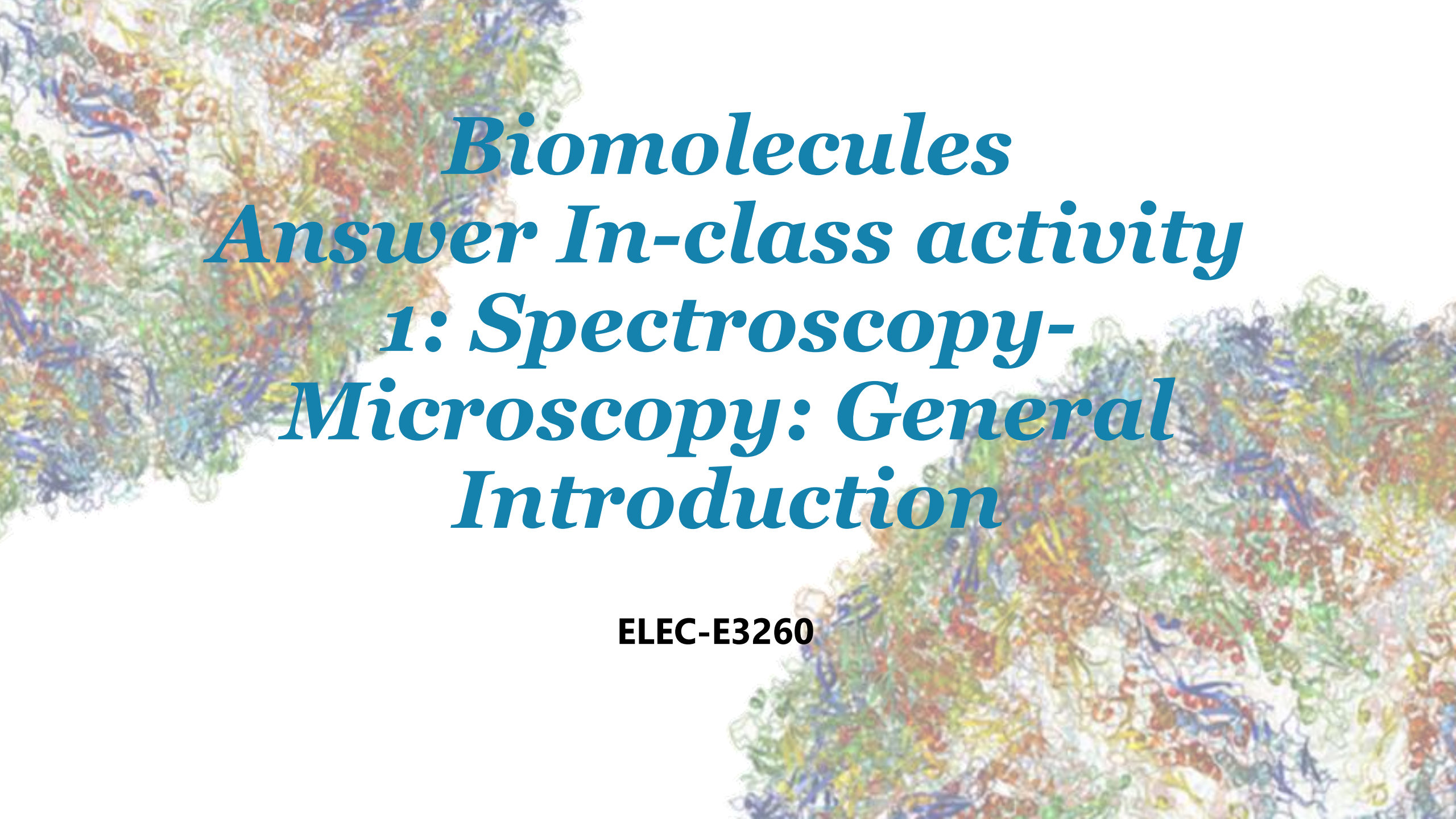
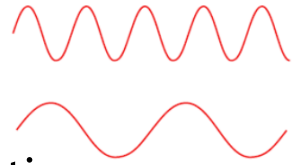


Biomolecules Answer In-class activity 1: Spectroscopy-Microscopy: General Introduction

ELEC-E3260

In-Class Activity

- 1. Calculate percent transmittance from the following values of absorbance:
  a) 4.0
  b) 0.23
  c) 1.6
- 2. Convert the following from percent transmittance to absorbance.
  a) 0.10%
  b) 23%
  c) 84%
- 3. In a 5.0 M solution, a solute absorbs 90% of a visible light as the beam passes through an 80 mm cell. Calculate the molar absorptivity of this solute.
- 4. When molecules are exposed to radiation with frequency, v, such that $\Delta E = h\nu$, do they travel through a transition from a higher to lower state, or lower to higher state?
- 5. a) Which wave has the higher frequency?
  b) If one wave represents visible light and the other represents infrared radiation, which wave is which?



- 6. The wavelength of the red line in the Hydrogen spectrum is 656 nm. What is the wavenumber and frequency of it?
- 7. The yellow light given off by a sodium vapor lamp used for public lighting has a wavelength of 589 nm.
  a) What is the frequency of this radiation?
  b) Calculate the energy of one photon of this yellow light

Answer in-class activity

1. We know that $A=log(\frac{1}{T})$, so we can deduce from that equation that: $T=10^{(-A)}$. Knowing that we can answer the question and we obtained:

a) $T=10^{(-4.0)}$= 1.10-4*100=**0.01%**
b) $T=10^{(-0.23)}$= 0.59*100=**59%**
c) $T=10^{(-1.6)}$= 0.025*100=**2.5%**

2. In the same way as for the first question, we use the equation:

$$A=log(\frac{1}{T})$$

a) A=log(1/(0.10/100))= **3**
b) A=log(1/(23/100))= **0.64**
c) A=log(1/(84/100))= **0.076**

Worth noted that the Absorbance can be calculated directly from the %T with the following formula: **A=2-log(%T)**

Answer in-class activity

- 3. For this question we can calculate the transmittance first:

$$T=1.0-0.9=\mathbf{0.1}$$

After we can deduce the Absorbance:

$$A=-\log(T)=-\log(0.1)=\mathbf{1}$$

And finally, with the Beer-Lamber law we can deduce the Molar absorptivity:

$$\varepsilon=\frac{A}{lC}$$

$$\varepsilon=\frac{1}{8.0*5.0}=\mathbf{2.5*10^{-2}\,L.mol^{-1}.cm^{-1}}$$

Answer in-class activity

- 4. When molecules are exposed to radiation with frequency, v, such that $\Delta E = h\nu$, they travel through a transition from lower to higher state.

- 5. a) The lower wave has a longer wavelength (greater distance between peaks). The longer the wavelength, the lower the frequency ($v = c/\lambda$). Thus, the lower wave has the lower frequency, and the upper wave has the higher frequency.

b) The electromagnetic spectrum indicates that infrared radiation has a longer wavelength than visible light. Thus, the lower wave would be the infrared radiation.

Answer in-class activity

- 6. We have λ = 656 nm = 656.10^{-9}m = 656.10^{-7}cm

From that we can deduce the wavenumber and frequency thanks to the 2 following formula :

$$\lambda = \frac{c}{\nu} \qquad \overline{\nu} = \frac{1}{\lambda}$$

So, we have : $\nu = \frac{c}{\lambda} = \frac{3.0*10^{8}}{656*10^{-9}}$ = **$4.57*10^{14}$ Hz**

And, $\overline{\nu} = \frac{1}{\lambda} = \frac{1}{656*10^{-7}}$ = **15 244 cm^{-1}**

Answer in-class activity

- 7. As for the previous question we calculate the frequency with the following equation:

$$\nu = \frac{c}{\lambda} = \frac{3.0*10^{8}}{589*10^{-9}} = \mathbf{5.09*10^{14}\ s^{-1}}$$

After that we can use the formula : E=h ν

And we get, E= 6,624.10^{-34} * 5.09*10^{14}=**3.37*10^{-19}J**