Homework - Chapter 3 Chem 2310

Name _____

I. Introduction to Spectroscopy

1. Answer the following questions.

- a) What causes molecules to absorb infrared light?
- b) What is a wavenumber?
- c) Which is higher in energy, bands with high wavenumbers or low wavenumbers?
- d) What are the two main types of molecular vibrations?
- e) What three factors cause a molecule to absorb light of a higher frequency?
- f) What two factors cause a molecule to absorb more light at a certain frequency?
- g) What is on the x-axis of an IR spectrum?
- h) What is on the y-axis of an IR spectrum?
- i) Where is the fingerprint region of the IR spectrum?
- j) What is the fingerprint region useful for?
- k) Where is the functional group region of the IR spectrum?
- 1) What are three ways in which an IR spectrum of a solid may be taken?

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- II. Molecular Vibrations
- 2. The IR spectrum of an amine is shown below.
 - a) Label the NH₂ stretching band.
 - b) Label the NH_2 bending band.
 - c) Which is at a higher frequency, and why?



3. The IR spectrum of an ester is shown below.

- a) Label the C=O band.b) Label the C-O bands.
- c) Which is at a higher frequency, and why?



- 4. The IR spectrum of an alcohol is shown below

 - a) Label the C-O band.b) Label the O-H band.
 - c) Which is at a higher frequency, and why?



5. The IR spectra of a ketone and an alkene are shown below.

- a) Label the C=C band.
- b) Label the C=O band.
- c) Which absorbs more IR light, and why?



6. The IR spectra of two alkenes are shown below, with structures shown below each.



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III. Identifying Functional Groups

7. In the IR spectra shown below, identify the bands which are marked with arrows. Then give the functional group or hydrocarbon category to which the compound belongs.









8. Circle the compound which best matches each of the spectra given. Explain your choice!



IV. Interpreting an IR Spectrum

9. For each reaction shown, a spectrum of the product is given. Indicate whether the reaction was successful or not, and how you know.

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10. Circle all compounds whose IR spectra would have the band described.

a) a broad, deep band between 1800 and 1650 cm^{-1}

b) a very broad band from 3400-2400 cm⁻¹

c) a strong, broad band between 1300 and 1000 cm⁻¹

d) one or two sharp bands between 1600 and 1500 cm⁻¹

e) a sharp band between 2200 and 2100 cm⁻¹

f) two small bands between 2900 and 2700 cm^{-1}

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11. What band would the following compound have in the range given?

