Name: Date:

Final Exam
Part I

Biophysics
Bioinformatics degree

1. (1.5 points) Thermodynamic.

We have a system in which a macromolecule could be in three different conformations depending on the degree of *opening a channel*. One experiment at 25ºC determines the population of these three states to be 60%, 35% and 5%, for opened, semi-opened and closed conformations, respectively. a) Determine the relative energies of these three states assuming a degeneration of one for the three levels.
b) Recompute the relative energies assuming a degeneration of 5 for the semi-open conformation.
c) Compute the temperature at which the population of opened and semi-opened states has the same population assuming the same degenerations of b).

2- (1.5 points) Chemical kinetics.

The following data were obtained on the initial rate of isomerization of a compound S catalyzed by an enzyme E:

$[S]_0$ /(mmol dm^{-3})		1.00	2.00	3.00	4.00
V_0 /(mmol dm^{-3} s^{-1})	(a)	4.5	9.0	15.0	18.0
	(b)	14.8	25.0	45.0	59.7
	(c)	58.9	120.0	180.0	238.0

The enzyme concentrations are (a) 1.0 mmol dm^{-3}, (b) 3.00 mmol dm^{-3}, and (c) 10.0 mmol dm^{-3}. Find the orders of reactions with respect to S and E, and the rate constant. It is not required to use all data of the table.

3) (1.5 points) Transport. A tetrameric protein of 100 kDa is diffusing in the cytoplasm at 37ºC. i) Discuss how will be the diffusion of the monomers with respect to the tetrameric protein. ii) Discuss how will be the diffusion of the same protein in water at the same temperature.

b) Estimate the time that is required for a initial concentration of 15 mM of glycerol to escape from the interior of a cell of a diameter of 0.5 μm. The permeability through the membrane of the cell of glycerol is of $4 \cdot 10^{-8}$ m/s. Consider a spherical shape for the cell, a null concentration of glycerol outside the cell and approximate that the the initial flux, corresponding to the initial concentration of glycerol, is constant during time.

Additional data:

M(H)=1 g mol^{-1}; M(C)=12 g mol^{-1}; M(O)=16 g mol^{-1}; M(N)=14 g mol^{-1}
k_B=1.3806488·10^{-23} J K^{-1}
R=8.314 J K^{-1} mol^{-1}
R=0.082 atm L K^{-1} mol^{-1}
N_A=6.022·10^{23} mol^{-1}

$$v^{mp}=\sqrt{(2RT/M)}$$

$$\bar{v}=\sqrt{(8RT/(\pi M))}$$

$$v^{rms}=\sqrt{(3RT/M)}$$

$$f(v)=4\pi\left(\frac{m}{2\pi k_B T}\right)^{3/2} v^2 e^{-mv^2/(2k_B T)}$$

$$\frac{1}{[A]_0-[B]_0}\ln\frac{[B]_0[A]}{[A]_0[B]}=kt$$

$$D=\frac{k_B T}{6\pi\eta a}$$