

# Worksheet

**Topics: Alkyl halides and Nucleophilic Substitution**

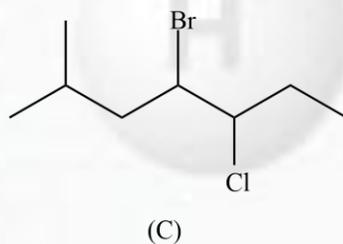
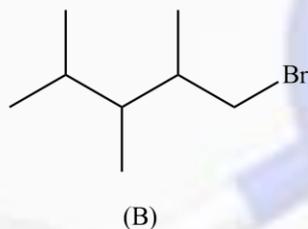
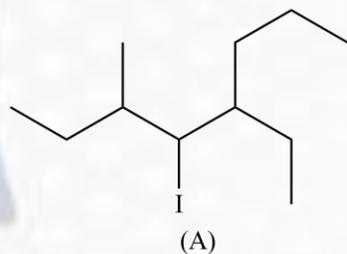
**Designed by  
Dr. Anuradha Mukherjee**

**Chemistry Affinity**  
**Conceptual, Real World, Happy Learning**

## 1. Draw the structures of the following compounds

- (i) 2-Chloro-3,3-dimethylpentane
- (ii) 1,1-Dichloro-4-isopropylcyclohexane
- (iii) 3-bromo-3-ethylhexane

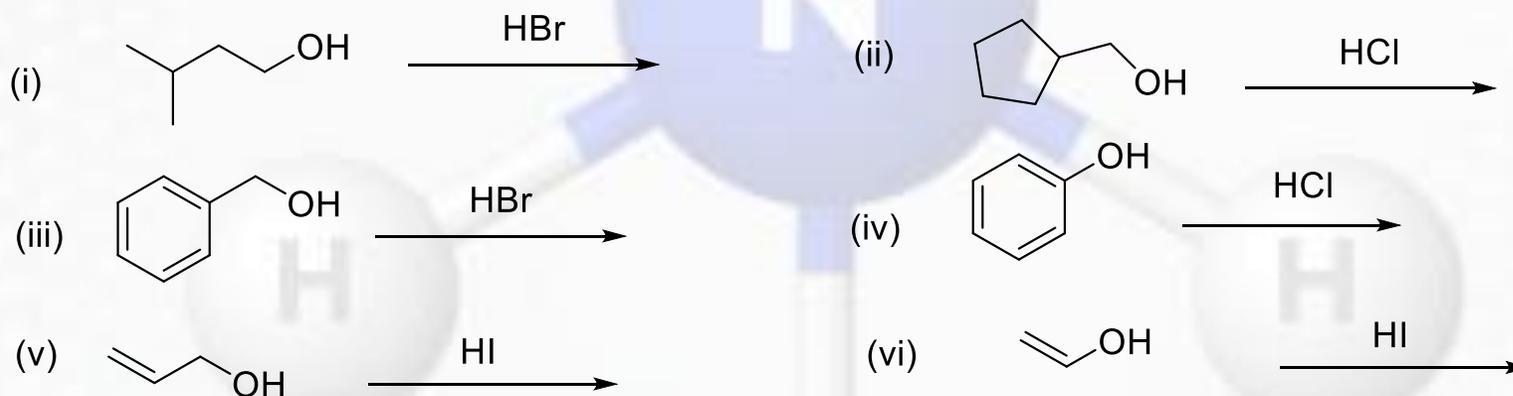
## 2. Give the IUPAC names of the following organohalides:



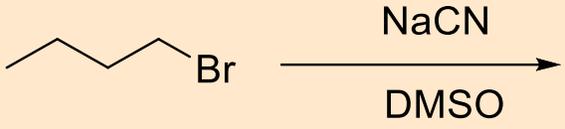
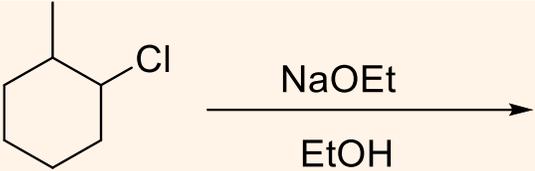
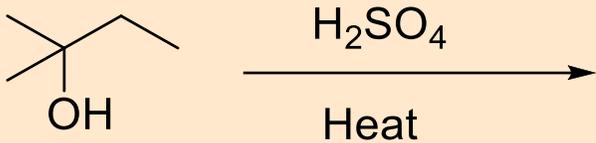
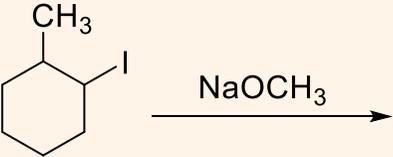
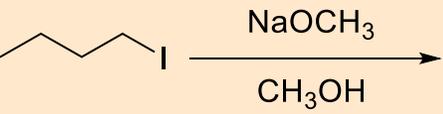
**3. Which of the following compounds will have highest melting point?**

**(a) Chlorobenzene (b) o-Dichlorobenzene (c) m-Dichlorobenzene (d) p-Dichlorobenzene**

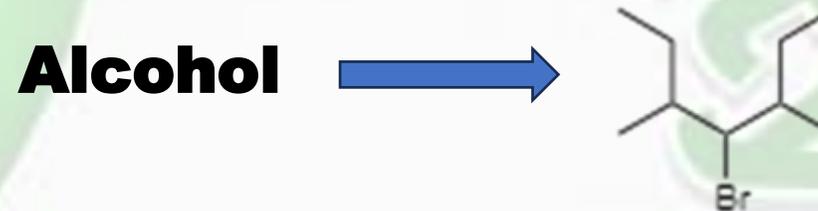
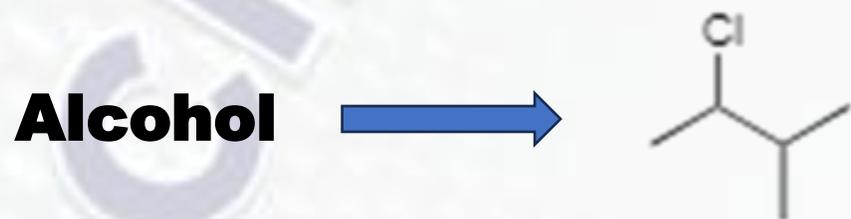
**4. Write down products and mention which mechanism they follow?**



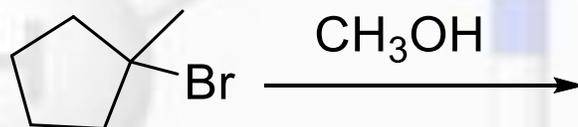
## 5. Let's Find out Elimination or Substitution Reaction

Reactions	Products	Types of Mechanism
 <p>1-bromopropane <math>\xrightarrow[\text{DMSO}]{\text{NaCN}}</math></p>		
 <p>1-chloro-2-methylcyclohexane <math>\xrightarrow[\text{EtOH}]{\text{NaOEt}}</math></p>		
 <p>2-methyl-2-butanol <math>\xrightarrow[\text{Heat}]{\text{H}_2\text{SO}_4}</math></p>		
 <p>1-iodo-2-methylcyclohexane <math>\xrightarrow{\text{NaOCH}_3}</math></p>		
 <p>1-iodopropane <math>\xrightarrow[\text{CH}_3\text{OH}]{\text{NaOCH}_3}</math></p>		

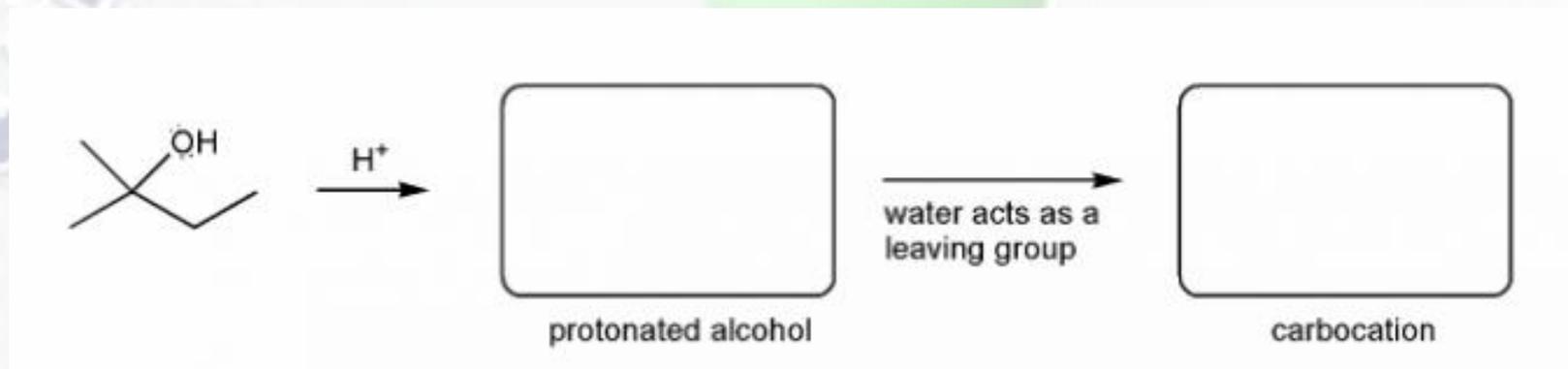
**6. Predict the alcohol required for the synthesis of the following halides**



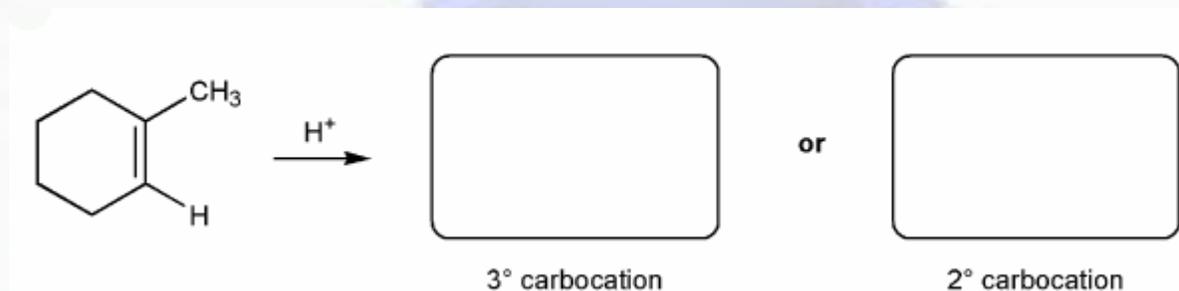
**7. (i) Write down the product of the reaction with curly arrow mechanism. (ii) If the following reaction sodium methoxide is used instead of methanol what will happen. Explain**



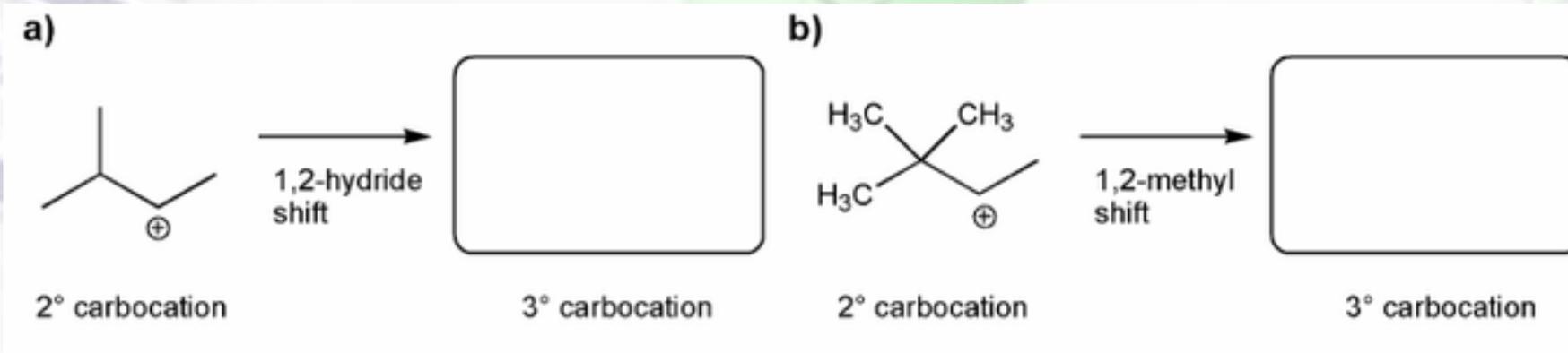
**8. Write in the curved arrows to show the formation of the protonated alcohol, and water acting as a leaving group to form a carbocation.**



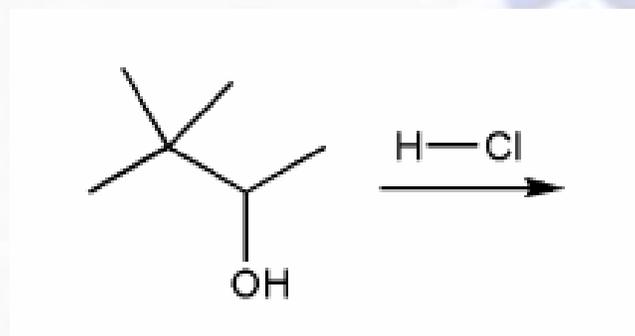
**9. Use curved arrows to show the two carbocations that can form from 1-methylcyclohexene.**



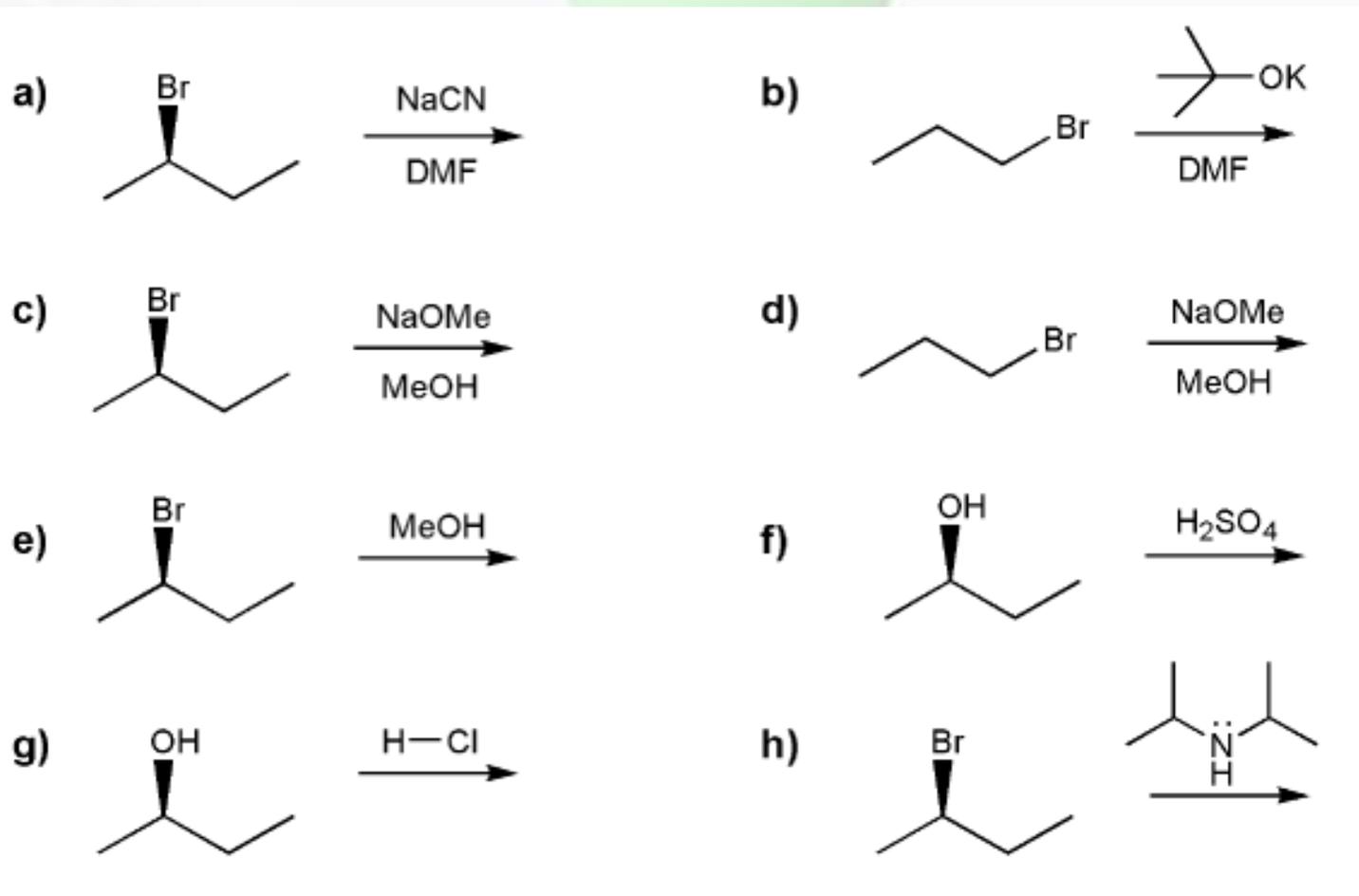
**10. Each of the carbocations below will spontaneously rearrange. Draw the structure of the expected rearrangement product.**



**11. Predict the product(s) of the reaction below, and use curved arrows to show a mechanism.**



**12 Write down appropriate products with correct stereochemistry. Also mention the reaction mechanism**



**13. Write the IUPAC name of the major product obtained when 2-bromopentane is heated with alcoholic KOH. Give equation and also name the reaction.**

**14. (a) write the IUPAC name of the following compound  
 $\text{CH}_2=\text{CH}-\text{CH}_2-\text{CH}_2-\text{Cl}$**

**(b) Why is thionyl chloride preferred for preparing alkyl halides from alcohols?**

**© What happens when methyl bromide reacts with KCN?**

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**15. Compound 'X' with molecular formula  $C_4H_9Br$  reacts with aqueous KOH to give an alcohol. The rate of this reaction depends only on the concentration of the compound 'X'. When an optically active isomer Y of the compound 'X' was treated with aqueous KOH solution, the rate of reaction was found to be dependent on concentration of compound Y' and aqueous KOH both.**

**(a) Write down the structural formula of both 'X' and Y'.**

**(b) Out of X' and 'Y', which one will undergo racemization and why ?**

**(c) Out of 'X' and 'Y, which one will form product with inversion of configuration and why? [2026 CBSE 12 board exam]**

**16. Among all the isomers of molecular formula  $C_4H_9Br$ , identify**

**(a) the one isomer which is optically active.**

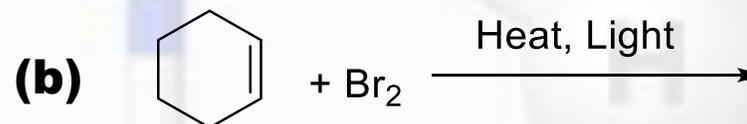
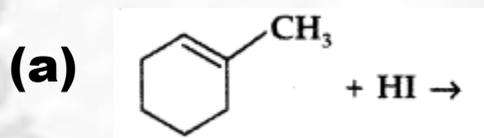
**(b) the one isomer which is highly reactive towards  $SN_2$ .**

**17. Write down all synthetic steps to synthesize trichlorotoluene from toluene.**

**18. A solution of KOH hydrolyses  $\text{CH}_3\text{CHClCH}_2\text{CH}_3$  and  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{Cl}$ . Which one of these is more easily hydrolyzed?**

**19. What happens when bromine attacks  $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{C} \equiv \text{CH}$**

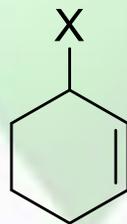
**20. Write down products with IUPAC nomenclature**



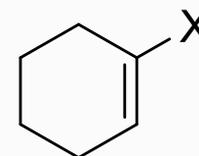
**21. Arrange the following in increasing order of boiling point:**



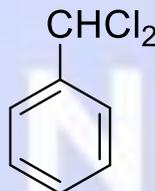
**22. Which is allylic halide?**



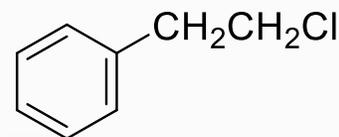
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**23. Which is benzylic halide?**



and

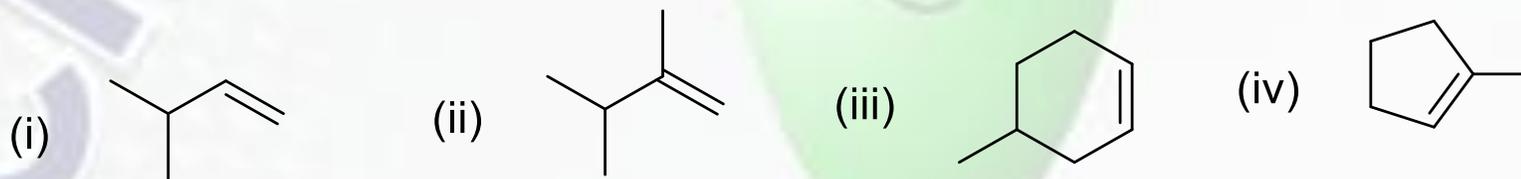


**24. Explain why :**

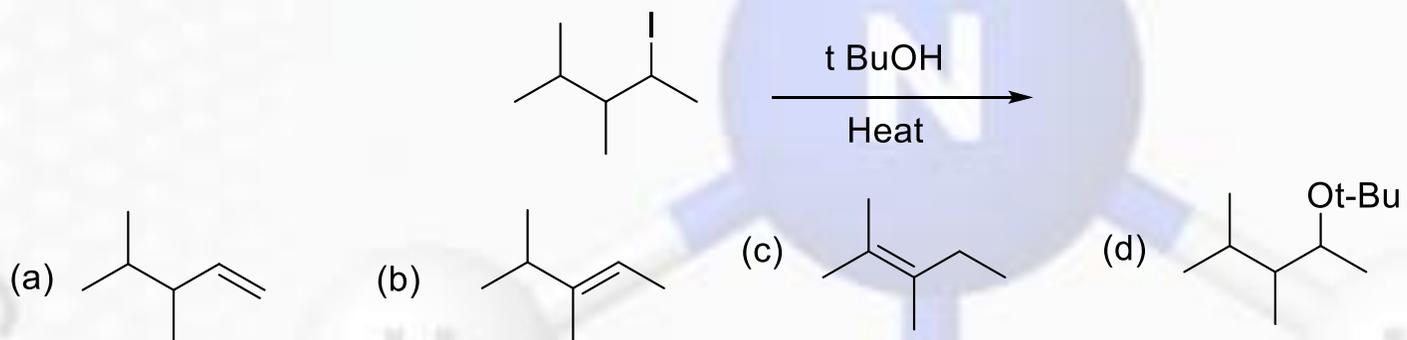
**(a) The dipole moment of chlorobenzene is lower than that of cyclohexyl chloride.**

**(b) Alkyl halides, though polar, are immiscible with water.**

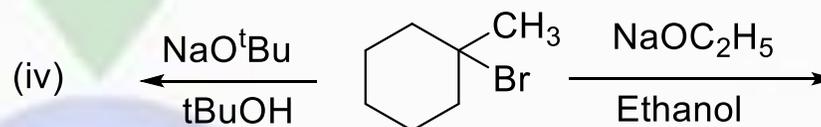
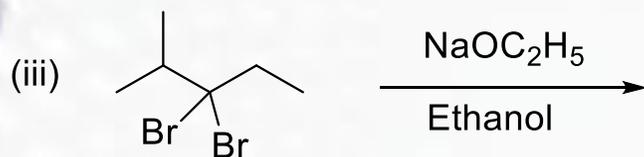
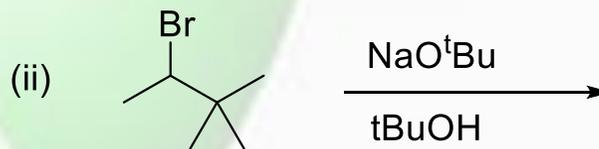
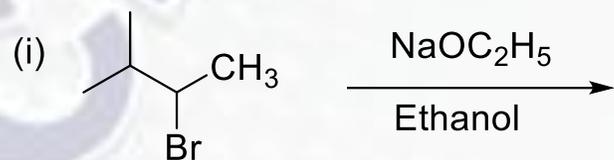
**25. Starting with an appropriate alkyl halide and base outline the synthesis of following alkenes as major products**



**26. The major product of the following reaction is**



## 27. Write down all major products of the following reaction



## 28. Which halogen compounds in each of the following pair will react faster in SN2 reaction

(a)  $\text{CH}_3\text{Br}$  and  $\text{CH}_3\text{I}$  (b)  $(\text{CH}_3)_3\text{C-Cl}$  and  $\text{CH}_3\text{Cl}$

**29. Which halogen compounds in each of the following pair will react faster in SN2 reaction**

**(a) CH<sub>3</sub>Br and CH<sub>3</sub>I (b) (CH<sub>3</sub>)<sub>3</sub>C-Cl and CH<sub>3</sub>Cl**

**30. Show the mechanism for the following reaction using curved arrows**



**31. Write down the product with mechanism. (ii) If the concentration of the nucleophile is double in the below reaction what effect does on the rate of the reaction?**



**32. Predict which alkyl halides can undergo a  $S_N2$  reaction.**

- a)  $C_6H_5Br$
- b)  $CH_3CH_2CH_2Br$
- c)  $CH_3CH_2Br$
- d)  $CH_3CH_2CH_2CHBrCH_3$

**33. Which of the following will undergo  $SN1$  faster?(i) 1-chloropropane and (ii) 2-chloropropane**

**34. What product(s) do you expect from the reaction of 1-bromopentane with each of the following reagents in an  $S_N2$  reaction?**

- a)  $KI$
- b)  $NaOH$
- c)  $CH_3C\equiv C-Li$
- d)  $NH_3$

**35. Which in the following pairs is a better nucleophile?**

a)  $(\text{CH}_3\text{CH}_2)_2\text{N}^-$  or  $(\text{CH}_3\text{CH}_2)_2\text{NH}$

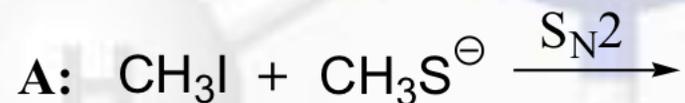
b)  $(\text{CH}_3\text{CH}_2)_3\text{N}$  or  $(\text{CH}_3\text{CH}_2)_3\text{B}$

c)  $\text{H}_2\text{O}$  or  $\text{H}_2\text{S}$

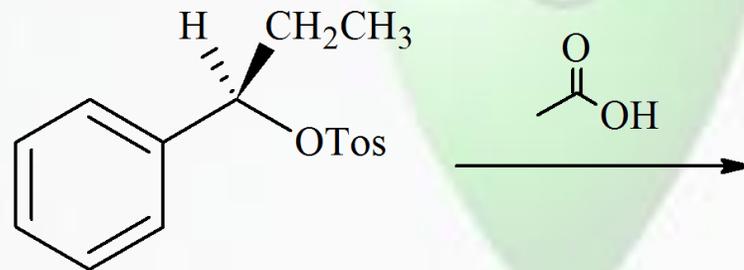
**36. Order the following in increasing reactivity for an  $\text{S}_{\text{N}}2$  reaction.**

$\text{CH}_3\text{CH}_2\text{Br}$ ,  $(\text{CH}_3\text{CH}_2)_3\text{CCl}$ ,  $(\text{CH}_3\text{CH}_2)_2\text{CHCl}$

**37. Consider two nucleophilic substitutions. Assume that reaction A is  $\text{S}_{\text{N}}2$ , and reaction B is  $\text{S}_{\text{N}}1$ . Predict, in each case, what would happen to the rate of the reaction if the concentration of the nucleophile were doubled, while all other conditions remained constant**



**38. Give the products of the following  $S_N1$  reaction. Show stereochemistry.**



**39. Which alkyl halides from given options will undergo  $S_N1$  reaction faster?**

- |   |   |
|---|---|
| (A) $(\text{CH}_3)_3\text{C}-\text{Br}$ | (B) $(\text{CH}_3)_2\text{CH}-\text{Br}$            |
| (C) $\text{CH}_3-\text{CH}_2-\text{Br}$ | (D) $(\text{CH}_3)_3\text{C}-\text{CH}_2-\text{Br}$ |

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**40. Arrange the following compounds in increasing towards  $S_N2$  reaction**

**(a) 2-bromopentane, (b) 1-bromopentane, © 2-bromo-2-methylbutane**

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**41. Which one of the following compounds is more reactive towards  $S_N1$  reaction (a)  $CH_2=CHCH_2Br$  (b)  $C_6H_5CH_2Br$ , ©  $C_6H_5CH(C_6H_5)Br$ , (d)  $C_6H_5CH(CH_3)Br$**

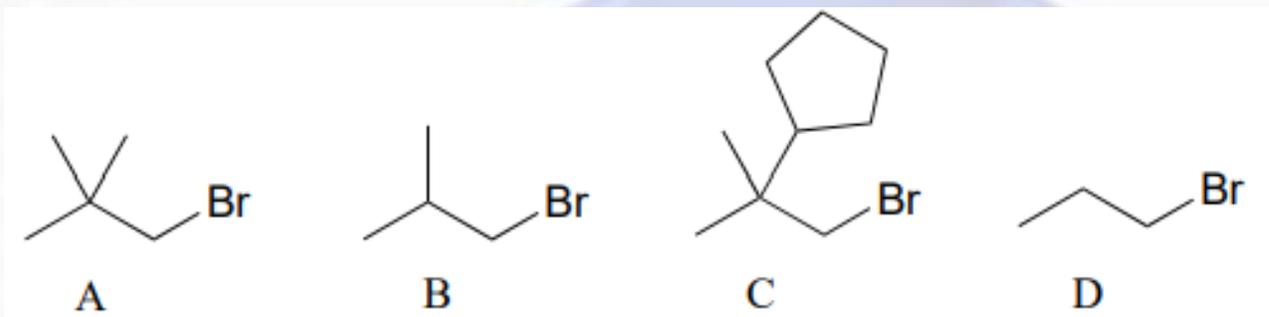
**42. Write down the reaction and all the products when the below mentioned reagents react with n-propyl chloride?**

**(a)  $NH_3$ , (b)  $NaOC_2H_5$ , ©  $C_6H_5NH_2$ , (d)  $NaCN$ , (e)  $NaSCH_3$**

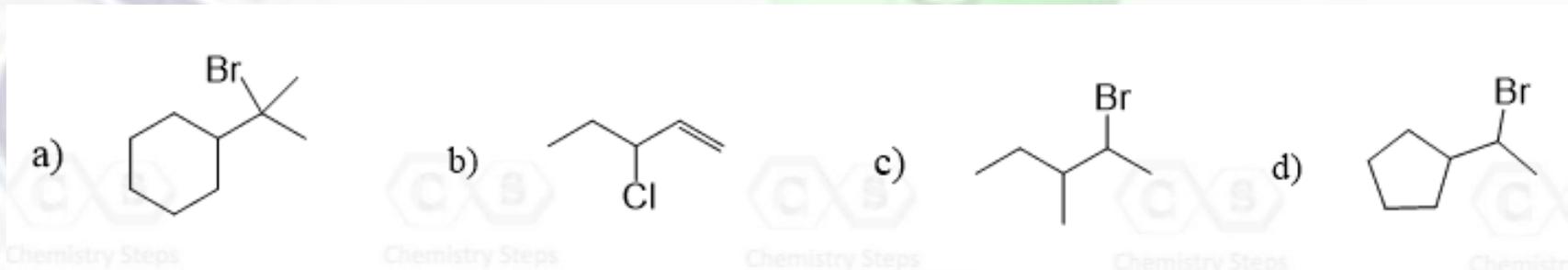
**43. How will you convert n-propyl bromide to n-propyl iodide and n-propyl chloride?**

**43. How will you convert n-butyl bromide to (a) butyl methyl ether? (b) to n-butyl alcohol? (c) pentanenitrile?, (d) to n-butylamine?, (e) n-butyilmagnesium bromide? and (f) to n butane**

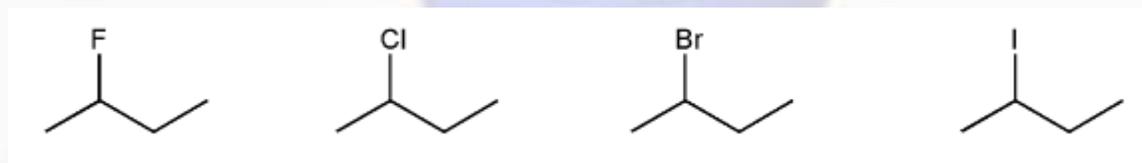
**44. Rank the following molecules in order of how fast they would be expected to react with  $\text{CH}_3\text{SNa}$  in acetone.**



**45. Draw the structure of carbocation intermediates forming upon ionization. Explain their stability.**



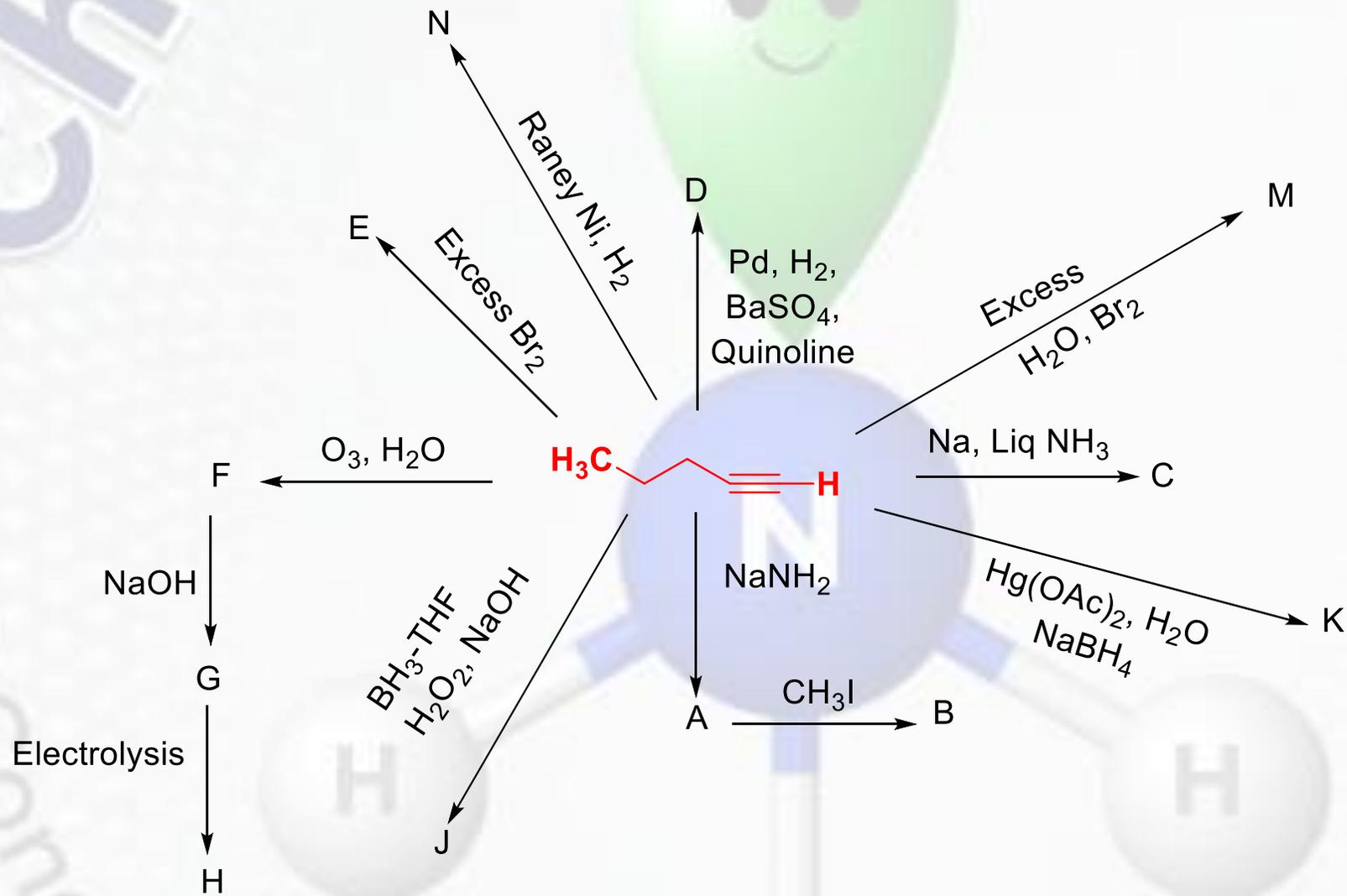
**46. Rank the following electrophiles in order of decreasing reactivity with  $\text{NaN}_3$  in DMF.**



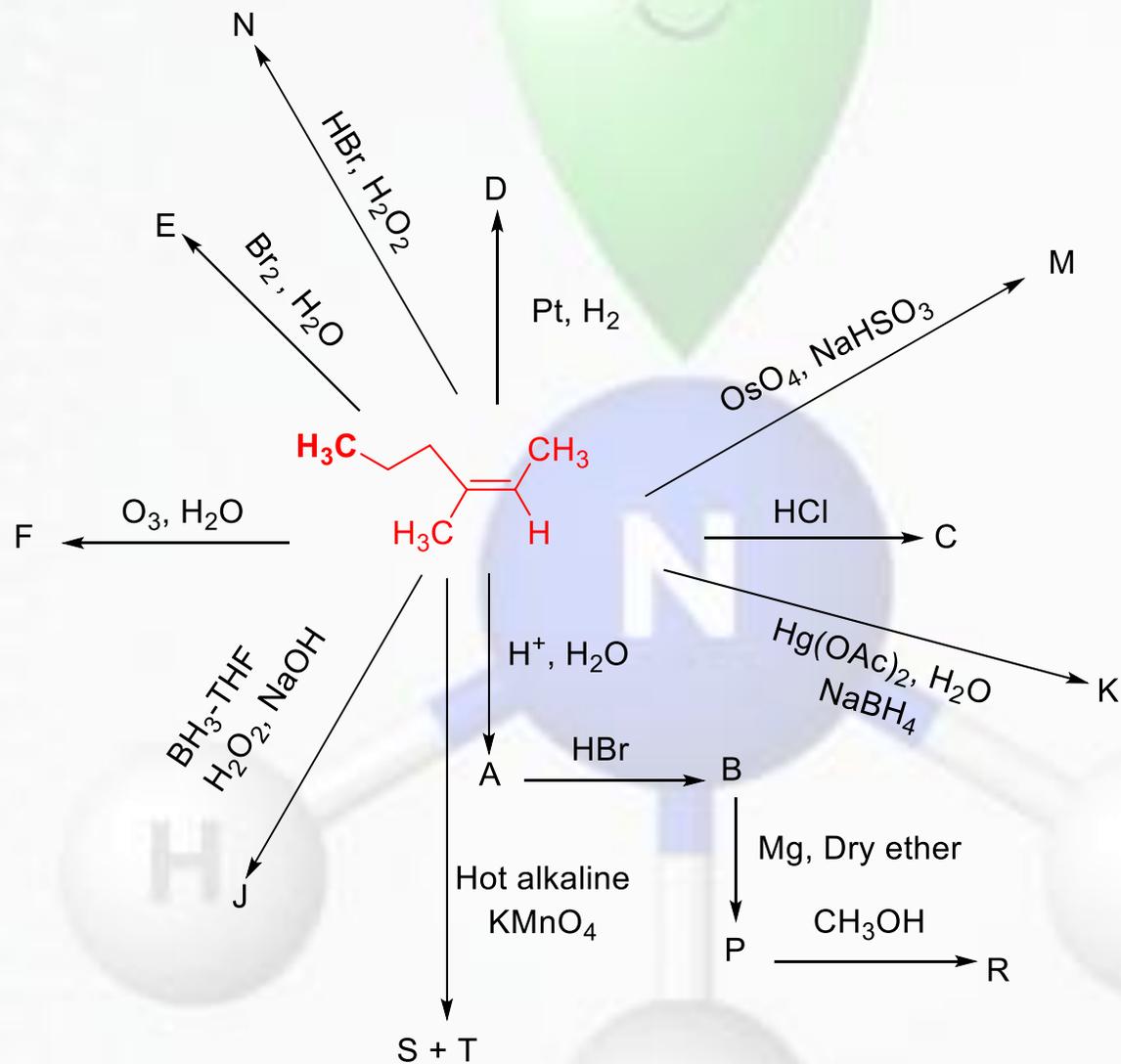
## 47. Fill the blanks

<b>Reactant</b>	<b>Reagent/reaction condition/Solvent</b>	<b>Product</b>	<b>Name of the reaction</b>
<b>Alkyl halide</b>	<b>Sodium, dry ether (solvent)</b>		
<b>Sodium salt of acetic acid</b>	<b>Electrolysis</b>		
<b>Alkyne</b>		<b>Cis-alkene</b>	
<b>Alkene</b>		<b>Alkyl halide</b>	
<b>Alkyl bromide</b>	<b>AgF</b>		
			<b>Finkelstein reaction</b>

# 48. Complete the reaction map

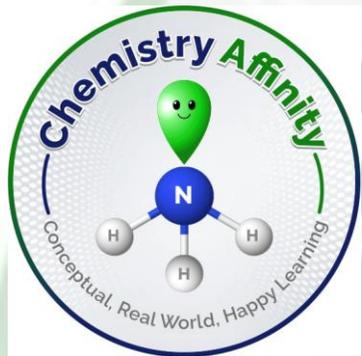


# 49. Complete the reaction map



## 50. Match list 1 and list 2

List 1	List 2
SN1	DMSO solvent
Electrophilic addition	Raney Ni, H <sub>2</sub>
SN2	OsO <sub>4</sub> , NaHSO <sub>3</sub>
Hydrogenation	More substituted alkene
Cis di ol	Elimination
Dehydration	Racemic mixture



**All the best**