

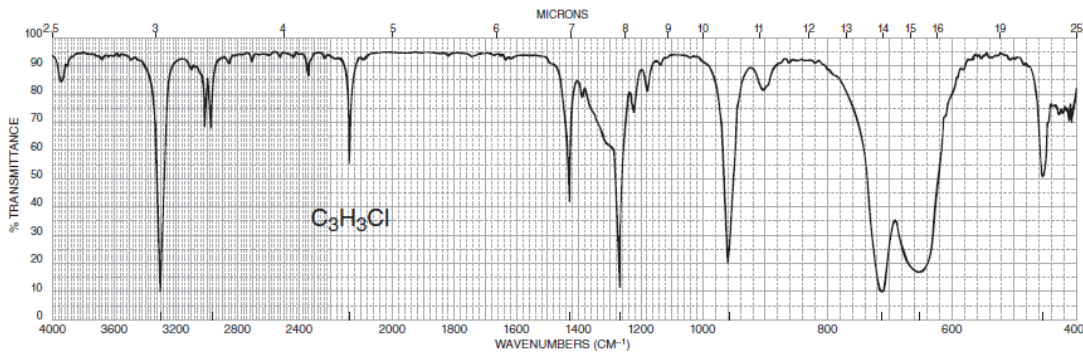
# Lecture note # 6

## PROBLEMS

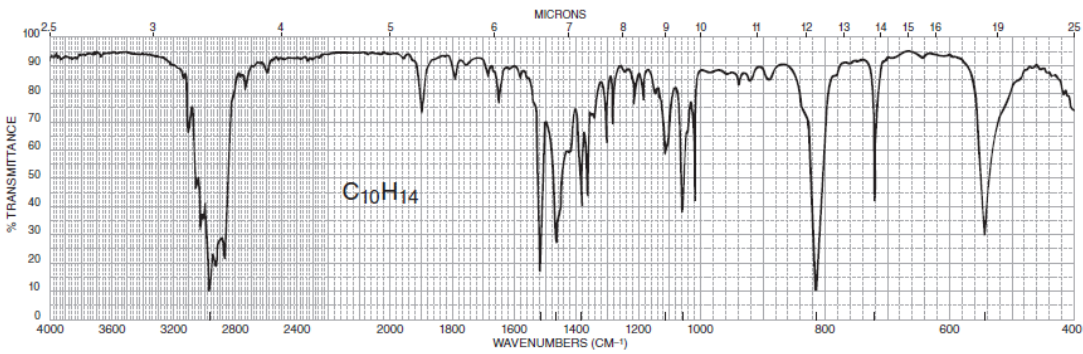
When a molecular formula is given, it is advisable to calculate an index of hydrogen deficiency (Section 1.4). The index often gives useful information about the functional group or groups that may be present in the molecule.

\*1. In each of the following parts, a molecular formula is given. Deduce the structure that is consistent with the infrared spectrum. There may be more than one possible answer.

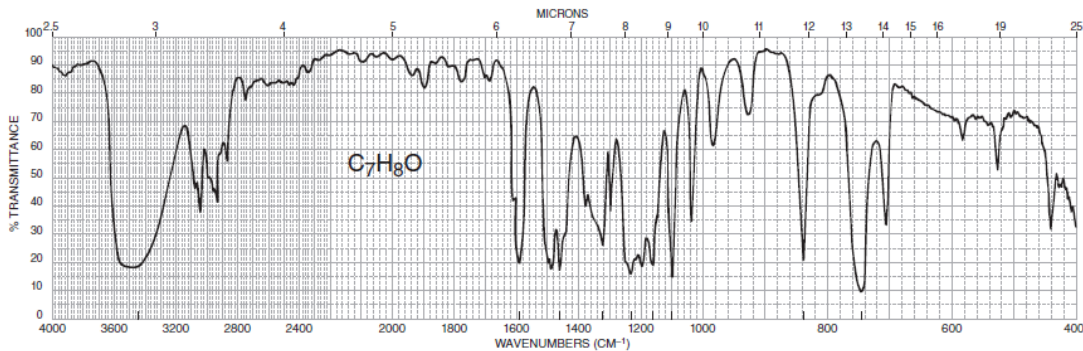
(a)  $C_3H_3Cl$



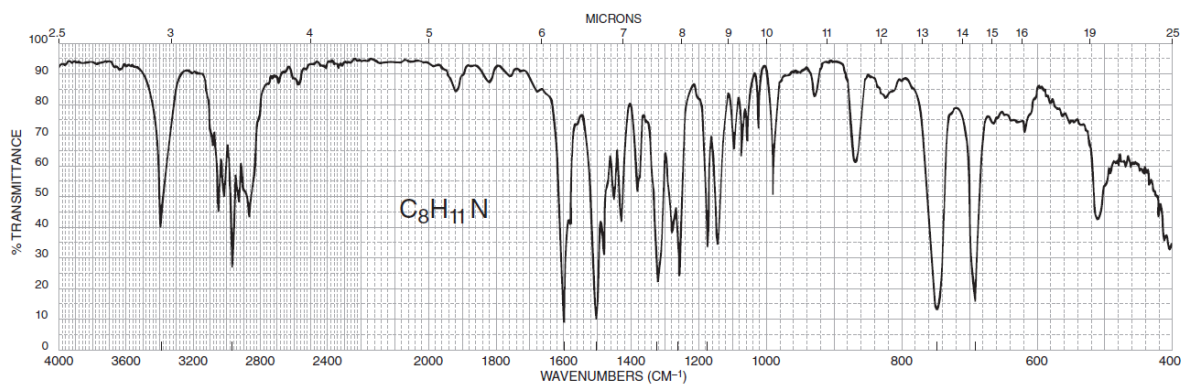
(b)  $C_{10}H_{14}$



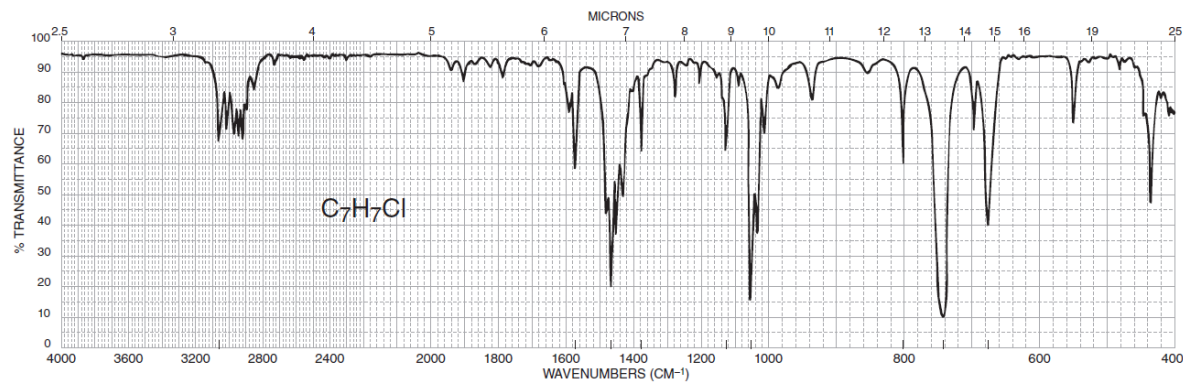
(c)  $C_7H_8O$



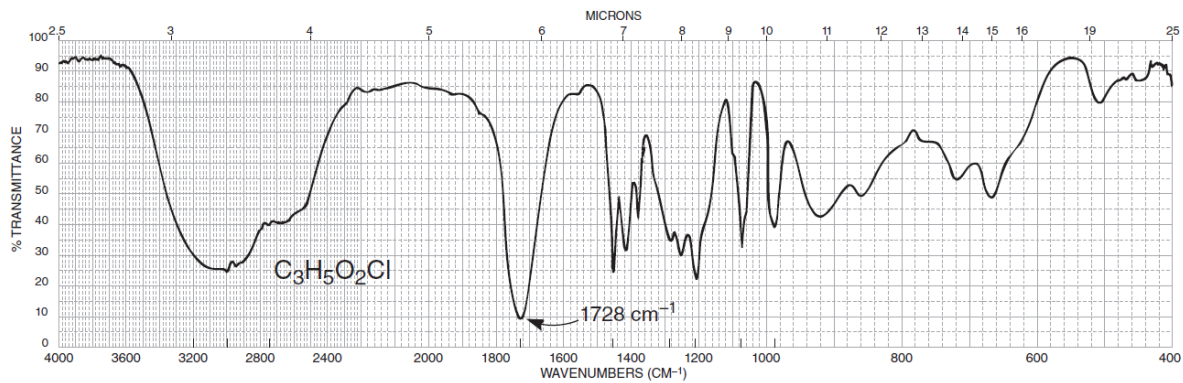
(d)  $C_8H_{11}N$



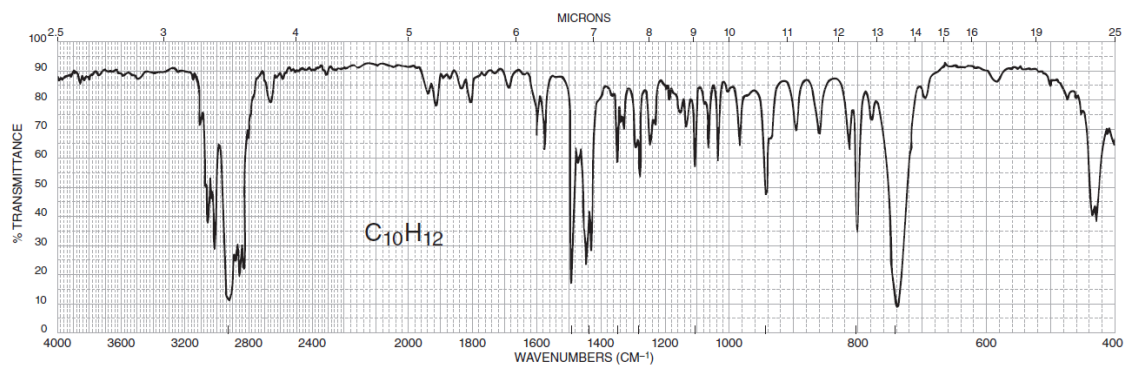
(e)  $C_7H_7Cl$



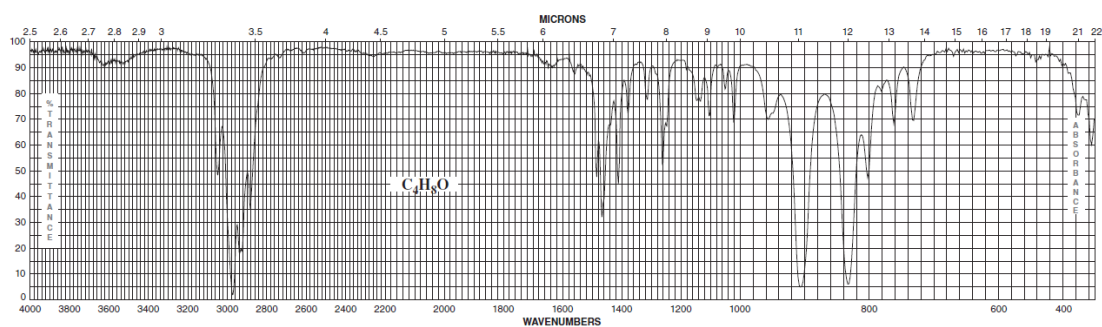
(f)  $C_3H_5O_2Cl$



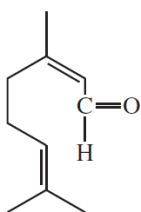
(g)  $C_{10}H_{12}$  (two six-membered rings)



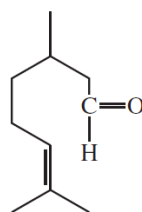
(h)  $C_4H_8O$



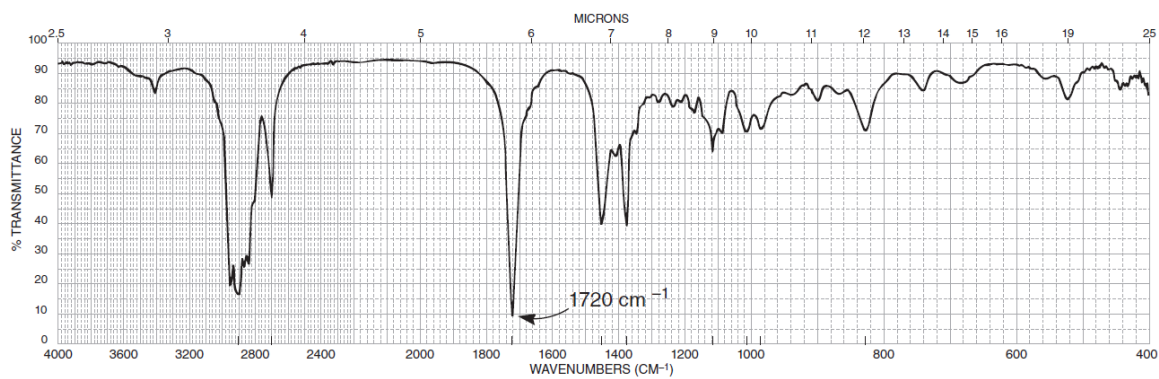
\*2. Ants emit tiny amounts of chemicals called alarm pheromones to warn other ants (of the same species) of the presence of an enemy. Several of the components of the pheromone in one species have been identified, and two of their structures follow. Which compound has the infrared spectrum shown?



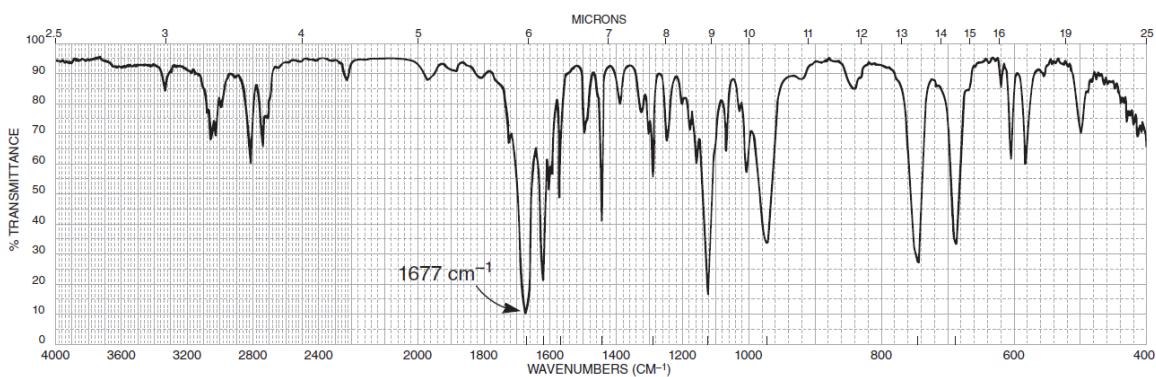
Citral



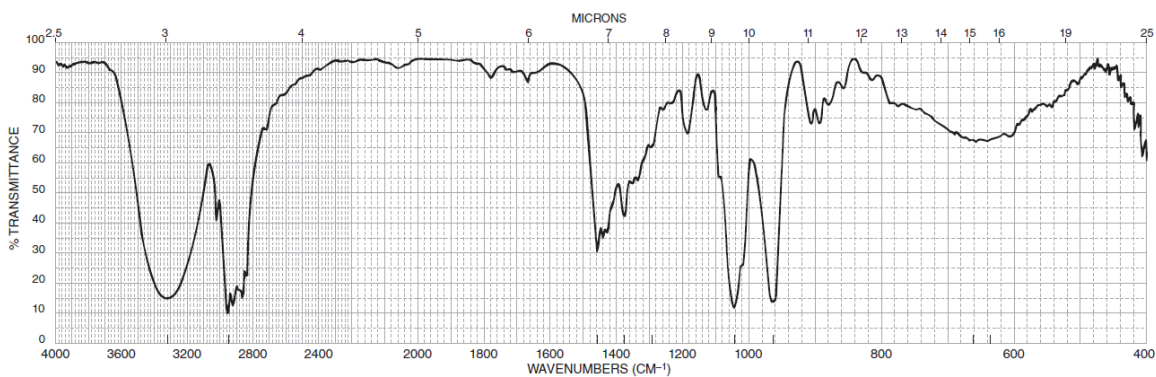
Citronellal

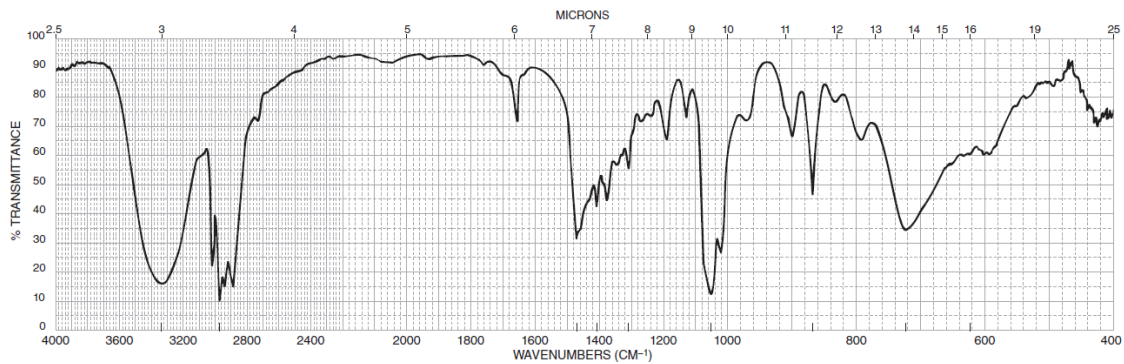


\*3. The main constituent of cinnamon oil has the formula C<sub>9</sub>H<sub>8</sub>O. From the following infrared spectrum, deduce the structure of this component.

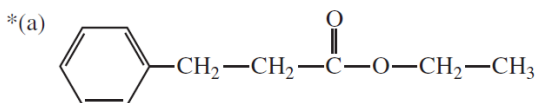


\*4. The infrared spectra of *cis*- and *trans*-3-hexen-1-ol follow. Assign a structure to each.

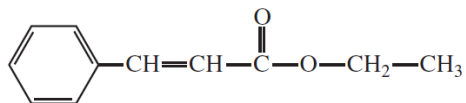




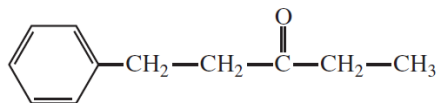
5. In each part, choose the structure that best fits the infrared spectrum shown.



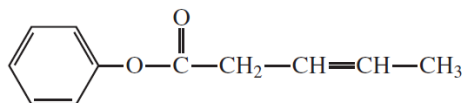
A



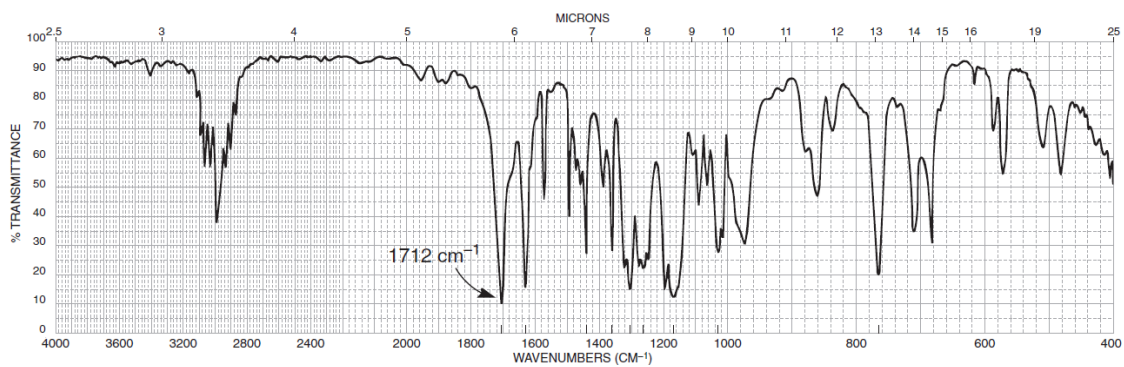
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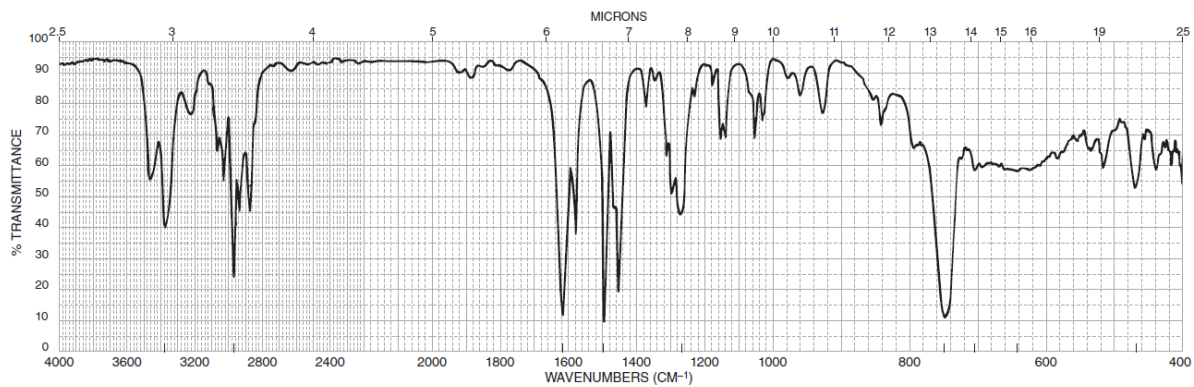
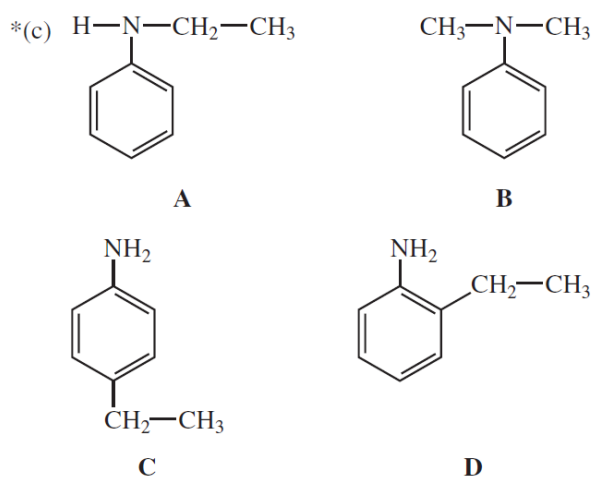
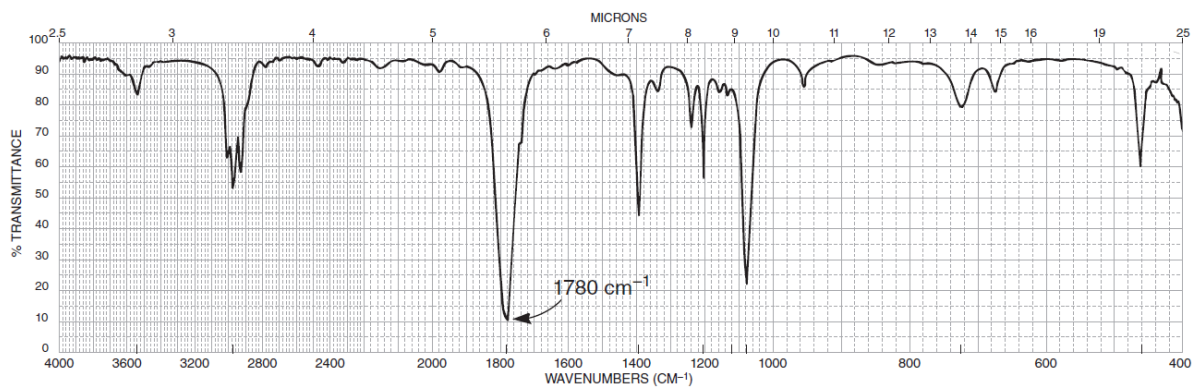
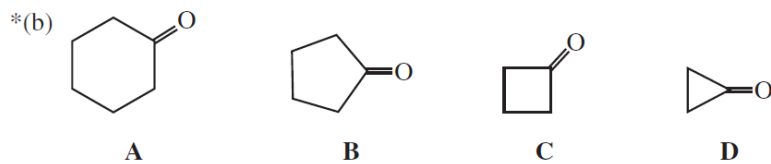


C



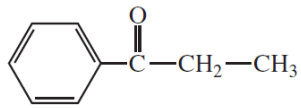
D



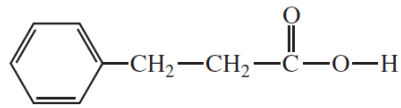




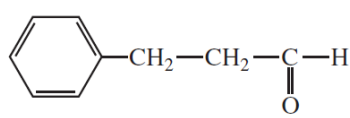
\*(d)



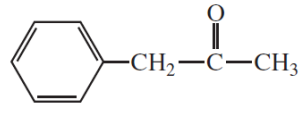
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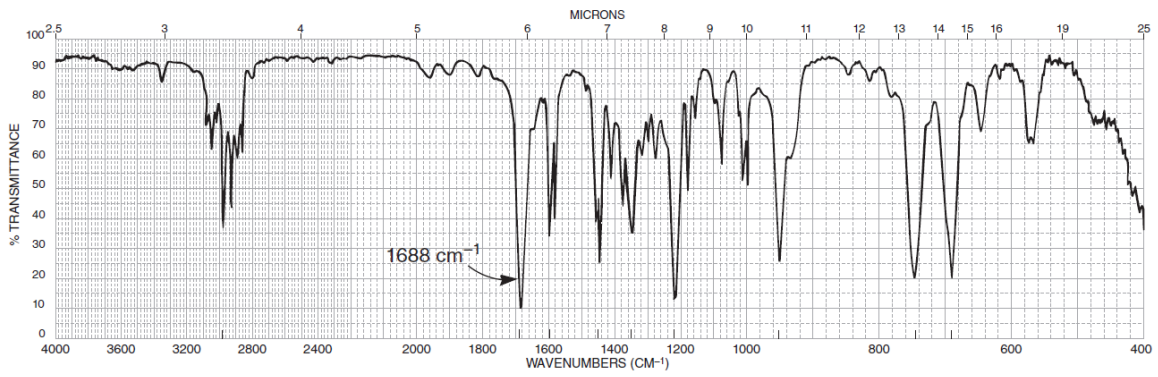
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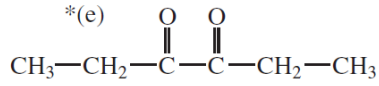
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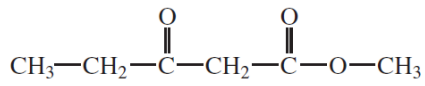
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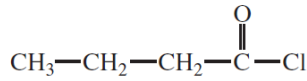
\*(e)



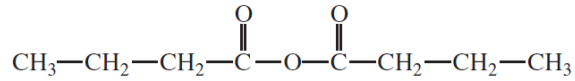
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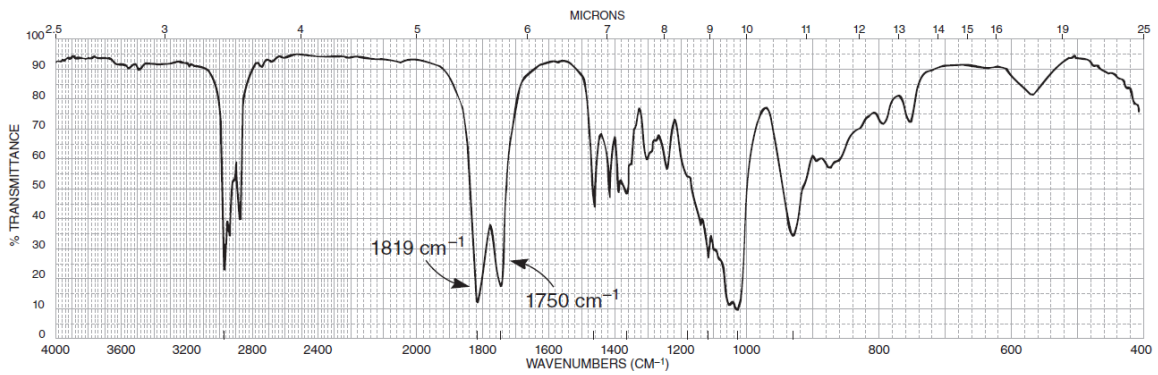
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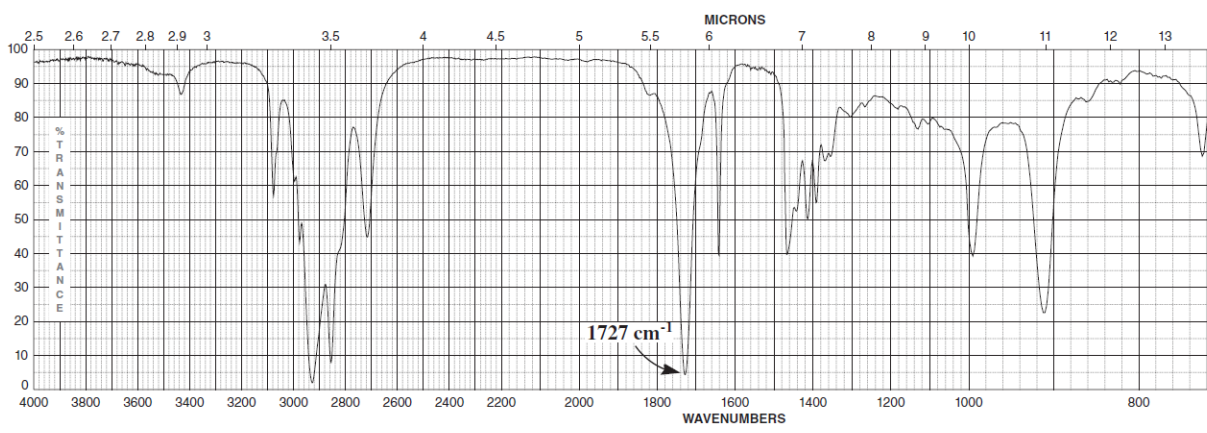
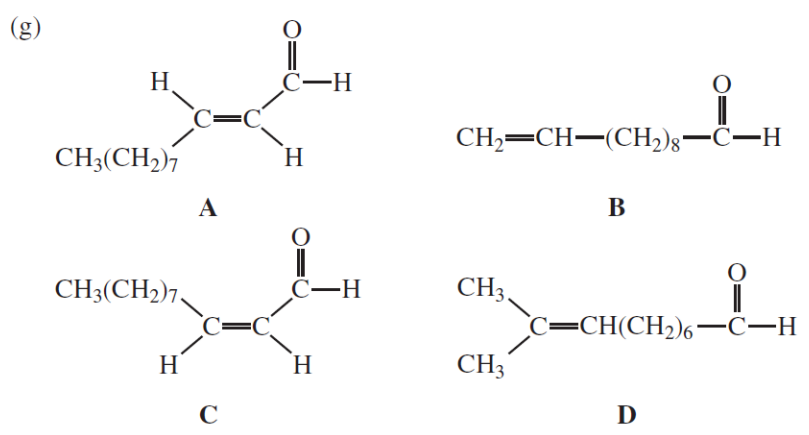
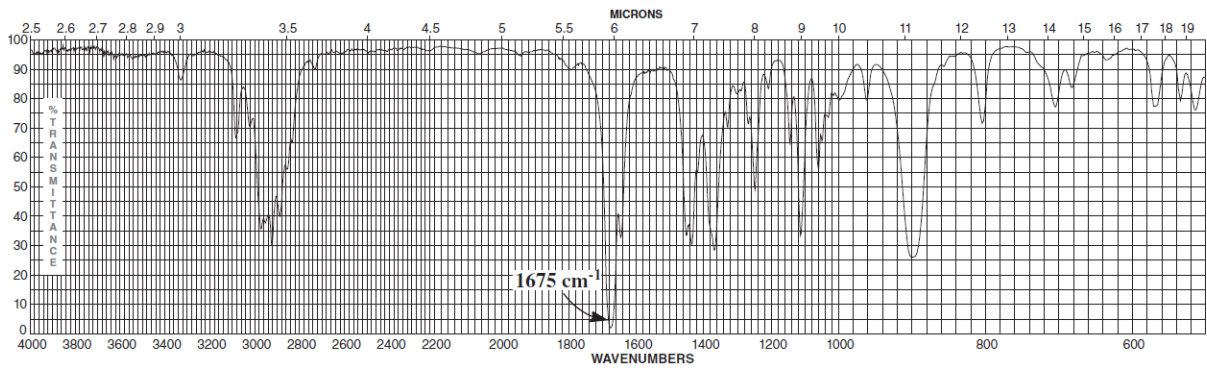
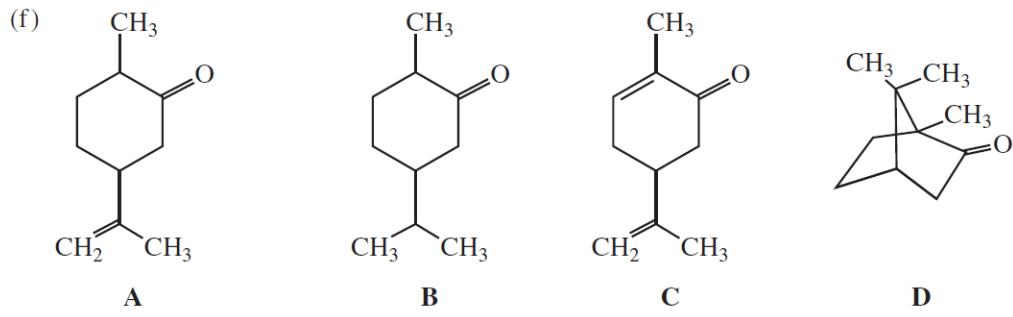


C



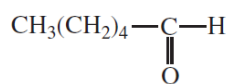
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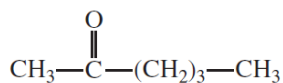




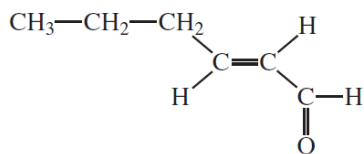
(h)



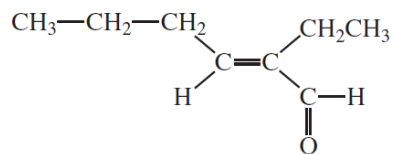
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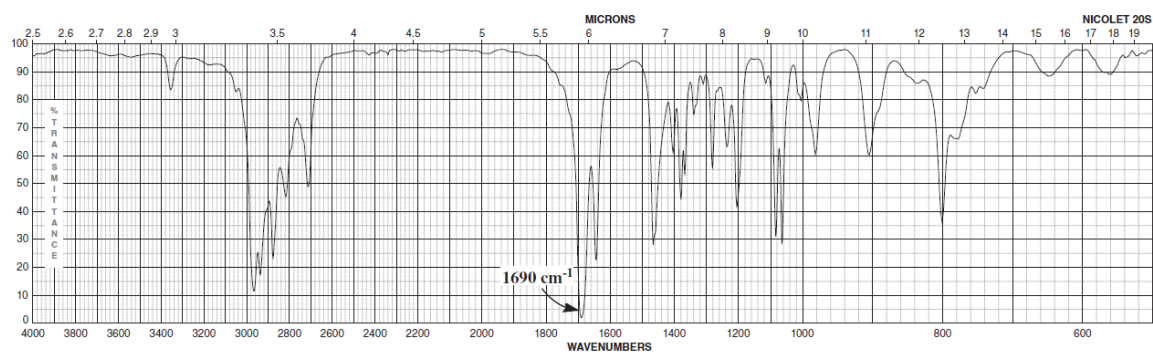
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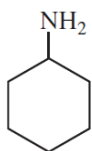
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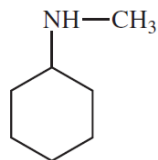
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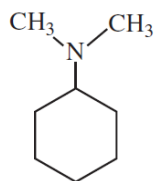
(i)



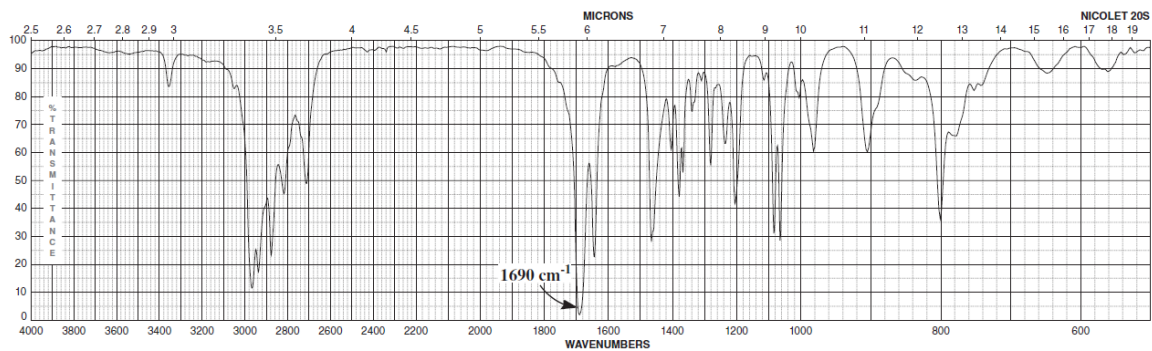
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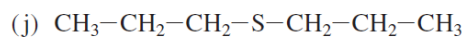


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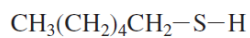


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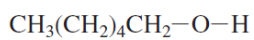




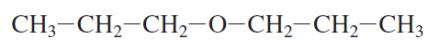
**A**



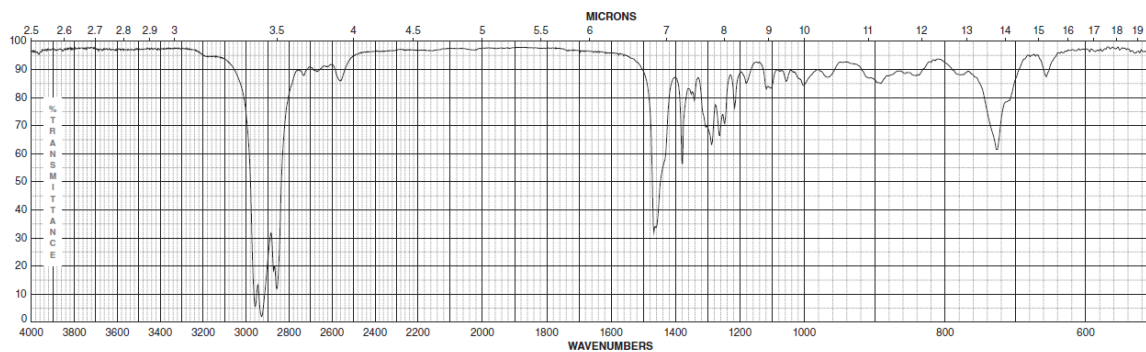
**B**



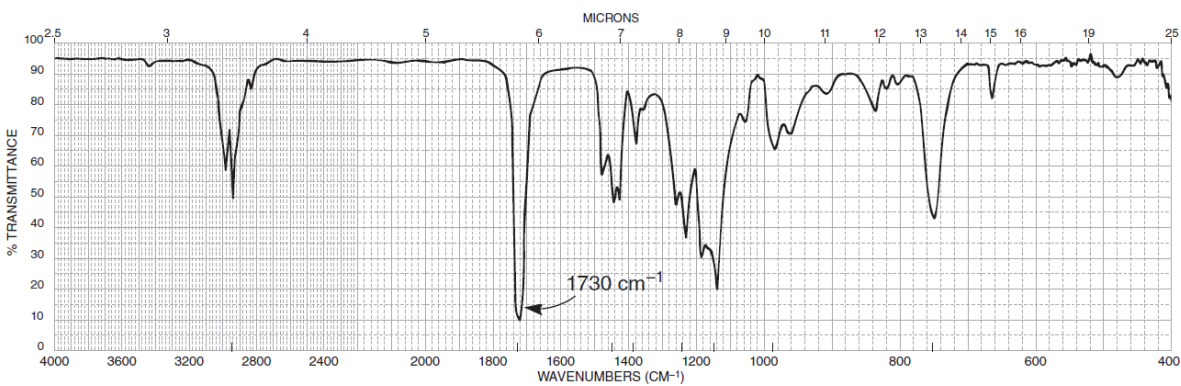
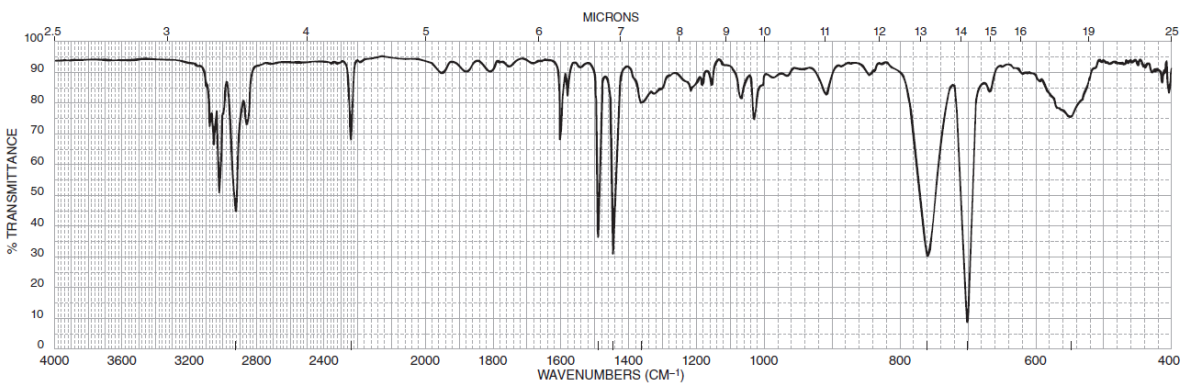
**C**

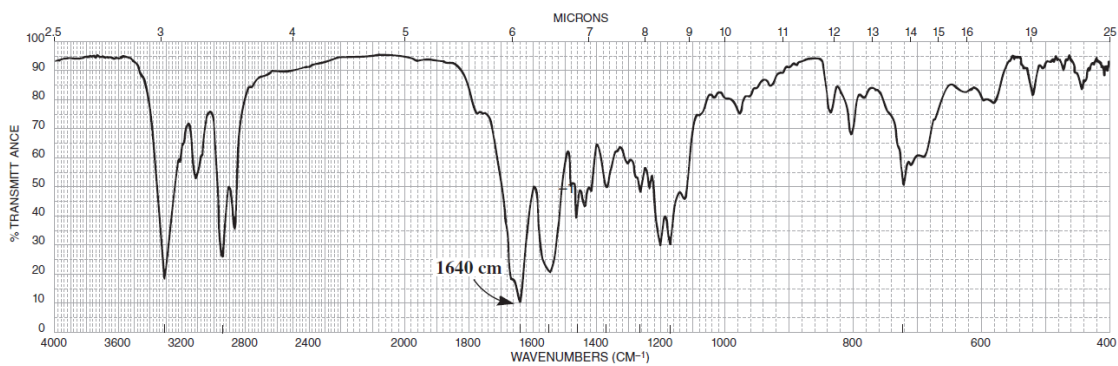


**D**

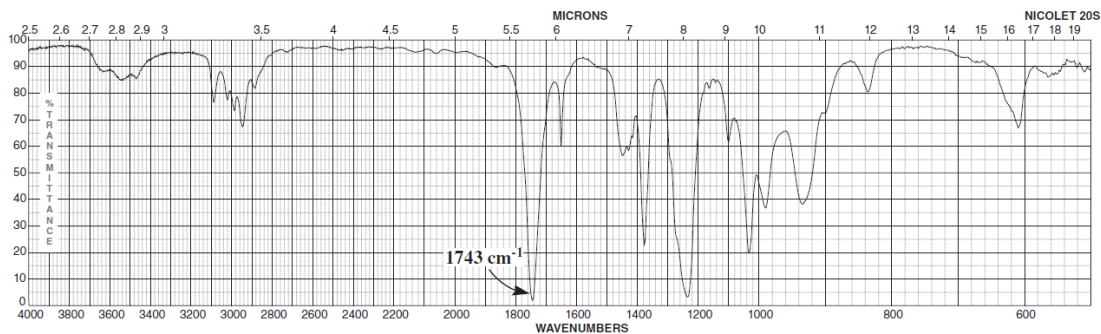
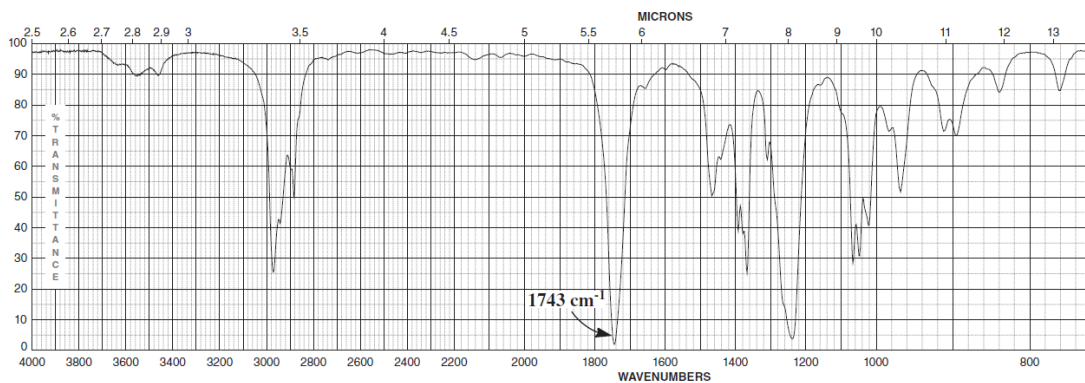
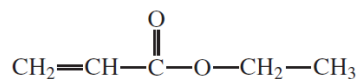
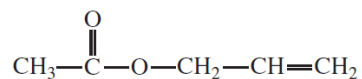
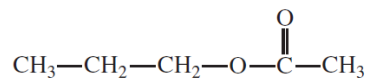
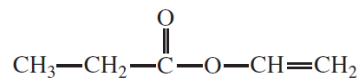


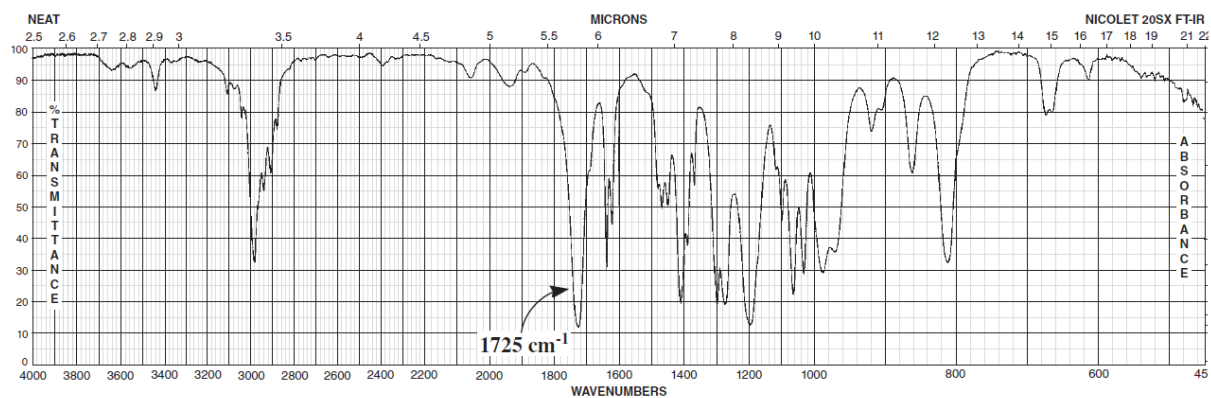
\*6. The infrared spectra of some polymeric materials follow. Assign a structure to each of them, selected from the following choices: polyamide (nylon), poly(methyl methacrylate), polyethylene, polystyrene, and poly(acrylonitrile-styrene). You may need to look up the structures of these materials.



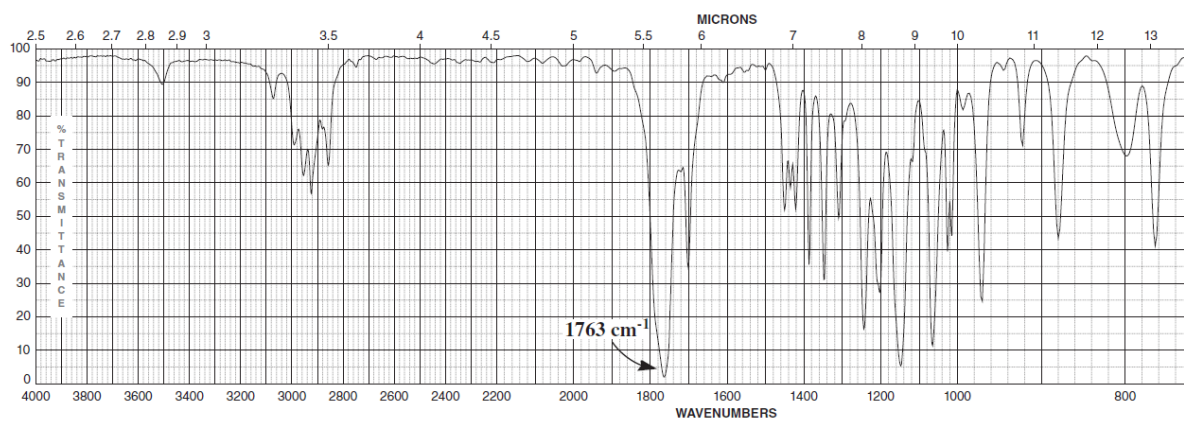
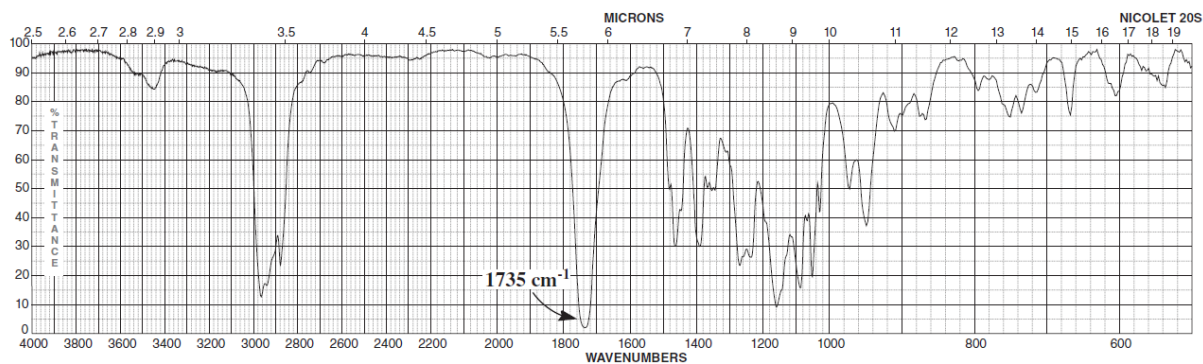
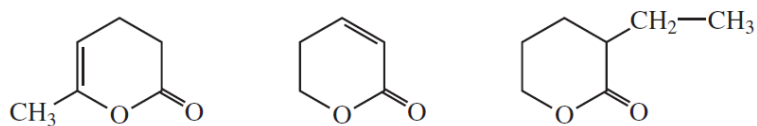


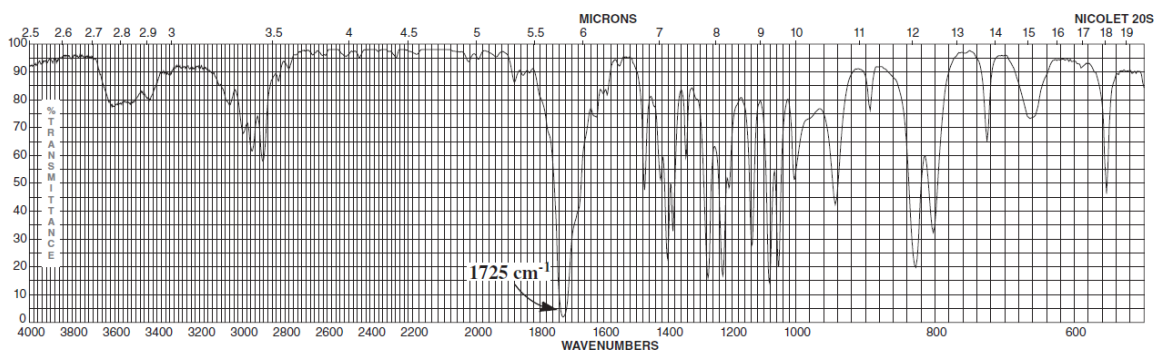
7. Assign a structure to each of the spectra shown. Choose from among the following 5-carbon esters:



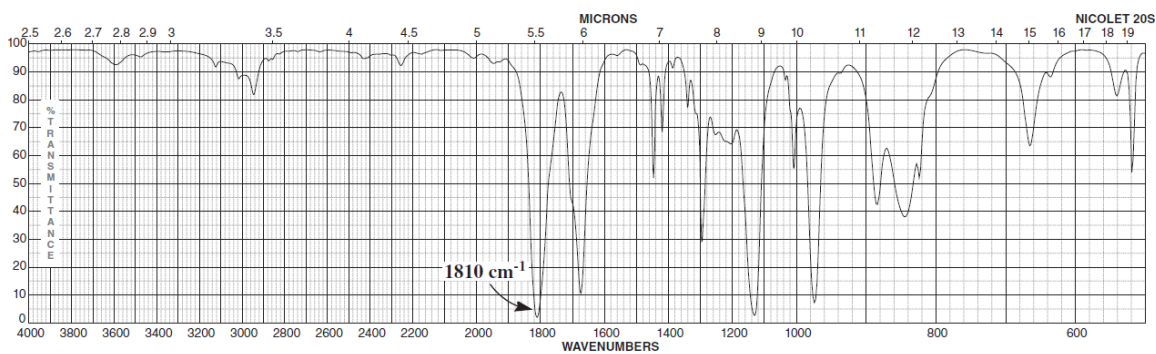
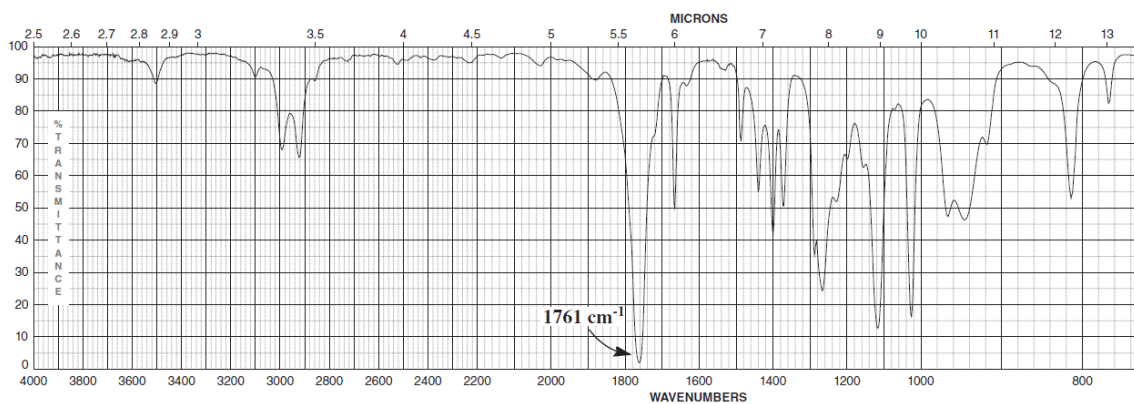
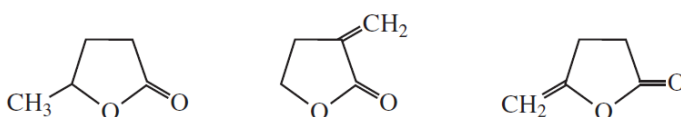


8. Assign a structure to each of the following three spectra. The structures are shown here.

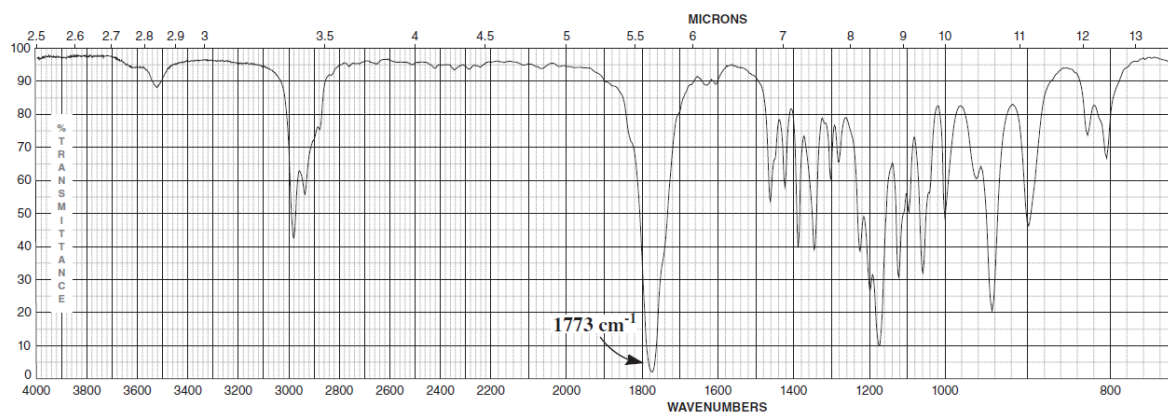




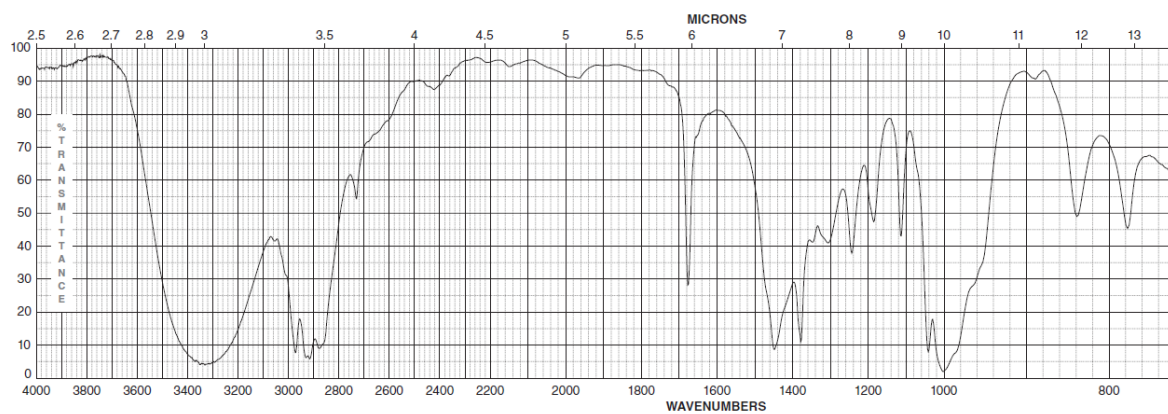
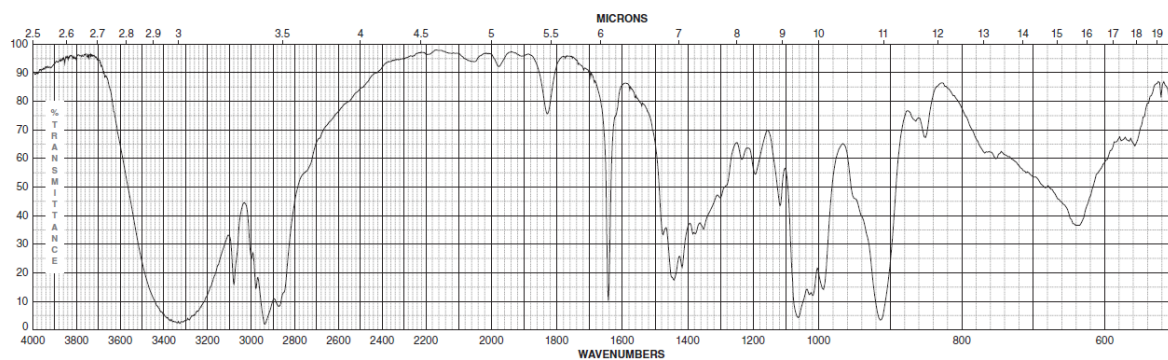
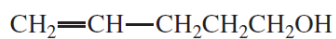
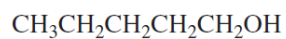
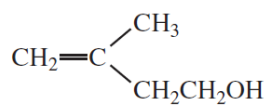
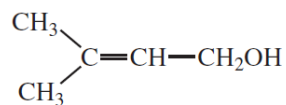
9. Assign a structure to each of the following three spectra. The structures are shown here.



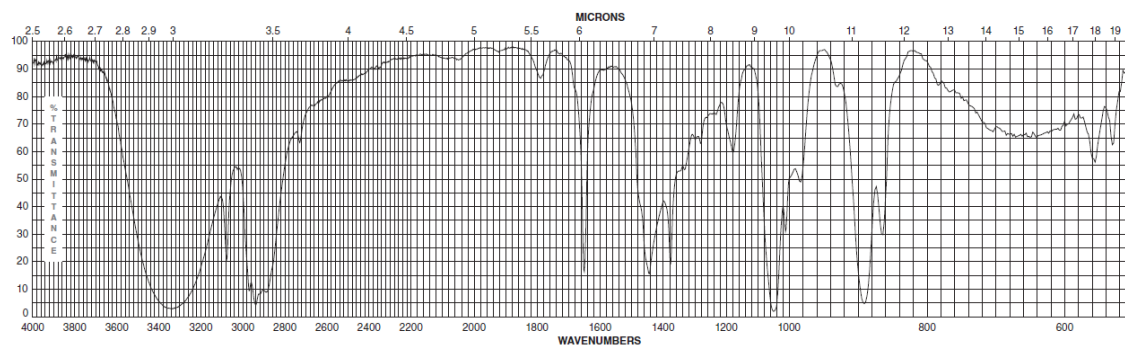




10. Assign a structure to each of the spectra shown. Choose from among the following 5-carbon alcohols:







11. Substitution of an amino group on the *para* position of acetophenone shifts the C=O frequency from about  $1685$  to  $1652\text{ cm}^{-1}$ , whereas a nitro group attached to the *para* position yields a C=O frequency of  $1693\text{ cm}^{-1}$ . Explain the shift for each substituent from the  $1685\text{ cm}^{-1}$  base value for acetophenone.