Chapter 17

(1)
a. double
b. halve
c. double

(2)
a. $E = h\nu = \frac{hc}{\lambda} = \frac{(6.6262 \times 10^{-34}\ J\,s)(2.9979 \times 10^{8}\ m\,s^{-1})}{650 \times 10^{-9}\ m}$

$= 3.06 \times 10^{-19}\ \frac{J}{photon} \cdot \frac{6.022 \times 10^{23}\ photon}{mol} = 184039\ \frac{J}{mol}$

$= \boxed{184\ kJ/mol}$

b. $E = \frac{(6.6262 \times 10^{-34}\ J\,s)(2.9979 \times 10^{8}\ m\,s^{-1})}{400 \times 10^{-9}\ m} = 4.97 \times 10^{-19}\ \frac{J}{photon}$

$4.97 \times 10^{-19}\ \frac{J}{photon} \cdot \frac{6.022 \times 10^{23}\ photon}{mol} \cdot \frac{1\ kJ}{1000\ J} = \boxed{299\ kJ/mol}$

(3) $\nu = \frac{c}{\lambda} = \frac{2.9979 \times 10^{8}\ m\,s^{-1}}{562 \times 10^{-9}\ m} = \boxed{5.33 \times 10^{14}\ Hz}$

$\tilde{\nu} = \frac{1}{\lambda} = \frac{1}{562 \times 10^{-7}\ cm} = \boxed{1.78 \times 10^{4}\ cm^{-1}}$

$E = h\nu = (6.6262 \times 10^{-34}\ J\,s)(5.33 \times 10^{14}\ s^{-1}) = \boxed{3.53 \times 10^{-19}\ J/photon}$

$3.53 \times 10^{-19}\ \frac{J}{photon} \cdot \frac{6.022 \times 10^{23}\ photon}{mol} = \boxed{2.13 \times 10^{5}\ J/mol}$

(4) microwave - molecular rotation
infrared - bond vibration + bending
visible - electron excitation
ultraviolet - electron excitation + bond breaking

⑥ Transmittance is the fraction of light that passes through a sample (is not absorbed) and is measured by the detector.

— The absorbance is related to transmittance by:
~~transmittan~~ Absorbance $= -\log T = 2 - \log \%T$ and is a measure of how much light has been absorbed by the sample

— Molar absorptivity is constant for any unique substance at a specific wavelength. Its magnitude indicates how well a substance absorbs light of a specific wavelength.

— Absorbance is proportional to concentration

⑦ The absorption spectrum displays absorbance as a function of wavelength

10 A high absorbance means low transmittance and very little light getting to the detector. This can lead to low accuracy.

A low absorbance means the transmittance measurement is based on a very small difference in light levels at the detector. This also can lead to low accuracy.

11 $A = \varepsilon bc \rightarrow \varepsilon = \frac{A}{bc} = \frac{0.822}{(1.00\,cm)(2.31\times10^{-5}\,M)}$

$= \boxed{3.56\times10^{4}\ M^{-1}\,cm^{-1}}$