

## Competition in biophysics/medical biophysics 2013.

1. We want to examine some details of bacteria that have about  $0.5 \mu\text{m}$  size. Estimate, whether or not we can do it with a microscope having 15x magnification objective of 1 cm diameter. The optical tube length is 160 mm. This microscope does not have any other objective and can be used only without immersion. (30 points)
2. In an isotope laboratory an experiment was done with  $^{24}\text{Na}$  isotope. One drop of isotope preparation contaminated the table. After finishing the experiment the isotope contamination was checked by dose rate measurement. In 20 cm distance above the drop the measured dose rate was  $150 \mu\text{Gy/h}$ . How many moles of Na-isotope were on the table? After how long time the activity decreases to one tenth without proper cleaning (decontamination) of the table? (25 points)
3. The flow velocity of blood in a vessel is 60 % of the critical velocity. The inner diameter of the vessel decreases by 5 % of the original value in one year due to atherosclerosis.
  - a) How many times higher pressure difference is necessary 5 years later to keep the same flow intensity if the other parameters do not change?
  - b) After how long time the flow becomes turbulent if the transported volume in unit time is considered constant? (25 points)
4. The gain level of a hearing aid device is 35 dB in the audible sound range. How many times the sound intensity is increased by the device? What is the intensity of that 1000 Hz frequency sound, which is sensed by a person having normal auditory threshold 40 phon loud, using the device? (20 points)
5. Give short definitions for the following terms (give the unit, where it is possible) 6x5 points)
  - Specific rotation
  - Resonance
  - Exposure
  - Critical angle
  - Transfer band of an amplifier
  - Compressibility
6. Give short answer to the following questions (5x10 points)
  - Draw an isotope accumulation curve. What kind of information can be obtained from it?
  - Describe the parts and function of photomultiplier.
  - Show the way of binary pulse counting.
  - How can you construct the integral vector of the heart and what is its significance?

**EM and EP:** - What is nearsightedness and how it can be corrected?

**ED:** - Compare type I and type II errors in statistics.
- 7 **EM:** FRET (meaning, conditions, practical applications). (20 points)

**ED and EP:** Compare the Donnan and Goldman – Hodgkin – Katz model of the resting potential.

## Angol verseny 2012/2013 megoldások és pontozás

1.  $1/f = 1/k + 1/t$  és  $k = N/t$  5 pont  
 $k = f + d$  (csak a tankönyvben szereplő közelítés)  
 $t = d(1/N + 1/N^2) = 11.4 \text{ mm}$  10 pont  

$$\sin \omega = \frac{D/2}{\sqrt{(D/2)^2 + t^2}} = 0,4$$
 5 pont

$$\delta = 0,61 \frac{\lambda}{n \sin \omega} = 606 \text{ nm, ha } \lambda = 400 \text{ nm és } n = 1$$
 10 pont

Ha sin helyett tg-t használ, 5 pont levonás

Ha nem jelzi, hogy milyen hullámhosszal számol, 5 pont levonás

2.  $A_0 = 13,5 \text{ MBq}$  5 pont  
 $n = 1,76 \text{ pmol}$  10 pont  
 $t = T/\lg 2 = 49,9 \text{ óra}$  10 pont

3.  $r = 0,95^5 r_0$   $\Delta p/\Delta p_0 = (r_0/r)^4 = 2,8$  10 pont  
 $A_0 0,6 v_{\text{krit}} = A v'_{\text{krit}}$   $r_0 0,6 = r$  10 pont  
 $r = 0,95^4 r_0$   $T = \lg 0,6/\lg 0,95 = 9,96 \text{ év}$  5 pont

4. a.  $35 = 10 \lg(I_{\text{ki}}/I_{\text{be}})$   
 $I_{\text{be}} * 10^{3,5} = I_{\text{ki}}$   
 $I_{\text{ki}} = 3162,28 * I_{\text{be}}$  8 pont

b.  $40 - 35 = 10 \lg I/I_0$   
 $0,5 = \lg(I/I_0)$   
 $I_0 * 10^{0,5} = I$   
 $I = 3,16 * 10^{-12} \text{ W/m}^2$  12 pont

Általános javítási elvek: számolási hiba: 20 % levonás,  
mértékegység hiba vagy hiány: 25 % levonás,  
átváltási hiba darabonként 25 % levonás,  
elvi hiba: 50 % levonás.

A kedvezmény feltétele : összesen legalább 100 pont elérése.

A kedvezményt elérték dolgozatát kérem **május 10-én 15 óráig**. (Ha valaki kedvezményt kap, a versenydolgozat tekintendő a vizsga írásbeli részének, tehát meg kell őrizni.) Akkor is kérek visszajelzést, ha a csoportból senki nem kap kedvezményt. **Kérem, hogy az egyeztetés előtt senki ne mondjon semmit a hallgatóinak az elért versenykedvezményről!**

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