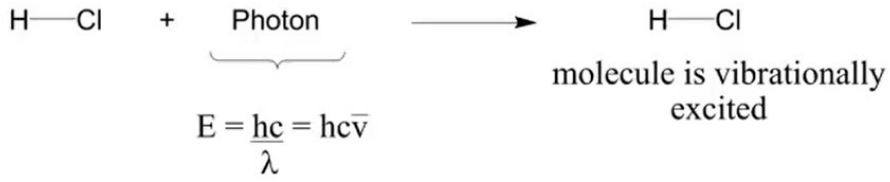
Infrared (IR) Spectroscopy



Irradiate sample with IR light

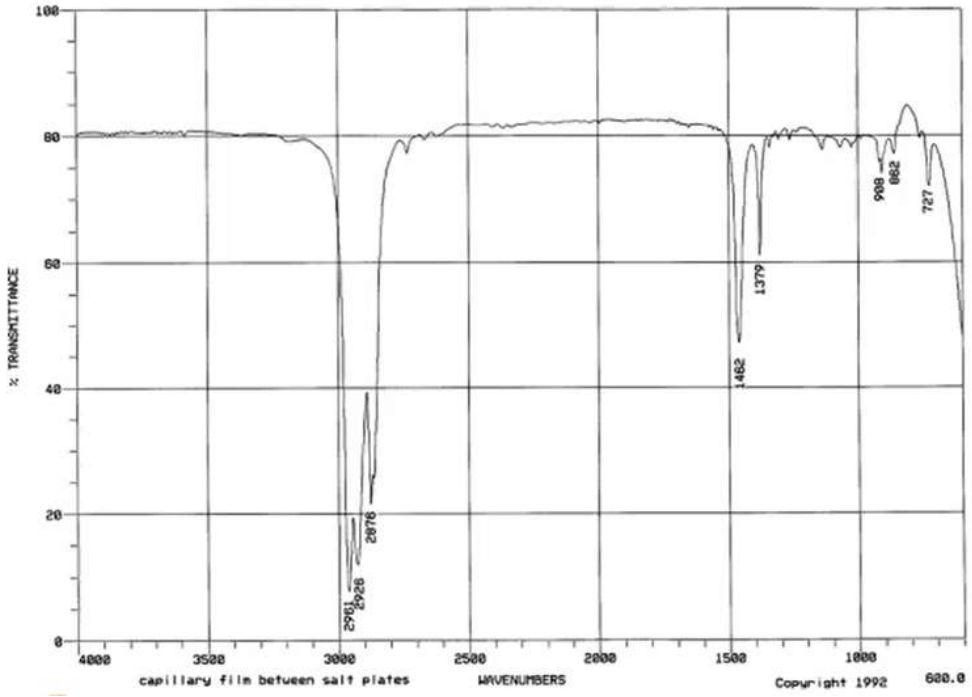
Record frequencies that are absorbed

Certain functional groups have characteristic absorptions

Intensity of absorption is proportional to change in dipole

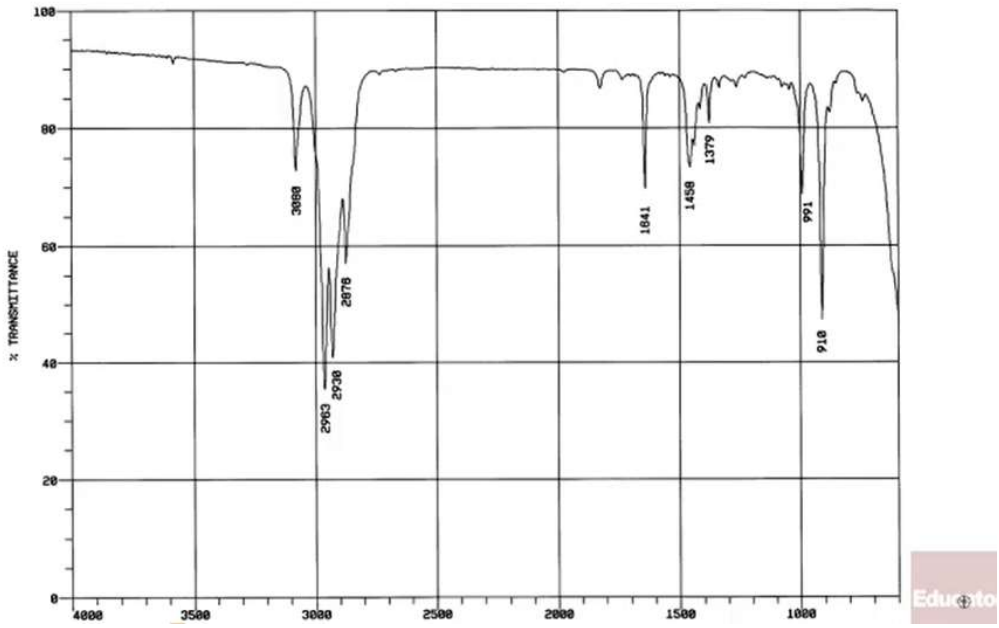
IR Spectrum of an Alkane

Pentane 



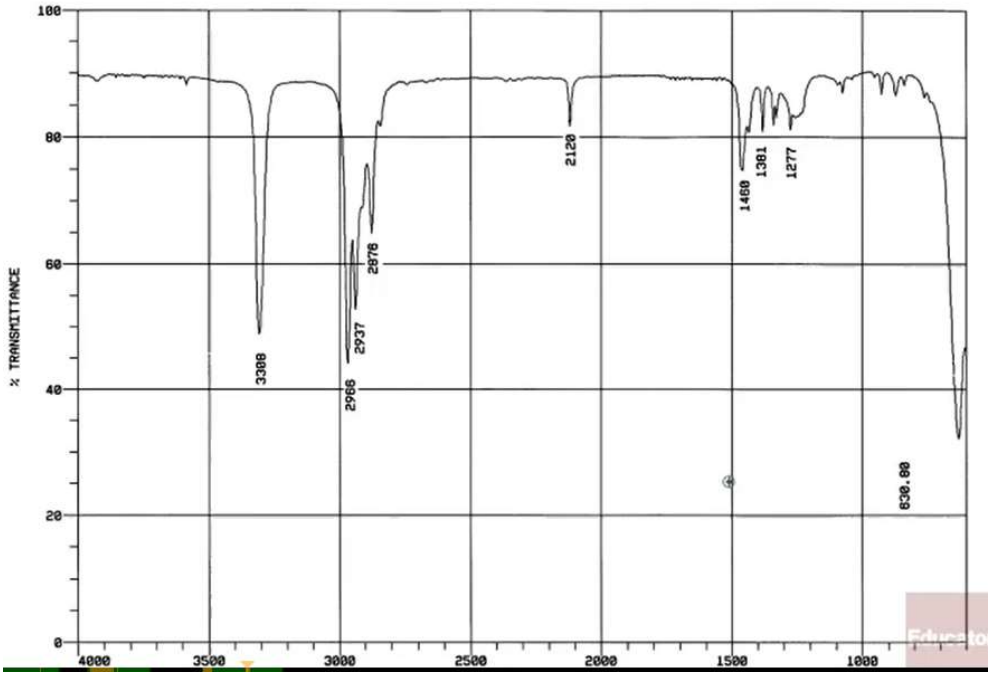
IR Spectrum of an Alkene

1-Pentene

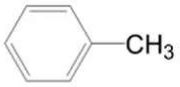


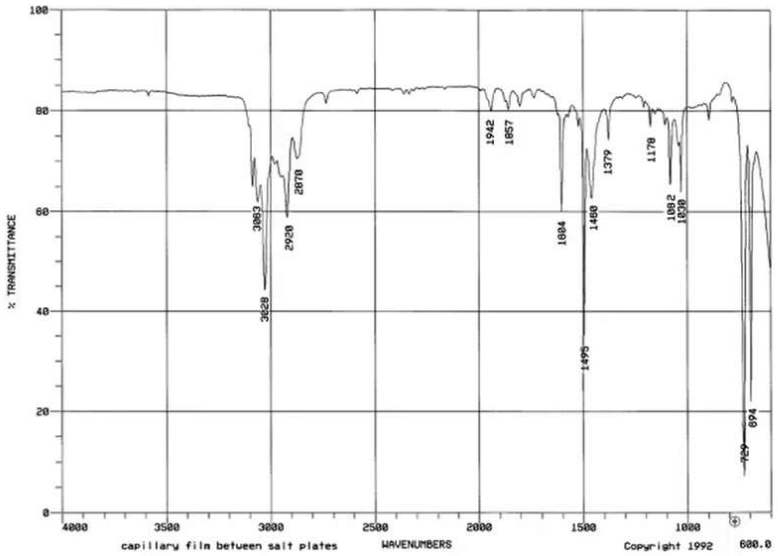
IR Spectrum of an Alkyne

1-Pentyne



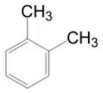
IR Spectrum of an Aromatic Compound

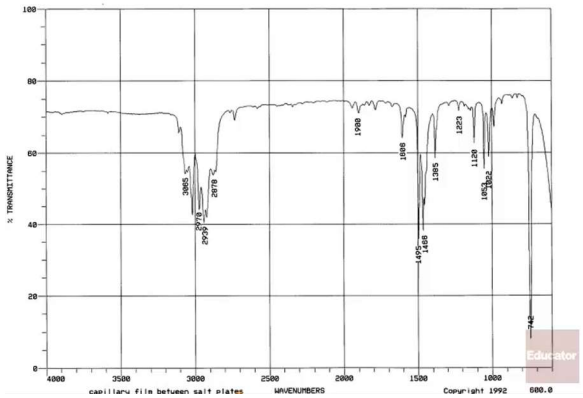
Methylbenzene 

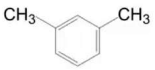


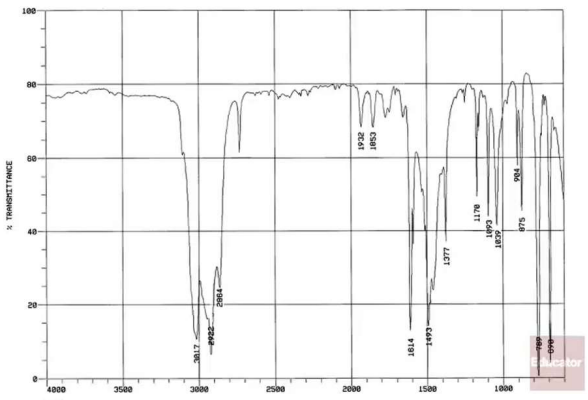
IR of Substituted Aromatic Compounds

Type	Out-of-plane bending peaks (cm^{-1})
monosubstituted 	~750 and ~690
1,2-disubstituted (ortho) 	~750
1,3-disubstituted (meta) 	three peaks: ~880, ~750, ~690
1,4-disubstituted (para) 	~815

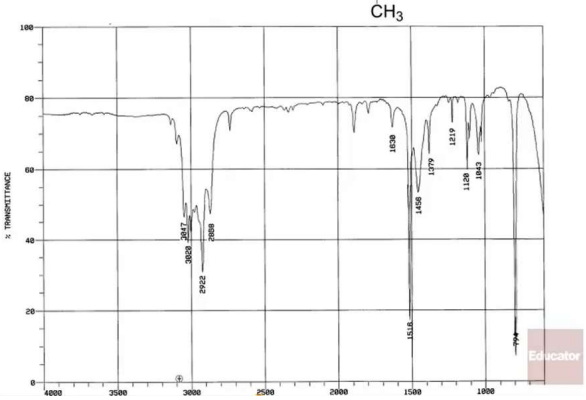
1,2-dimethylbenzene 



1,3-dimethylbenzene 

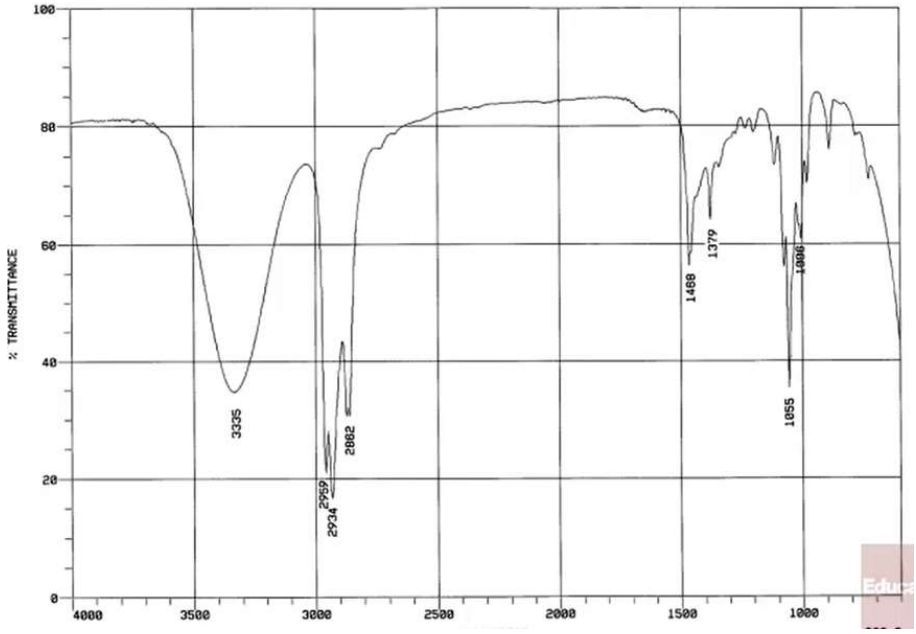


1,4-dimethylbenzene 



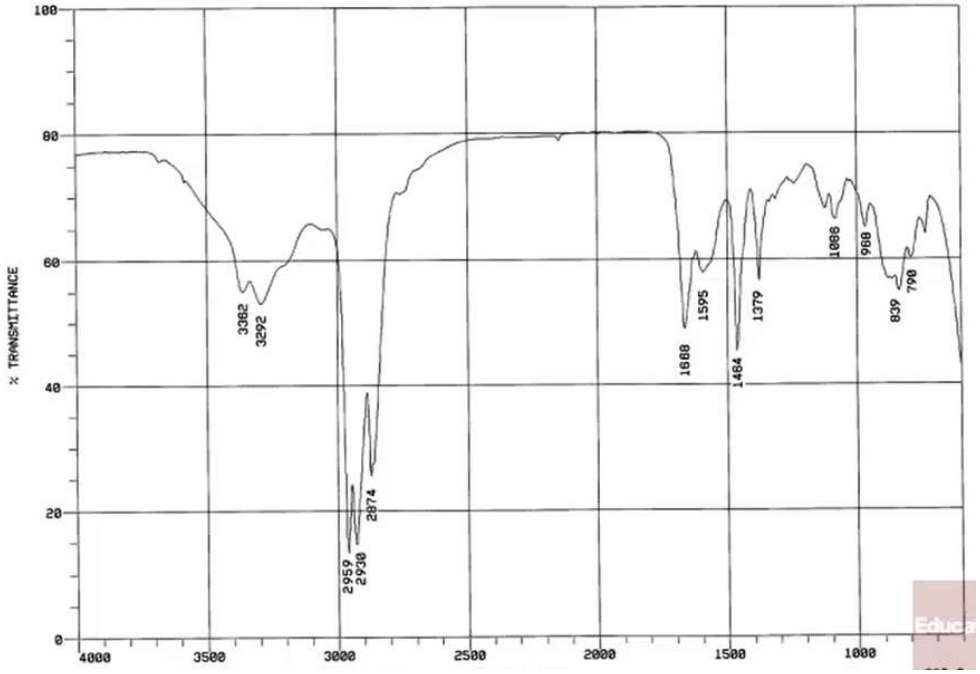
IR Spectrum of an Alcohol

1-pentanol 



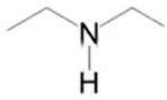
IR Spectrum of an Amine

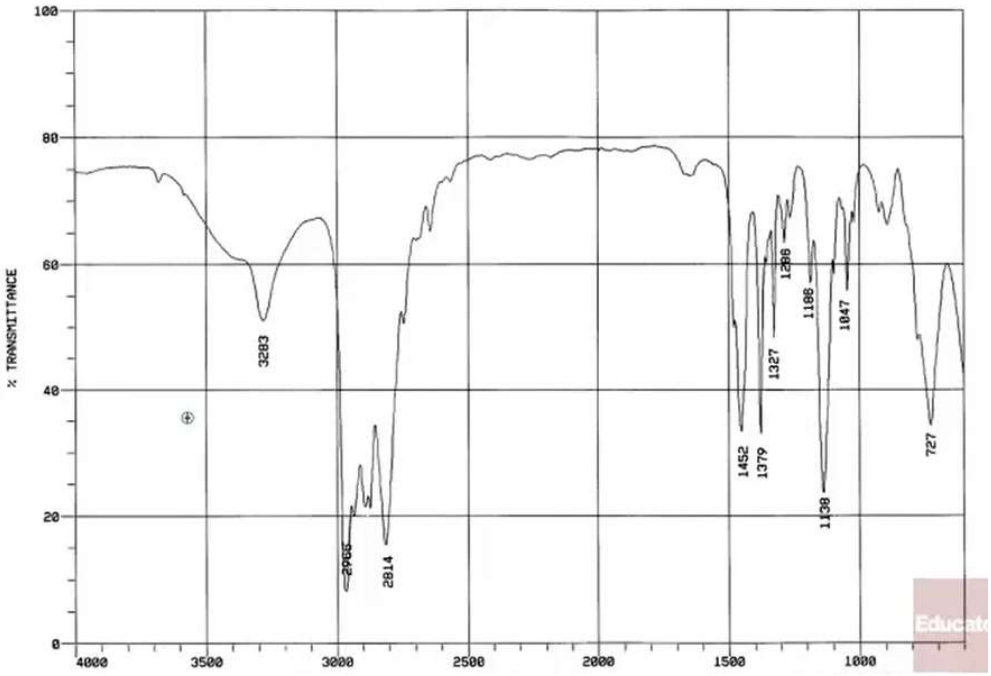
1-butanamine 



IR Spectrum of a 2° Amine

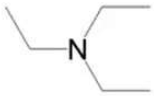
diethylamine

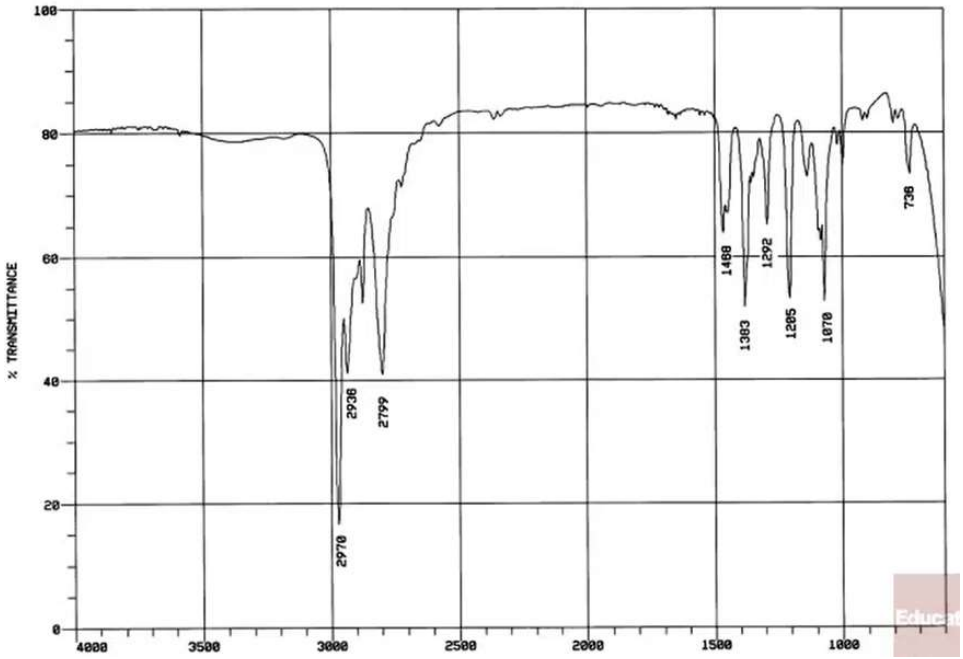




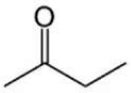
IR Spectrum of a 3° Amine

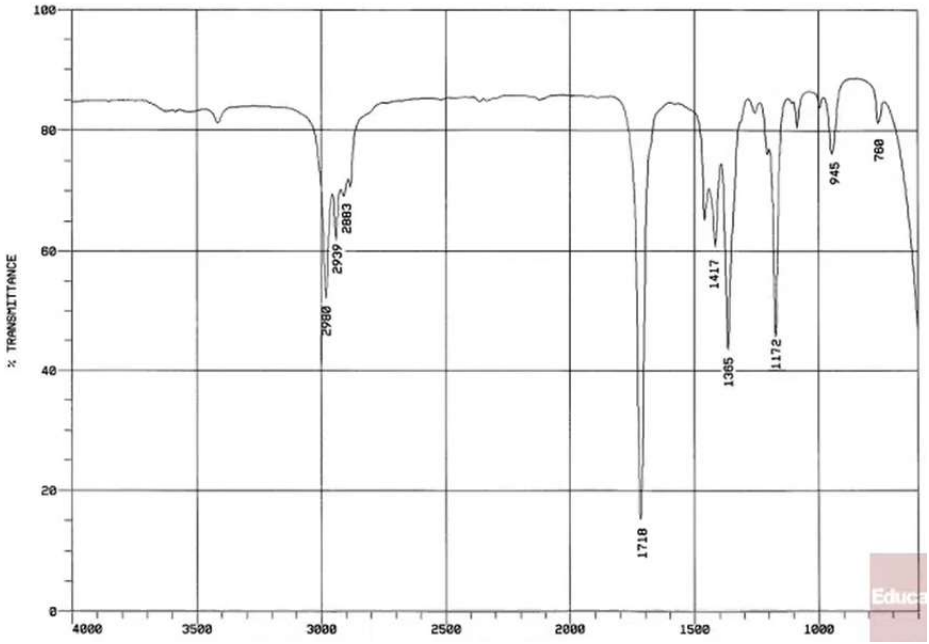
triethylamine



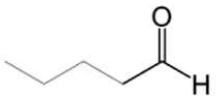


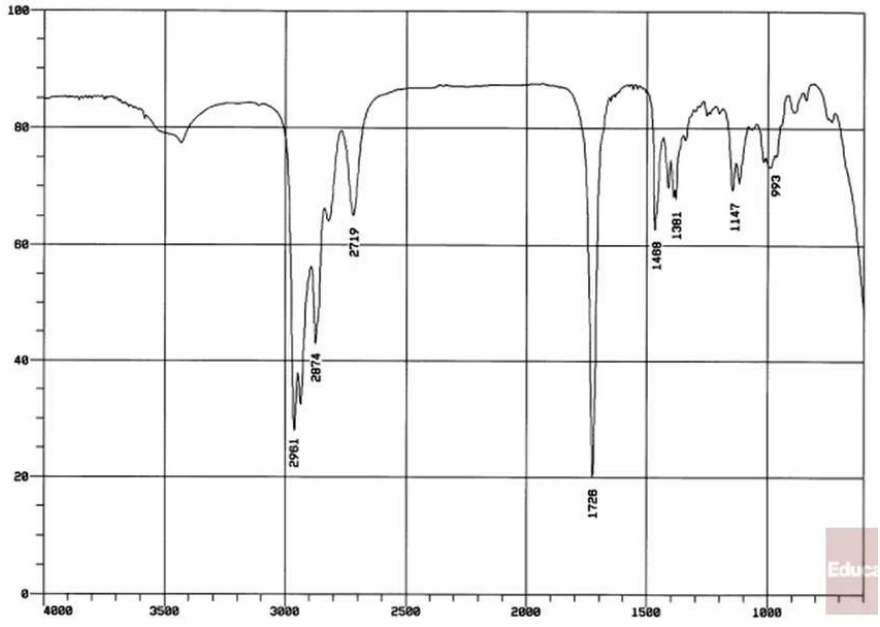
IR Spectrum of a Ketone

2-butanone 



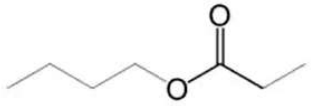
IR Spectrum of an Aldehyde

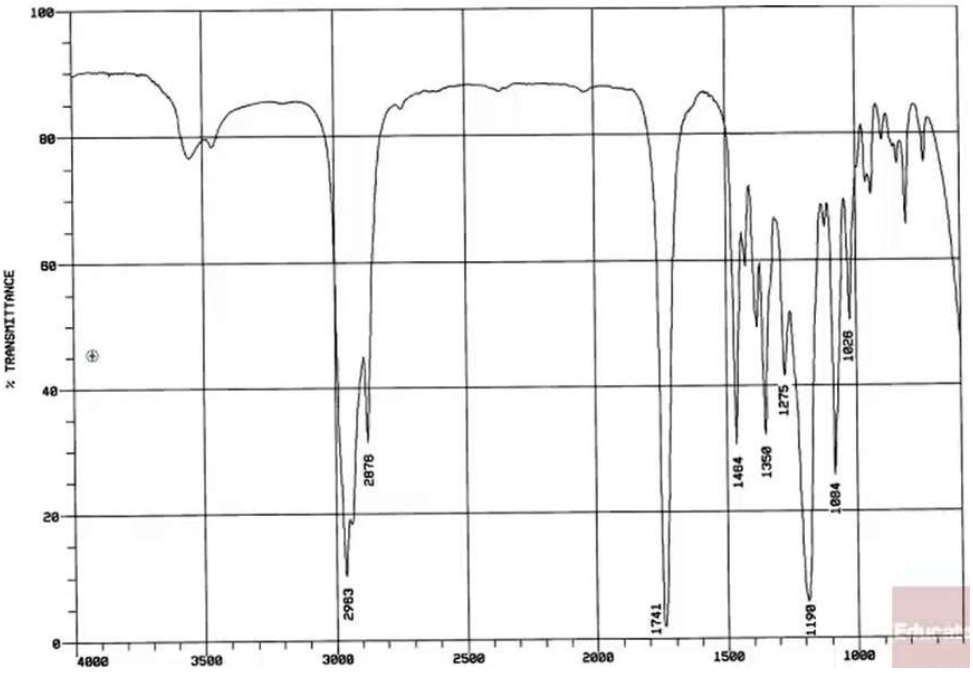
pentanal 



IR Spectrum of an Ester

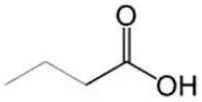
butyl propanoate

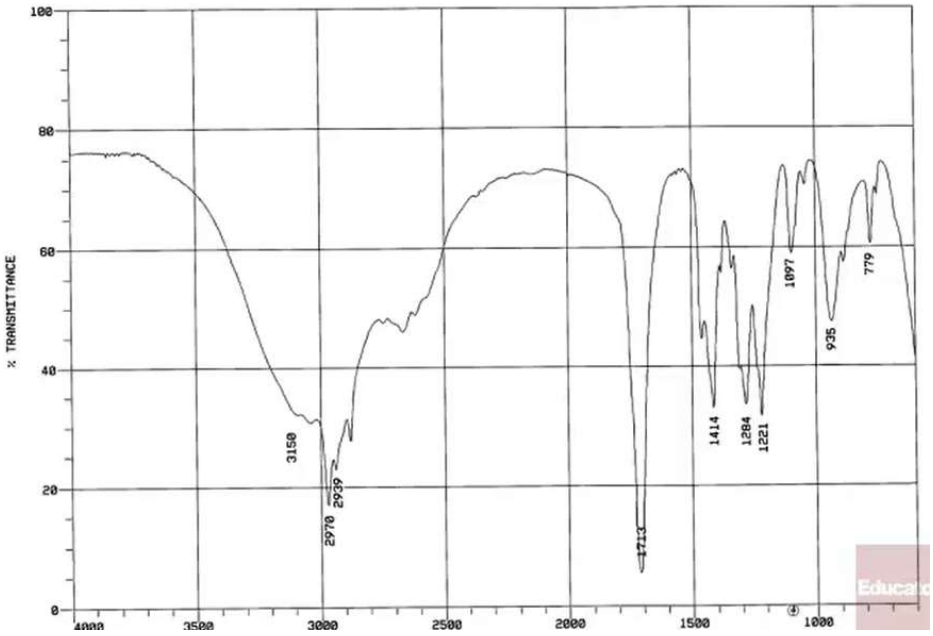




IR Spectrum of a Carboxylic Acid

butanoic acid





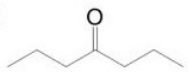
Sample IR Correlation Chart

Wavenumber	Functional Group
3600-3300 (s, broad)	O-H stretch (alcohol, phenol)
3400-2400 (s, very broad)	O-H stretch (carboxylic acid)
3500-3300 (m)	N-H stretch
3300 (s)	sp C-H stretch (alkyne ≡C-H)
3080-3020 (m) (just above 3000)	sp^2 C-H stretch (alkene or aromatic =C-H)
2960-2850 (s) (just below 3000)	sp^3 C-H stretch (alkane)
2850 and 2750 (w)	aldehyde C-H stretch (O=C-H)
2260-2100 (w)	C≡C stretch (alkyne)
2260-2220 (w)	C≡N stretch (nitrile)
1680-1620 (v)	C=C stretch (alkene or aromatic)
1750-1650 (s)	C=O stretch
1300-1000 (s)	C-O stretch (ether, ester)

Predicting IR Spectra: Sample Structures

ndicate ALL of the significant peaks you would expect to find in the IR spectrum of each compound. (e.g., sp^2 CH above 3000 or C=O around 1700)

1



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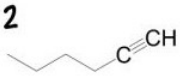

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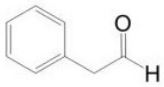

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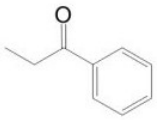

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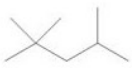

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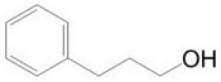

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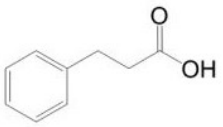

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