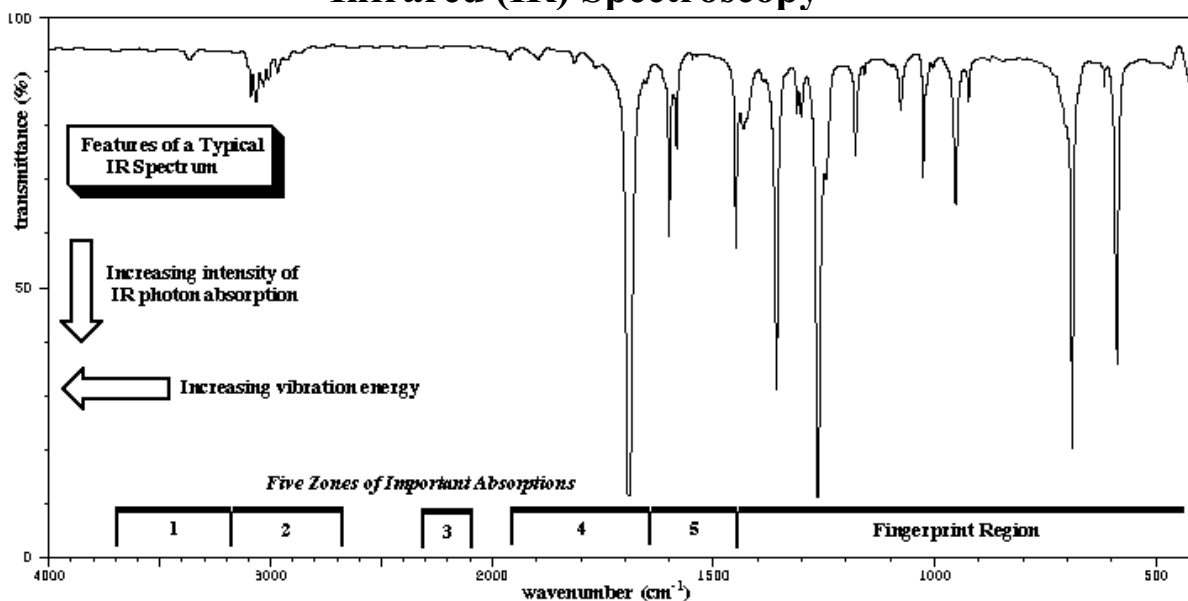


Infrared (IR) Spectroscopy

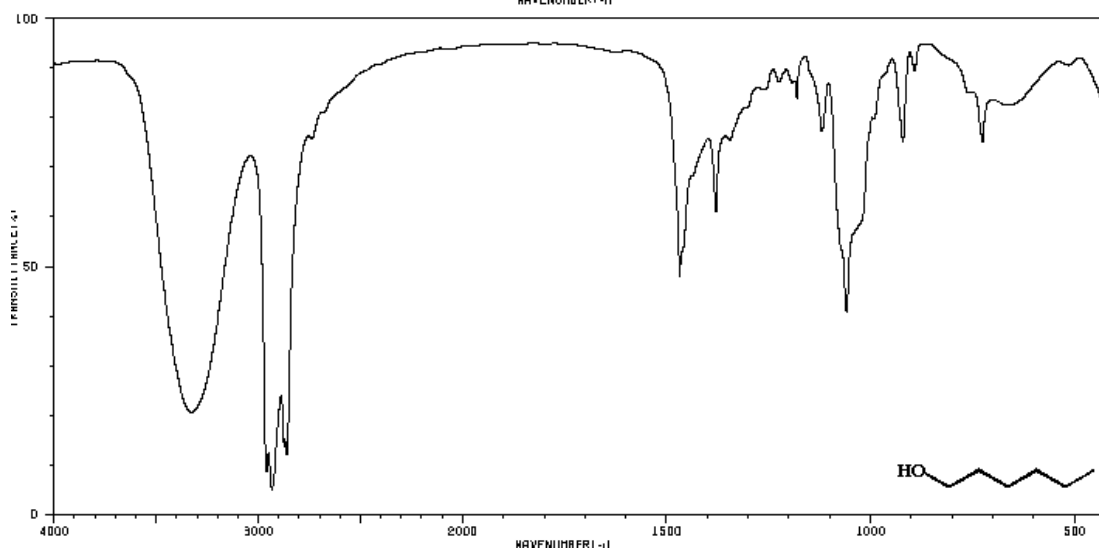
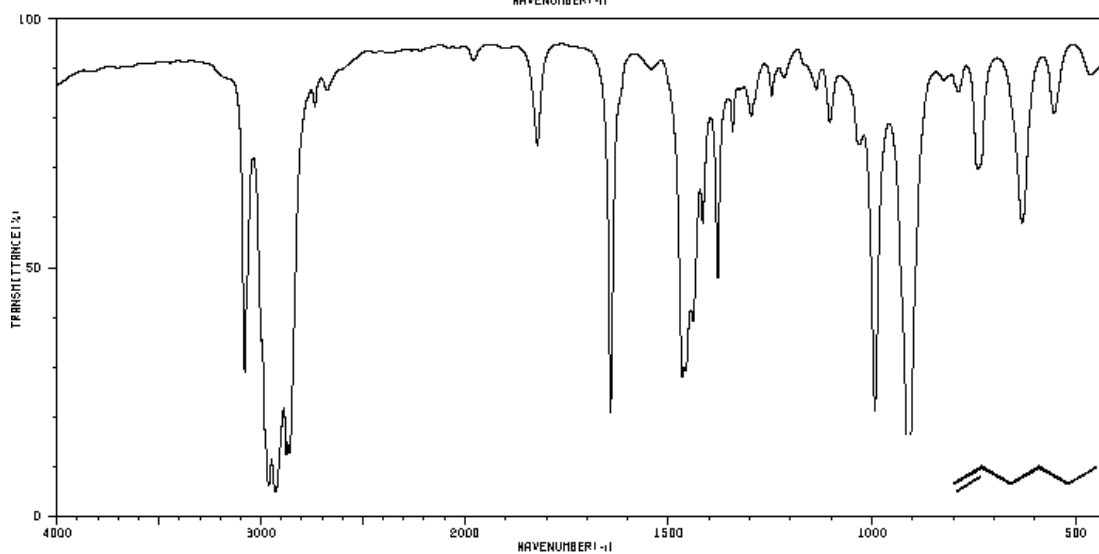
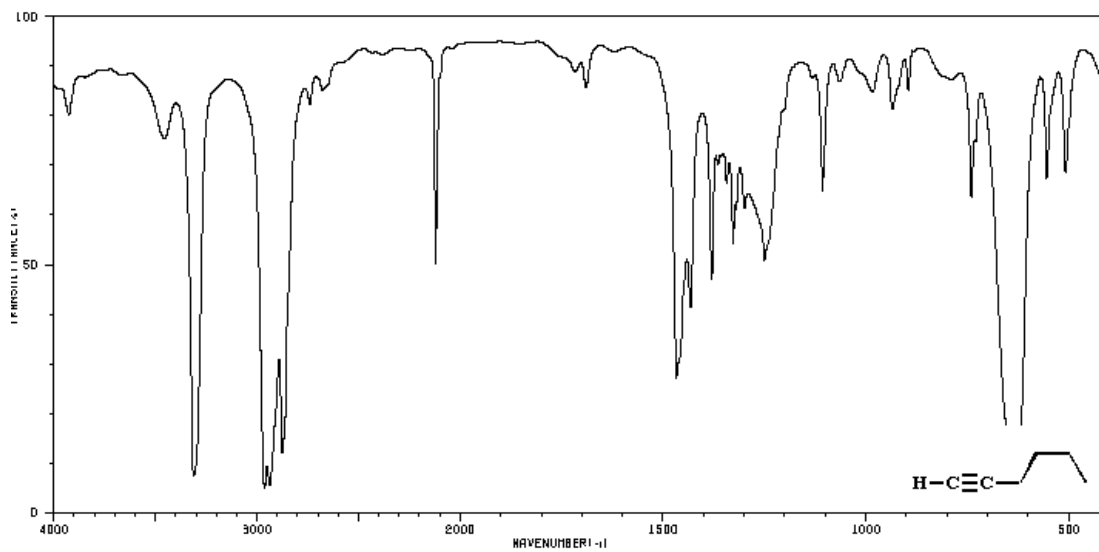


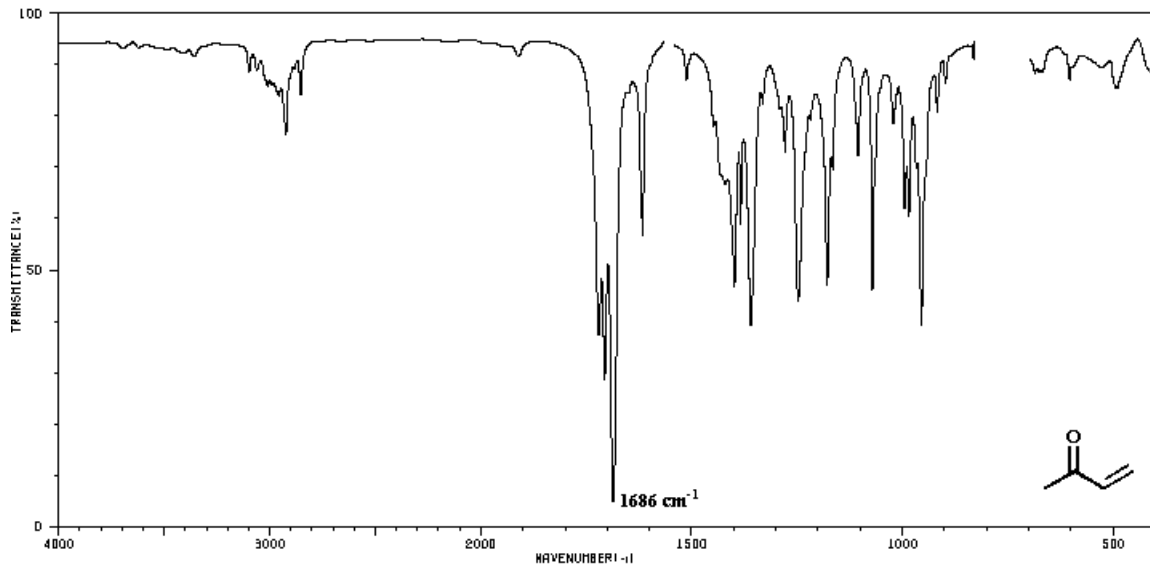
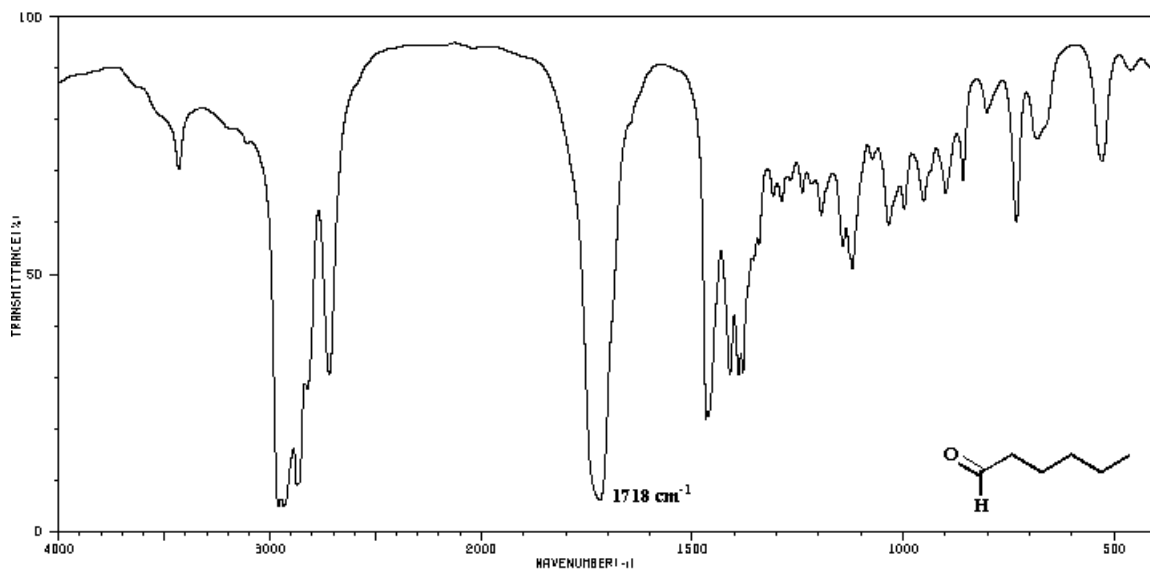
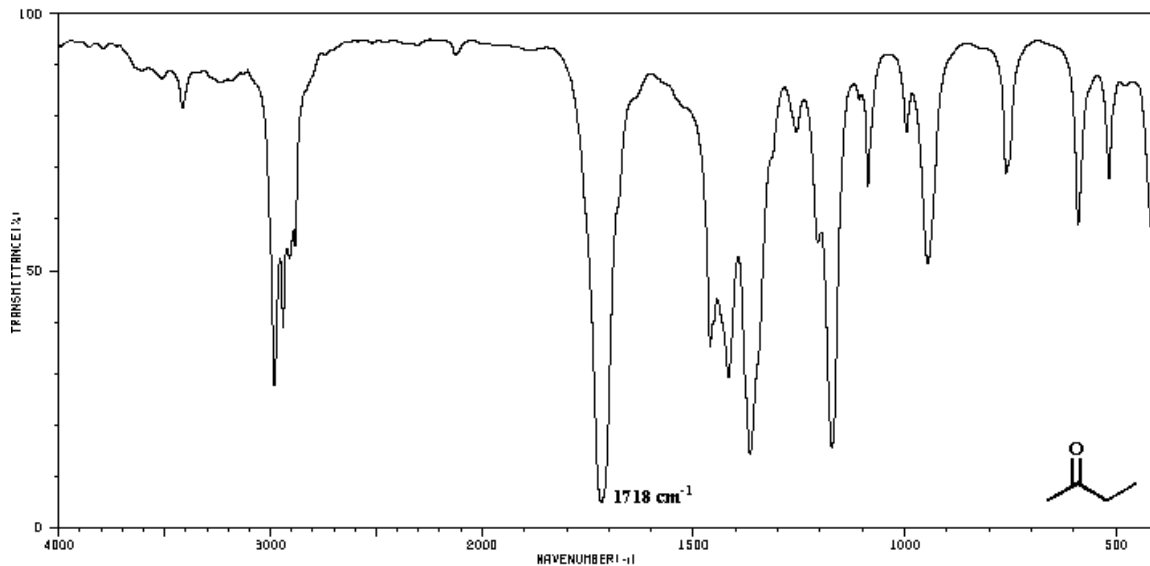
Characteristic IR Stretching Frequencies

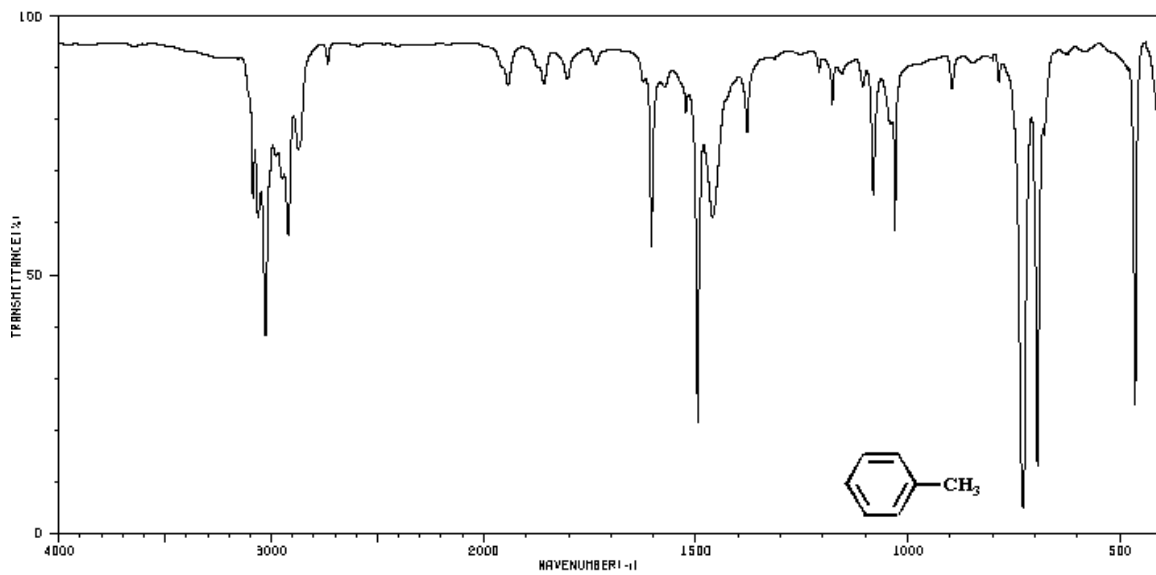
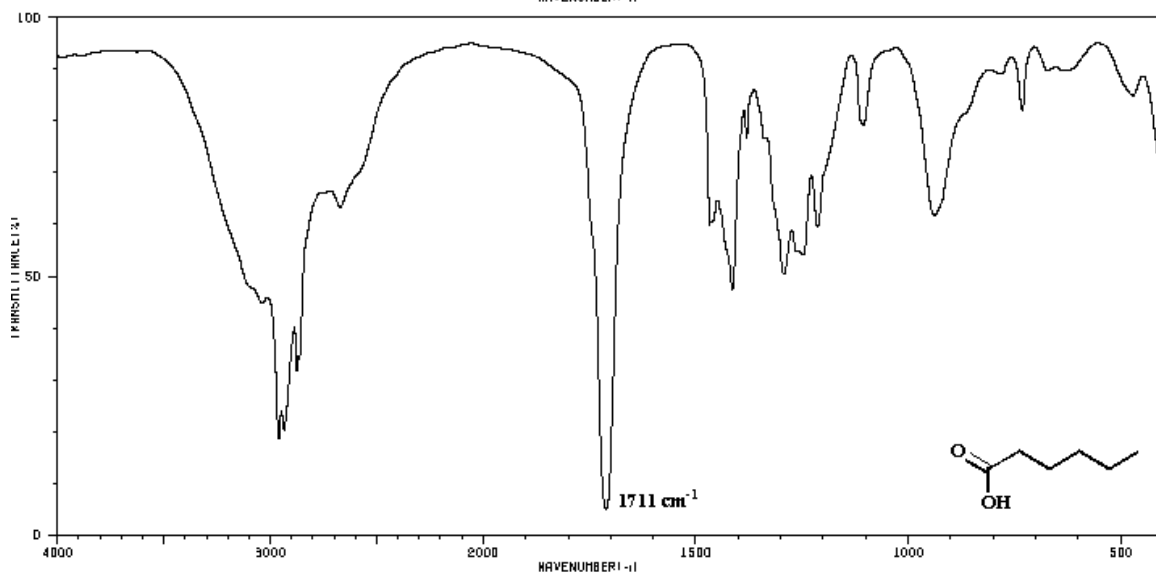
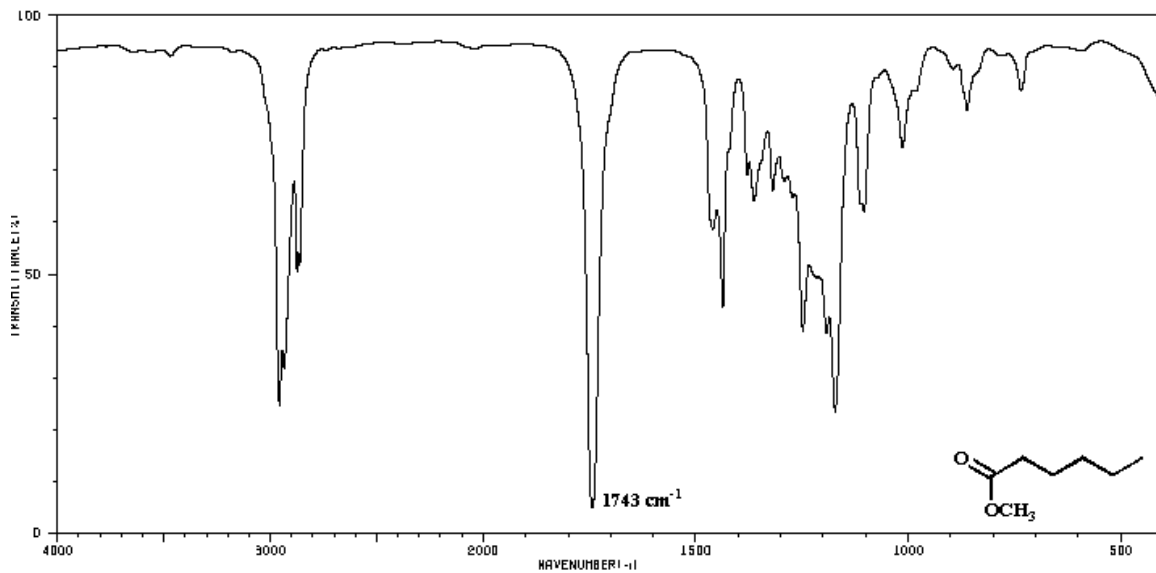
Functional Group	Bond	Stretching, cm^{-1}	Intensity
Zone 1: 3700 – 3200 cm^{-1}			
alcohol	O-H	3650 – 3200	variable; usually broad
alkyne	$\equiv\text{C-H}$	~ 3300	strong
amine, amide	N-H	3500 – 3300	medium, often broad
Zone 2: 3200 – 2700 cm^{-1}			
alkane	sp^3 C-H	2960 – 2850	variable
aryl, vinyl	sp^2 C-H	3100 – 3000	variable
aldehyde	sp^2 C-H	$\sim 2900, \sim 2700$	medium, 2 bands
carboxylic acid	O-H	3000 – 2500	strong, broad
Zone 3: 2300 – 2100 cm^{-1}			
alkyne	$\text{C}\equiv\text{C}$	2260 – 2100	variable
nitrile	$\text{C}\equiv\text{N}$	2260 – 2220	variable
Zone 4: 1950 - 1650 cm^{-1}			
aldehyde	$\text{C}=\text{O}$	1740 – 1720	strong
amide	$\text{C}=\text{O}$	1690 – 1650	strong
aryl ketone	$\text{C}=\text{O}$	1700 – 1680	strong
carboxylic acid	$\text{C}=\text{O}$	1725 – 1700	strong
ester	$\text{C}=\text{O}$	1750 – 1735	strong
ketone	$\text{C}=\text{O}$	1750 – 1705	strong
enone ($\text{C}=\text{C}-\text{C}=\text{O}$)	$\text{C}=\text{O}$	1685 – 1665	strong
aromatic overtones		1950 – 1750	3 or 4 small humps
Zone 5: 1680 – 1450 cm^{-1}			
alkene	$\text{C}=\text{C}$	1680 – 1620	variable
aromatic	$\text{C}=\text{C}$	$\sim 1600, 1500-1450$	variable; 1600 often 2 bands
Fingerprint region: < 1450 cm^{-1}			

The functional groups in each zone must be learned. (Do lots of problems!) The exact stretching frequency data for each functional group does not need to be memorized. It will be provided on an exam if needed.

Sample IR Spectra

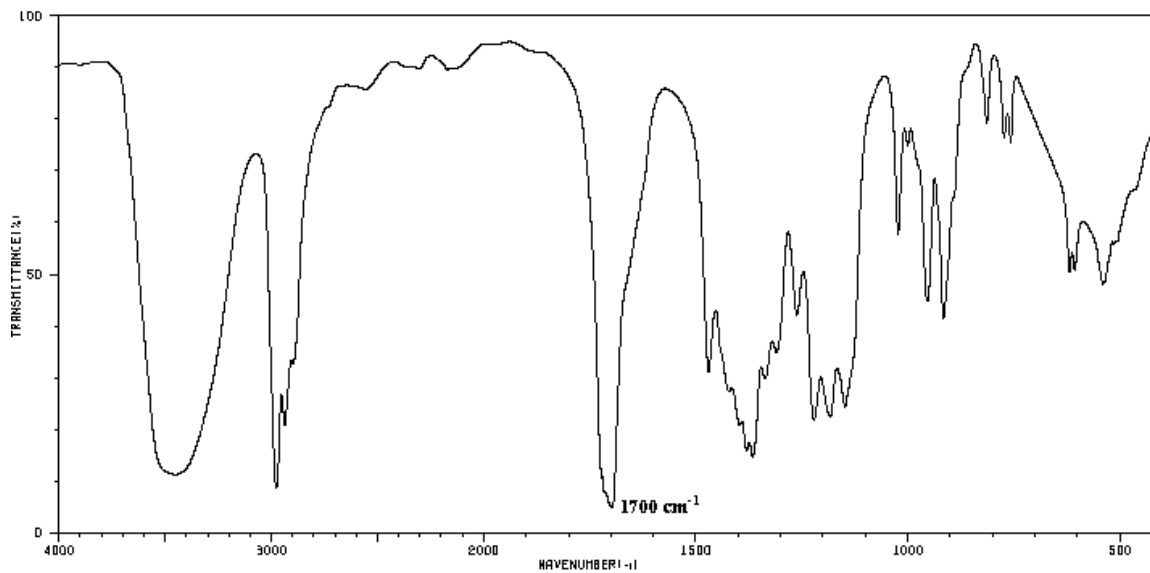




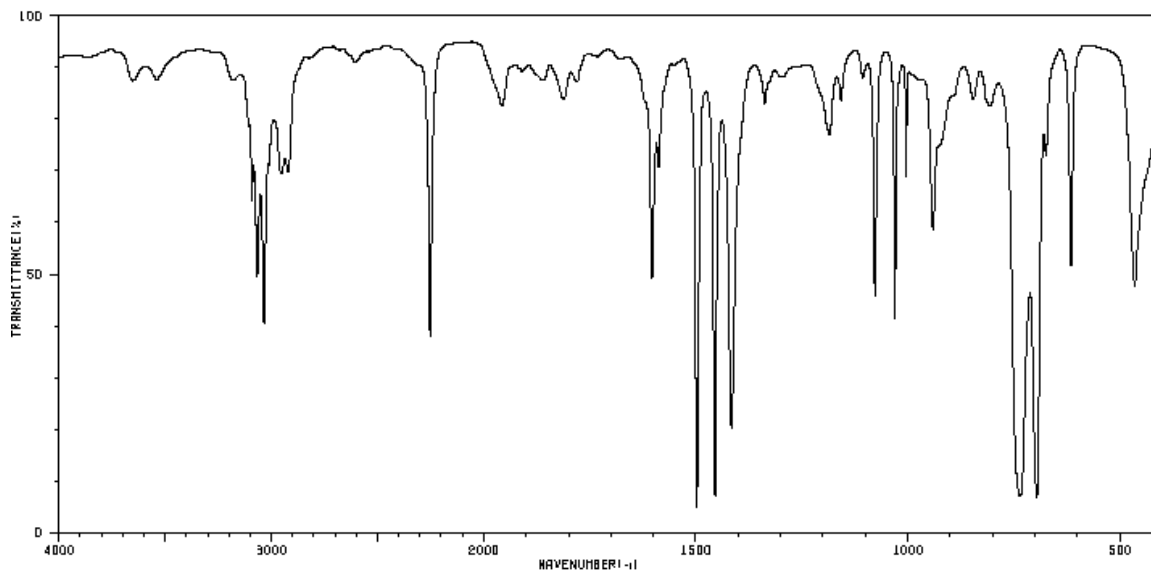


Five Zone Analysis Practice Problems

Formula: $C_6H_{12}O_2$



Formula: C_8H_7N



Formula: $C_2H_3ClO_2$

