Competition in biophysics/medical biophysics 2021.

1. Calculate the number of moles of radioactive technetium in a ^{99m}Tc preparation of 0.5 GBq activity. (25 points)

2. What is the relative (in %) compression in a 30 cm long tibia of a person with 80 kg weight standing erect. The bone is regarded as a hollow circular tube with internal diameter of 2.5 cm and external diameter of 3.5 cm. Its Young's modulus along the axis is $2*10^{10}$ N/m^2. The calculated "spring constant" is $4*10^4$ kN/m. (25 points)

3. The molar extinction coefficient of dilute ethanolic solution of pentafluorophenyl-porphyrin used in photodynamic therapy is 5.94 10^5 dm^3/(mol cm). What is the concentration of it, if in a cuvette with 10 mm width 20 % difference was found between the light intensities coming out from the sample and from the reference solutions. (20 points)

4. What is the anode voltage on the x-ray tube if the wavelength of the produced x-ray photons having the highest energy is 10 pm?
   What is the value of anode current if $5 \cdot 10^{15}$ electrons hit the anode in one minute?
   What is the x-ray power, if the anode is tungsten (Z=74)? (30 points)

5. Give <u>short</u> definitions for the following terms (give the unit, where it is possible) 6x5 points)
   - **EM:** Persistence length; **ED:** Permeability; **EP:** Thermodynamic force
   - **EM, EP:** Arrhenius plot (drawing and description) **ED:** Stokes shift
   - **EM, EP:** Nematic liquid crystals **ED:** Exposure
   - **EM:** Nephelometry; **ED:** Specific rotation; **EP:** Absorption spectrometry
   - Ideal black body
   - Space constant of membrane

6. Give the unit of the following quantities (10*2 points)
   - acoustic impedance
   - radiation intensity
   - mass attenuation coefficient
   - compressibility
   - **EM, EP:** entropy **ED:** permeability constant
   - diffusion coefficient
   - electrochemical potential
   - spring constant
   - specific capacity
   - radiation weighting factor

7. **EM, EP:** Describe the thermooptical and electrooptical phenomena and their applications.
   ED: Describe the normal distribution, and the estimation of its parameters from a sample
   (25 points)

8. Describe the refractive disorders of the eye and the way for correction of them. (25 points)