

BME-1056 Cellular interactions  
28.5.2010

Maximum amount of points 36p: 30p from the exam + 6p from the assignment  
Max 6 extra points from the home exercises.

1. Tell Shortly:

- bone matrix composition 3 p
- The definition of the multipotent mesenchymal stem cell 1,5 p
- What are the main things affecting the differentiation of stem cells? 1,5 p

1. Kerro lyhyesti:

- Luun soluväliaineen koostumus 3 p
- Multipotentin mesenkymaalisen kantasolun määrittelykriteerit 1,5 p
- Mitkä tekijät vaikuttavat kantasolujen erilaistumiseen 1,5

2. Define shortly

- A) Organization phase in embryo development 2 p
- B) Gastrulation 2 p
- C) Pluripotent stem cell 2 p

2. Määritä lyhyesti:

- A) Organisaatiovaihe alkionkehityksessä 2 p
- B) Gastrulaatio 2 p
- C) Pluripotentti kantasolu 2 p

3. Tell shortly

- A) The role of gap junctions in cellular electric interaction 2 p
- B) Ca<sup>2+</sup> imaging 2 p
- C) Hodgkin-Huxley model 2 p

3. Kerro lyhyesti

- A) Aukkoliitosten merkitys solujen sähköisessä viestinnässä 2 p
- B) Ca<sup>2+</sup> kuvantaminen 2 p
- C) Hodgkin-Huxley malli 2 p

4. The route of glycoprotein mRNA to functional cell surface glycoprotein. Describe what happens to the product in cellular organelles that product passes on its way. (6p)



5.

a) A cell in 37°C temperature has the following ionic concentrations and membrane permeabilities:

	Intracellular concentration(mM)	Extracellular concentration (mM)	Relative permeability
K <sup>+</sup>	135	5	1
Na <sup>+</sup>	15	140	0.05
Cl <sup>-</sup>	5	110	0.45

Calculate the resting membrane potential of the cell using the Goldman-Hodgkin-Katz equation. (3p)

Constants:

$$R=8.3145 \frac{J}{K mol}, F=96485 \frac{C}{mol}, k_B=1.3807 \cdot 10^{-23} \frac{J}{K}, e=1.602 \cdot 10^{-19} C$$

b) The membrane resistance  $R_m$  of a long cylindrical cell (diameter 70  $\mu m$ ) is 125  $\Omega cm^2$ . The resistivity of the cell axoplasm  $\rho_i$  is 1  $\Omega cm$  and the extracellular resistance  $r_o=5 \Omega/cm$ . What

is the characteristic length  $\lambda = \sqrt{\frac{r_m}{r_o + r_i}}$  of the cell? (3p)

6. Points from the assignment (max 6p)