Biophysics exam row 2. Answer the questions on your own paper. Solve also the MCQ question, on the extra paper. Read all questions and answer them in the order you prefer. All dots in numbers are the equivalent to dots in computer science. Example: $4.31 = \frac{431}{100}$

Name (make sure I can easily read it): _____

1. (1 point) To kill the HIV virus, heat treatments with different temperature T and holding time t are used. We know that the bond to be broken during these heat treatments has a value of $\Delta E = 84.5 k_B T_{room}$ where $T_{room} = 300K$. Treatment B has a holding time of 72h at 80^{o}C. A new proposed treatment at 76^{o}C is treatment D. What is the holding time needed at 76^{o}C so that the treatment D will have the same efficacy as treatment B?

2. (2 points) The total energy of a biomembrane is given by the Helfrich-Canhan hamiltonian $H = \int [\sigma + 2kH^2 + k_s K] dA$, where H and K are curvatures, defined as $\frac{1}{R}$, with R being a radius, while dA is a membrane area element. k is the bending modulus and k_s is the splay modulus. Indicate the correct units for the splay modulus k_s.

   - ◯ Newtons N
   - ◯ Newtons times square meters Nm^2
   - ◯ Joules
   - ◯ Joules per square meters $\frac{J}{m^2}$
   - ◯ Joules times square meters Jm^2

3. (1 point) Ultrasound equipment used in the medical profession uses sound waves of a frequency above the range of human hearing. If the frequency of the sound produced by the ultrasound machine is f=30 kHz, what is the wavelength of the ultrasound in bone, if the speed of sound in bone is $v = 3000 \frac{m}{s}$?

4. (1 point) The wing cycling frequency of a hummingbird, during flight, is approximately 260Hz. Assuming that the diffusion coefficient for Ca^{2+} in water (and in the intracellular fluid) is $10^{-5} cm^2 s^{-1}$, calculate the radius of such a bird typical muscle cell if these ions are able to reach the very centre of the cell.

5. (2 points) A person weighing 50kg has a basal metabolic rate of $1800 \frac{kcal}{day}$. The person has just got ill from a viral infection and during a time interval of one hour his body temperature raised from 37^{o}C to 38^{o}C. Find out the percentage increase of this person's metabolic rate **during** the one hour time interval when his body temperature went from 37^{o}C to 38^{o}C. One calorie is 4.186J. The water specific heat, the approximation to be used for the body specific heat, is $4186 \frac{J}{Kg \cdot K}$.

6. (1 point) A far sighted person sees that her contact lens prescription is 1.00 D. What is her near point? The length of eye lens to retina is 2cm. The near point for ideal vision is 25cm.