Practice Exam on Infrared Spectroscopy
Wade, Chapter 12, 15 Multiple Choice Questions

Q1 Which type of light has the highest photon energy?
Hint Review Chapter 12-1 on introduction to infrared spectroscopy and mass spectroscopy.
a. Radio waves
b. Microwaves
c. Ultraviolet light
d. Visible light
e. Infrared light

Q2 How does the energy of a photon depend on the characteristics of the electromagnetic wave?
Hint Review Chapter 12-2 on the electromagnetic spectrum.
a. Energy proportional to frequency
b. Energy inversely proportional to frequency
c. Energy proportional to wavelength
d. Energy proportional to ratio between wavelength and frequency
e. Energy proportional to product between wavelength and frequency

Q3 Which type of radiation is used in nuclear magnetic resonance spectroscopy?
Hint Review Chapter 12-2 on the electromagnetic spectrum.
a. Radio waves
b. Microwaves
c. Infrared light
d. Visible light
e. Ultraviolet light

Q4 Which type of radiation is used in the medical diagnostics technique MRI (magnetic resonance imaging)?

Hint Review Chapter 12-2 on the electromagnetic spectrum.

a. Radio waves

b. Microwaves

c. Infrared light

d. Visible light

e. Ultraviolet light

Q5 How long is a "micron", aka micrometer, in meters?

Hint Review Chapter 12-3 on the infrared region.

a. 10^{-2} m

b. 10^{-3} m

c. 10^{-4} m

d. 10^{-5} m

e. 10^{-6} m

Q6 What is the wavelength in nanometers of a photon with a wavenumber of 2500 reciprocal centimeters (1/cm)?

Hint Review Chapter 12-3 on the infrared region.

a. 0.4 nm

b. 4 nm

c. 40 nm

d. 400 nm

e. 4000 nm

Q7 Which of the following terms does **not** describe a bending vibration?

Hint Review Chapter 12-4 on molecular vibrations.

a. Rock

b. Twist

c. Shake

d. Scissor

e. Wag

Q8 Which statement best described the asymmetric stretching vibration of water?

Hint Review Chapter 12-4 on molecular vibrations.

a. Both HO bonds shorten/lengthen at the same time, HOH angle hardly affected.

b. Both HO bonds shorten/lengthen at the same time, HOH angle varies greatly.

c. One HO bond shortens while the other lengthens, HOH angle changes little.

d. One HO bond shortens while the other lengthens, HOH angle changes greatly.

e. OH bonds change marginally, mostly HOH angle change.

Q9 Which area of the IR spectrum is called the "functional group region"? [Wavenumbers are given.]

Hint Review Chapter 12-4 on molecular vibrations.

a. 4,000 - 3,000

b. 4,000 - 2,000

c. 4,000 - 1,000

d. 3,000 - 1,000

e. 2,000 - 400

Q10 Which one of the following alkenes does not show any IR band for the symmetric C=C bond stretch?

Hint Review Chapter 12-5 on IR-active and IR-inactive modes.

a. 1-butene

b. *Cis* 2-butene

c. 2-methyl-2-butene

d. *Trans*-2,3-dimethyl-2-butene

e. 2,3-dimethyl-2-heptene

Q11 Which one of the following molecules has the weakest IR absorption for the stretching vibration (if any)?

Hint Review Chapter 12-5 on IR-active and IR-inactive modes.

a. HF

b. HCl

c. HBr

d. N_2

e. CO

Q12 In which region would you look for CC triple bond stretching modes?

Hint Review Chapter 12-7 on infrared spectroscopy of hydrocarbons.

a. Around 1200

b. Around 1700

c. Around 2200

d. Around 2700

e. Around 3200

Q13 What is the effect of hydrogen-bonding on the position and shape of the OH stretching band?

Hint Review Chapter 12-8 on characteristic absorptions of alcohols and amines.

a. Shifted to lower wavenumbers, stays sharp
b. Shifted to higher wavenumber, stays sharp
c. Stays at the same wavenumber, broadens
d. Shifted to lower wavenumbers, broadens
e. Shifted to higher wavenumber, broadens

Q14 Which one of the following molecules R-CO-OCH_2CH_3 shows the highest wavenumber for the carbonyl stretching vibration?

Hint Review Chapter 12-9 on characteristic absorptions of carbonyl compounds.

a. R = methyl
b. R = ethyl
c. R = chloromethyl
d. R = fluoromethyl
e. R = difluoromethyl

Q15 Which one of the following compounds shows the lowest carbonyl frequency?

Hint Review Chapter 12-9 on characteristic absorptions of carbonyl compounds.

a. Cyclohexanone
b. 2-butenal
c. Benzoic acid
d. Acrolein
e. Amide of butanoic acid