BT 301: Biophysics **QUIZ 2** on 11 Sep 23 Instr: R. Swaminathan

Total marks = 15 time = 45 mins Questions carry two marks unless indicated.

Name: Roll Number:

(if name or roll number is not filled, ZERO marks will be awarded)

1. Identify two electronic transitions that account for absorption of light by peptide bond.

$n \rightarrow \pi^*$ (210 - 220 nm) $n \rightarrow \sigma^*$ (175 nm)

$\pi \rightarrow \pi^*$ (~ 190 nm)

2. Growth of *E.Coli* bacteria in a liquid culture is tracked by measuring Absorbance at 600 nm. Which chromophore accounts for absorption at 600 nm by the bacteria?

There is no chromophore to account for 600 nm absorption. Absorbance arises due to scattering by bacteria.

3. If $k_r = 1.1 \times 10^9\ s^{-1}$ and $k_{nr} = 2 \times 10^8\ s^{-1}$. Calculate fluorescence lifetime and quantum yield.

$$\tau = \frac{1}{k_r + k_{nr}} = \frac{1}{13} \times 10^{-8} = 7.69 \times 10^{-10}\ s$$

$$\phi = 7.6923 \times 10^{-10} \times 1.1 \times 10^{9} = 0.846$$

4. a) Calculate ellipticity when minor/major axis = 0.031; b) Calculate molar ellipticity if concentration is 0.00001 M and path length = 1 cm.

$$\theta = \tan^{-1}(0.031) = 0.031\ rad = 1.776\ deg.$$

$$[\theta] = \frac{100 \times 1.776}{10^{-5}\ M \times 1\ cm} = 177.6 \times 10^{5}\ deg\ M^{-1} cm^{-1}$$

$$= 1.77 \times 10^{7}\ deg\ M^{-1} cm^{-1}$$

5. Calculate the ratio of ground (n_a) to excited state (n_b) population, if energy gap between the two states corresponds to light of frequency = 1×10^{12} Hz and temperature = 298 K.

$$\frac{n_a}{n_b} = \exp\left(\frac{6.626 \times 10^{-34}\ Js \times 10^{12}\ s^{-1} \times N_a}{8.314\ J K^{-1} mol^{-1} \times 298\ K}\right)$$

$$= e^{\left(\frac{399.01772}{2477.572}\right)} = e^{0.161}$$

$$= 1.175$$

6. List two unique differences between fluorescence and phosphorescence emission.

$\tau = \sim ns$

$S_1 \rightarrow S_0$ transition

Allowed transition

$\tau = \sim ms - s$

$T_1 \rightarrow S_0$ transitio

Spin Forbidden transitio

7. Name one intrinsic and one extrinsic fluorescent probe for investigating proteins.

Trp

GFP

Dansyl

ANS

8. How much time does it take for a chromophore to absorb a photon of light and make a transition to higher electronic state. [1]

femtoseconds.

**********space below can be used for rough work only**********