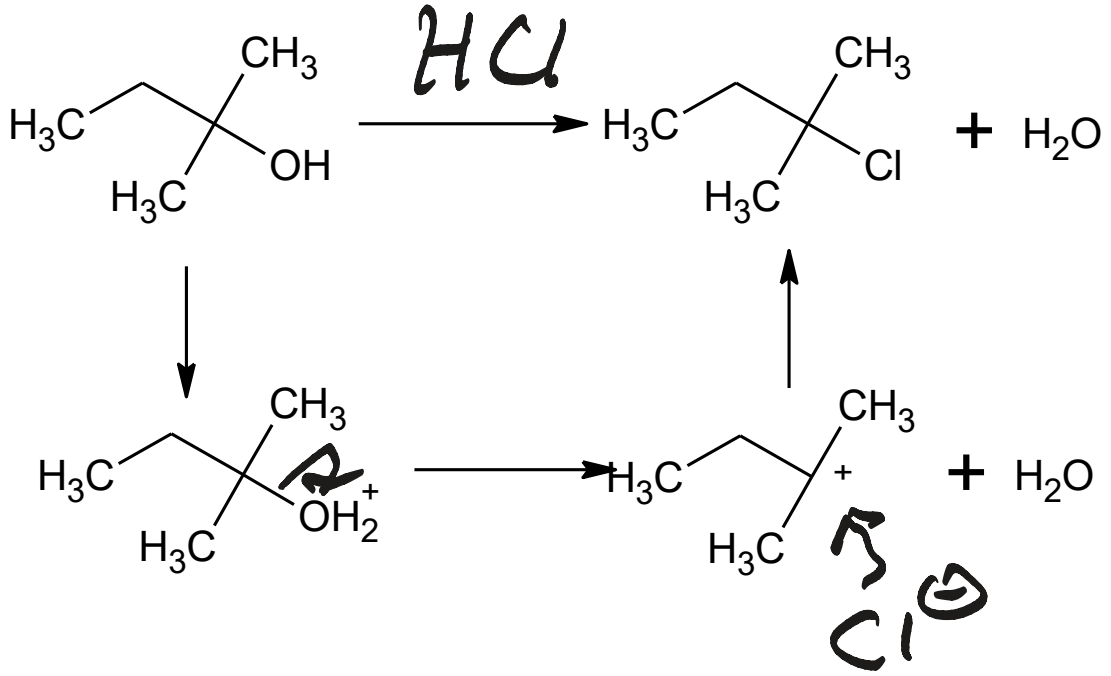
Nucleophilic Substitution

220C

7/6/26



Cl⊖

NaCl

:OH⊖

Wash

% yield

SN2 1°>2°>3° IR, Halide tests

$NaI + R\text{-}X \rightarrow NaX_{(s)} + R\text{-}I$

$AgNO_3 + R\text{-}X \rightarrow AgX_{(s)} + R\text{-}ONO_2$

SN1 3°>2°>1°

C-C

C-OH

C=O

C-H

Functional group Region

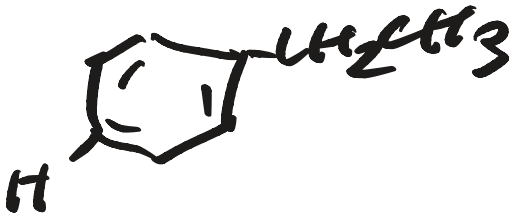
4000 cm^{-1} ~ 1250 cm^{-1}

TABLE IR.1 A Simplified Correlation Table

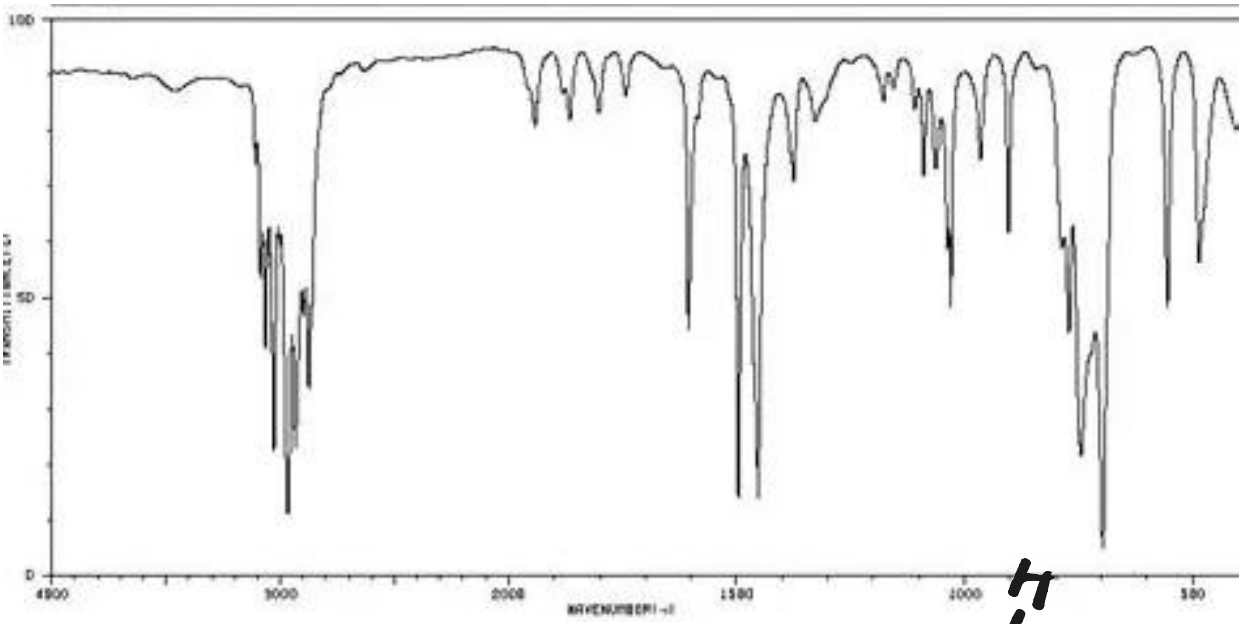
	Type of Vibration		Frequency (cm^{-1})	Intensity
C—H	Alkanes	(stretch)	3000–2850	s
	—CH_3	(bend)	1450 and 1375	m
	—CH_2—	(bend)	1465	m
	Alkenes	(stretch)	3100–3000	m
		(bend)	1700–1000	s
	Aromatics	(stretch)	3150–3050	s
		(out-of-plane bend)	1000–700	s
	Alkyne	(stretch)	ca. 3300	s
	Aldehyde		2900–2800	w
			2800–2700	w
C—C	Alkane	Not interpretatively useful		
C=C	Alkene		1680–1600	m–w
	Aromatic		1600–1400	m–w
C≡C	Alkyne		2250–2100	m–w
C=O	Aldehyde		1740–1720	s
	Ketone (acyclic)		1725–1705	s
	Carboxylic acid		1725–1700	s
	Ester		1750–1730	s
	Amide		1700–1640	s
	Anhydride		ca. 1810	s
			ca. 1760	s
C—O	Alcohols, ethers, esters, carboxylic acids		1300–1000	s
O—H	Alcohol, phenols			
	Free		3650–3600	m
	H-Bonded		3400–3200	m
	Carboxylic acids		3300–2500	m
N—H	Primary and secondary amines		ca. 3500	m
C≡N	Nitriles		2260–2240	m
N=O	Nitro (R—NO_2)		1600–1500	s
			1400–1300	s
C—X	Fluoride		1400–1000	s
	Chloride		800–600	s
	Bromide, iodide		< 600	s

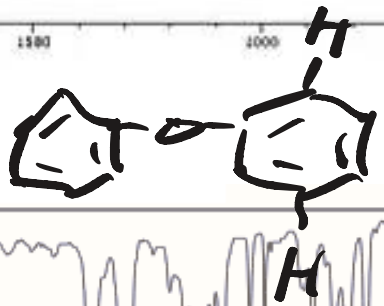
NOTE: s, strong; m, medium; w, weak.

Peak Frequency vs Peak Intensity

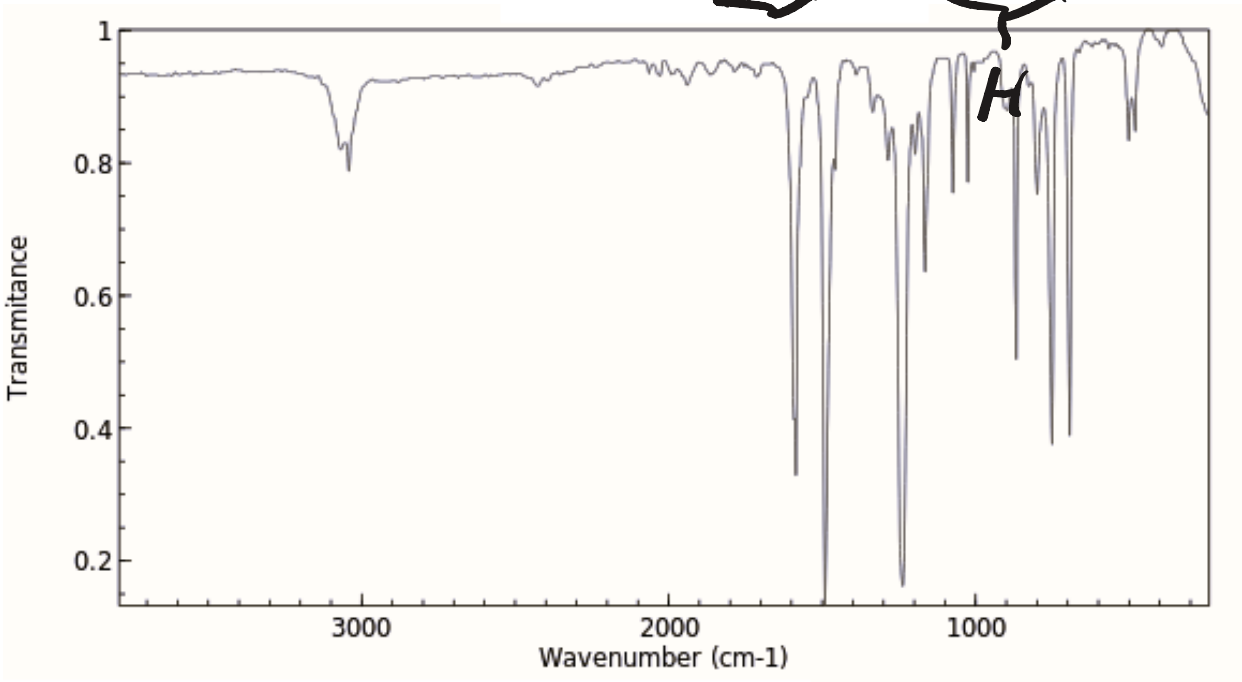


Ethyl Benzene





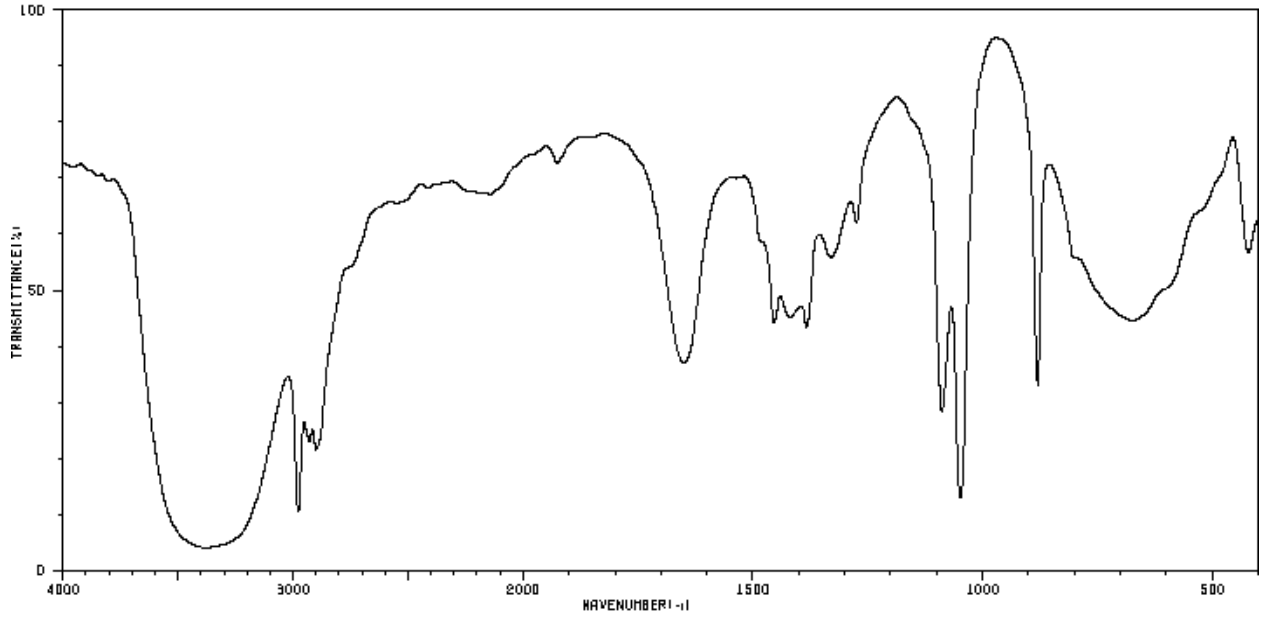
Diphenyl Ether



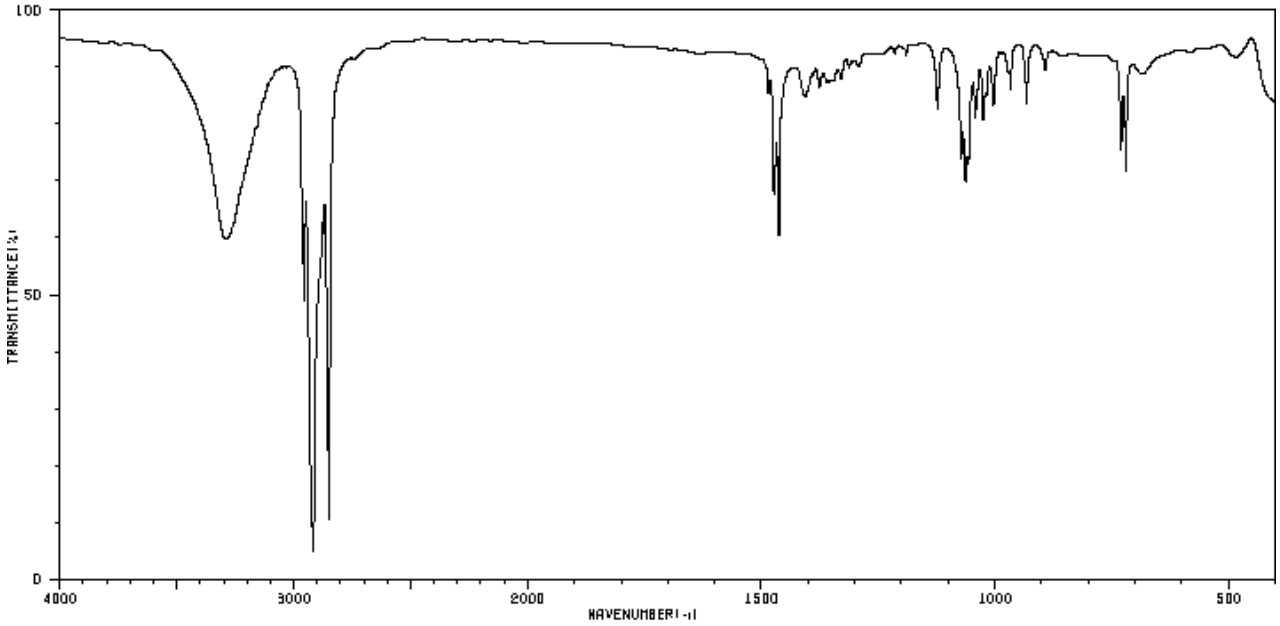
CH_3CH_2OH

C-H
C-Cl

Ethanol



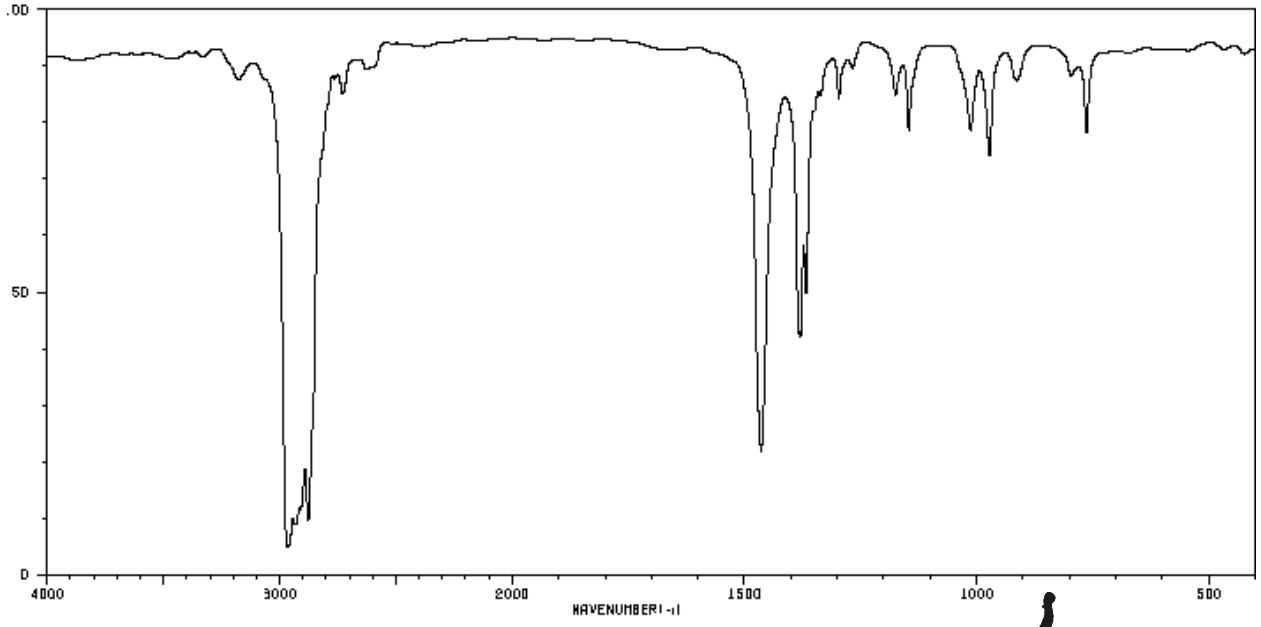
Tetradecanol

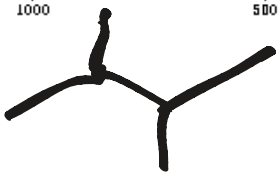


Fingerprint Region

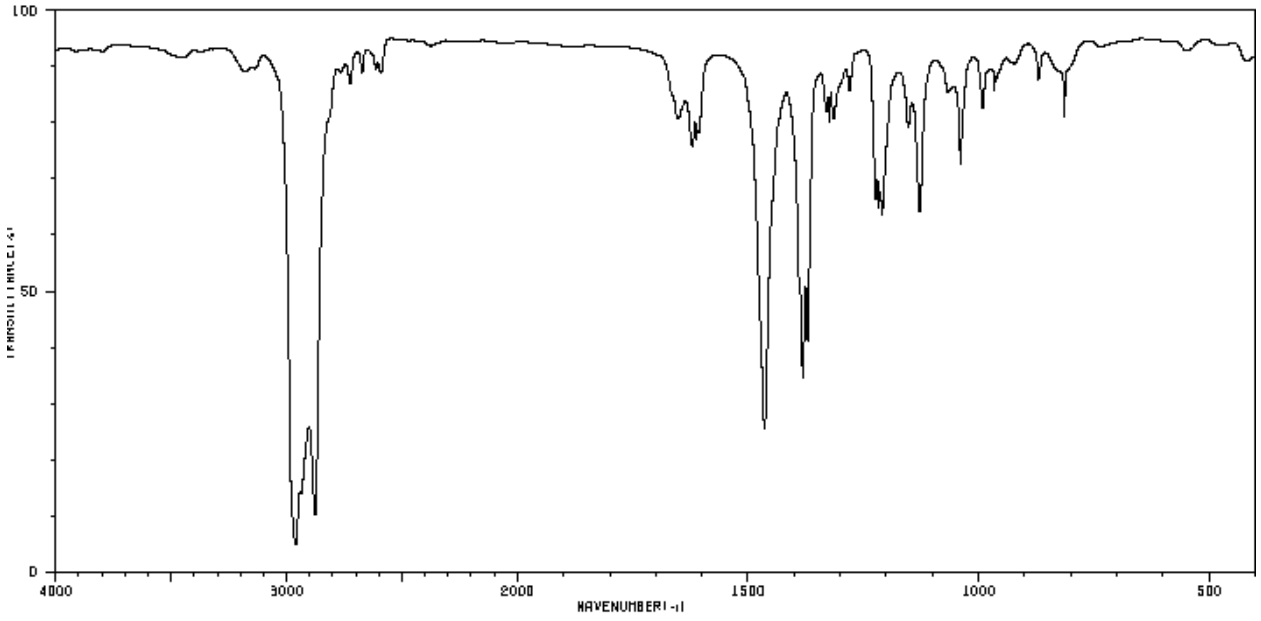
1250 cm^{-1} ~ 400 cm^{-1}

2-methylbutane

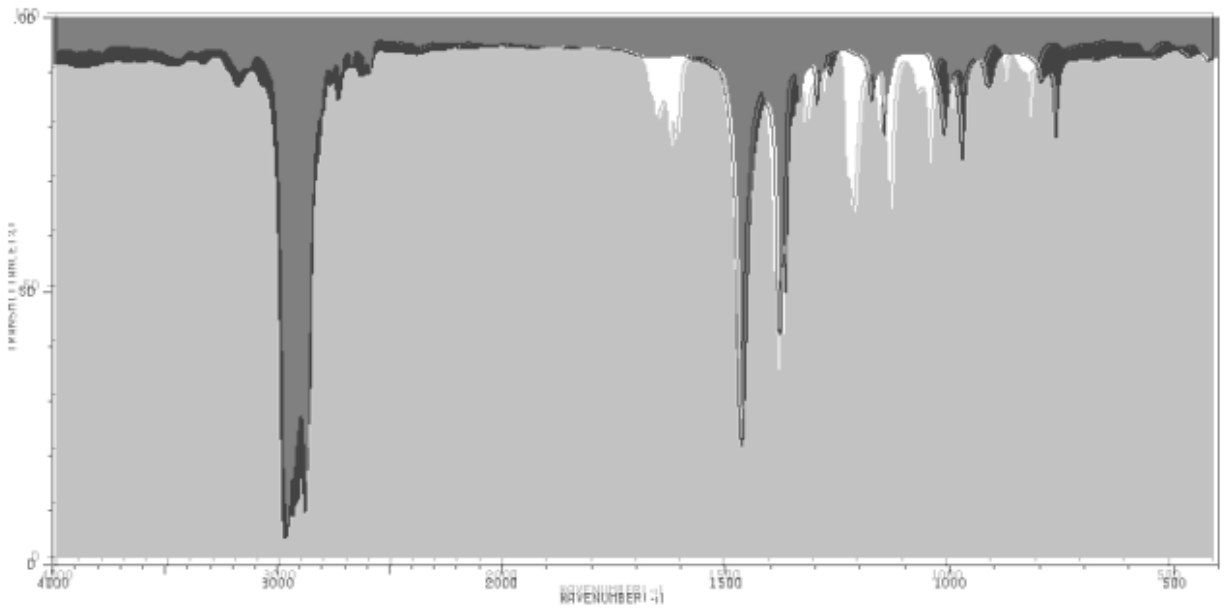




2,3-dimethylbutane



Overlay



1. Clean area
2. Clean IR
3. patience
4. Look at IR