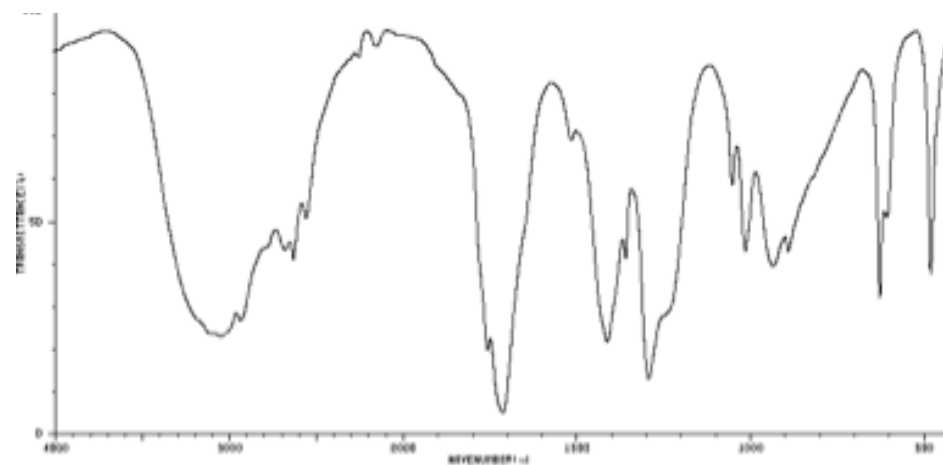
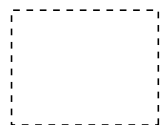
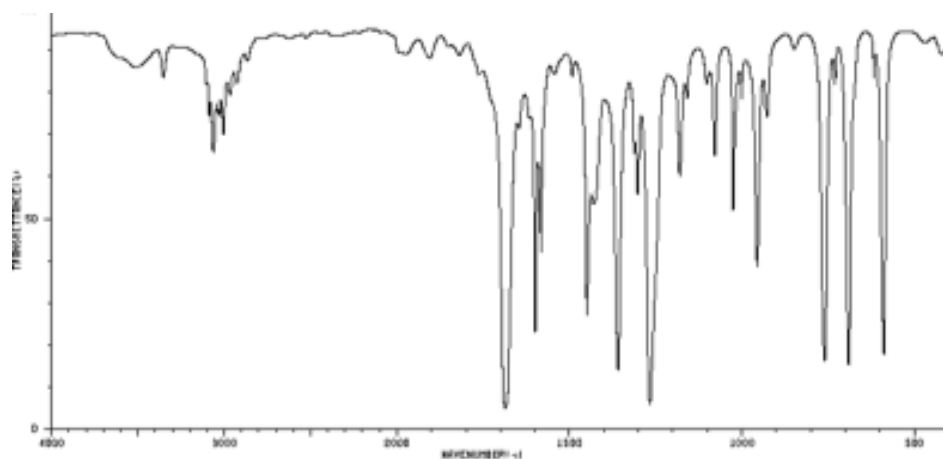
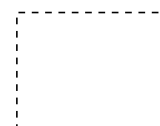
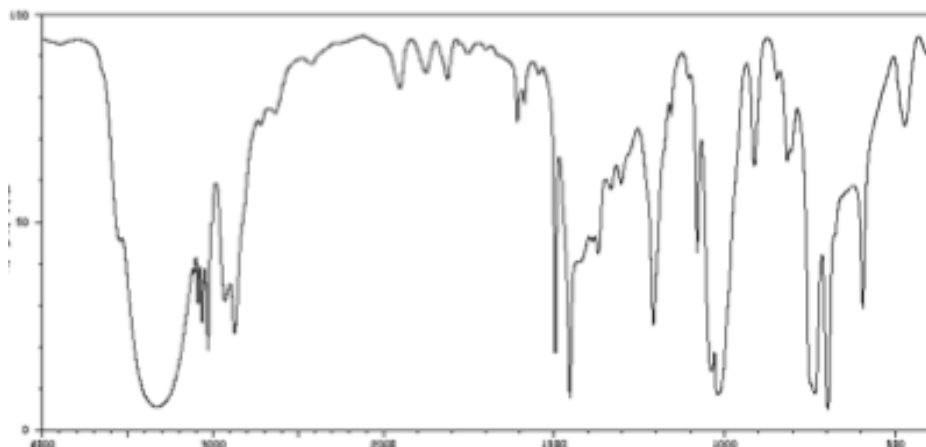
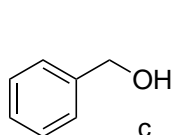
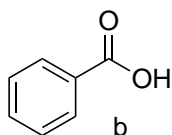
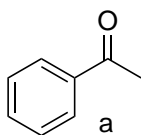


CEM 251, Problem Set 6: Spectroscopy

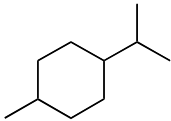
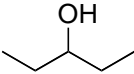
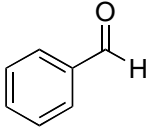
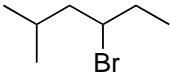
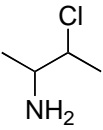
1. Match the following compounds with the IR spectra given.



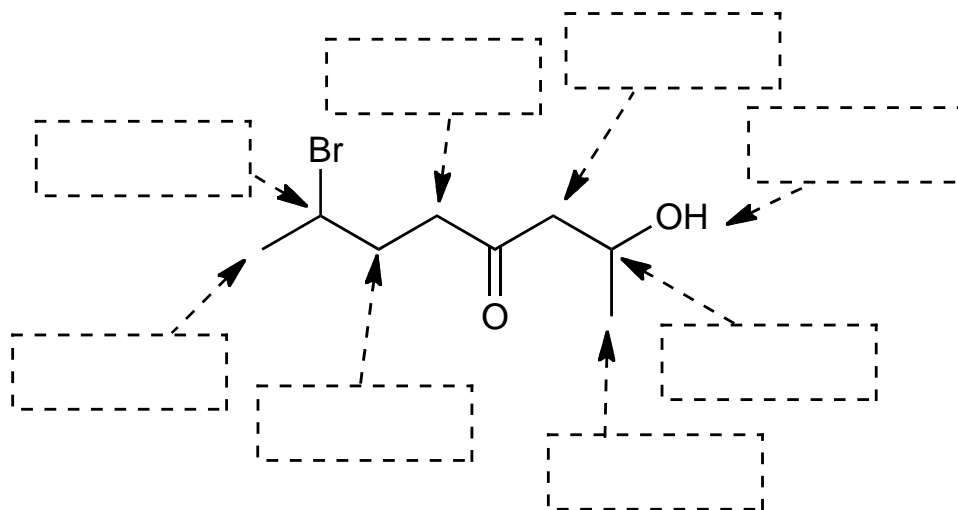
2. For the following molecular formulas calculate the number of RDBs (rings or double bonds, degrees of unsaturation).

	#RDBs
C_8H_7N	
$C_7H_{11}BrO$	
$C_8H_{15}NO$	
$C_{10}H_{14}$	
C_6H_8O	
$C_{10}H_{22}NCl$	

3. For the following molecules, how many different signals (peaks) would you expect to see in the 1H NMR spectrum?

	# of 1H NMR peaks
	
	
	
	
	

4. What should be the multiplicity of the ^1H NMR peaks of each of the following groups of protons:



5. Which group of protons of the following molecule corresponds to which peak on the NMR spectrum shown?

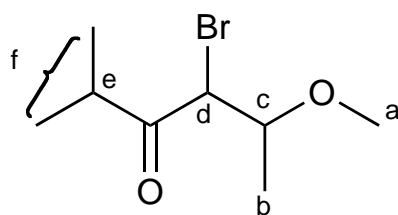
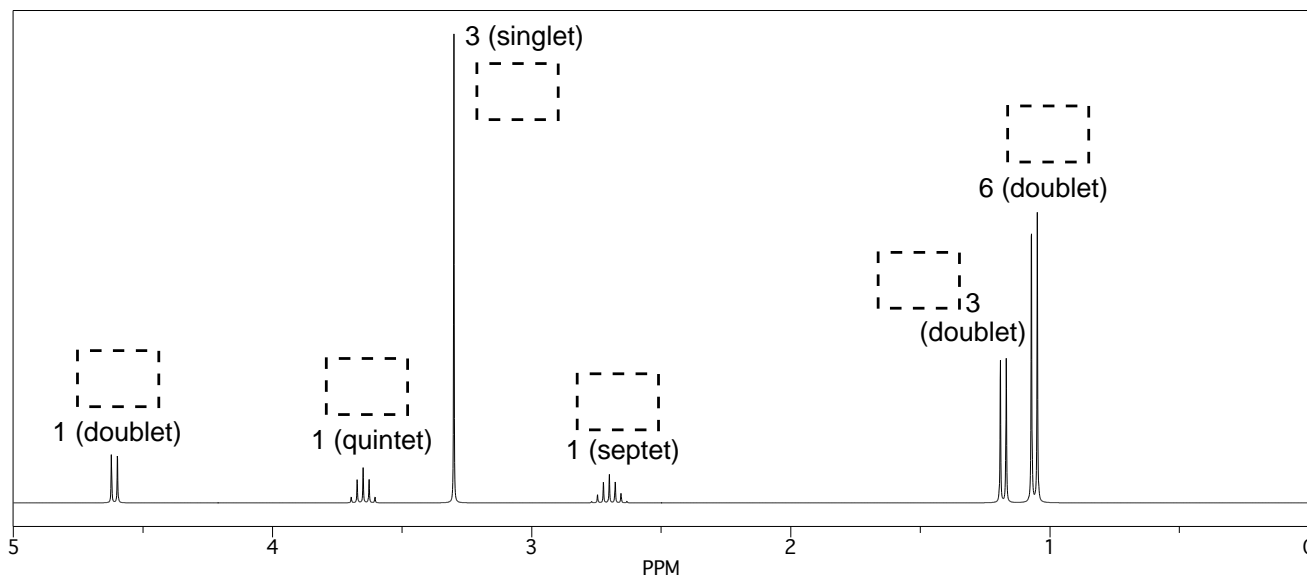





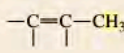



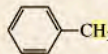
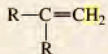

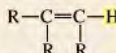


TABLE 13.1 Approximate Values of Chemical Shifts for ^1H NMR^a

Type of proton	Approximate chemical shift (ppm)	Type of proton	Approximate chemical shift (ppm)
$(\text{CH}_3)_4\text{Si}$	0		6.5–8
$-\text{CH}_3$	0.9		9.0–10
$-\text{CH}_2-$	1.3		2.5–4
	1.4		2.5–4
	1.7		3–4
	2.1		4–4.5
	2.3	RNH_2	variable, 1.5–4
$-\text{C}\equiv\text{C}-\text{H}$	2.4	ROH	variable, 2–5
$\text{R}-\text{O}-\text{CH}_3$	3.3	ArOH	variable, 4–7
	4.7		variable, 10–12
	5.3		

^aThe values are approximate because they are affected by neighboring substituents.

Table of IR Absorptions

Functional Group	Characteristic Absorption(s) (cm^{-1})
Alkyl C-H Stretch	2950 - 2850 (m or s)
Alkenyl C-H Stretch	3100 - 3010 (m)
Alkenyl C=C Stretch	1680 - 1620 (v)
Alkynyl C-H Stretch	~3300 (s)
Alkynyl C=C Stretch	2260 - 2100 (v)
Aromatic C-H Stretch	~3030 (v)
Aromatic C-H Bending	860 - 680 (s)
Aromatic C=C Bending	1700 - 1500 (m,m)
Alcohol/Phenol O-H Stretch	3550 - 3200 (broad, s)
Carboxylic Acid O-H Stretch	3000 - 2500 (broad, v)
Amine N-H Stretch	3500 - 3300 (m)
Nitrile C≡N Stretch	2260 - 2220 (m)
Aldehyde C=O Stretch	1740 - 1690 (s)
Ketone C=O Stretch	1750 - 1680 (s)
Ester C=O Stretch	1750 - 1735 (s)
Carboxylic Acid C=O Stretch	1780 - 1710 (s)
Amide C=O Stretch	1690 - 1630 (s)
Amide N-H Stretch	3700 - 3500 (m)