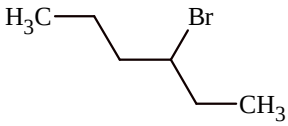
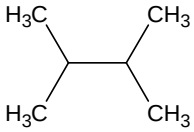
HYDROCARBONS

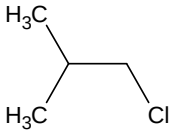
SOLUTION TO ASSIGNMENT PROBLEMS (SUBJECTIVE)

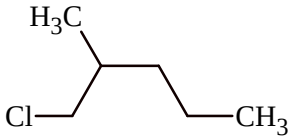
Level – I

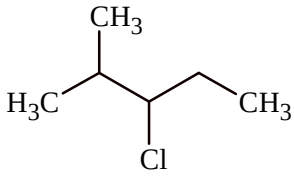
SHORT ANSWER TYPE QUESTIONS

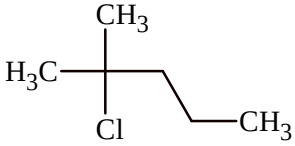
1. 

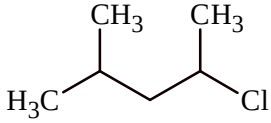
2. 

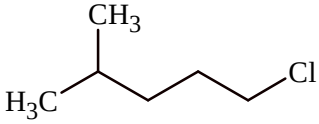
3. 

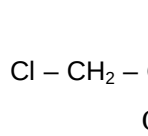
4. (i) 

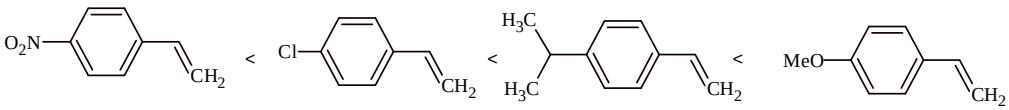
(ii) 

(iii) 

(iv) 

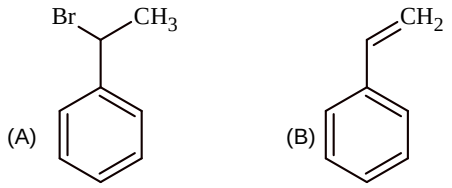
(v) 

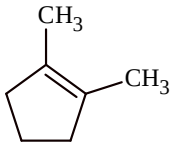
5.  The proton attached with C* is very acidic due to the –I effect of both the chlorine atoms.

6. 

7. $MeCH=CH_2 < MeCH=CHMe(cis) < MeCH=CHMe(trans) < Me_2C=CH_2 < Me_2C=CHMe$

8. $Br - CH_2 - CH_2 - CO_2H$

9. 

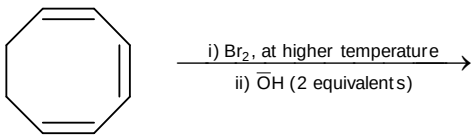
10. 

11. FILL IN THE BLANKS

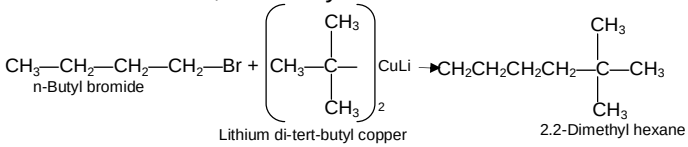
(i) branched, straight
(ii) Hg^{2+} salts, dilute acid
(iii) chlorine
(iv) cracking
(v) elimination (dihydrohalogenation), alkenes
(vi) ethene
(vii) hyperconjugation
(viii) $C_2H_5HSO_4$
(ix) ethylene chlorohydrin
(x) sp

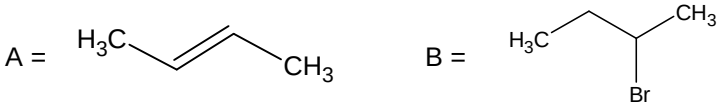
EXPLANATORY QUESTIONS

12. What will be the major products in the following reactions?



13. The alkane was 2,2-dimethyl hexane



14. 

15. $C_6H_{10} \xrightarrow{\text{Reduction}} C_6H_{12} \xrightarrow{\text{Reduction}} C_6H_{14}$
(A) (B) (C)

As (A) on ozonolysis yields two Aldehydes, its formula suggest that it has two double bonds.

As (D) = CH_3CHO and E = $\begin{matrix}CHO\\|\\CHO\end{matrix}$

So, A = $\begin{matrix}CH=CH-CH_3\\|\\CH=CH-CH_3\end{matrix}$ (Hexa-2,4-diene)

$$\underset{(A)}{CH_3CH=CH-CH=CH-CH_3} \xrightarrow[H_2O/Zn]{O_3} \underset{(D)}{2CH_3CHO} + \underset{(E)}{\begin{matrix}CHO\\|\\CHO\end{matrix}}$$

$$CH_3CH=CH-CH=CH-CH_3 \xrightarrow{H_2} \underset{1,4\text{-addition}}{CH_3CH_2CH=CH-CH_2-CH_3}$$

$$\downarrow H_2$$

$$CH_3CH_2CH_2CH_2CH_2CH_3$$

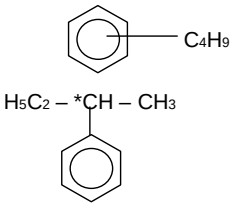
$$CH_3CH_2CH_2=CH-CH_2-CH_3 \xrightarrow[KMnO_4/H^+]{[O]} \underset{(F)}{2CH_3CH_2COOH}$$

16. Given,

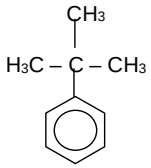
$$\underset{\text{Chiral (C)}}{C_{10}H_{14}} \xrightarrow[\text{alk. } KMnO_4]{} \text{C}_6\text{H}_5\text{COOH}$$

$$\underset{\text{(D) achiral}}{C_{10}H_{14}} \longrightarrow \text{Inert to oxidation}$$

Since benzoic acid is the product, 'C' should be monosubstituted benzene.



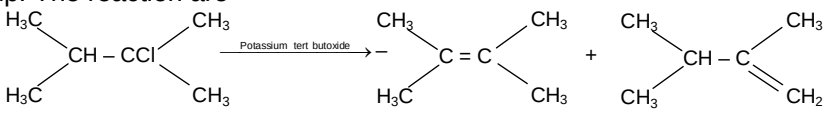
(C)



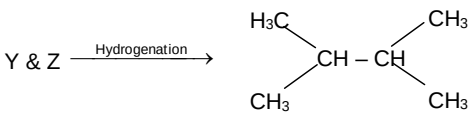
(D)

Achiral and resistant to oxidation

17. An alkyl halide X($C_6H_{13}Cl$) gives two isomeric alkenes Y and Z. Since it is forming two isomeric alkane on dehydrohalogenation reaction, Cl should not be at the terminal alkyl group. The reaction are



(Y) (Z)

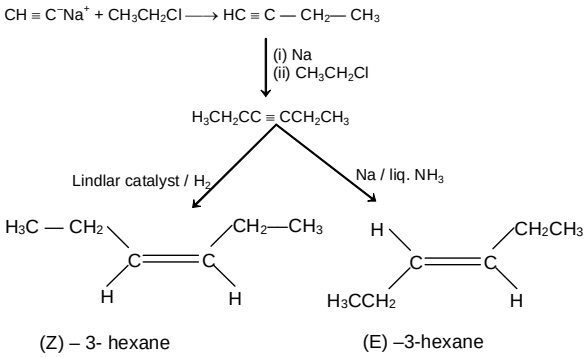


(Z)

18. $HC \equiv CH \xrightarrow{Na} HC \equiv C^- Na^+$ …(1)

$HC \equiv CH \xrightarrow{H_2} CH_2 = CH_2 \xrightarrow{HCl} CH_3 - CH_2Cl$ …(2)

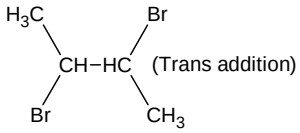
Combine Eqs. (1) and (2)



(Z) – 3- hexane (E) –3-hexane

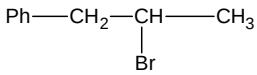
In the above reaction acetylene is the only organic reagent used.

19.



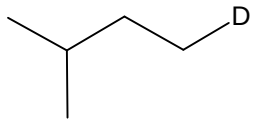
(Trans addition)

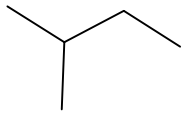
(A)

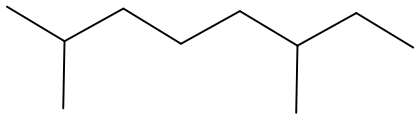


(B)

Level – II

1. B = 

C = 

D = 

2. The degree of unsaturation in the compound is = (number of carbon) – $\frac{\text{Number of hydrogen}}{2}+1=(10+1)-\frac{10}{2}=11-5=6$

This compound contains 6 bonds and on oxidative cleavage it is producing only one compound, so all the multiple bonds should be at the terminal atom.

$HC\equiv CH-CH_2-\underset{\underset{(A)\ \ CH_2-C\equiv CH}{|}}{CH}-C\equiv CH \xrightarrow{KMnO_4/H^+}$

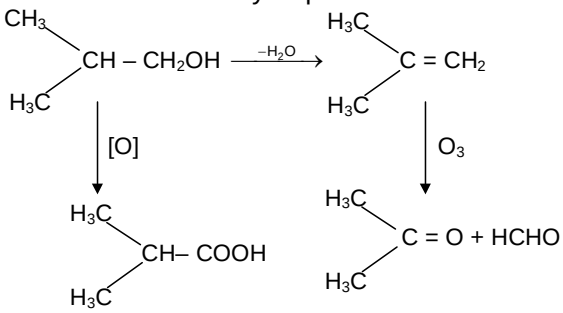
$HOOC-CH_2-\underset{\underset{(B)\ \ CH_2COOH}{|}}{CH}-CH_2COOH$

3. $PV = nRT = \frac{W}{M}RT$

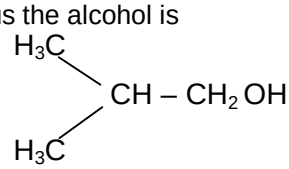
$\frac{0.37\times0.521\times273}{1\times11.2\times15^{-3}}=74$

Mol. wt. of ROH = 74

Acetone is the ozonolysis product of the alkene. Therefore, the reactions are



Thus the alcohol is



4. $PV = nRT = \frac{W}{M}RT$

$= \frac{1.49 \times 0.821 \times 273}{1 \times 448 \times 10^{-3}} = 74.54$

The compound A decolourizes bromine and absorbs hydrogen catalytically. It also gives precipitate with ammoniacal cuprous chloride. Thus, it should be a terminal alkyne.

Molecular wt. of the chlorocompound (R – Cl) = 74.5

Molecular wt.of alkyl group is 74.5 – 35.5 = 39

R = C_3H_3

Thus, A is $ClH_2C—C\equiv C—H$

5. (a) $C_2H_5COONa + NaOH \xrightarrow{CaO} C_2H_6 + Na_2CO_3$

(b) $Al_4C_3 + 12H_2O \longrightarrow 3CH_4 + 4Al(OH)_3$

(c) (i) $3C_2H_5I + 3HI \xrightarrow{150^oC} 3C_2H_6 + 3I_2$

(ii) $2P + 3I_2 \longrightarrow 2PI_3$

(d) $2CH_3COOK + 2H_2O \longrightarrow C_2H_6 + 2CO_2 + 2KOH + H_2$

(e) $2C_2H_5I + 2Na \longrightarrow C_4H_{10} + 2NaI$

(f) (i) $CH_4 + I_2 \rightleftharpoons CH_3I + HI$

(ii) $2HI + O \longrightarrow H_2O + HI$

(g) $C_6H_{14} \xrightarrow[600^\circ C]{Cr_2O_3/Al_2O_3} C_6H_6 + 4H_2$

(h) $C_2H_6 + HNO_3 \xrightarrow{450^\circ C} C_2H_5NO_2 + H_2O$

(i) $Li(CH_3)_2Cu + C_2H_5Br \longrightarrow C_3H_8 + CH_3Cu + LiBr$

6. (a) $C_2H_5Br + 2Na + BrC_2H_5 \longrightarrow C_2H_5.C_2H_5 + 2NaBr$

(b) $CH_3COOH + KOH \longrightarrow CH_3COOK + 2NaBr$

$\downarrow$ Electrolysis

$CH_3 – CH_3$

(c) $C_2H_4 + H_2 \xrightarrow[300^oC]{Ni} C_2H_6$

(d) $CH_3COOH + NaOH \longrightarrow CH_3COONa \xrightarrow[CaO]{NaOH} CH_4$

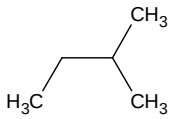
(e) $CH_4 \xrightarrow[h\nu]{Cl_2} CH_3Cl \xrightarrow[Ether]{Na} CH_3 - CH_3$

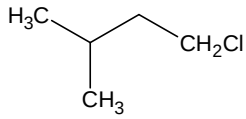
(f) $C_2H_5OH \xrightarrow{P/HI} C_2H_6$

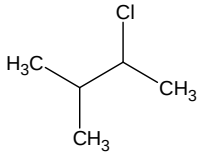
(g) $Al_4C_3 \xrightarrow{H_2O} CH_4 \xrightarrow[h\nu]{Cl_2} CH_3Cl$

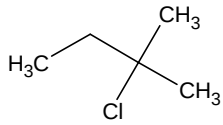
(h) $CH_4 + Cl_2 \xrightarrow{h\nu} CH_3Cl \xrightarrow{Na} CH_3 - CH_3 \xrightarrow[h\nu]{Cl_2}$

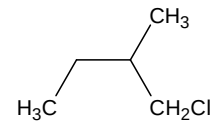
$CH_3CH_2Cl \xrightarrow[Li]{CuI} Li(CH_3CH_2)_2Cu \xrightarrow{CH_3Cl} CH_3CH_2CH_3$

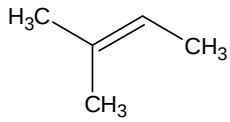
7. A = 

B = 

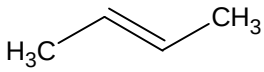
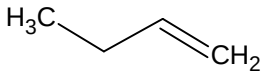
C = 

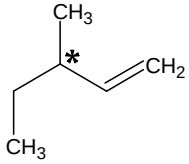
D = 

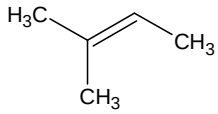
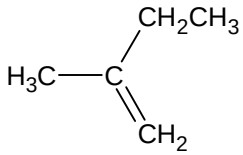
E = 

F = 

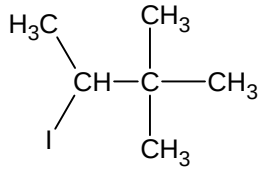
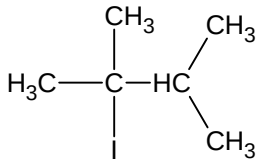
G = CH_3COCH_3 H = CH_3COOH

8. A =  B = 

C = 

9. A =  B = 

C = $H_2C{=}CHCH(CH_3)_2$

10. A =  B = 

SOLUTION TO ASSIGNMENT PROBLEMS (OBJECTIVE)

Level – I

31. (A). Straight chain compound with more number of carbon atoms will have highest boiling point.

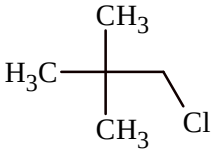
32. (B). $RMgX + H_2O \longrightarrow RH + Mg\begin{matrix}X\\OH\end{matrix}$

33. (B). In group, electronegativity of the atom decreases. So, the reactivity of halogen decreases in group. Thus, the order of reactivity is $F_2 > Cl_2 > Br_2$.

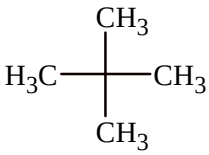
34. (A). The initiation step in chlorination of alkane involves breaking of Cl–Cl bond. The required enthalpy comes from UV light.
$Cl : Cl \longrightarrow Cl^{\bullet} + Cl^{\bullet}$; $\Delta H = 243$ kJ/mol

35. (B). Homolytic bond dissociation energy is inversely related to the stability of radicals.
1°H, $\Delta H°$ = 98 kcal/mol
2°H, $\Delta H°$ = 94 kcal/mol
3°H, $\Delta H°$ = 91 kcal/mol
Thus, the order of reactivity is 3°H > 2°H > 1°H.

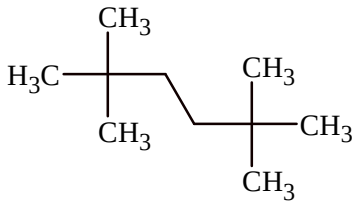
36. (A). B is neopentyl chloride.



(A)



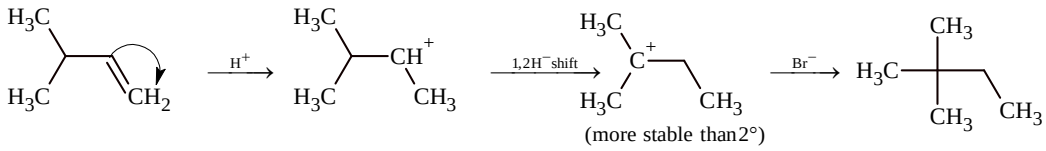
(B)



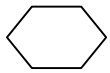
37. (B). $CH_2 = CH - CH = CH_2 \xrightarrow[1,4\text{ addition}]{H_2} \underset{(A)}{CH_3 - CH = CH - CH_3} \xrightarrow{O_3/H_2O} \underset{(B)}{2CH_3COOH}$

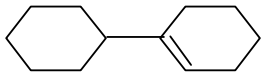
[Zinc is not present hence CH_3CHO first formed is oxidized to CH_3COOH.]

38. (C)

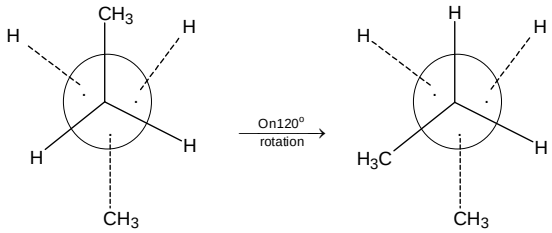


(more stable than 2°)

45. (B). Intermediate is  , ⊕ which combines with second molecule to form



48. (C).



The resulting conformer is a Gauche conformer.

49. (A). Li/liq NH_3 brings about trans addition of H_2.

50. (A).