

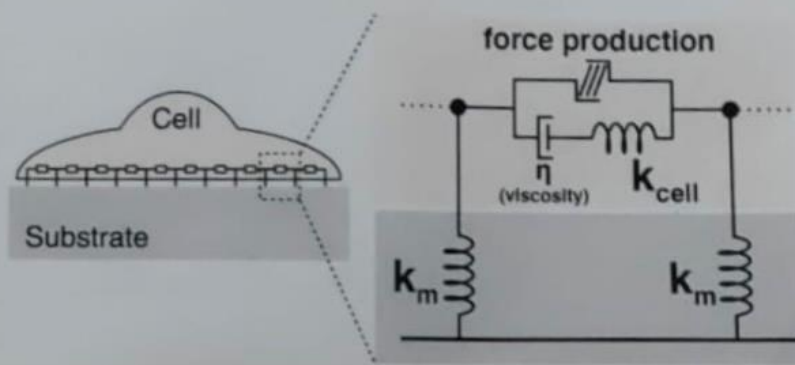
BMT-72106 Cellular Biophysics

Exam 9.5.2022

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Please answer the four (4) exam questions below.

1. Describe the structure of cell-cell and cell-ECM junctions (3p), and mechanotransduction processes in both of the junction types (3p).
2. Cell-ECM mechanics can be described by using following approach or simplistic model:



Explain shortly the principle and origin of

- a) Extracellular elasticity, k_m (2p)
 - b) Cellular force production (2p)
 - c) Cellular viscosity η and elasticity, k_{cell} (2p)
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- a) What are the two main features that affect the visual performance in an animal eye? How could these features be improved? (3p)
 - b) Explain the following electrophysiological phenomena/concepts:
 - i. Action potential propagation in long axons and factors affecting the conduction velocity (1p)
 - ii. Equivalent circuit model of the cell membrane (1p)
 - iii. Calcium imaging (1p)

4. A mechanosensitive cell responds to increased membrane tension (i.e., membrane strain) with a change in transmembrane current as shown in figures A) and B).

a. Explain what happens in the electrophysiological recordings shown in A). Give a short description of what technique and recording configuration is used. What are the cellular components causing the current changes? Estimate the number of these cellular components in the recordings and justify your reasoning. (3p)

b. From current responses in A), sketch the average response to the applied $0.6 \mu\text{m}$ membrane strain. (1p)

c. Figure B) shows responses of a single mechanosensitive cell to a series of strains increasing from $-0.3 \mu\text{m}$ to $1.1 \mu\text{m}$ in $0.2 \mu\text{m}$ steps. Explain how this recording configuration differs from (A) in practice. Draw the steady-state stimulus-response curve and estimate the strain that is needed for half-maximal activation of the cell. Note that the two smallest responses (with positive polarity) overlap. Remember to give also a written explanation of your answers. (2p)

