

1) Predict the number of signals in the following compounds. Circle the most deshielded proton in the compound. For compounds (c) through (g) give the splitting of each of the protons.

a) Benzene

b) Cyclohexane

c) $\text{CH}_3\text{OCH}_2\text{CH}_2\text{CHCl}_2$

d) $\text{CH}_3\text{CH}_2\text{C}\equiv\text{CH}$

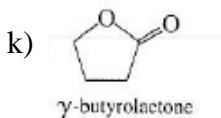
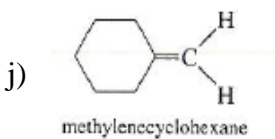
e) $\text{CH}_3\text{CH}_2\text{COCH}_3$

f) $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$

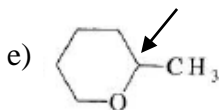
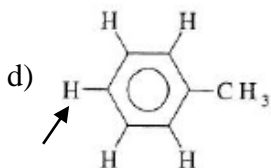
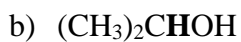
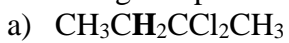
g) $\text{CH}_3\text{CH}_2\text{CHO}$

h) (cis)- $\text{CH}_3\text{CH}=\text{CHCHO}$

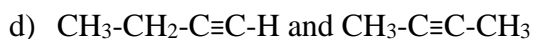
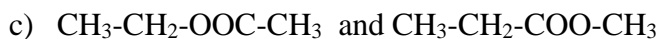
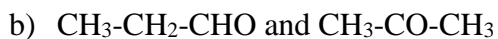
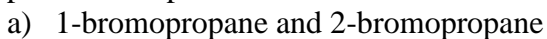
i) $\text{HOOC}-\text{CH}_2\text{CH}_2\text{COOCH}(\text{CH}_3)_2$



2) Predict the multiplicity (splitting) for each of the protons that is bolded or pointed to, in the following compounds.



3) Indicate precisely how you would use proton NMR spectra to distinguish between the following pairs of compounds.



- 4) An unknown compound has the molecular formula $C_9H_{11}Br$. Its proton NMR spectrum shows the following absorptions. Propose a structure for the compound.

Singlet, 7.1, integral 4.4 cm

Singlet, 2.3, integral 13.0 cm

Singlet, 2.2, integral 6.7 cm

- 5) A compound of formula $C_6H_{10}O_2$ shows only two absorptions in the NMR: a singlet at 2.67 ppm and a singlet at 2.15 ppm. These peaks have areas in the ratio of 2:3. The IR spectrum shows a strong absorption at 1708 cm^{-1} . Propose a structure for this compound.

- 6) The proton NMR spectrum of a compound of formula $C_{10}H_{12}O$ is shown below. This compound reacts with an acidic solution of 2,4-dinitrophenylhydrazine to give a crystalline derivative, but gives a negative with Tollens test. Propose a structure for this compound and give the peak assignments.

