gives E_2 reaction



$$CH_3-\underset{Br}{\underset{|}{CH_2}} \xrightarrow{alc \cdot KOH} CH_2=CH_2 + HBr.$$

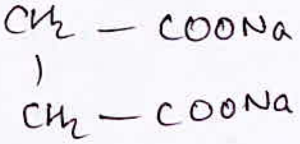
9) (3) $H-C\equiv C-H$ acytelene

10) (2)



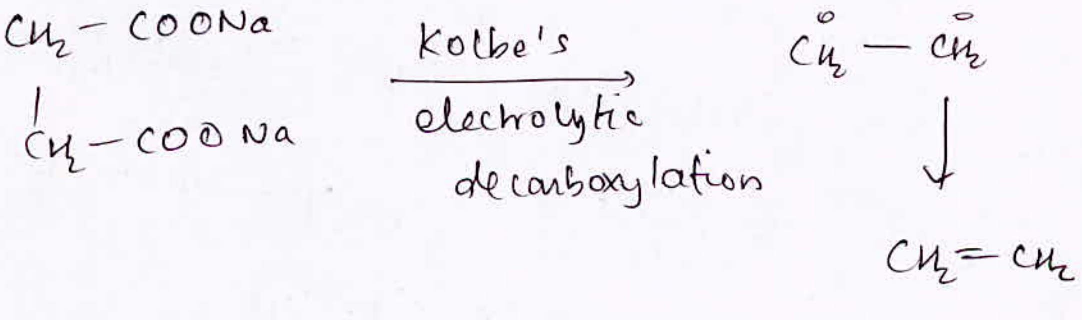
$$\begin{matrix} CH_2-COOH \\ | \\ CH_2-COOH \end{matrix}$$

succinic acid



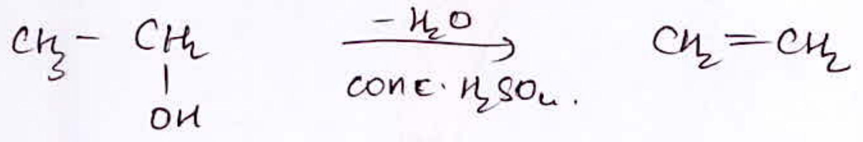
$$\begin{matrix} CH_2-COONa \\ | \\ CH_2-COONa \end{matrix}$$

sodium succinate



$$\begin{matrix} CH_2-COONa \\ | \\ CH_2-COONa \end{matrix} \xrightarrow[\text{electrolytic decarboxylation}]{\text{Kolbe's}} \overset{\circ}{C}H_2-\overset{\circ}{C}H_2 \downarrow CH_2=CH_2$$

11) (3) Conc. H_2SO_4 is a dehydrating agent.



$$CH_3-\underset{OH}{\underset{|}{CH_2}} \xrightarrow[\text{conc. } H_2SO_4]{-H_2O} CH_2=CH_2$$

12) (i) Because of π bond (non polarised), addition reaction is favoured.

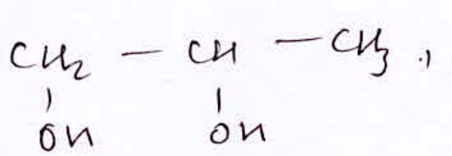
13) (3) Tetraethyl lead reduces knockeing in engine. Hence it is used as petroleum additive.

14) (1) Non polarised π bond − addition.

15) (1) Frankland reaction

$$2R-Cl + Zn \longrightarrow R-R + ZnCl_2$$

16) (2) Alkaline $KMnO_4$ is decolourised if it oxidises something. In the given options, only C_3H_6 has a π bond ($CH_2=CH-CH_3$). Hence Baeyer's reagent reacts with ~~et~~ C_3H_6 and forms

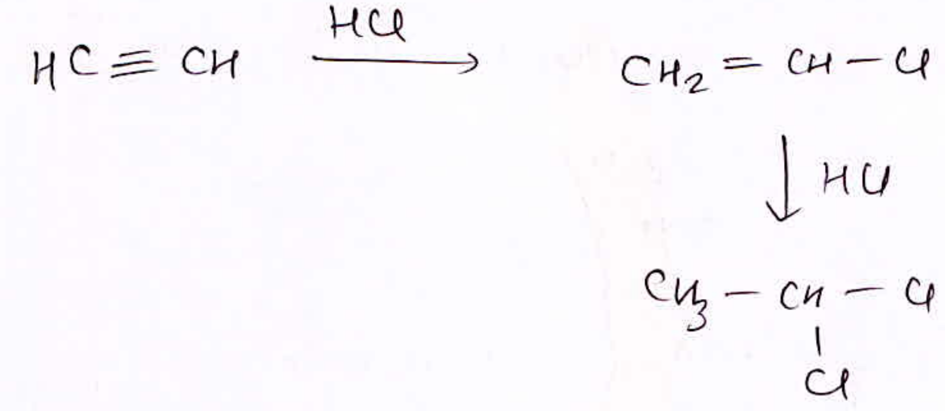


$$\underset{OH}{\underset{|}{CH_2}}-\underset{OH}{\underset{|}{CH}}-CH_3$$

, and $KMnO_4$ is ~~ded~~ decolorised.

17) (2) It is photolytic substitution. 2 H of C_3H_8 are substituted by Cl. The remaining Cl forms bond with the 2H removed, and HCl is formed.

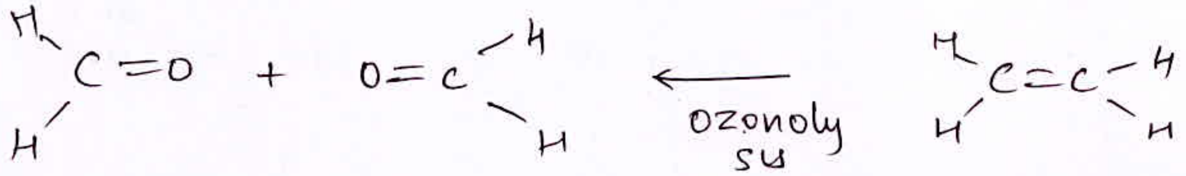
18) (1)



$$HC\equiv CH \xrightarrow{HCl} CH_2=CH-Cl \xrightarrow{HCl} CH_3-CH(Cl)-Cl$$

19) (3) $CH_2=CH-CH=CH_2$ butadiene

20)



$$H_2C=O + O=CH_2 \xleftarrow{\text{ozonolysis}} H_2C=CH_2$$

ethene
or ethylene

21) (1)

22) (1) Fact

23) (4)

~~25~~
24) (1) $HC\equiv C-CH_3$

acidic hydrogen due to higher electronegativity of sp hybrid C attached to it.

25) (2) Increase in branching ~~more~~ decreases surface area. Van der Waal's forces are directly proportional to surface area of molecule. More the Van der Waal's forces, higher is the BP.

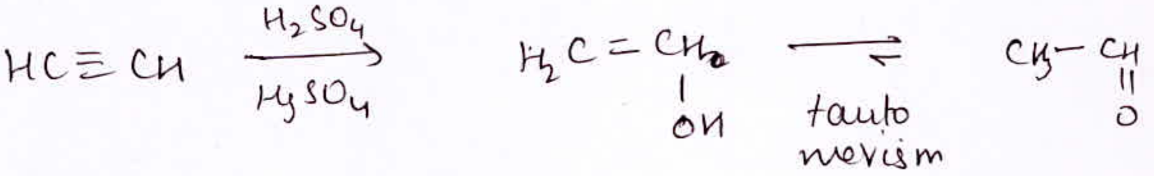
Hence n-octane has highest boiling point, since it has no branching and large surface area.

26) (1) CO_2 has C in oxidation no. 4.

27) (3)

$CH_3-CH_2(Br) \xrightarrow[\text{ation}]{\text{elimin}} CH_2=CH_2$

28) (2) Addition of water without rearrangement = Oxymercuration demercuration.



$HC\equiv CH \xrightarrow[HgSO_4]{H_2SO_4} H_2C=CH_2(OH) \xrightleftharpoons[\text{merism}]{\text{tauto}} CH_3-\overset{\displaystyle O}{\overset{\|}{C}}H$

29) (3) Kolbe's electrolytic decarboxylation. Mechanism given previously.

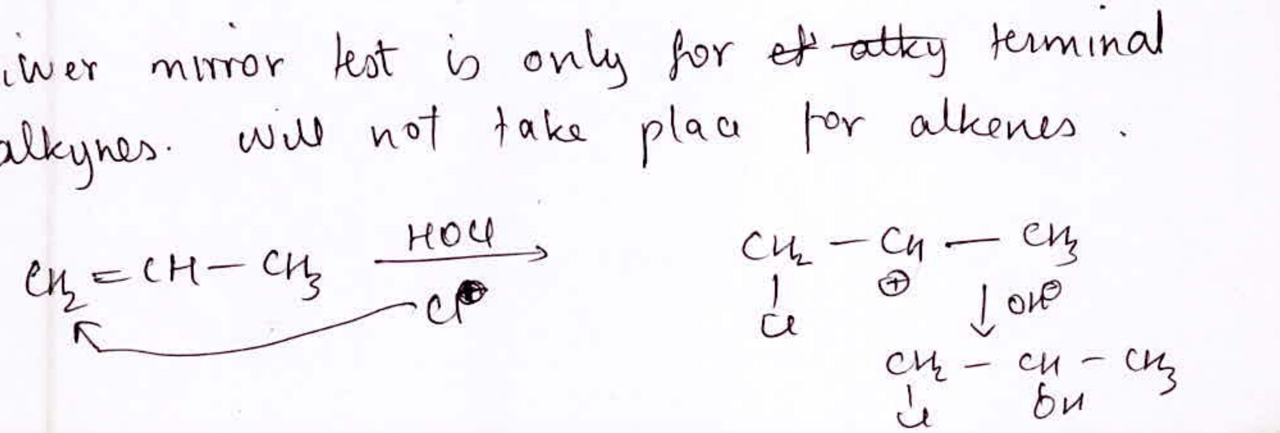
30) (4) It is called silver mirror test, but does not actually form silver mirror

31) (3) Aldehydes will be further oxidized to acids.

32) (2) In polar protic solvent, since HI is the strongest acid, conc. of $I^{\ominus}$ will be highest, then $Br^{\ominus}$, $Cl^{\ominus}$ $F^{\ominus}$ in decreasing order.

33) (4) Silver mirror test is only for ~~et alky~~ terminal alkynes. will not take place for alkenes.

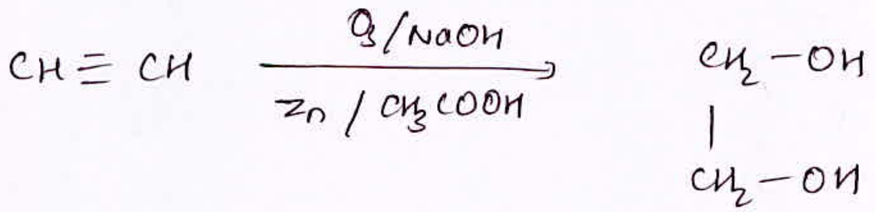
34) (2)



$CH_2=CH-CH_3 \xrightarrow{HOCl} CH_2(Cl)-\overset{\oplus}{C}H-CH_3 \xrightarrow{OH^{\ominus}} CH_2(Cl)-CH(OH)-CH_3$

35) (3) H–Cl bond is stronger than C–H bond.
H–I does not react because RDS ΔG becomes >0, C–C π bond is weaker than HI bond, energy must be supplied ∴ ΔH>0 & ΔS<0, ∴ ΔG >0, reaction does not happen.

36) ~~H–C≡~~ (4) the entire reaction is reductive ozonolysis



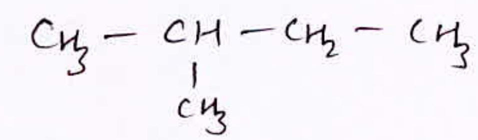
$$CH\equiv CH \xrightarrow[Zn/CH_3COOH]{O_3/NaOH} \begin{array}{c} CH_2-OH \\ | \\ CH_2-OH \end{array}$$

37) (4) Oxidation reaction to be remembered.

$$CH_4 + O_2 \xrightarrow[200°C,\ 100\ atm]{copper\ tube} CH_3-OH$$

methanol.

38) (3)



$$\begin{array}{l} CH_3-CH-CH_2-CH_3 \\ \quad\quad\ \ | \\ \quad\quad CH_3 \end{array}$$

isopentane has one 3° carbon. Most stable free radical C is formed here in ~~Hence~~ RDS step. Hence it is fastest.

39) (1)

40) (3) Red P + HI (not I_2) is used for obtaining alkane from ketone. $NaBH_4$ reduces ketone to alcohol stage only.

41) (1) Fact

42) (2) Fact

43) (2) Fact

44) (4) Monochlorination by homolysis.

45) (2) Because in decarboxylation of methane, CO_2 is formed ~~or~~ only

~~46)~~ Reduction with $LiAlH_4$ will only reduce it till alcohol stage.

46) (3) $CH_3-CH_2-CH_3$ MW = 44.

∴ 1 mole of propane is reacting

$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$

∴ with 1 mole of propane, 5 moles of O_2 will be needed.

~~But in 1 mole air, only 0.2 moles~~

Air has 20% oxygen by mass, hence 20% oxygen by moles also. Hence, 5 moles of air will contain 1 mole of O_2. Hence 25 moles of air will contain 5 moles of O_2.

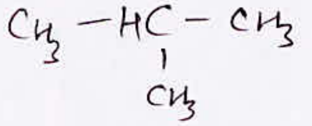
47) (4) All are valid reactions.

Reduction of alkyl iodide by HI/Red P or by corey house synthesis.

2nd option is self explanatory

Reduction of Ketone by Clemmensen's or Wolff Kishner reduction.

48) (4)



$CH_3-\underset{\underset{CH_3}{|}}{HC}-CH_3$

Can give propene and methane on pyrolysis, but not ethane.

49) (4) Acidic ~~p~~ $KMnO_4$ is potentially a strong oxidizing agent. Hence will cause oxidative cleavage.

50) (3) $H_2C=CH-Br \xrightarrow[\text{dust}]{\text{Zn}} CH\equiv CH$

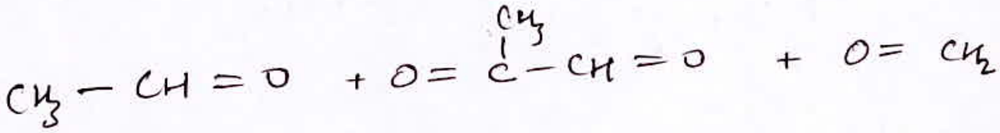
alkyne formed.

Level 02

1) (4) $(C_2H_5)^{\ominus} Mg^{2+} Br^{\ominus}$ and D_2O

$CH_3-CH_2^{\ominus}$ is the anion of the weaker acid CH_3-CH_3 with respect to D_2O. Hence $CH_3-CH_2^{\ominus}$ will abstract a D^+ from D_2O, will form C_2H_5D.

2) (3)

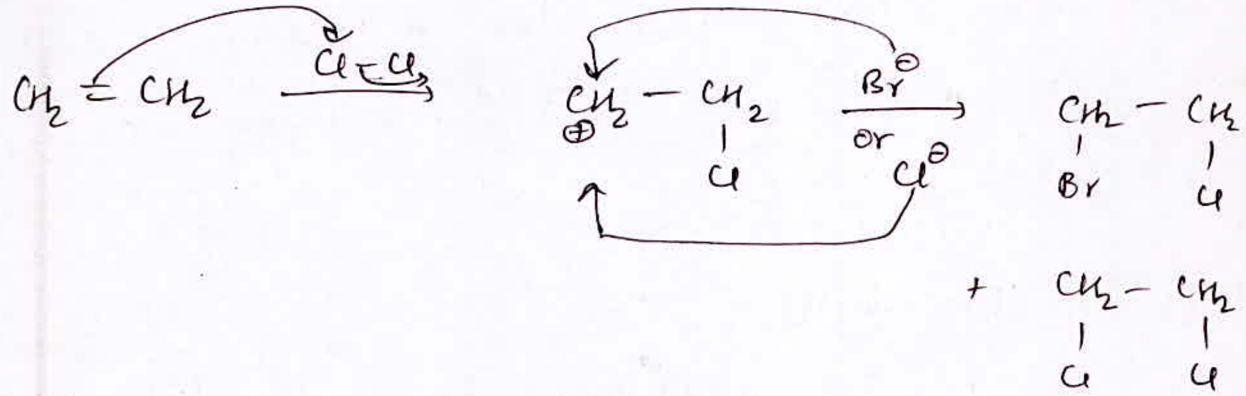


$$CH_3-CH=O + O=\overset{\overset{CH_3}{|}}{C}-CH=O + O=CH_2$$

3) (3) Red P & conc. HI can reduce CH_3-CH_2-COOH to $CH_3CH_2CH_3$.

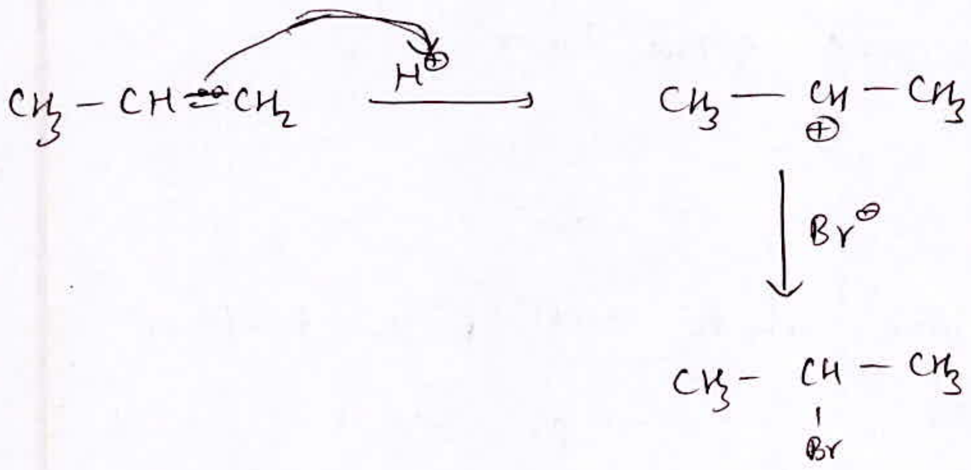
4) (3) Fact.

5) (3)



$$CH_2=CH_2 \xrightarrow{Cl-Cl} \underset{\oplus}{C}H_2-\underset{\underset{Cl}{|}}{CH_2} \xrightarrow[\text{or } Cl^{\ominus}]{Br^{\ominus}} \underset{\underset{Br}{|}}{CH_2}-\underset{\underset{Cl}{|}}{CH_2} + \underset{\underset{Cl}{|}}{CH_2}-\underset{\underset{Cl}{|}}{CH_2}$$

6) (2)



$$CH_3-CH=CH_2 \xrightarrow{H^{\oplus}} CH_3-\underset{\oplus}{CH}-CH_3 \xrightarrow{Br^{\ominus}} CH_3-\underset{\underset{Br}{|}}{CH}-CH_3$$

(Formed because more stable than 1° carbocation)

7)(i) $RC\equiv CH \xrightarrow[\text{in } NH_3]{Cu^{\oplus}} RC\equiv CCu$

Silver mirror test.

8) (1) Substitution in presence of sunlight. Chlorination by formation of free radical.

9) (1) $CH_3-CH_2-CH_3 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$

$\therefore$ 1 Vol of C_3H_8 requires 5 volumes of O_2.

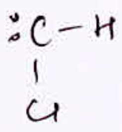
10) (4) Explained in prev. exercise.

11) (4) Upto octane are gases/liquids at room temp.

12) (3) π bond in alkene reacts with Br_2/addition of Br_2. Decolourises brown colour of solution. (1) & (2) are tests for alkyne, and (4) is a dehydrating agent.

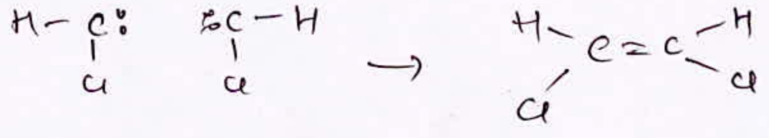
13) (1) Chloroform = $CHCl_3$

First, two $Cl^{\ominus}$ will be abstracted, forming carbene of the form

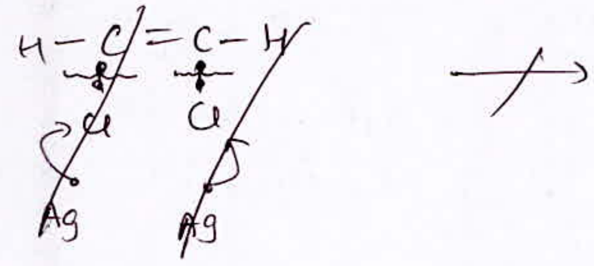


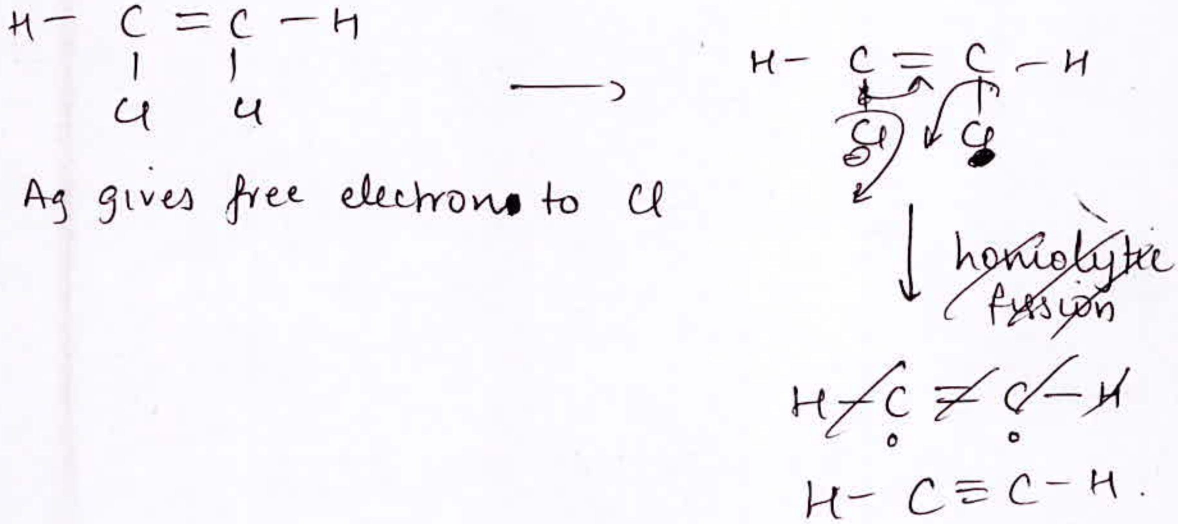
$\underset{Cl}{\underset{|}{\ddot{C}}}-H$

Two of these will react to form



lastly, two $Cl^{\ominus}$ will again be abstracted, forming alkyne





Ag gives free electrons to Cl

14) (1) order of EN ⟹ $sp > sp^2 > sp^3$.

More EN the C atom, more is its anion stable.

Hence alkyne > alkene > alkane in acidic strength.

15) (4) Both high T & P required for polymerization of ethene.

16) (1) Remember.

17) (1) 1,3- Pentadiene

conjugated
stabilized by
resonance.

1,4 pentadiene

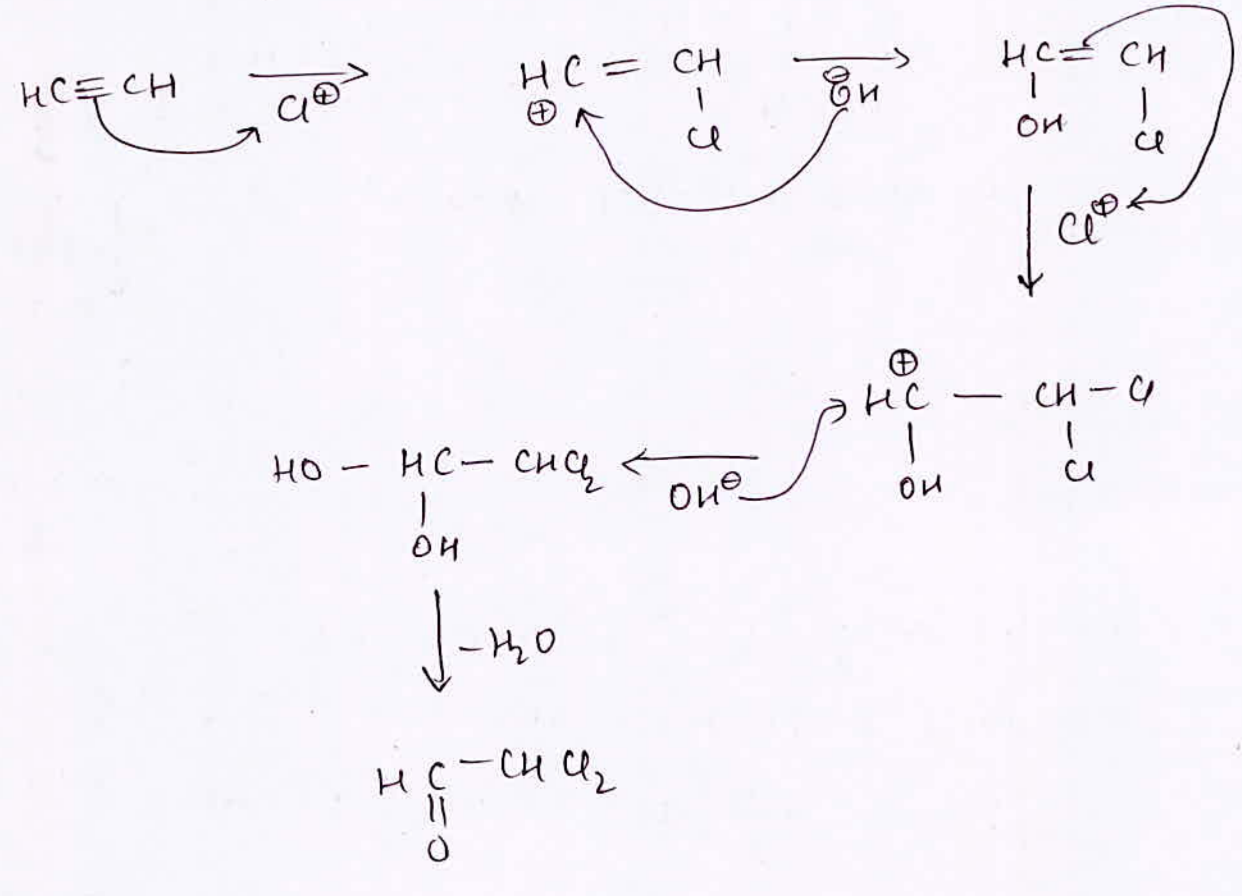
not conjugated.

18) (3) $CH_2=CH-CH_2-CH_3$ and $CH_3-C\equiv CH$

Tollen's reagent Ag complexed with NH_3, reacts with terminal alkynes, but not terminal alkenes.

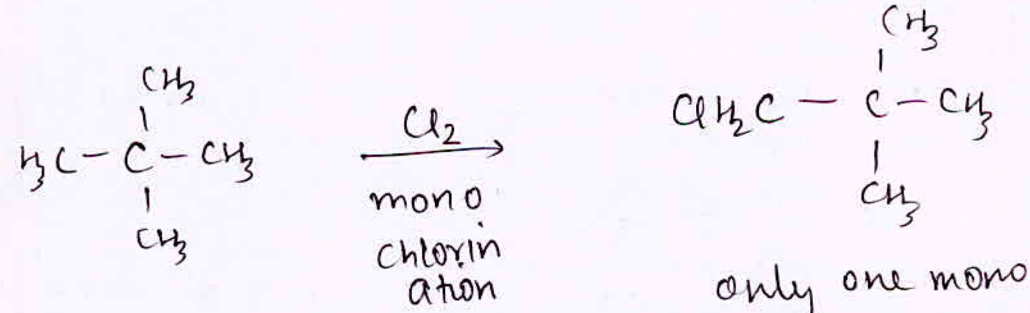
19) (1) $\overset{\ominus}{O}H$ is the anion of a stronger acid, i.e., H_2O. Hence it will not give acid base reaction with alkyne.

20) (3)



21) (1) $CH_2=CH-CH_2-CH_3 \xrightarrow[\text{hydrogenation}]{Pd/H_2} CH_3-CH_2-CH_2-CH_3$

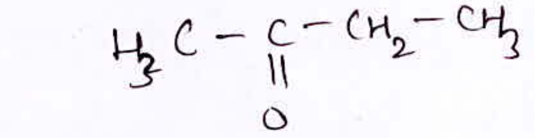
22) (1)



$$H_3C-\underset{CH_3}{\overset{CH_3}{C}}-CH_3 \xrightarrow[\text{mono chlorination}]{Cl_2} ClH_2C-\underset{CH_3}{\overset{CH_3}{C}}-CH_3$$

only one mono chloro product possible.

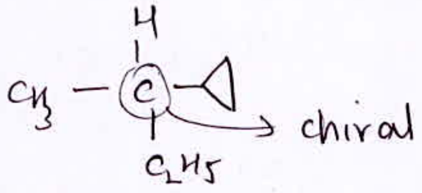
23) (1) Butane-2-one



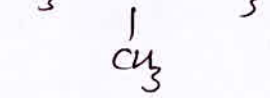
$H_3C-\underset{\overset{\|}{O}}{C}-CH_2-CH_3$

Zn & HCl → clemensen's reduction

24) (3)



25). (1) Isobutane



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

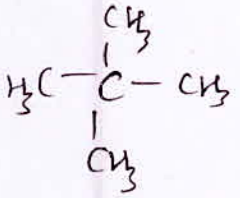
Branching reduces surface area, decreased surface area decreases Van der waal's ~~ref~~ forces, which decreases boiling point.

26) (4) Both (2) & (3) release CO_2, forming propane.

27) (1) $R-X \xrightarrow[C_2H_5OH]{Zn-Cu} R-H$.

Remember reduction reaction.

28) (3)



$H_3C-\underset{CH_3}{\overset{CH_3}{C}}-CH_3$

most branched. Lowest surface area. Least Van der Waal's forces. Lowest BP, hence most volatile.

29) (2) $R-Cl \xrightarrow{Na} R-R$

Hence best for making symmetrical alkanes.

30) (3) Hydrocarbons are also gases upto a certain number of C atoms.

31) (2) 3° H is most reactive because 3° C is most stable free radical when formed.

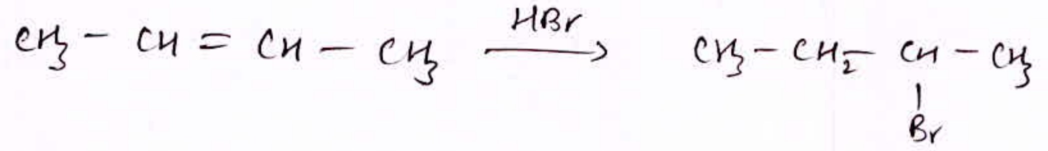
32) (1) $CH_3-OH + CH_3MgI \rightarrow \underset{\text{gas.}}{\underset{\downarrow}{CH_4}} + CH_3-O^{\ominus}MgI$

$n = \frac{1.04}{22400}$ = same number of moles of CH_3OH added because equal stoichiometric coeff in balanced reaction.

$\therefore$ mass $= \frac{1.04}{22400} \times$ (MW of CH_3OH)

$= \frac{1.04}{22400} \times 32 = 1.485 \times 10^{-3}$ g

33) (3) Only one possible product in 2-butene



$CH_3-CH=CH-CH_3 \xrightarrow{HBr} CH_3-CH_2-\underset{Br}{\underset{|}{CH}}-CH_3$

34) (1) Fact.

35) (4)

$CH_3-\underset{CH_3}{\underset{|}{C}}=\underset{CH_3}{\underset{|}{C}}-CH_3 \rightarrow CH_3-\underset{CH_3}{\underset{|}{C}}=O + O=\underset{CH_3}{\underset{|}{C}}-CH_3$

propanone

36) (3) Tollen's reagent acts as a test for terminal alkynes.

37) (3) $Mg_2C_3 \xrightarrow{\text{hydrolysis}} C_3H_4 \equiv CH_3-C\equiv CH$

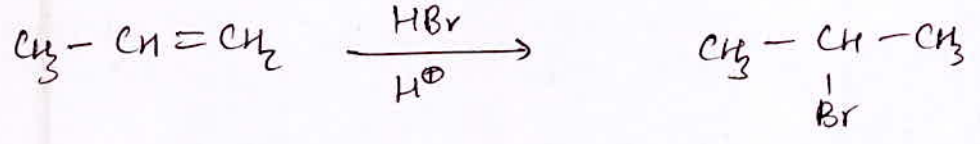
38) (3) 67.2 l = 3 moles of CH_4 formed.

$\therefore$ 3 hydroxyl groups present

39) (4) Remember.

40) (2) $CH_3-CH_2-CH_2-COOH$ forms intermolecular H bond in solution. Hence BP is highest. Butanol also forms H-bond, but to a lesser extent. Butanal doesnt form H-bond due to absence of H on highly EN atom.

41) (2) $CH_3-CH_2-CH_2-Br \xrightarrow[\Delta]{\overset{\ominus}{O}H \text{ alc.}} CH_3-CH=CH_2$



$$CH_3-CH=CH_2 \xrightarrow[H^{\oplus}]{HBr} CH_3-\underset{Br}{\underset{|}{C}H}-CH_3$$

Markownikoff's addition of HBr.

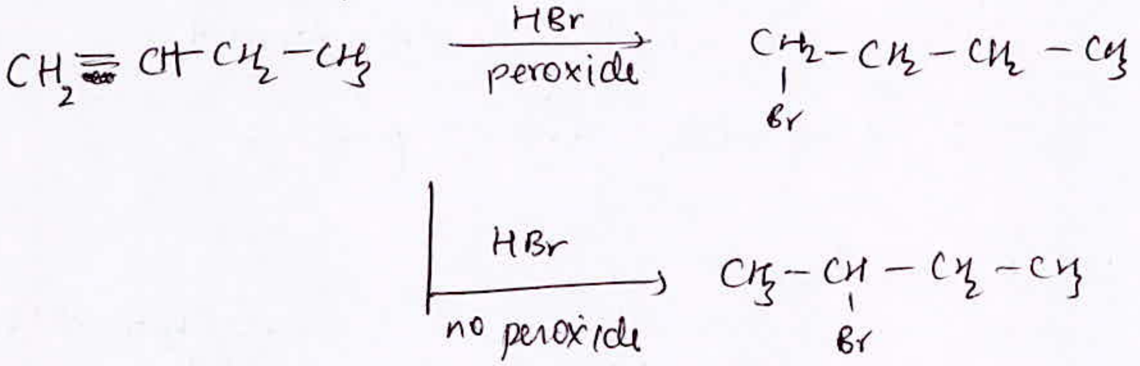
42) (4) Test for terminal alkyne

43) (3)

~~44) (3) (4)~~

~~44) (1) Option~~

44) (2) Option should be 1-butene, HBr.



$$CH_2{=}CH-CH_2-CH_3 \xrightarrow[\text{peroxide}]{HBr} \underset{Br}{\underset{|}{CH_2}}-CH_2-CH_2-CH_3$$

$$\xrightarrow[\text{no peroxide}]{HBr} CH_3-\underset{Br}{\underset{|}{CH}}-CH_2-CH_3$$

45) (2) $CH_3-C\equiv C-CH_3 \xrightarrow{NaNH_2} CH_3-CH_2-C\equiv CH$

isomerisation reaction.

46) (2) Mechanism :- Reaction with NBS follows via free radical mechanism

$$CH_2=CH-CH_2-CH=CH_2 \xrightarrow[-HBr]{Br^\circ} CH_2=CH-\overset{\circ}{C}H-CH=CH_2$$

$$\updownarrow \text{resonance}$$

$$CH_2=CH-CH=CH-CH_2-Br \xleftarrow[Br^\circ]{} CH_2=CH-CH=CH-\overset{\circ}{C}H_2$$

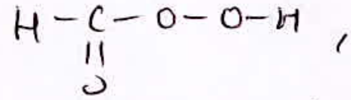
more stable.

47) (2) A is HBO, which is anti markownikoff's addition of water

B is OMD, which is markownikoff's addition of water without rearrangement.

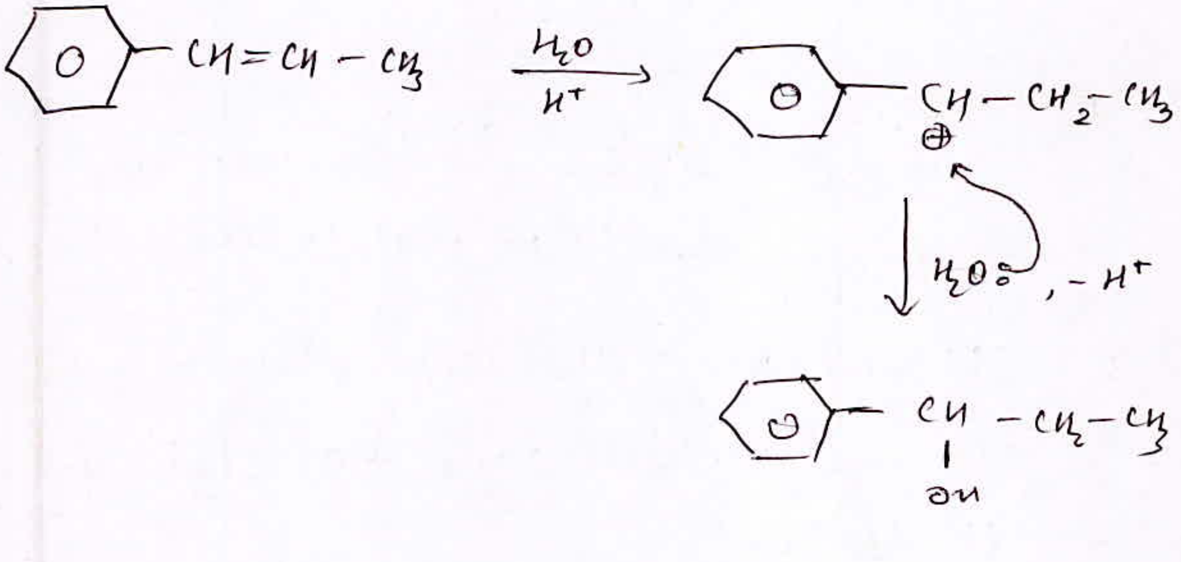
C is hydration, addition of water with ~~arra~~ rearrangement.

48) (1) X is MnO_4^-, OH^-, which does syn hydroxylation

Y is  $H-\underset{\overset{\|}{O}}{C}-O-O-H$, or peracid, which does anti hydroxylation.

49) (2) Given reaction is Birch reduction. It exhibits stereo specificity, if the one stereo isomer is more stable than the other.

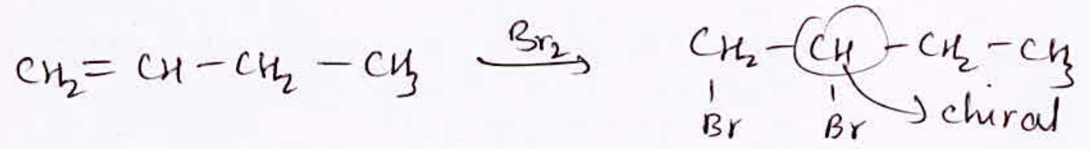
50) (2)



Assertion and Reason

1) (1) The reaction proceeds via free radical mechanism, to produce anti markownikoff's addition of HBr to alkene.

2) (1)



$CH_2=CH-CH_2-CH_3 \xrightarrow{Br_2} \underset{Br}{CH_2}-\underset{Br}{\boxed{CH}}-CH_2-CH_3$ chiral

3) (3) Assertion is true, but because it has large ring strain. Bent bonds ~~are~~ do cause loss of overlap, but are not present in cyclobutane, but in cyclopropane. In cyclopropane, they reduce the ring strain.

4) (1)

Pyrrole. The lone pair on N also takes part in resonance.

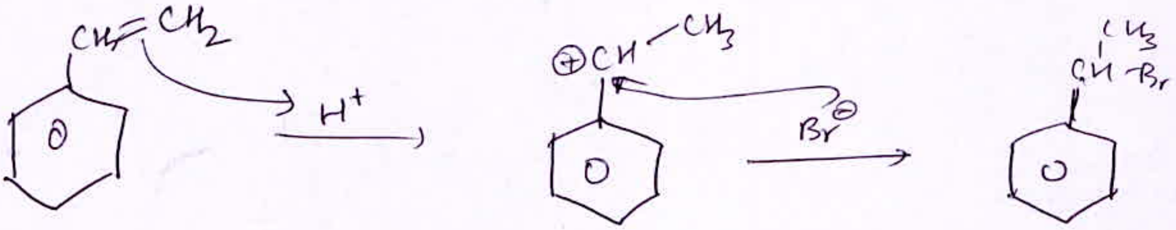
5) (2) Chlorination of CH_4 takes place in presence of UV rays, which cause homolytic fission of Cl−Cl bond.

6) (2) Alkyl benzene is not prepared by FC alkylation because, alkylation increases the reactivity of the ring which results in poly alkylation, which may not be desired. Reason is a true fact

7) (4) A: False because sodium ethoxide is not a bulky group and will give saytzeff product, i.e., ~~2-bromo~~ 2-butene.

B: 2 butene is more stable because of hyper-conjugation.

8) (2) A: reaction takes place by simple addition of HBr, not by alkyl radical intermediate.



R: True, but not reason of A.

9) (2) R is not reason of A, but the ~~def~~ A is definition of R.

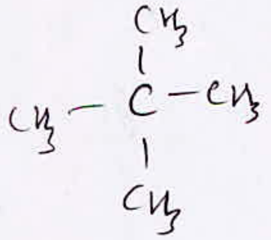
10) (2) A: ~~Vicinal~~ Iodination of alkanes by free radical mechanism is reversible because C–I bond is relatively weak as compared to C–Cl bond, because I atom is layer than Cl atom.

R: True, but not reason of A.

11) ~~(5)~~(2) ~~Self explanatory~~. 3° R–H reacts with $KMnO_4 + \Delta$ to give 3° R–OH. remember exception.

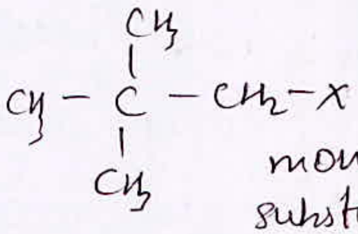
12) (5) Self explanatory. Tetraethyl lead is not used as a catalyst for halogenation, but it reduces knocking in fuel engines.

13) (3)



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

neopentane



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

mono substituted product.
Only one possible.

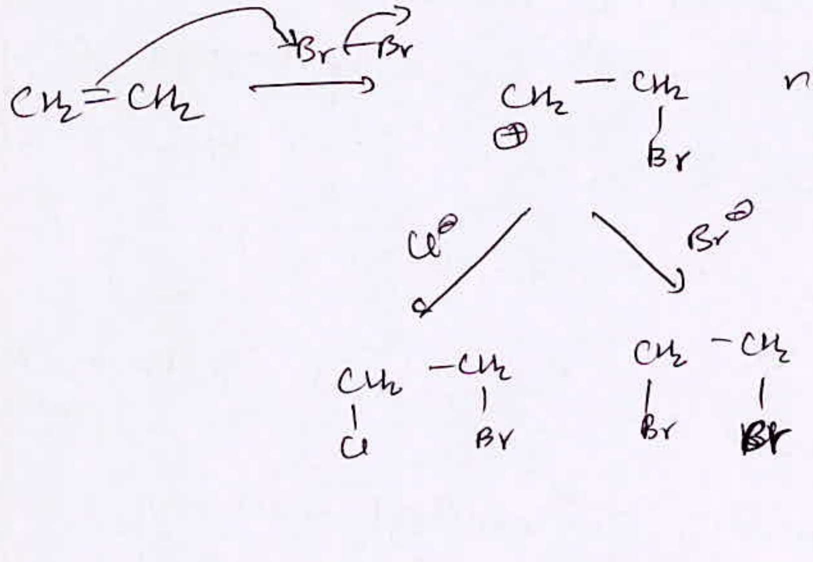
14) (2) Neopentane has lower surface area than N-pentane.

15) (2) But in fact, A is the reason of R.

16) (2)

17) (1) 2-butanol on dehydration gives both 1-butene and 2-buteno, but it follows saytzeff rule and gives 2-butene as major product.

18) (3) This reaction takes place by simple addition, not free radical addition



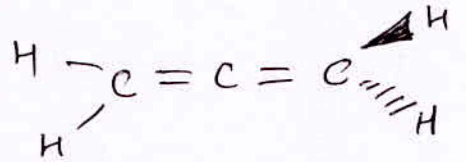
now both $Br^{\ominus}$ & $Cl^{\ominus}$ present in solution

19) (2) Branching increases octane number. R is true.

20) (1) Corey House synthesis

$R-Cl \xrightarrow{R'MgX} R-R'$ R & R' can be any ~~alkanes~~ alkyl groups

21) (4) A: false because both pairs of H lie in perpendicular planes. ~~that~~



R: false because middle C is sp hybrid.

22) (4) A: false because in presence of peroxide, addition of HBr follows anti Markownikoff's rule.

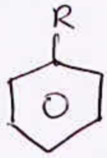
R: false because anti Markownikoff's addition of HBr takes place by free radical mechanism.

23) (3) ~~NH~~ Stronger acid gives H^+ to anion of weaker acid.

$HC\equiv CH$ is stronger acid than NH_3

24) (2) Aryl halides are less reactive toward nucleophilic substitution because C–Cl bond is stronger due to sp^2 hybrid C atom of benzene ring.

25) (5) Because if benzene is used as solvent, a lot of



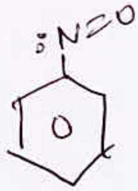
product will also form.

26) (2)

27) (1) Methyl group in toluene makes the benzene ring more reactive by increasing electron density on the ring by hyperconjugation.

28) (5)

29) (3) A: reactivity of benzene ring increases with increase in π e^- density, which increases if there's an electron donating group attached to it.



$-N=O$ group donates e^- by LP, but $=O$ pulls electrons. Overall effect is, by resonance. weakly deactivating.

30) (3) Reaction with $CH_3-\underset{\overset{\|}{O}}{C}-Cl$ is a friedel crafts acylation reaction. R is true.

31) (5) Annulenes are with even number of cyclic conjugated C atoms.

32) (3) Three properties of Aromaticity:-
1) planar structure
2) cyclic ring.
3) Complete conjugation over cyclic ring.

33) (1) Because it is non planar, and planarity is one of the criterion of aromaticity, 10 annulene is non aromatic.

34) (3) C-D bond is stronger than C-H bond.

35) (1) Aromatic rings are highly stable as compared to non aromatic molecules of similar characteristics.

Previous Years Questions

2014

1) (3) $CH_3-CH_2-CH=CH_2 \xrightarrow[\text{peroxide}]{HBr} CH_3-CH_2-CH_2-CH_2-Br$

$$\downarrow \overset{\ominus}{O}C_2H_5$$

$$CH_3-CH_2-CH_2-CH_2-O-C_2H_5$$

2) (4) CO_2 is sp hybrid, and so is ethyne.

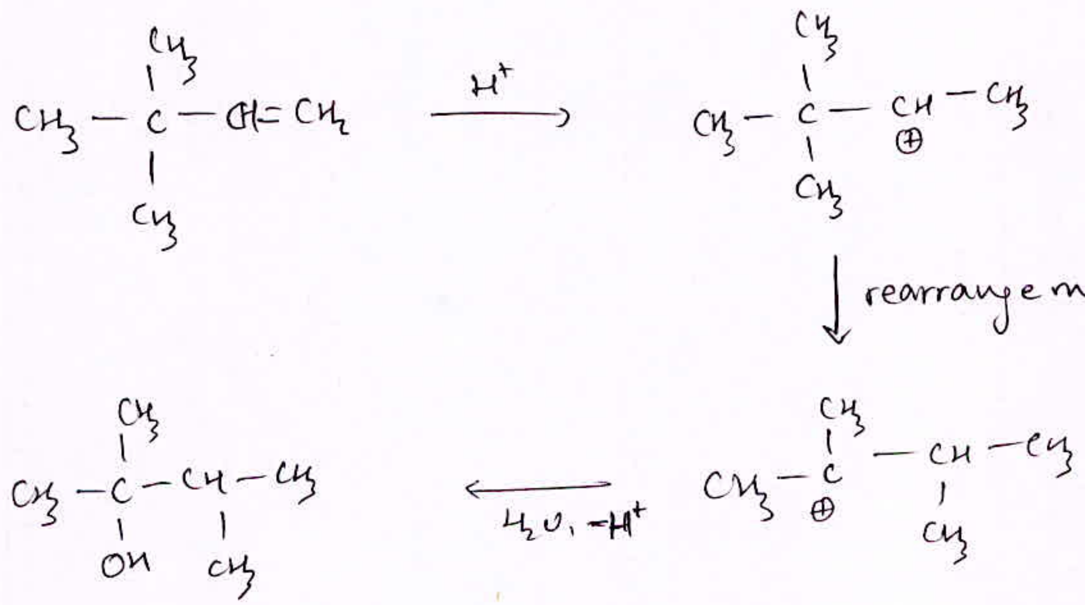
2013

1) (1) Remember as fact

2) (4) Nitro group is electron with drawing. Deactivates benzene ring.

2012

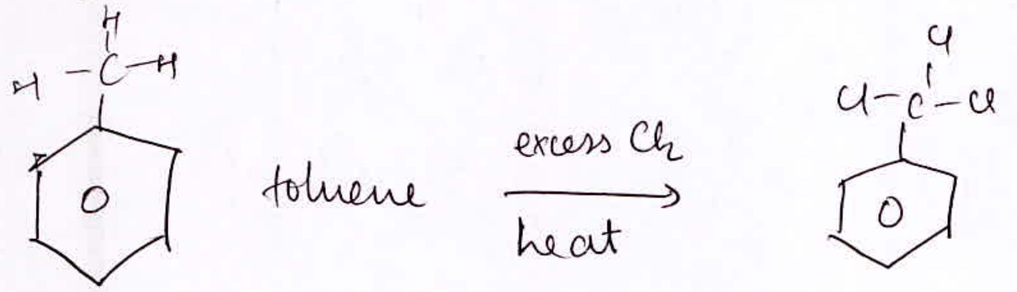
1) (1)



$$CH_3-\underset{CH_3}{\overset{CH_3}{C}}-CH=CH_2 \xrightarrow{H^+} CH_3-\underset{CH_3}{\overset{CH_3}{C}}-\underset{\oplus}{CH}-CH_3 \xrightarrow{\text{rearrangement}} CH_3-\underset{\oplus}{\overset{CH_3}{C}}-\underset{CH_3}{CH}-CH_3 \xrightarrow{H_2O,\,-H^+} CH_3-\underset{OH}{\overset{CH_3}{C}}-\underset{CH_3}{CH}-CH_3$$

2) (1) $NH_2^\ominus$ does acid base reaction with terminal alkyne.

3) (4)

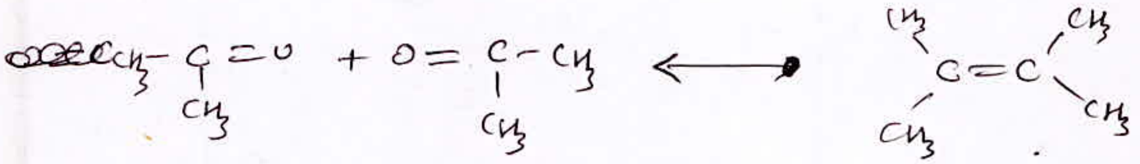


4) (1) Remember

5) (2)

~~6)~~

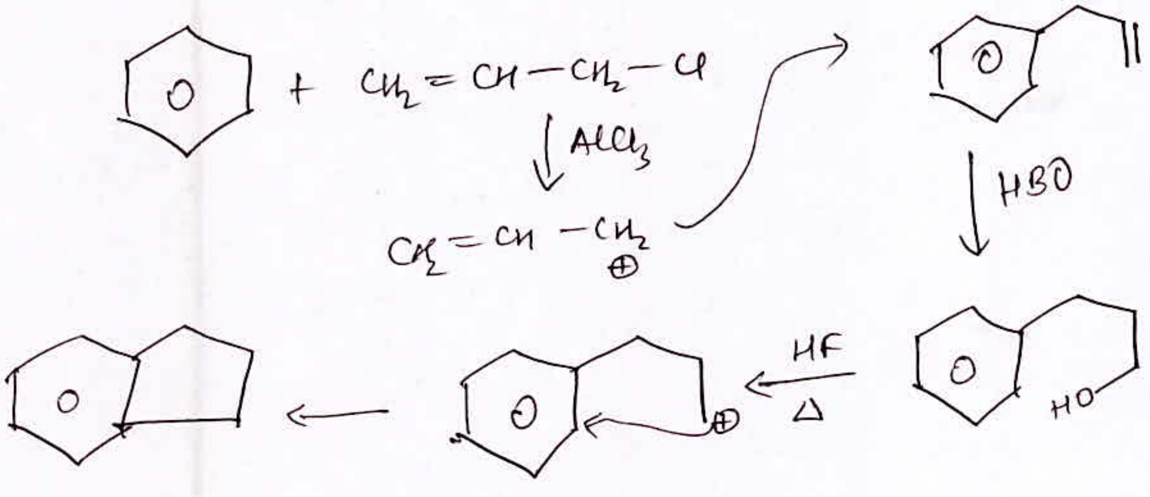
6) (3)



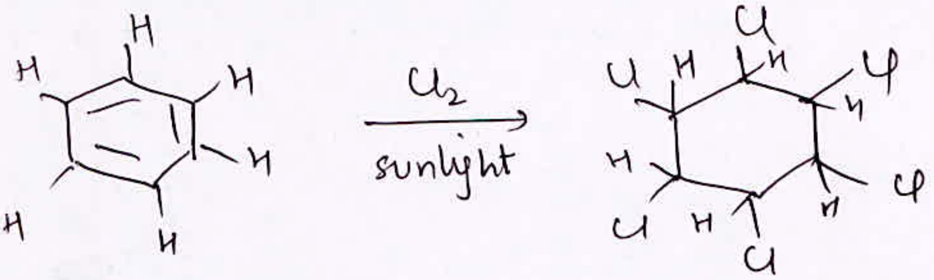
7) (4) Definition

8) (1) Hydroboration oxidation is anti Markownikoff's addition of water.

9) (2)



10) (2)



called 666 lindane.

11) (4) Boiling point depends ~~of~~ on surface area. Lesser the surface area of molecule, lower is BP.

12) (1) $CaC_2 + H_2O \longrightarrow HC \equiv CH$ (Remember hydrolysis)

$\downarrow$ addition of water

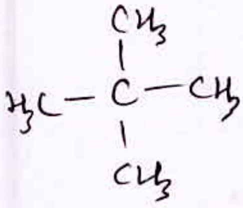
$H_2C = CH(OH) \underset{\text{tauto}}{\rightleftharpoons} CH_3-C(=O)-H$

Petroleum

1) (3)
2) (1)
3) (4)
4) (4)
5) (4)
6) (1)
7) (3)
8) (4) Octane number is equal to the % of iso octane in mixture of the hydrocarbons.
9) (1) Given above
10) (1)
11) (1)
12) (1)
13) (1)
14) (3)
15) (1)
16) (2)
17) (3)

Alkanes

1) (3)



$H_3C-C(CH_3)_2-CH_3$

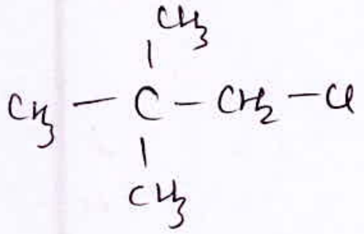
Neopentane.

2) (2) Lowest BP ≡ Lowest surface area of molecule and lowest molecular weight.

3) (4) Wurtz reaction combines 2 alkyl groups. Hence smallest product possible is ethane, so methane is not possible.

4) (1) Highest BP ≡ highest molecular weight & surface area.

5) (4)

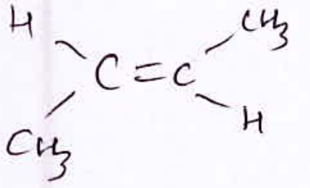


$CH_3-C(CH_3)_2-CH_2-Cl$

only one monosubstituted product possible.

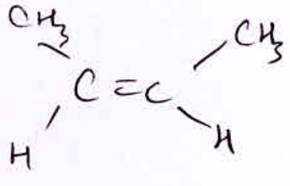
6) (3) Reduction of alkyl iodide by conc. HI & heat.

7) (4)



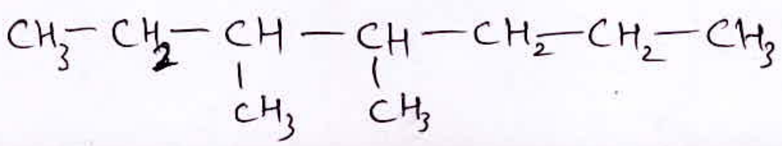
trans

&

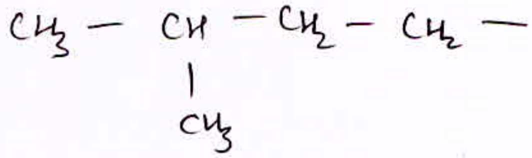


cis.

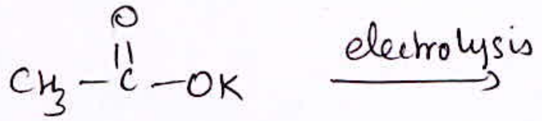
8) (1)



$CH_3-CH_2-CH(CH_3)-CH(CH_3)-CH_2-CH_2-CH_3$

9) (4) 

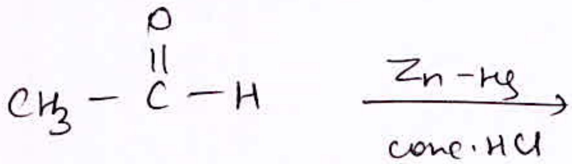
$CH_3-\underset{CH_3}{\underset{|}{CH}}-CH_2-CH_2-$ 3 methyl butyl group.

10) (1) 

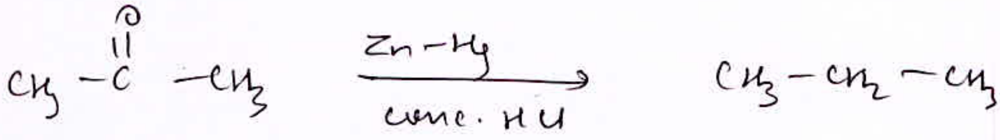
$CH_3-\overset{O}{\overset{||}{C}}-OK \xrightarrow{electrolysis}$ at anode, CH_3-CH_3 and CO_2 will form.

CH_3-CH_3 will form when two ~~$CH_3^{\circ}-CH$~~ CH_3° radicals combine.

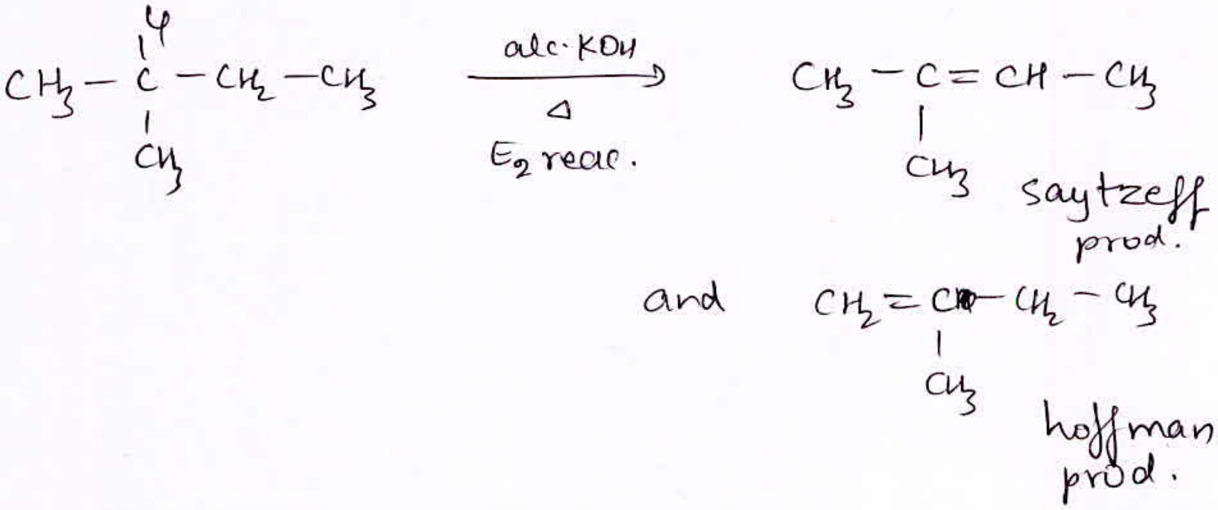
11) (4) The reduction is called clemmensen's reduction



$CH_3-\overset{O}{\overset{||}{C}}-H \xrightarrow[conc.HCl]{Zn-Hg} CH_3-CH_3$

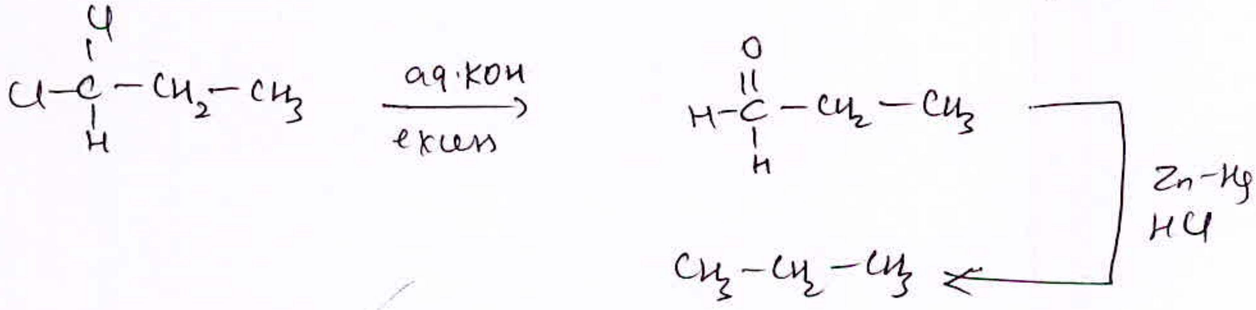


$CH_3-\overset{O}{\overset{||}{C}}-CH_3 \xrightarrow[conc.HCl]{Zn-Hg} CH_3-CH_2-CH_3$

12) (5) 

$CH_3-\underset{CH_3}{\underset{|}{\overset{Cl}{\overset{|}{C}}}}-CH_2-CH_3 \xrightarrow[\Delta \; E_2 \, reac.]{alc.KOH} CH_3-\underset{CH_3}{\underset{|}{C}}=CH-CH_3$ saytzeff prod.

and $CH_2=\underset{CH_3}{\underset{|}{C}}-CH_2-CH_3$ hoffman prod.

13) (4) 

$Cl-\underset{H}{\underset{|}{\overset{Cl}{\overset{|}{C}}}}-CH_2-CH_3 \xrightarrow[excess]{aq.KOH} H-\underset{H}{\underset{|}{\overset{O}{\overset{||}{C}}}}-CH_2-CH_3 \xrightarrow[HCl]{Zn-Hg} CH_3-CH_2-CH_3$

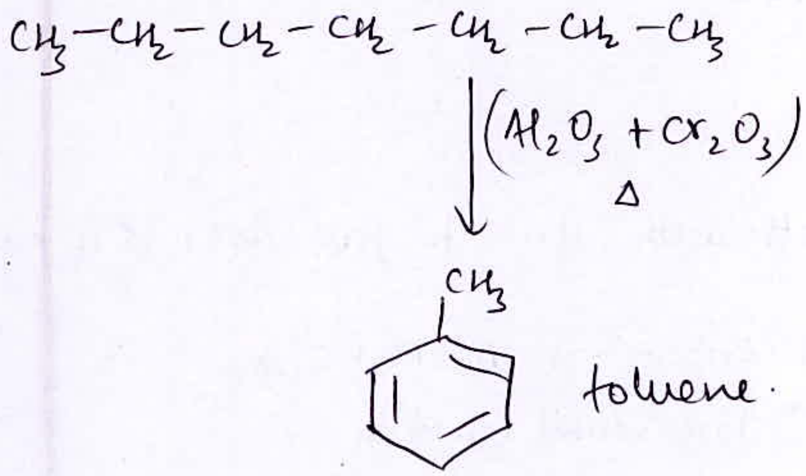
14) (1) $CH_3I \xrightarrow[\Delta]{\text{conc HI}} CH_4$

$CH_3I \xrightarrow[\text{wurtz reac.}]{Na} CH_3-CH_3$

15) (1) Remember

16) (3) the reaction is wurtz reaction.

17) (2)

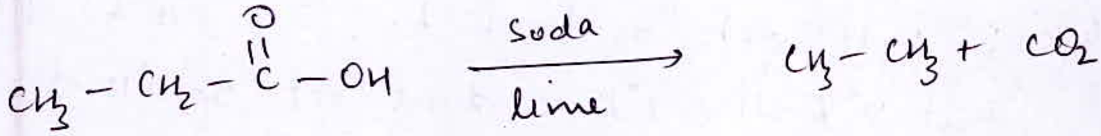


18) (4) $CH_3-I + CH_3-I \xrightarrow{\text{wurtz}} CH_3-CH_3$

$CH_3-I + CH_3-CH_2-I \xrightarrow{\text{wurtz}} CH_3-CH_2-CH_3$

$CH_3-CH_2-I + CH_3-CH_2-I \xrightarrow{\text{wurtz}} CH_3-CH_2-CH_2-CH_3$

19) (3)



$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-OH \xrightarrow[\text{lime}]{\text{soda}} CH_3-CH_3 + CO_2$

20) (4)

21) (4)

22) (1) Remember

23) (2) Ethane gives highest heat of combustion because ethane is more stable than ethene or ethyne.

24) (4) Remember oxidation reaction

$$CH_4 + O_2 \xrightarrow{MoO} CH_3OH$$

25) ~~(4)~~ ~~$SiC + H_2O \rightarrow$~~

(3) $VC + H_2O \longrightarrow V(OH)_4 + CH_4$

26) (5) Remember

27) (3) Na reacts with H_2O to give NaOH & H_2 gas.

28) (4) $2R-X + Zn \longrightarrow R-R + ZnX_2$

Frankland reaction

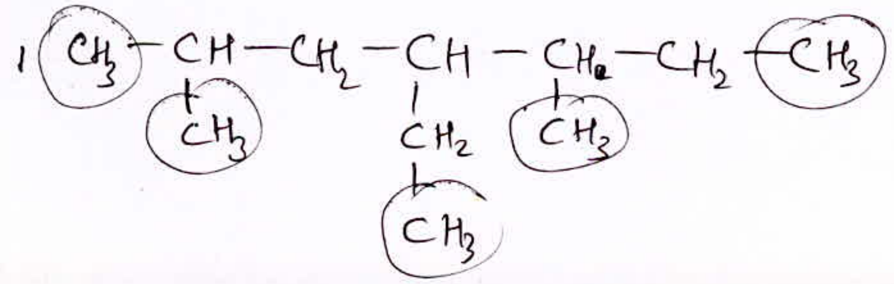
29) (1) Photochlorination of ethane gives good yeild of CH_3-CH_2-Cl

30) (3) Remember

31) (3) Remember

32) (4) 3° R-H gets oxidized to 3° R-OH by $KMnO_4$ + heat, but 2° R-H & 1° R-H dont get oxidized. In n-pentane, there are no 3° R-H but in isopentane, there is one 3° R-H.

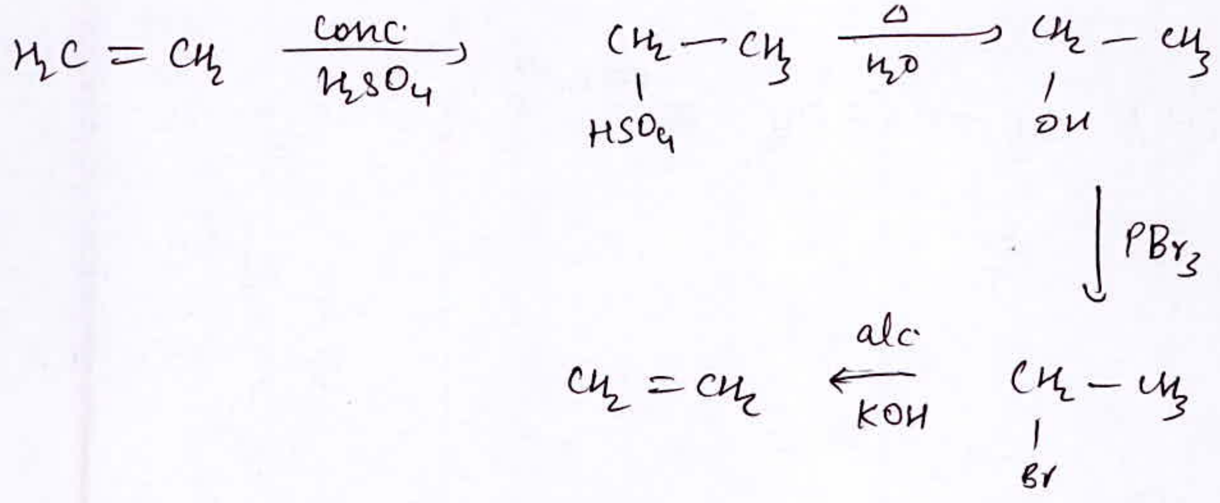
33) (4)



$$1\ CH_3-\underset{CH_3}{CH}-CH_2-\underset{\underset{CH_3}{CH_2}}{CH}-\underset{CH_3}{CH_2}-CH_2-CH_3$$

Alkenes

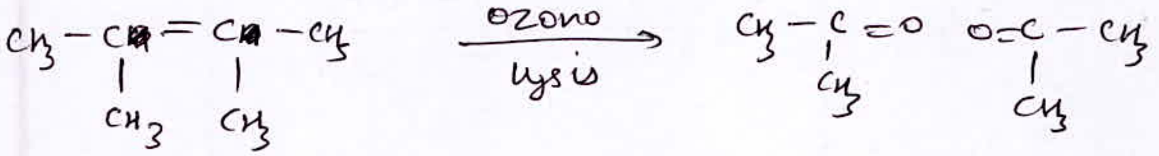
1) (4)



$$H_2C=CH_2 \xrightarrow[H_2SO_4]{conc} \underset{HSO_4}{CH_2}-CH_3 \xrightarrow[H_2O]{\Delta} \underset{OH}{CH_2}-CH_3 \xrightarrow{PBr_3} \underset{Br}{CH_2}-CH_3$$

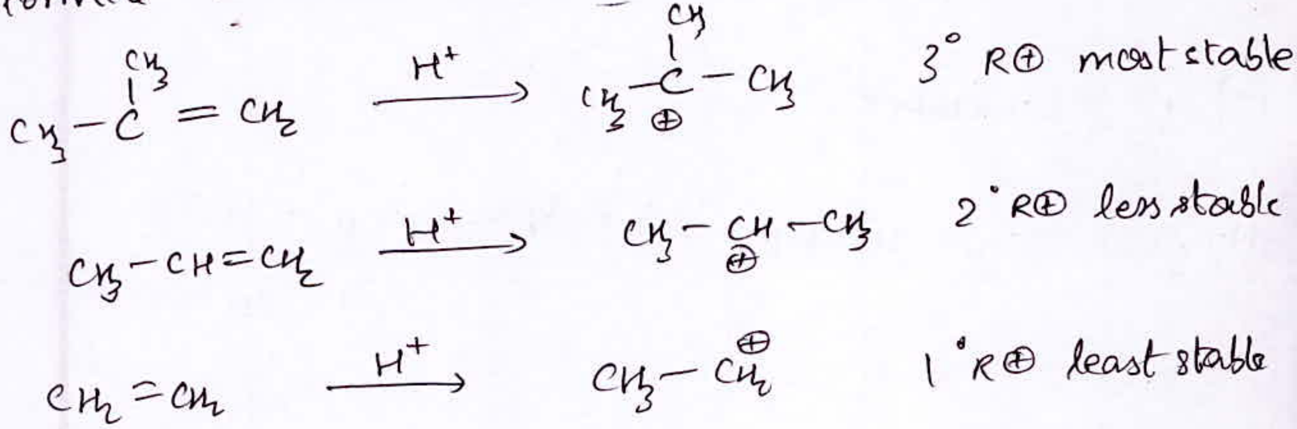
$$CH_2=CH_2 \xleftarrow[KOH]{alc} \underset{Br}{CH_2}-CH_3$$

2) (5)



$$CH_3-\underset{CH_3}{C}=\underset{CH_3}{C}-CH_3 \xrightarrow[lysis]{ozono} CH_3-\underset{CH_3}{C}=O \quad O=\underset{CH_3}{C}-CH_3$$

3) (3) In acid catalyzed hydration, stability of cation formed will determine the rate of reaction.



$$CH_3-\overset{CH_3}{C}=CH_2 \xrightarrow{H^+} CH_3-\underset{\oplus}{\overset{CH_3}{C}}-CH_3$$

3° R⊕ most stable

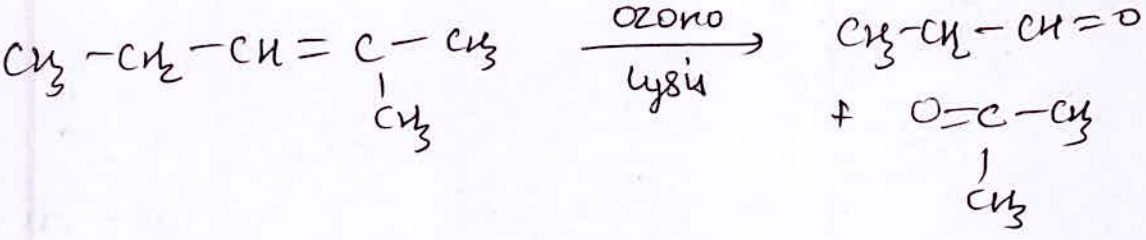
$$CH_3-CH=CH_2 \xrightarrow{H^+} CH_3-\underset{\oplus}{CH}-CH_3$$

2° R⊕ less stable

$$CH_2=CH_2 \xrightarrow{H^+} CH_3-\overset{\oplus}{CH_2}$$

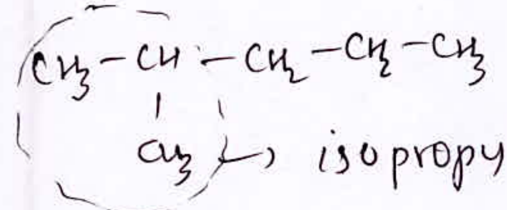
1° R⊕ least stable

4) (1)



$$CH_3-CH_2-CH=\underset{CH_3}{C}-CH_3 \xrightarrow[lysis]{ozono} CH_3-CH_2-CH=O + O=\underset{CH_3}{C}-CH_3$$

5) (4)

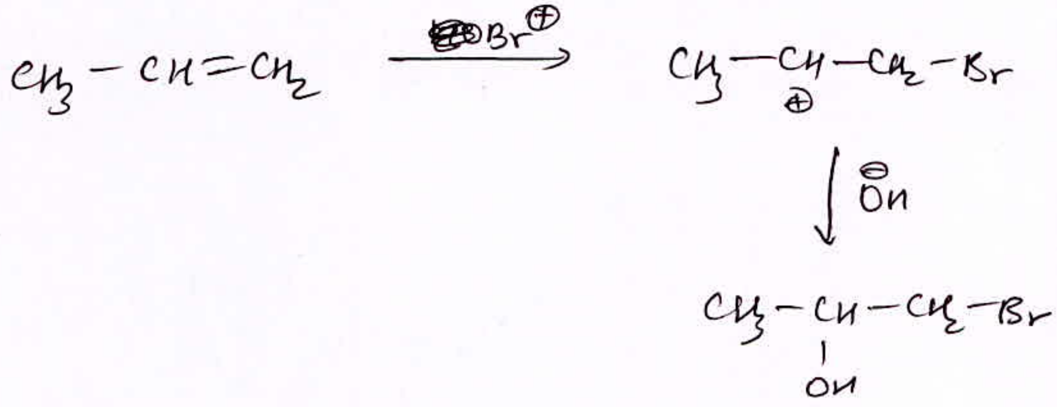


$$CH_3-\underset{CH_3}{CH}-CH_2-CH_2-CH_3$$

→ isopropyl group.

6) (3) $CH_3-CH_2-COOH \xrightarrow[\text{lime}, \Delta]{\text{soda}} CH_3-CH_3 + CO_2$

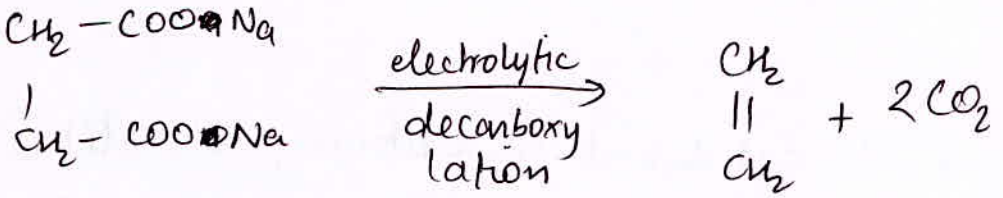
7) (4)



$$CH_3-CH=CH_2 \xrightarrow{Br^{\oplus}} CH_3-\underset{\oplus}{CH}-CH_2-Br \xrightarrow{\overset{\ominus}{O}H} CH_3-\underset{OH}{\underset{|}{CH}}-CH_2-Br$$

8) (4) $CH_3-CH=CH-CH_3 \xrightarrow[\text{ozonolysis}]{\text{reductive}} 2\,CH_3-CH=O$

9) (2)

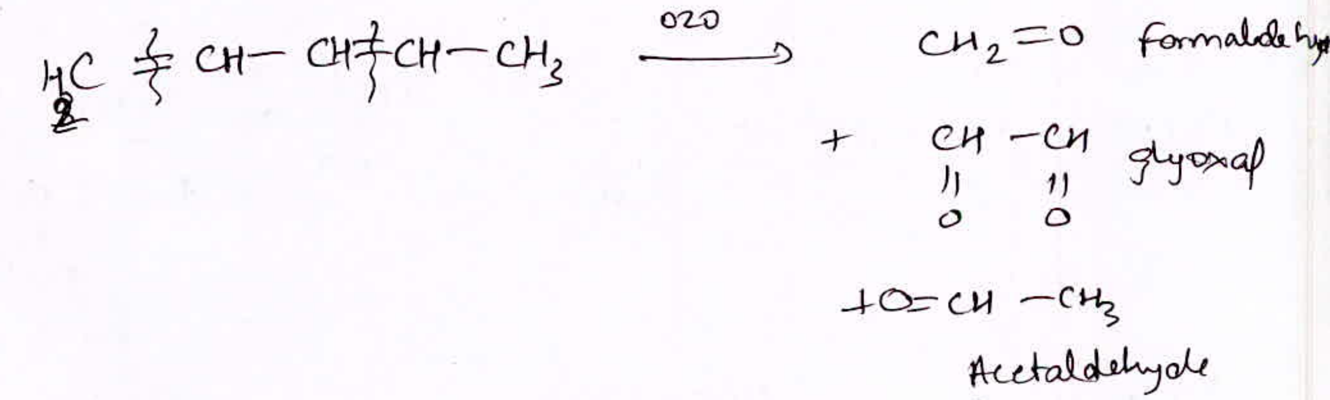


$$\begin{matrix} CH_2-COONa \\ | \\ CH_2-COONa \end{matrix} \xrightarrow[\text{decarboxylation}]{\text{electrolytic}} \begin{matrix} CH_2 \\ \| \\ CH_2 \end{matrix} + 2CO_2$$

10) (2) Remember

11) (2) $CH_3-CH=CH_2 \xrightarrow{\text{ozonolysis}} CH_3-CH=O$
$+\ CH_2=O$

12) (3)



$$H_2C \wr CH-CH \wr CH-CH_3 \xrightarrow{\text{ozo}} CH_2=O \text{ formaldehyde} + \underset{O}{\overset{}{\underset{\|}{CH}}}-\underset{O}{\underset{\|}{CH}} \text{ glyoxal} + O=CH-CH_3 \text{ Acetaldehyde}$$

13) (3) Resonance is not possible, hence it is not a conjugated system.

14) (1) $CH_3-CH_2-CH_2-Cl \xrightarrow{alc.\ KOH} CH_3-CH=CH_2$

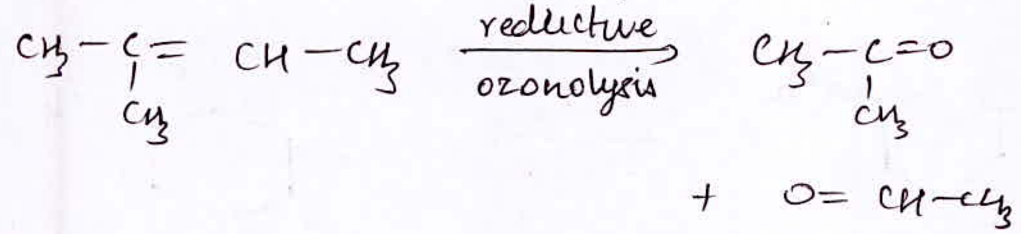
$$CH_3-CH=CH_2 \xrightarrow{BH_3,\ THF,\ HAc} CH_3-CH_2-CH_2-OH$$

Anti Markownikoff's addition of water.

15) (1) Remember.

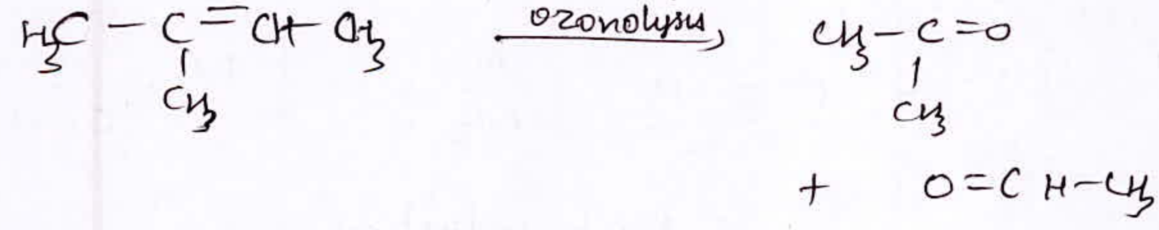
16) (1) Solved earlier

17) (2)



$$CH_3-\underset{CH_3}{\underset{|}{C}}=CH-CH_3 \xrightarrow[ozonolysis]{reductive} CH_3-\underset{CH_3}{\underset{|}{C}}=O + O=CH-CH_3$$

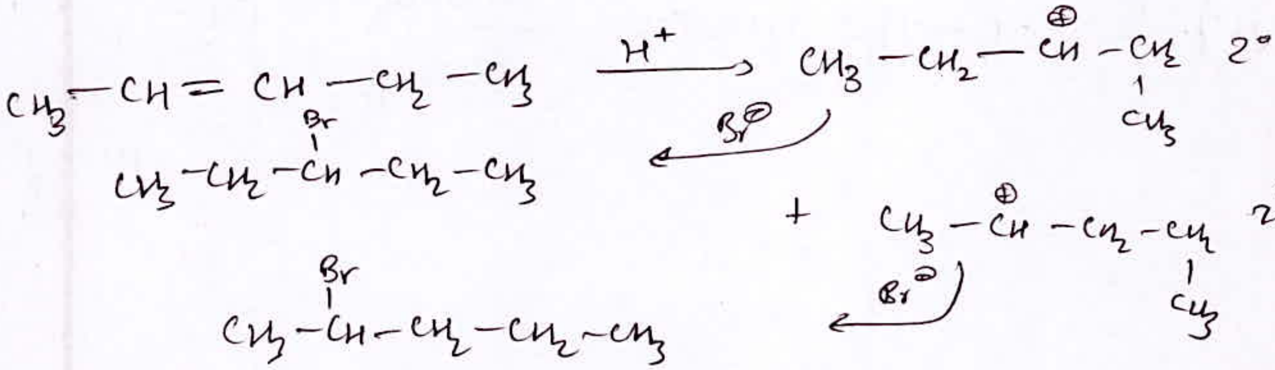
18) (1)



$$H_3C-\underset{CH_3}{\underset{|}{C}}=CH-CH_3 \xrightarrow{ozonolysis} CH_3-\underset{CH_3}{\underset{|}{C}}=O + O=CH-CH_3$$

19) (3) $CH_3-CH=CH-CH_3 \longrightarrow CH_3-CH=O + O=CH-CH_3$

20) (3)

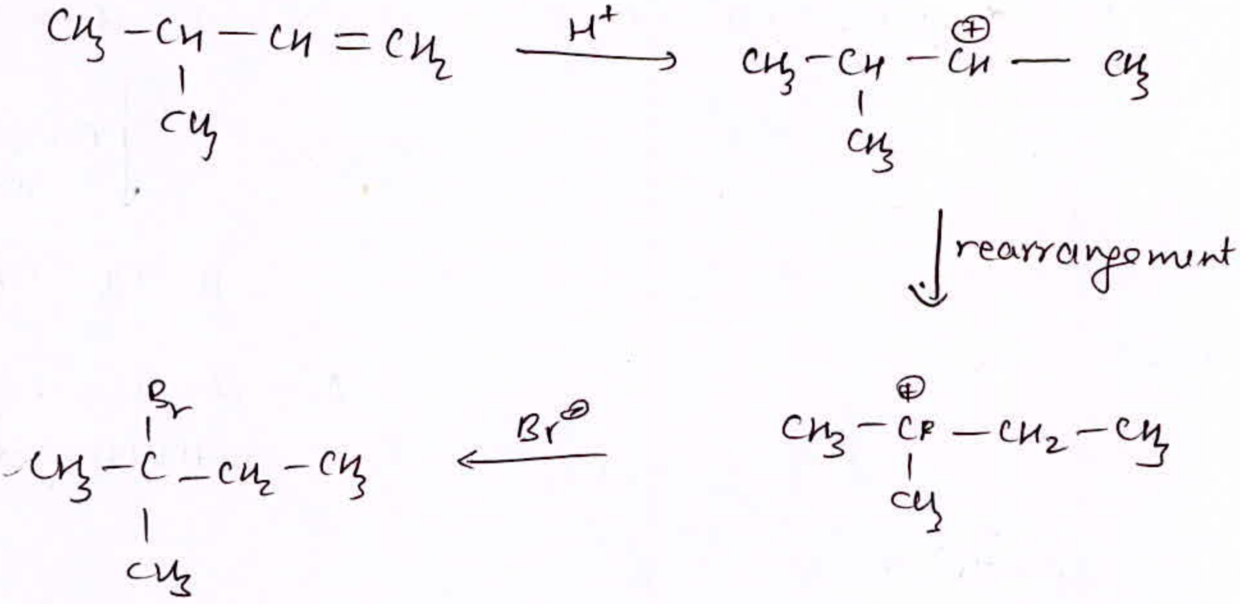


$$CH_3-CH=CH-CH_2-CH_3 \xrightarrow{H^+} CH_3-CH_2-\overset{\oplus}{C}H-CH_2 \ (2^\circ) + CH_3-\overset{\oplus}{C}H-CH_2-CH_2 \ (2^\circ)$$

$$\xrightarrow{Br^\ominus} CH_3-CH_2-\overset{Br}{\overset{|}{C}H}-CH_2-CH_3 \qquad \xrightarrow{Br^\ominus} CH_3-\overset{Br}{\overset{|}{C}H}-CH_2-CH_2-CH_3$$

21) (3) Ammoniacal Cu_2Cl_2 is a test for terminal alkyne. white ppt is formed with acytelene.

22) (2)

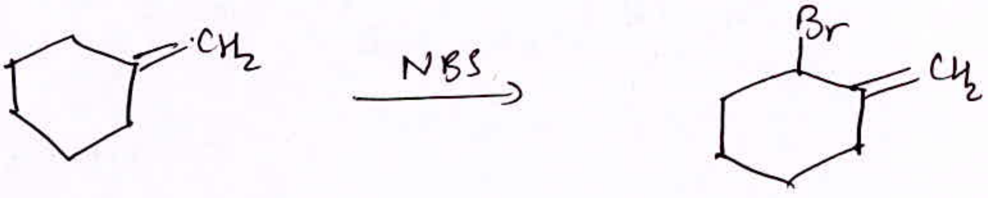


$$CH_3-\underset{\underset{CH_3}{|}}{CH}-CH=CH_2 \xrightarrow{H^+} CH_3-\underset{\underset{CH_3}{|}}{CH}-\overset{\oplus}{CH}-CH_3$$

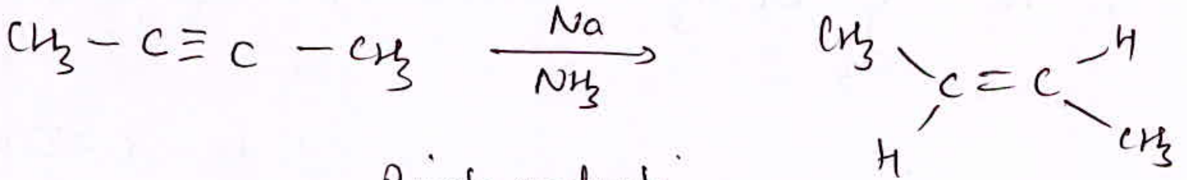
$$\downarrow \text{rearrangement}$$

$$CH_3-\overset{\overset{Br}{|}}{\underset{\underset{CH_3}{|}}{C}}-CH_2-CH_3 \xleftarrow{Br^{\ominus}} CH_3-\overset{\oplus}{\underset{\underset{CH_3}{|}}{C}}-CH_2-CH_3$$

23) (1) NBS is used for allylic bromination



24) (1)

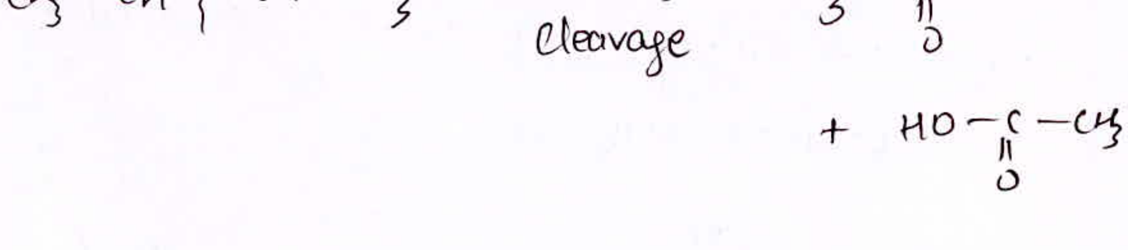


$$CH_3-C\equiv C-CH_3 \xrightarrow[NH_3]{Na} \overset{CH_3}{}\!\!\!\!\!\!\!\!\!\!\!\!\ C=C$$

Birch reduction

trans
major product.

25) (2)



$$CH_3-CH=CH-CH_3 \xrightarrow[\text{Cleavage}]{\text{oxidative}} CH_3-\underset{\underset{O}{\|}}{C}-OH + HO-\underset{\underset{O}{\|}}{C}-CH_3$$

26) (4) $CaC_2 + H_2O \longrightarrow Ca(OH)_2 + C_2H_2$

acytelene.

~~27) (3)~~ ~~$R-\underset{R''}{C}=CH-R' \xrightarrow[H^+, H_2O]{acid} R-\underset{R''}{CH_2}-\underset{OH}{CH}-R'$~~

~~if R' is CH_3, secondary~~

27) (3) $R-\underset{R''}{C}=CH-R' \xrightarrow{H^+, H_2O} R-\underset{R''}{\overset{\oplus}{C}}-CH_2-R'$

$$\downarrow H_2O$$

$$R-\underset{R''}{\overset{OH}{C}}-CH_2-R$$

if R'' = H, secondary alc. formed

R'' = CH_3 or higher, tert. alc. formed.

28) (4) $CH_3-CH_2-C\equiv CH + HCl \longrightarrow CH_3-CH_2-\underset{Cl}{C}=CH_2$

$$\downarrow HI$$

$$CH_3-CH_2-\underset{Cl}{\overset{I}{C}}-CH_3$$

29) (4) $Ph-CH=CH-Ph \xrightarrow{ox} Ph-\underset{OH}{CH}-\underset{OH}{CH}-Ph$

$$\downarrow ox$$

$$2\times\ Ph-\underset{O}{\underset{\|}{CH}}$$

30) (3) $CH_2=CH-CH_2-Cl \xrightarrow[\ominus CH_3]{} CH_2=CH-CH_2-CH_3$

31) (4) $CH_2=CH-CH_3 \xrightarrow[\text{Peroxide}]{HBr} \underset{Br}{\underset{|}{CH_2}}-CH_2-CH_3$

Anti Markownikoff's
addition of HBr

32) (2) A: true, and gives two isomeric products, i.e., enantiomers

$CH_3-CH=CH-CH_3 \xrightarrow{HBr} CH_3-\underset{Br}{\underset{|}{\boxed{CH}}}-CH_2-CH_3$ → chiral

R: true.

33) (2) $(Ph_3P)_3RhCl$ is Lindlar's catalyst.

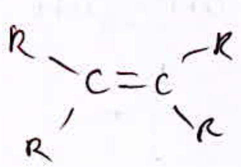
34) (3) Draw products and see.

35) (1) $CH_2=CH_2 \xrightarrow{HBr} CH_3-\underset{Br}{\underset{|}{CH_2}} \xrightarrow[KOH]{alc} CH_2=CH_2$.

36) (i) Order of reactivity :-

$HC\equiv CH > CH_2=CH_2 > R-CH=CH_2 > R-CH=CH-R$

$\vee$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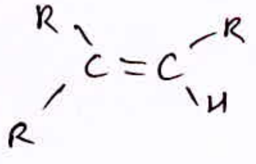
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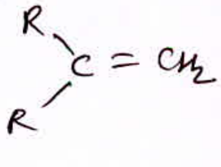
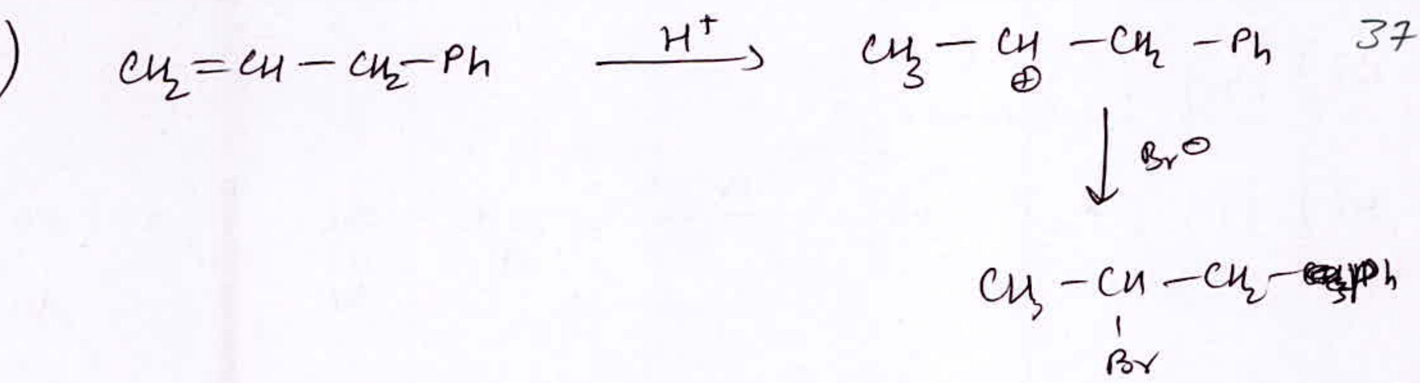


37)



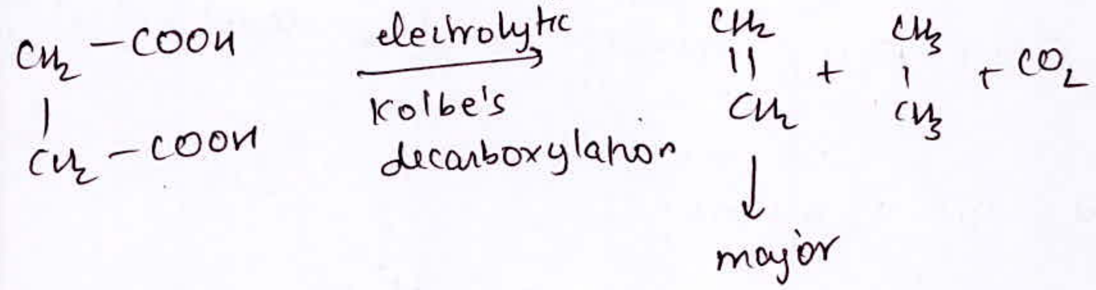
$$CH_2=CH-CH_2-Ph \xrightarrow{H^+} CH_3-\overset{}{\underset{\oplus}{CH}}-CH_2-Ph \xrightarrow{Br^\ominus} CH_3-\underset{Br}{\underset{|}{CH}}-CH_2-Ph$$

38) (1) Because of most hyperconjugation.

39) (2) Heat of hydrogenation $\propto \frac{1}{\text{stability}}$.

40) (2) Definition.

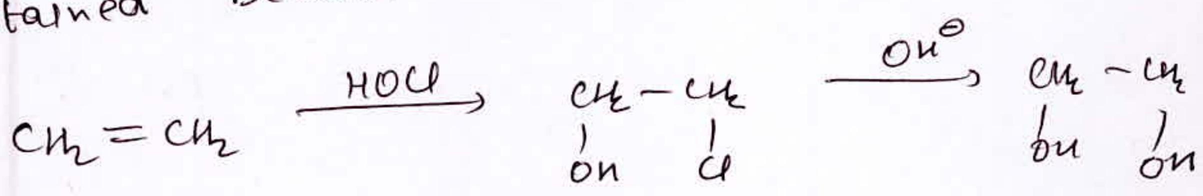
41) (1)



$$\begin{matrix} CH_2-COOH \\ | \\ CH_2-COOH \end{matrix} \xrightarrow[\text{Kolbe's decarboxylation}]{\text{electrolytic}} \underset{\text{major}}{\begin{matrix} CH_2 \\ \| \\ CH_2 \end{matrix}} + \begin{matrix} CH_3 \\ | \\ CH_3 \end{matrix} + CO_2$$

42) (4) E_2 reaction takes place, but saytzeff product is obtained because base is non bulky.

43) (1)

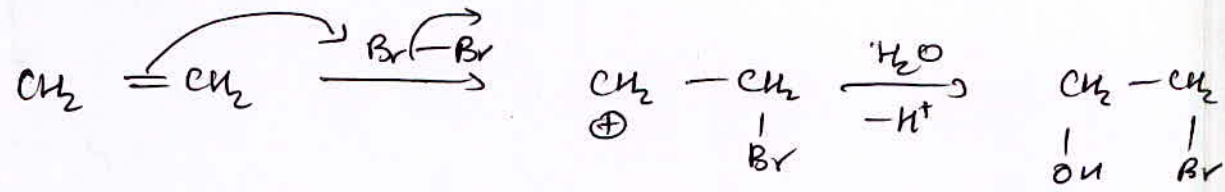


$$CH_2=CH_2 \xrightarrow{HOCl} \underset{OH}{\underset{|}{CH_2}}-\underset{Cl}{\underset{|}{CH_2}} \xrightarrow{OH^\ominus} \underset{OH}{\underset{|}{CH_2}}-\underset{OH}{\underset{|}{CH_2}}$$

44) (4) ~~Bro~~ Brown colour of bromine water ~~is~~ disappears when alkene is put into it. Test for unsaturation.

45) (2) Remember

46) (1)



$$CH_2=CH_2 \xrightarrow{Br-Br} \underset{\oplus}{CH_2}-\underset{Br}{CH_2} \xrightarrow[-H^+]{H_2O} \underset{OH}{CH_2}-\underset{Br}{CH_2}$$

47) (3) ~~C_2~~ $CH_2=CH_2 \xrightarrow[\Delta]{H_2SO_4} C_2H_5-OSO_3H$

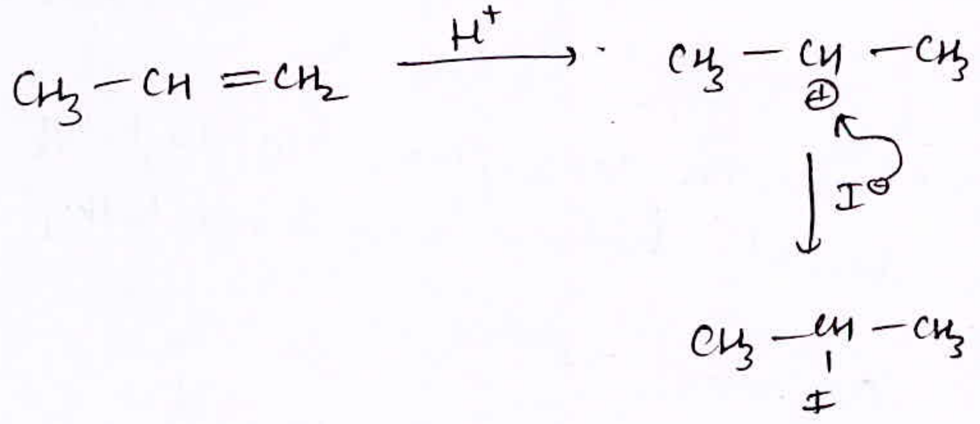
$$\downarrow H_2O$$

$$C_2H_5-OH + H_2SO_4$$

48) (3) C_2H_4 becomes ethylene glycol. Test for unsaturation

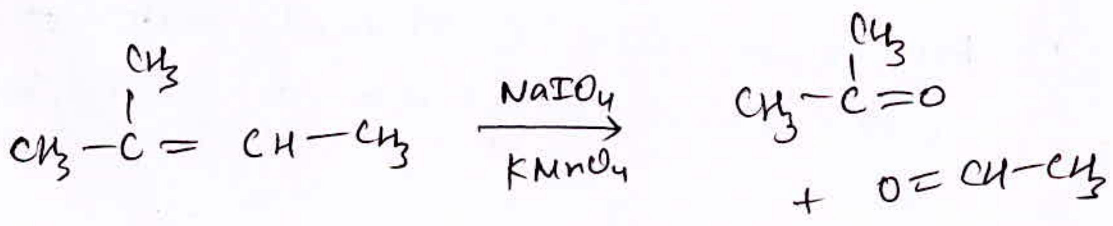
49) (1) Remember

50) (1)



$$CH_3-CH=CH_2 \xrightarrow{H^+} CH_3-\underset{\oplus}{CH}-CH_3 \xrightarrow{I^\ominus} CH_3-\underset{I}{CH}-CH_3$$

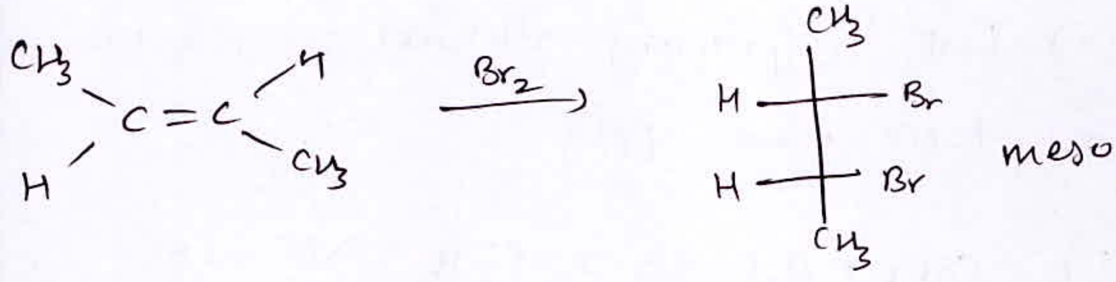
51) (1) Oxidative cleavage



$$CH_3-\overset{CH_3}{C}=CH-CH_3 \xrightarrow[KMnO_4]{NaIO_4} CH_3-\overset{CH_3}{C}=O + O=CH-CH_3$$

53) (2) Explained earlier

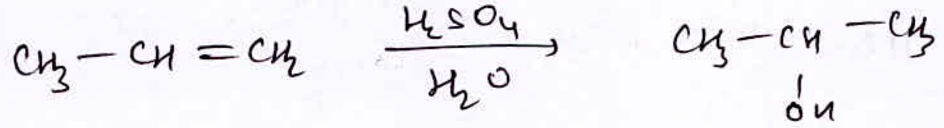
52) (3)



Anti addition.

54) (4) $CH_2=CH_2 \xrightarrow[Cu_2Cl_2,\ H^+]{PdCl} CH_3-CH_2-Cl \xrightarrow{HCN} CH_3-CH_2-CN$

55) (2)

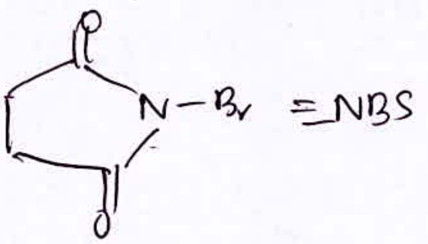


$CH_3-CH=CH_2 \xrightarrow[H_2O]{H_2SO_4} CH_3-\underset{OH}{CH}-CH_3$

56) (3) Diels Alder reaction

57) (2) In But-2-ene, both Markownikoff's & anti Markownikoff's products are identical.

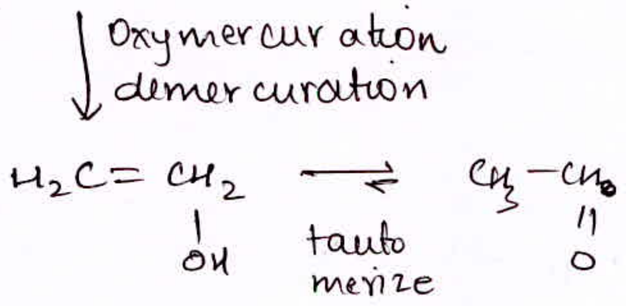
58) (1) NBS → used for allylic halogenation.



Alkynes

1) (3) Test for primary alkynes is reaction with $AgNO_3$. forms white ppt.

2) (4) $CaC_2 + H_2O \longrightarrow C_2H_2 \Rightarrow HC \equiv CH$



$$HC\equiv CH \xrightarrow{\text{Oxymercuration demercuration}} \underset{\substack{|\\OH}}{H_2C=CH_2} \underset{\text{tautomerize}}{\rightleftharpoons} \underset{\substack{\|\\O}}{CH_3-CH_2}$$

3) (2) Explained above

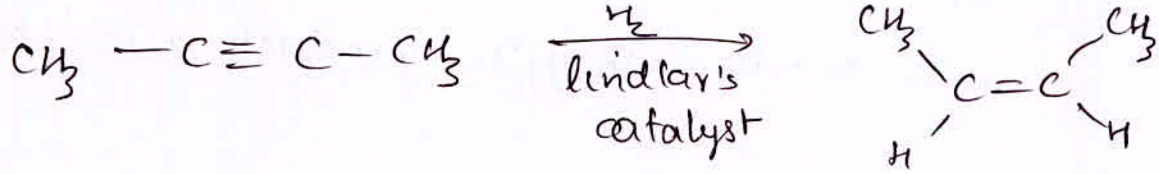
4) (3) Test for terminal alkyne. Remember.

5) (3) $HC\equiv C-CH_2-CH_3 \xrightarrow[\text{cleavage}]{\text{oxidative}} CO_2 + CH_3-CH_2-COOH + H_2O$.

6) (2)

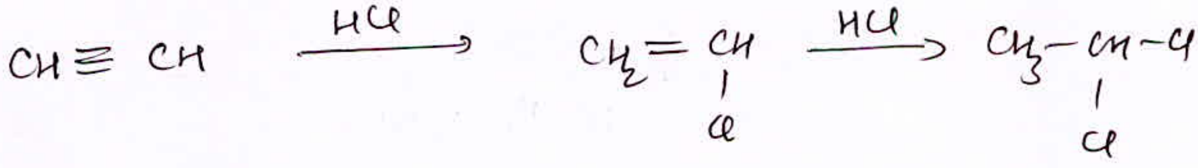
7) (2) $CaC_2 + H_2O \longrightarrow C_2H_2 + Ca(OH)_2$

8) (1)



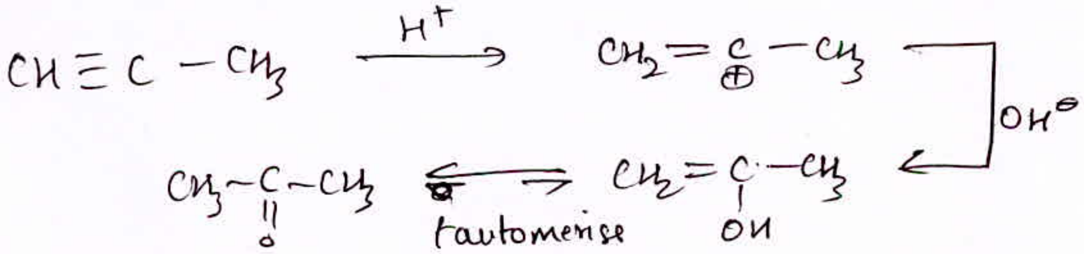
$$CH_3-C\equiv C-CH_3 \xrightarrow[\text{lindlar's catalyst}]{H_2} (CH_3)HC=CH(CH_3)$$

9) (2)



$$CH\equiv CH \xrightarrow{HCl} \underset{\substack{|\\Cl}}{CH_2=CH} \xrightarrow{HCl} \underset{\substack{|\\Cl}}{CH_3-CH-Cl}$$

10) (1)



$$CH\equiv C-CH_3 \xrightarrow{H^+} CH_2=\underset{\oplus}{C}-CH_3 \xrightarrow{OH^\ominus} \underset{\substack{|\\OH}}{CH_2=C-CH_3} \underset{\text{tautomerise}}{\rightleftharpoons} \underset{\substack{\|\\O}}{CH_3-C-CH_3}$$

11) (4) Homologue → add CH_2 group.

12) (4) Alkanes are unaffected by ozonolysis.

13) (4) Hydrogenation Reaction :- syn addition of H_2

$$HC\equiv CH \xrightarrow{H_2,\,Pd} H_2C=CH_2$$

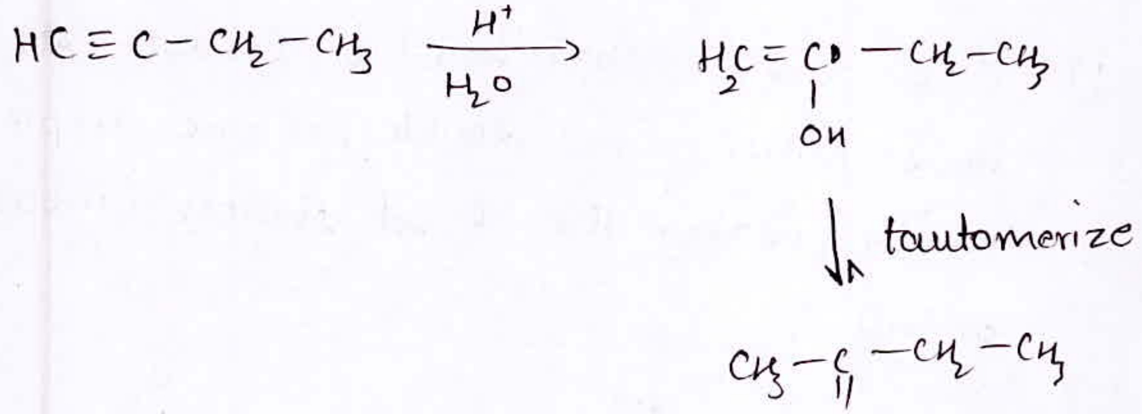
14) (2) $$Br-CH_2-CH_2-Br \xrightarrow[\text{elimination}]{E_2} HC\equiv CH + 2HBr$$

$$Br-CH_2-CH_2-Br \xrightarrow{-Br_2} CH_2=CH_2$$

15) (4) Acytelene (~~AH~~ Terminal alkynes) have acidic character.

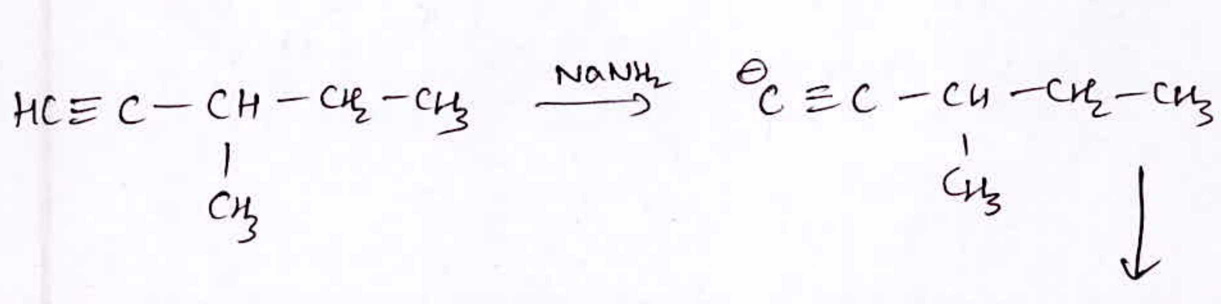
16) (4) Explained earlier

17) (4)

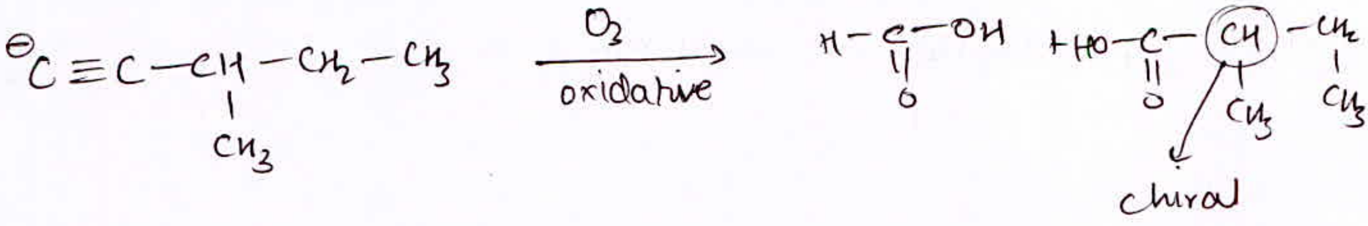


$$HC\equiv C-CH_2-CH_3 \xrightarrow[H_2O]{H^+} H_2C=\underset{OH}{\underset{|}{C}}-CH_2-CH_3 \xrightarrow{\text{tautomerize}} CH_3-\underset{O}{\underset{\|}{C}}-CH_2-CH_3$$

18) (4)



$$HC\equiv C-\underset{CH_3}{\underset{|}{CH}}-CH_2-CH_3 \xrightarrow{NaNH_2} {}^{\ominus}C\equiv C-\underset{CH_3}{\underset{|}{CH}}-CH_2-CH_3 \downarrow$$



$$^{\ominus}C\equiv C-\underset{CH_3}{\underset{|}{CH}}-CH_2-CH_3 \xrightarrow[\text{oxidative}]{O_3} H-\underset{O}{\underset{\|}{C}}-OH + HO-\underset{O}{\underset{\|}{C}}-\underset{CH_3}{\underset{|}{\boxed{CH}}}-\underset{CH_3}{\underset{|}{CH_2}}$$

chiral

19) ~~(1)~~ (2) Birch reduction results in trans product, while addition of H_2 with catalyst ~~gives~~ is syn, product, is cis.

20) (1) $CH_3-CH_2-OH \xrightarrow[\Delta]{conc.\,H_2SO_4} CH_2=CH_2$

$CHI_3 \xrightarrow[\text{Ag powder}]{\Delta}$ ~~$CH_3=CH_3$~~ Acytelene.

$CH_3COONa \xrightarrow{elec.} CH_3-CH_3 + CO_2$

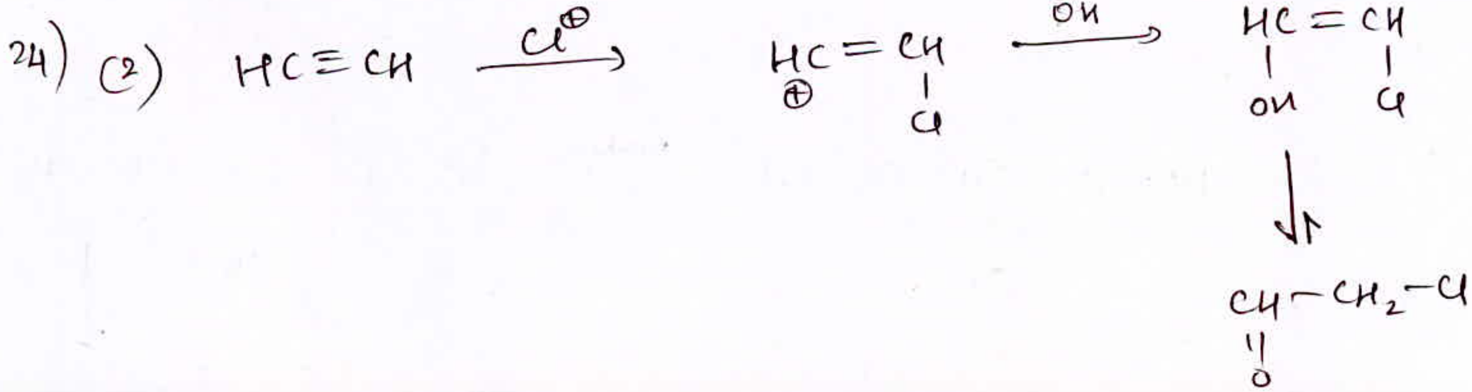
$CH_3COONa \xrightarrow[CaO,\,\Delta]{NaOH} CH_4 + CO_2$

21) (3) $AgNO_3$ → test for terminal alkyne.

22) (4)

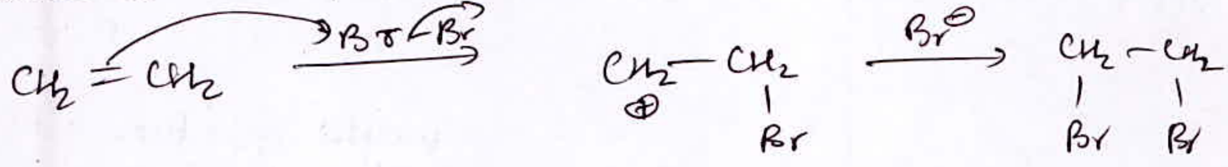
23) (1) C-C single sigma bond is longest. All other options have either one double, or one triple bond which makes the bond shorter (increases bond order)

24) (2)



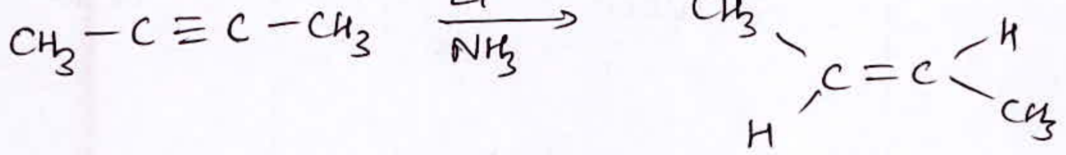
$$HC\equiv CH \xrightarrow{Cl^{\oplus}} \underset{\oplus}{HC}=\underset{Cl}{\underset{|}{CH}} \xrightarrow{\overset{\ominus}{O}H} \underset{OH}{\underset{|}{HC}}=\underset{Cl}{\underset{|}{CH}} \rightleftharpoons \underset{O}{\underset{\|}{CH}}-CH_2-Cl$$

25) (3) Standard test. Remember.



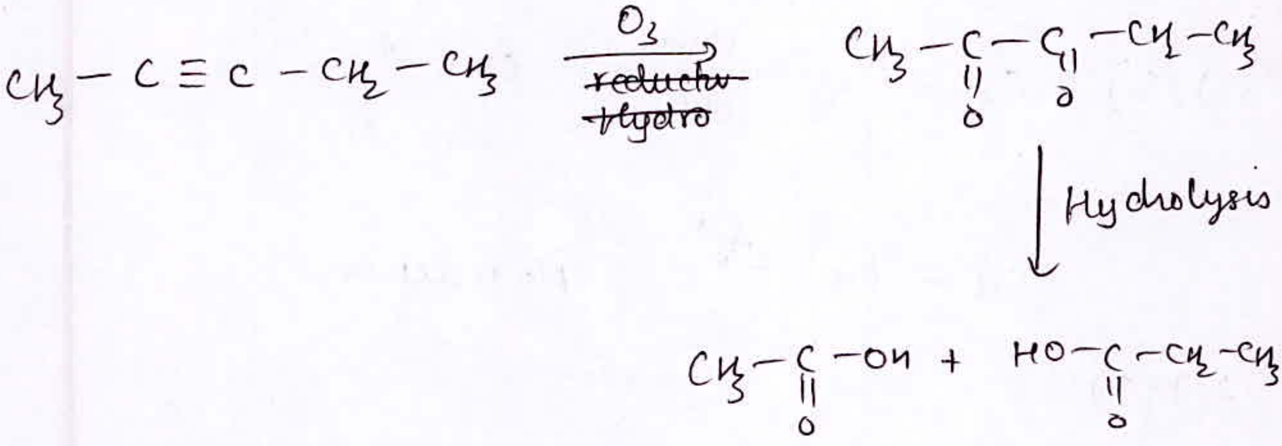
$$CH_2=CH_2 \xrightarrow{Br-Br} \underset{\oplus}{C}H_2-\underset{Br}{CH_2} \xrightarrow{Br^{\ominus}} \underset{Br}{CH_2}-\underset{Br}{CH_2}$$

26)



$$CH_3-C\equiv C-CH_3 \xrightarrow[NH_3]{Li}$$

27) (3)

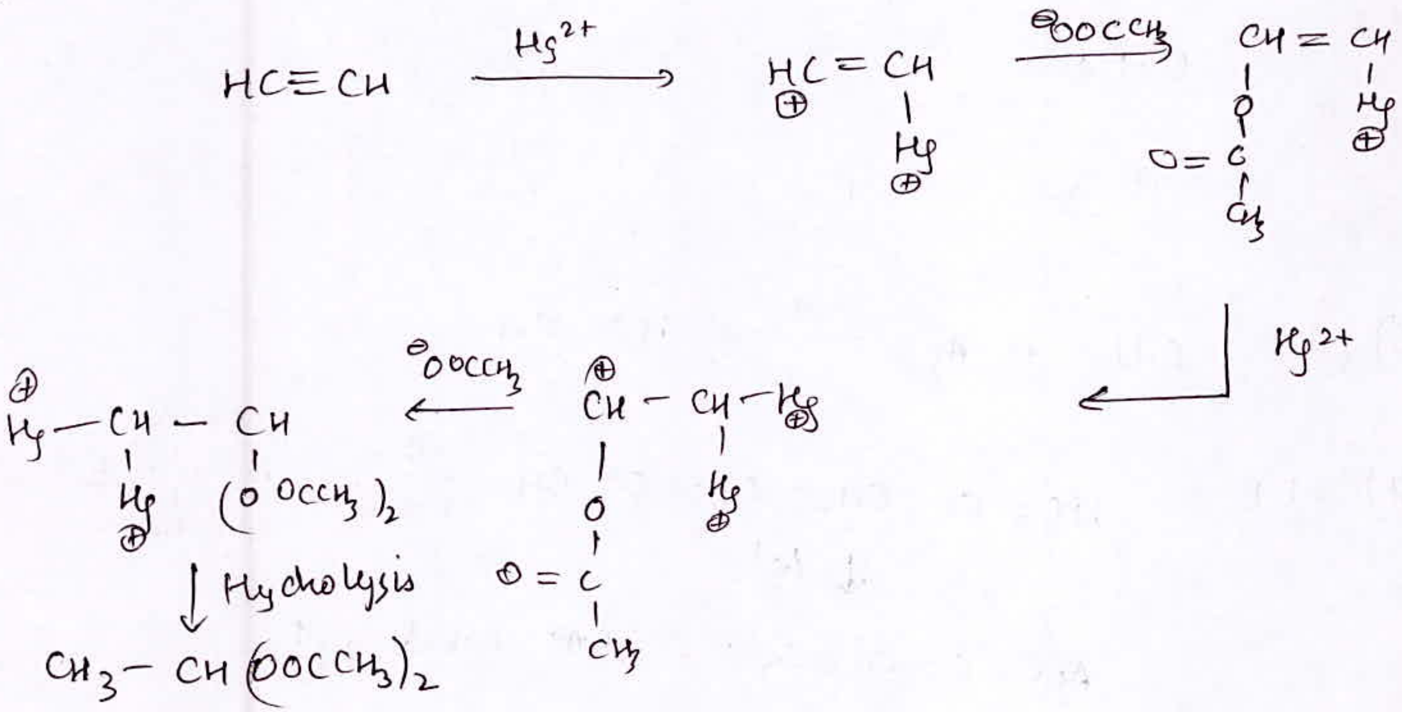


$$CH_3-C\equiv C-CH_2-CH_3 \xrightarrow[\cancel{\text{reductive}}\ \cancel{\text{Hydro}}]{O_3} CH_3-\underset{O}{\underset{\|}{C}}-\underset{O}{\underset{\|}{C}}-CH_2-CH_3 \xrightarrow{\text{Hydrolysis}} CH_3-\underset{O}{\underset{\|}{C}}-OH + HO-\underset{O}{\underset{\|}{C}}-CH_2-CH_3$$

28) (2) $Mg_2C_3 \xrightarrow{H_2O} Mg(OH)_2 + C_3H_4$

$$C_3H_4 \equiv HC\equiv C-CH_3$$

29) (1) The reaction is oxymercuration demercuration.



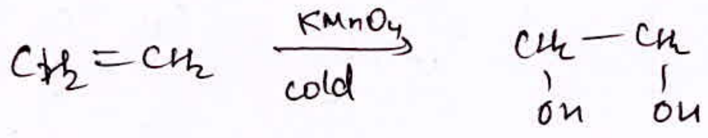
30) (1) $CH_3-CH_2-C\equiv C^{\ominus}Ag^{\oplus}$ total weight = $127+(12)(4)+5 = 180$

weight of silver = 127

$\therefore$ % silver = $\frac{127}{180}\times 100 = 67.08\%$

31) (3) Due to its acidic properties.

32) (3)

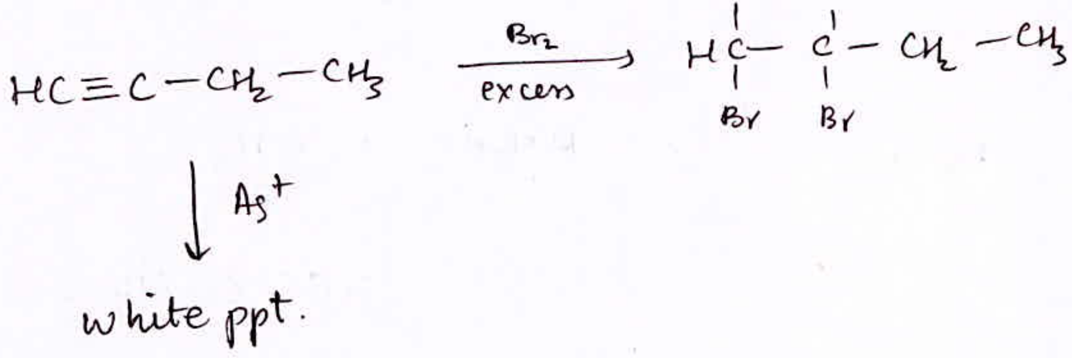


$$CH_2=CH_2 \xrightarrow[\text{cold}]{KMnO_4} \underset{OH}{\underset{|}{CH_2}}-\underset{OH}{\underset{|}{CH_2}}$$

$$CH_2=CH_2 \xrightarrow{Ag^+} \text{No reaction.}$$

33) (2)

34) (3)



$$HC\equiv C-CH_2-CH_3 \xrightarrow[\text{excess}]{Br_2} H\overset{Br}{\underset{Br}{C}}-\overset{Br}{\underset{Br}{C}}-CH_2-CH_3$$

$\downarrow Ag^+$

white ppt.

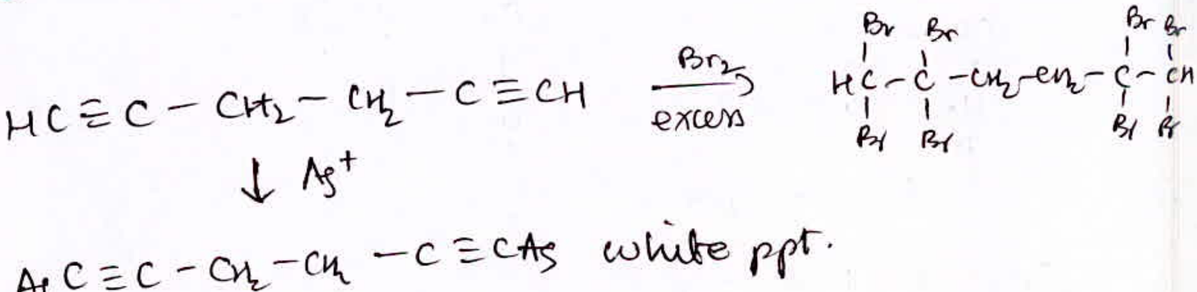
35) (2) Methane $\rightarrow sp^3$ $\therefore$ % s = $\frac{1}{1+3} = 25\%$

Ethene $\rightarrow sp^2$ $\therefore$ % s = $\frac{1}{1+2} = 33\%$

Ethyne $\rightarrow sp$ $\therefore$ % s = $\frac{1}{1+1} = 50\%$

36) (2) $CHI_3 + Ag \xrightarrow{\Delta} HC\equiv CH$

37) (1)



$$HC\equiv C-CH_2-CH_2-C\equiv CH \xrightarrow[\text{excess}]{Br_2} H\overset{Br}{\underset{Br}{C}}-\overset{Br}{\underset{Br}{C}}-CH_2-CH_2-\overset{Br}{\underset{Br}{C}}-CH$$

$\downarrow Ag^+$

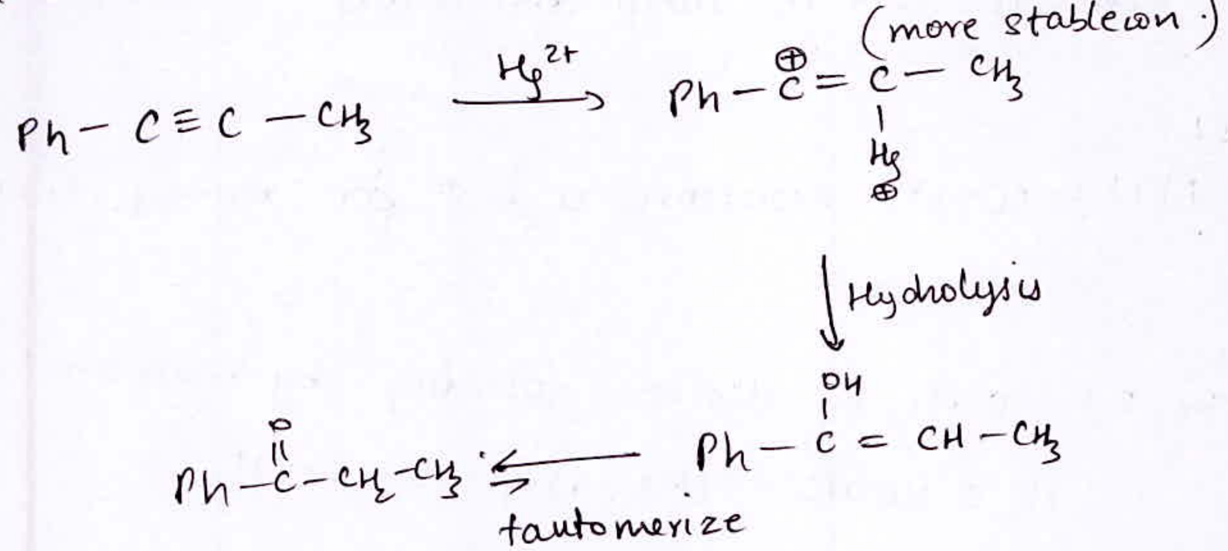
$AgC\equiv C-CH_2-CH_2-C\equiv CAg$ white ppt.

38) (1) Test for terminal alkyne

39) (1) Remember

40) (1) Remember

41) (1)

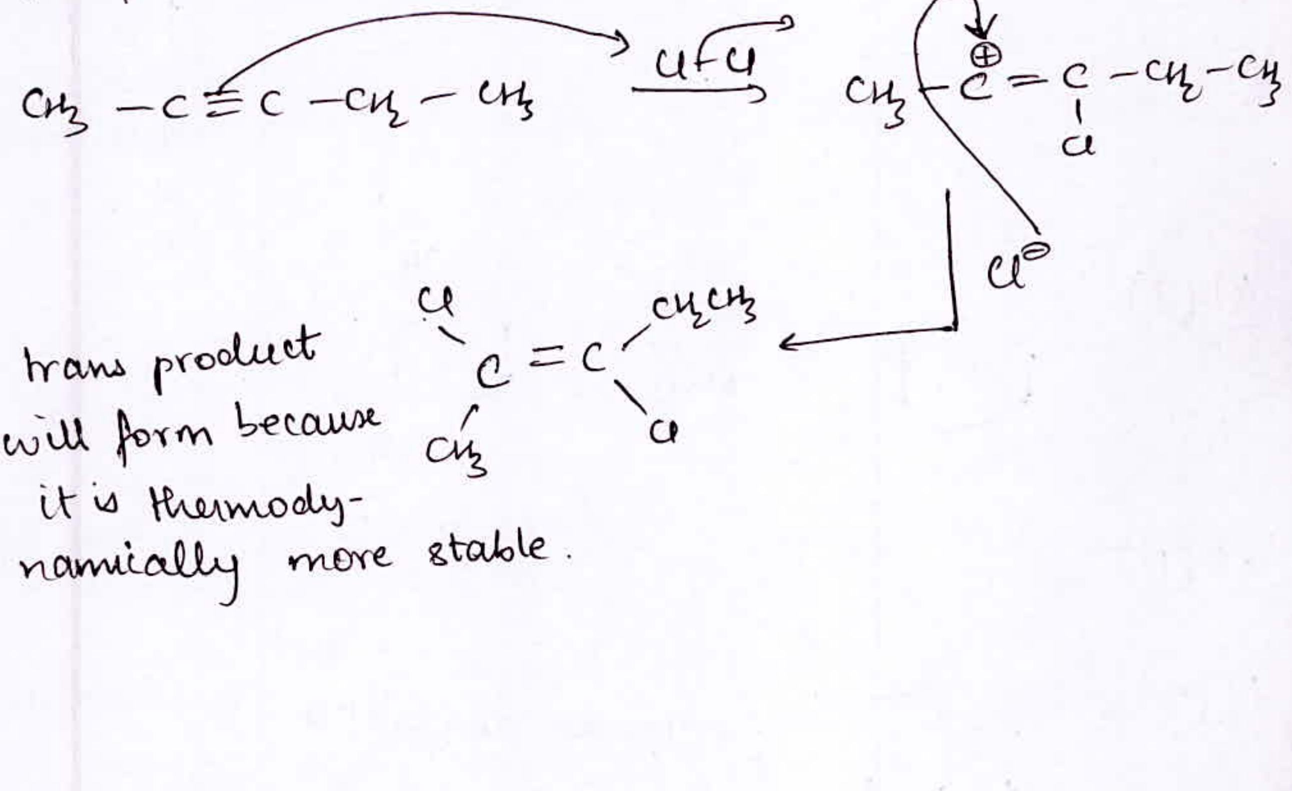


42) (2) Remember

43) (1) $H_2C=CH-C\equiv CH$

44) (2) Test for terminal alkyne.

45) (4)



trans product will form because it is thermodynamically more stable.

46) (1) Remember.

47) (1) $CH_3-C\equiv CH$ propyne.

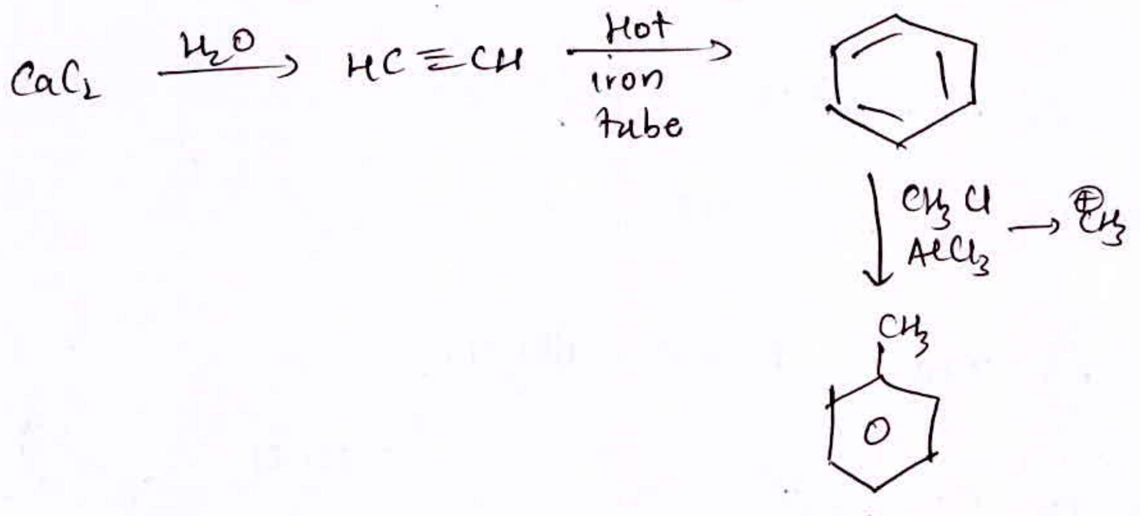
Benzene and its alkyl derivatives

~~(1)~~

1) (1) Wurtz reaction is best for making small symmetrical alkanes.

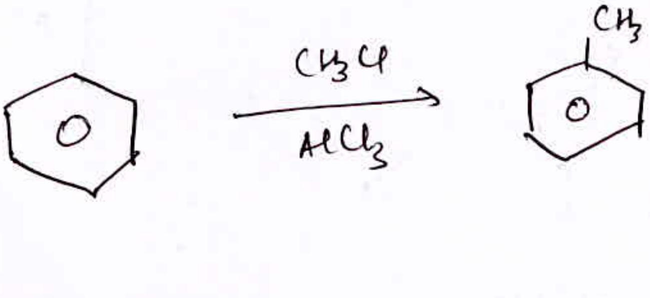
2) (2) $-\ddot{O}-H$ is electron donating by resonance. Hence it activates the ring the most.

3) (3)



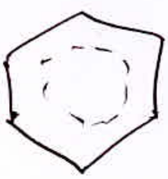
toluene.

4) (3)



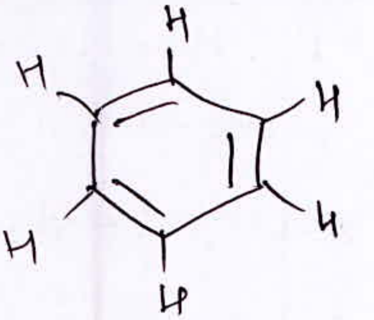
5) (1)

6) (2)



3π bonds conjugated over entire ring.

7) (1)

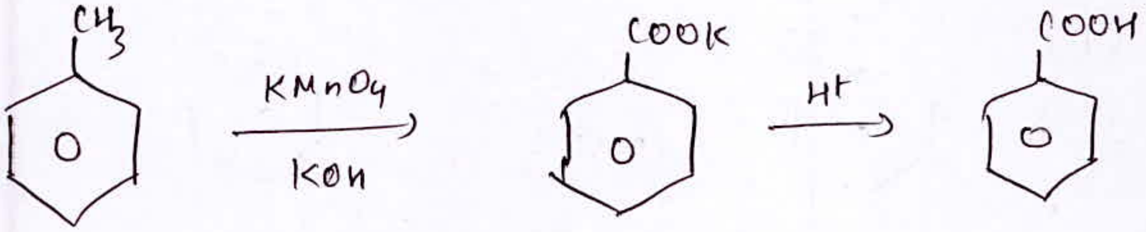


$\sigma = 12 \quad \pi = 3$

$\frac{\sigma}{\pi} = 4$

8) (2)

9) (4)



10) (3) Resonance stabilized system is highly stable. Hence addition reaction is not favoured, because addition will remove the resonance property, which will destabilize ~~tha~~ the ~~at~~ molecule.

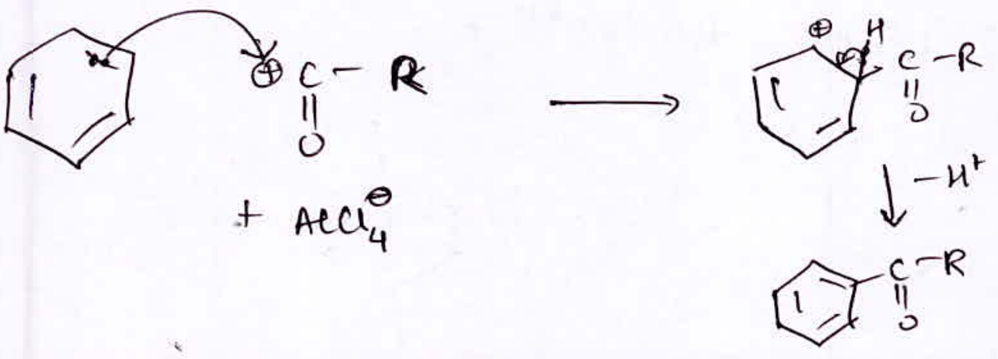
11) (2) $-CH_3$ is $\bar{e}$ donating by hyperconjugation

$-COOH$ is $\bar{e}$ withdrawing by resonance.

$-NO_2$ is strongly $\bar{e}$ withdrawing by resonance.

12) (1) Explained earlier

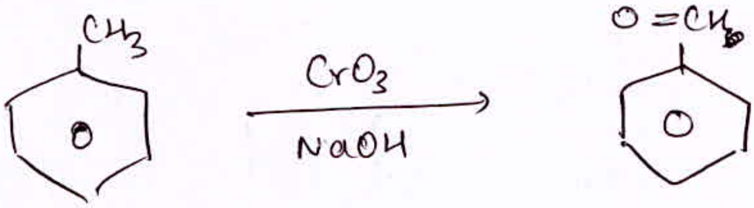
13) (1)



14) (4) Because the ring is conjugated, there is only $\frac{1}{2}$ a π bond between 2 C of benzene. Hence it is longer than a traditional C=C π bond. But it is still shorter than a C–C σ bond.

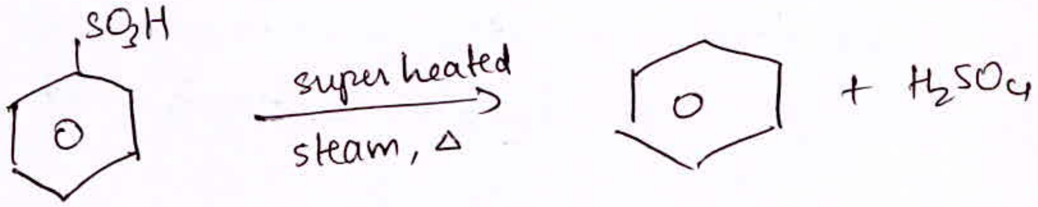
15) (5)

16) (1)



17) (2) BCl_3 anhydrous has an affinity toward chloride ion. $AlCl_3$ anhydrous is also used.

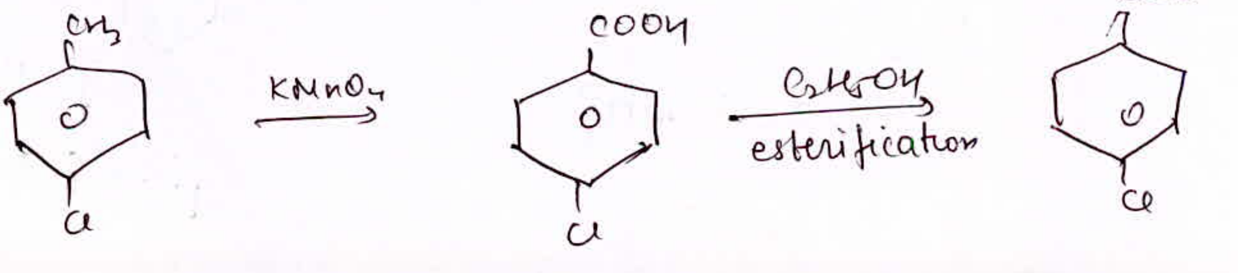
18) (1)



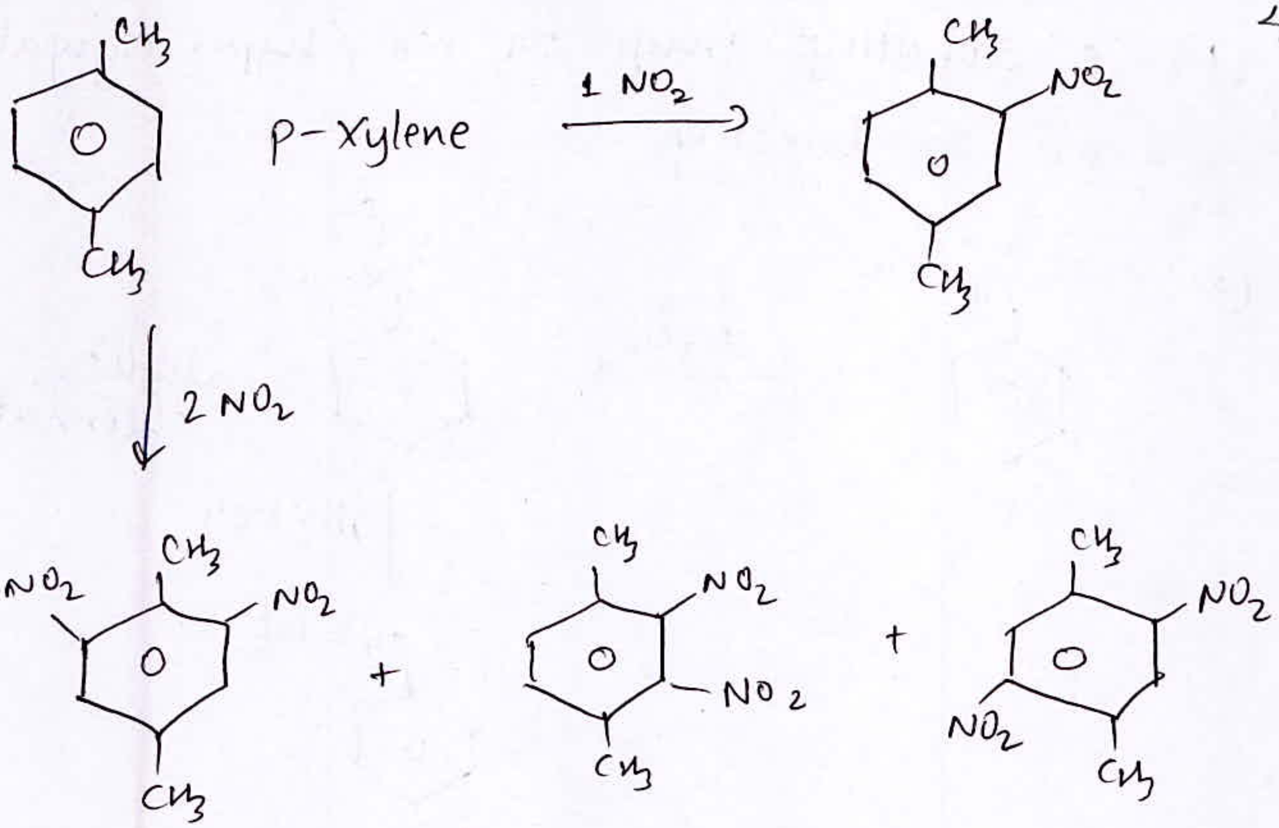
19) (4) $CH_3-\ddot{O}-$ e^- donating by resonance increases stability.

20) (3) If benzene is used as solvent, alkylation will occur in benzene itself and less on bromobenzene, because bromine group is slightly deactivating.

21) (3)

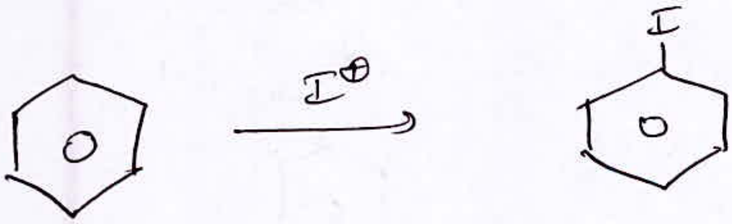


22) (4)

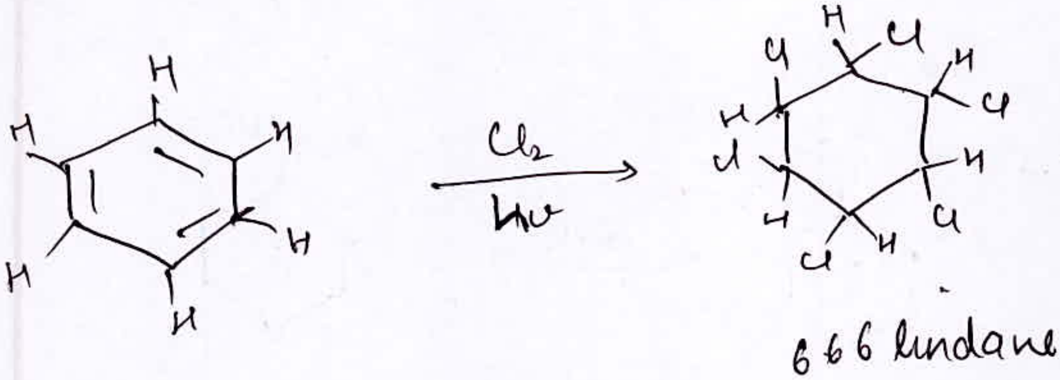


23) (1)

24) (2) $ICl \xrightarrow{AlCl_3} I^{\oplus} + AlCl_4^{\ominus}$



25) (3)

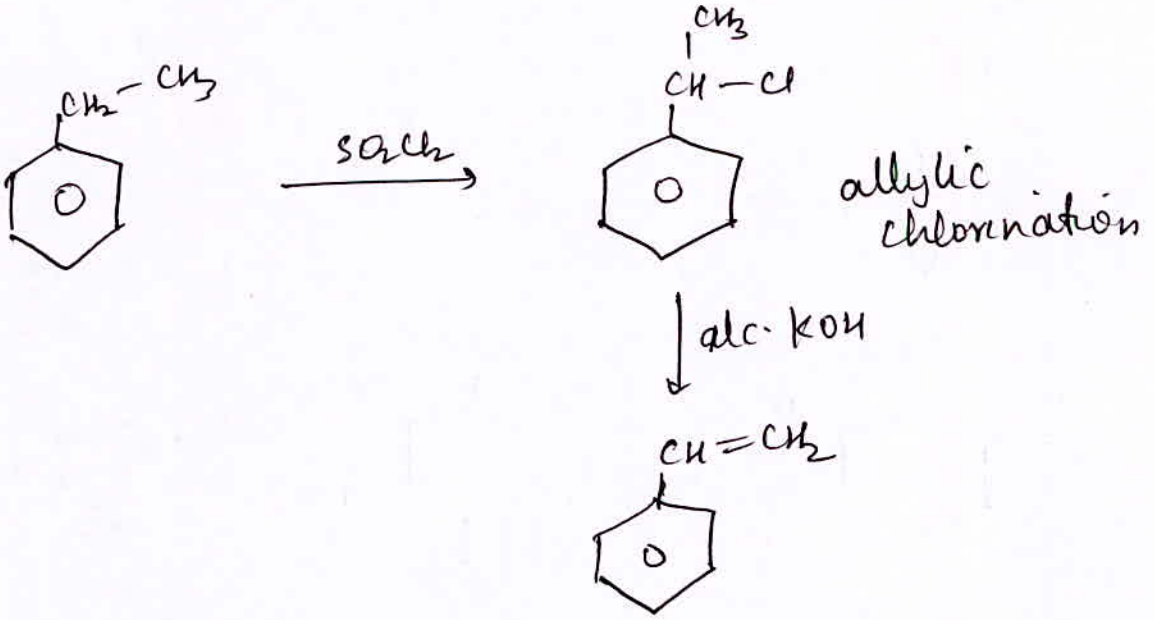


666 lindane

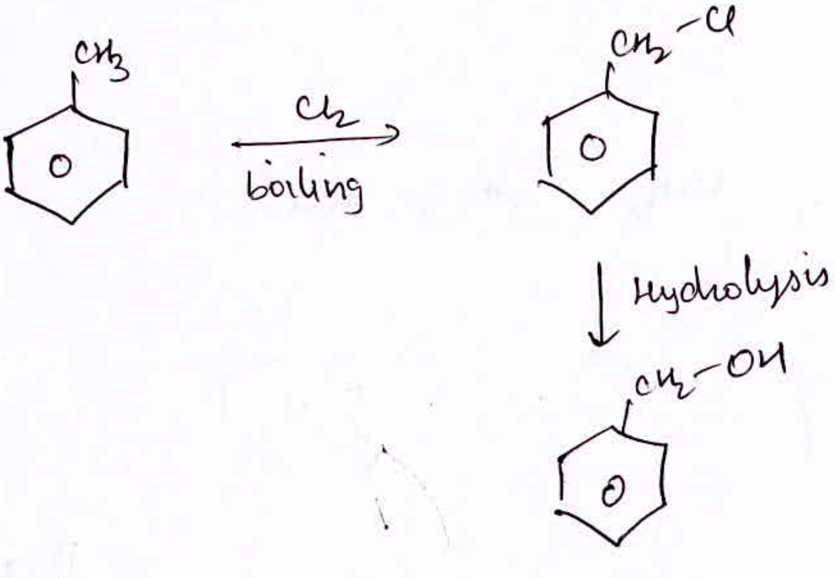
26) (3)

27) (1) e^- donating group by reso / hyperconjugation are op directing.

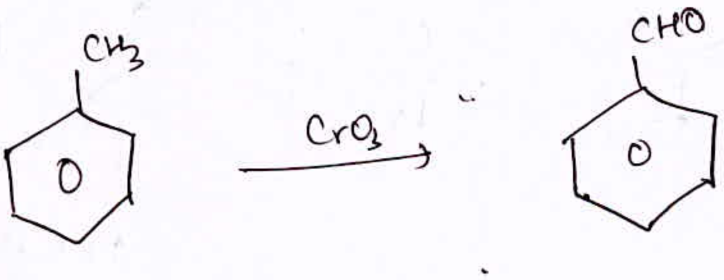
28) (2)



29) (4)

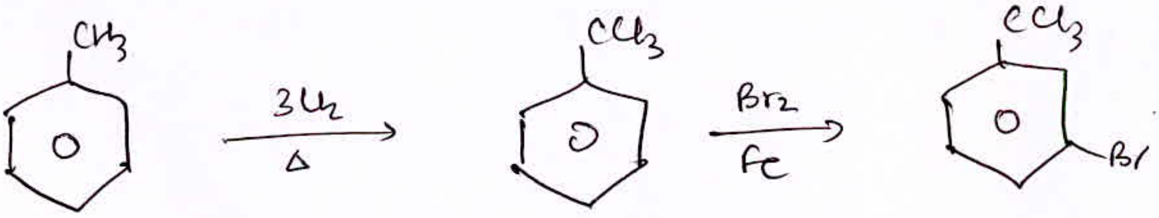


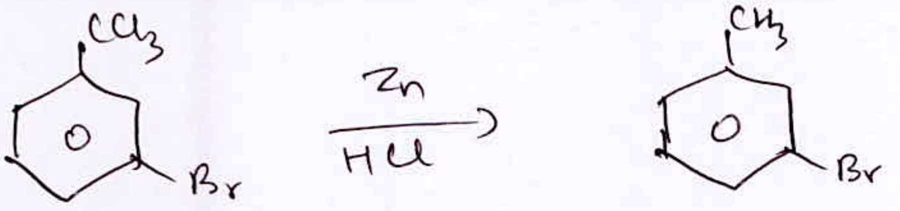
30) (4)



etard reaction.

31) (2)





~~337~~

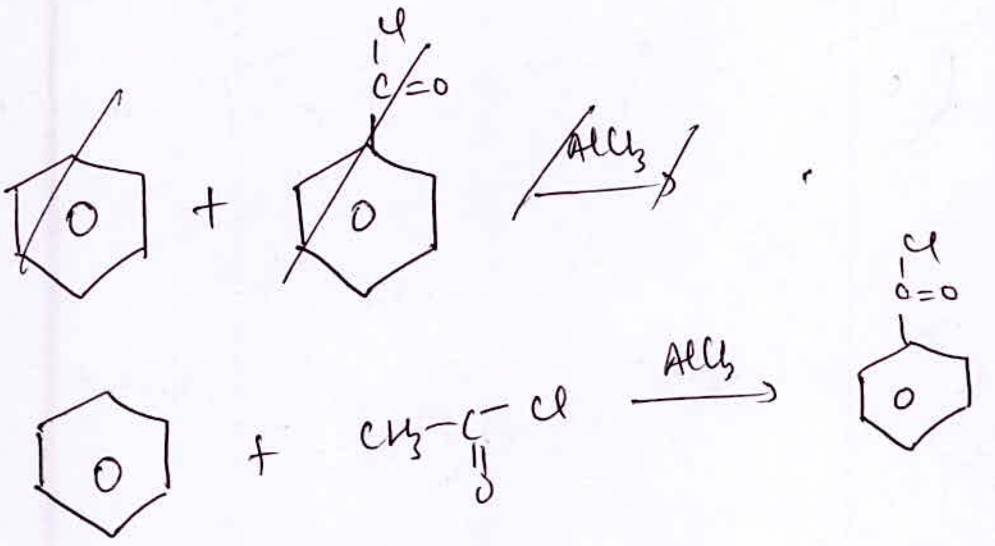
32) (4)

33) (3) Should not have highly polar part.

34) (4) Explained earlier

35) (2) $-CH_3$ on toluene activates benzene ring. All other options are deactivating groups.

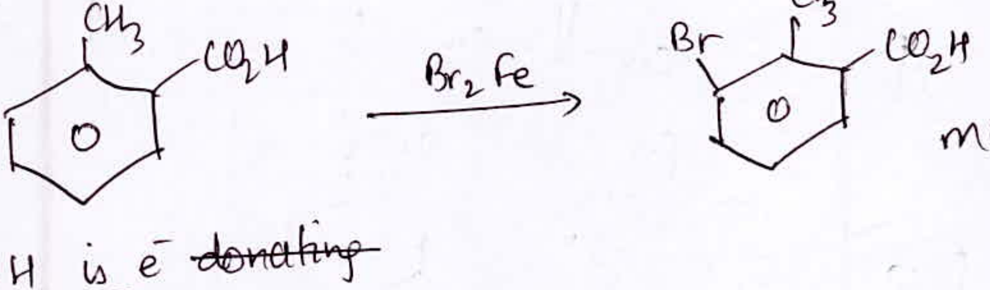
36) (3)



37) (2) Highly stable structure

38) (4) $-\ddot{\ddot{Cl}}$ is $\bar{e}$ donating by reso. Hence op directing.

39)



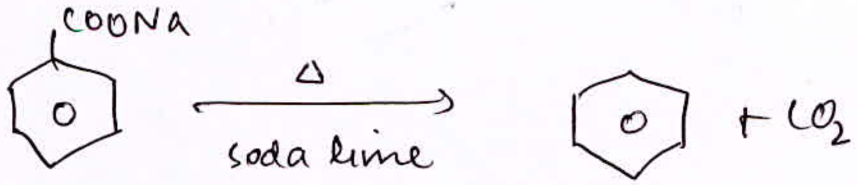
major.

CO_2H is $\bar{e}$ ~~donating~~ withdrawing by reso

CH_3 is $\bar{e}$ donating by hyper. CO_2H will dominate

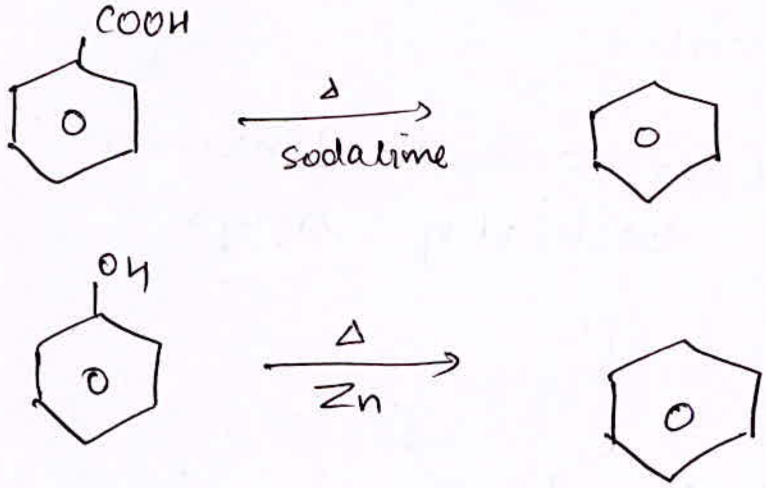
40) (2)

41) (4)



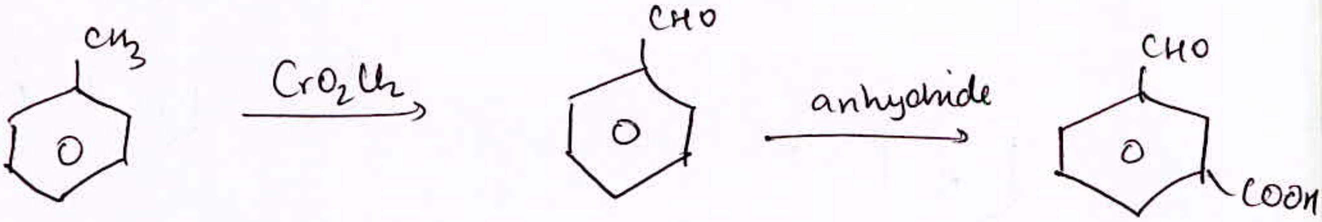
42) ([illegible])(1) Remember

43) (2)



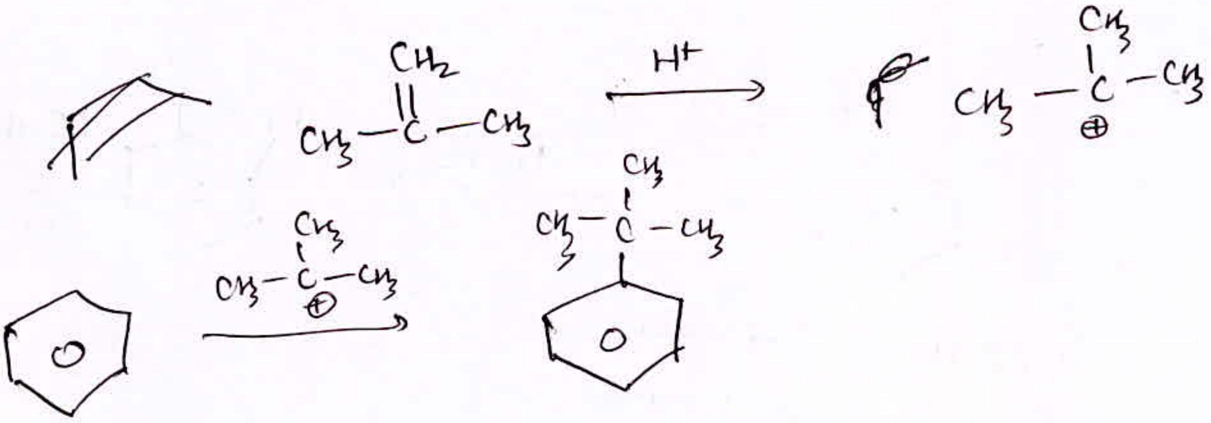
remember.

44) (1)



45) (4) Para product generally dominates.

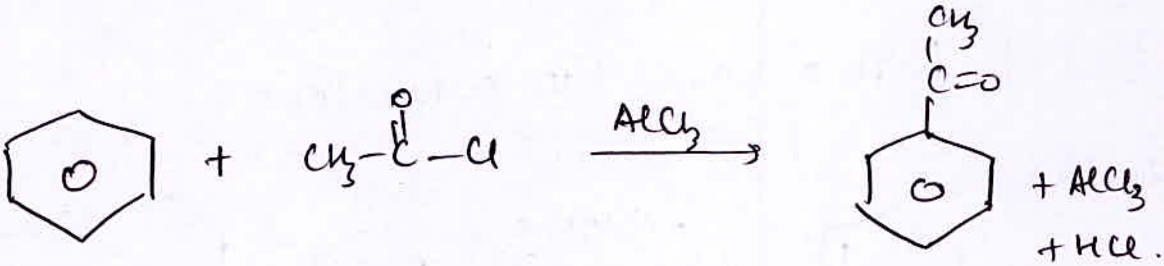
46) (2)



47) ~~(2) (3) Reason is false.~~

(2) Acyl halides are more reactive, but alkyl benzene is more reactive than acyl benzene, hence alkyl benzene disubstituted or poly substituted product can form.

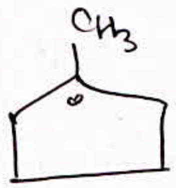
48) (3)



49) (2) Remember.

Alicyclic compounds

1) (3)

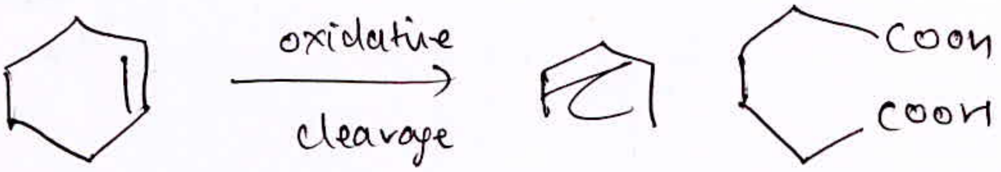


is most stable free radical

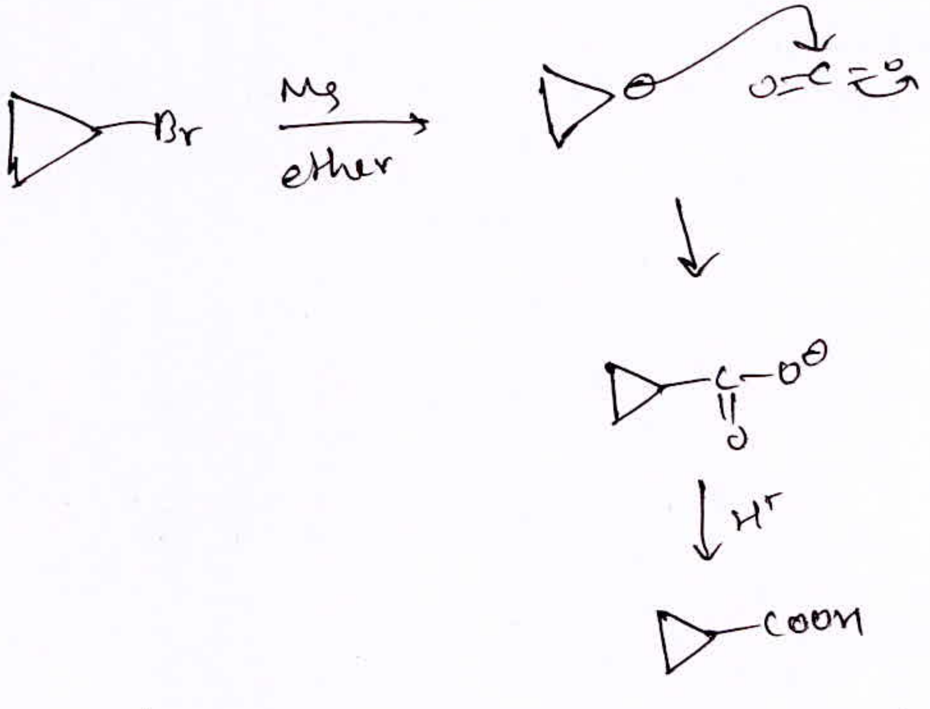
2) (4)

3) (2) Both have 1 π equivalent

4) (4)



5) (1)



6) (4) Forms chair form, which is free from angular strain.

7) (3) Minimum hyperconjugation on both π bonds. Draw h structures and see.

8) (1) Remember

9) (2) One π equivalent

10) (4) Most stable $\equiv$ lowest heat of combustion.