

Course
KMG050
Cell and Molecular Biology 2

Written exam, March 15th 2013, 14:00-18:00

Examiner: Associate Professor Dina Petranovic

Dina will visit the students around 16h.

- 1) In order to reduce the amount of paper, please do answer more than 1 question on the same sheet of paper.
- 2) The written exam is in English only thus it is allowed to have a dictionary at the exam.
- 3) Other materials such as notes, lecture slides, books, computers and other paper or electronic items and devices that can store information are NOT allowed during the examination.
- 4) There are 15 questions and the points are expressed in %. The maximum is 95%. There are no negative points and it is possible to get partial points in the answer. The last 5% attributed from the literature exercise.
- 5) If you write in this document, don't forget to put your student code on your copy and include it when you submit your exam. Also, mark on your papers that the answer is in the exam copy, so I know where to find your answer.
- 6) Whenever you think a figure is more suited to explain something, feel free to draw, but don't forget to mark what is what and how mechanism work.
For maximal points, be as comprehensive and detailed as possible.

I hope you do your best and good luck to all!



- 1) a. Describe in detail the mode of regulation and action of PKA. Do not hesitate to use drawings in addition to text. (3%)
b. Describe the general features of intracellular receptors and the signal molecules that target them. (3%)
- 2) Explain how does the lack of vitamin C in the diet influence the structure and function of connective tissues? Give a detailed overview of the relevant molecular pathway (drawings supplemented to text would be appreciated) (10%)
- 3) Explain and draw the structure of skin: mark and list 4 layers of epidermis, 2 layers of dermis and hypodermis. Describe how different layers of epidermis and dermis are different. (3%)
- 4) Fill-in the blanks (in your own paper or this paper but then don't forget to submit it!) (7 %). The complement system is made of about a) soluble, circulating proteins that are produced by the b). There are 3 pathways to activate the cascade: c), d) and e). The activation of C3 component is necessary to the activation of C5 component that is the initiation step for the creation of the membrane attack complex that creates a pore in the target cell. The pore is made of f) proteins and its role is g).
- 5) a. What is the difference between a multipotent hematopoietic stem cell and a multipotent hematopoietic progenitor cell? (2%)
b. Explain the regulatory mechanism that promotes the change from this stem cell towards this progenitor cell. (3%)
c. what is the progenitor line that gives rise to platelets? (1%)
- 6) Explain briefly the main features of viral and non-viral vectors used in gene therapy. Comment on the respective advantages and disadvantages. (4%)
- 7) Fill-in the blanks (in your own paper or this paper but then don't forget to submit it!) (12%).

Our blood is composed of different types of cells: a) (that lack a nucleus and carry oxygen), b) (that are not real cells, but parts of megakaryocytes and their role is in coagulation) and c) (that have a role in immunity). The immune cells can be subdivided into d), e) and f). Neutrophils, g) and h) are in the class of granulocytes, and i), j) and natural killers are in the class of k). At least, there are also l) that are part of the innate immune system and give rise to macrophages and dendritic cells.

- 8) In the embryonic development of the frog, some molecular features are already determined by the egg, and some are contributed by the sperm. Explain the

molecular mechanisms how are determined the vegetal and the animal poles and the dorsal and the ventral sides. (8%)

- 9) Embryonic stem cells (ESC) collected from an adult brown mouse are injected in a blastocyst that originates from a white mouse. The chimeric blastocyst is then inserted into a foster mother, in this case a black mouse. The blastocyst develops, and the baby mouse is born. What is the color of the baby mouse and why is it like that? (6%)
- 10) In order to optimize their performance, many professional sportsmen train in higher altitudes, in order to promote the oxygenation of the tissues (muscles). The effect can persist for several weeks and can contribute to the improved physical performance at the low altitude.
Explain two molecular mechanisms that contribute to this effect. (8%)
- 11) Explain how and where T-cells and dendritic cells interact and what is the purpose and the result of such interactions. (8%)
- 12) Name the protein representing the main and most popular target for HIV vaccine design. What is its most important region for vaccine design? Why is this region preferable for vaccine design? (4%)
- 13) Explain the difference between direct and indirect fitness benefit. The advantage given by a direct fitness benefit is quite obvious, although the same cannot be said for the indirect fitness benefit. Provide a possible evolutionary justification for microbial behaviors oriented towards providing indirect fitness benefits. (4%)
- 14) a. Describe what is known about the mechanism of action of the antimalarial drug chloroquine. (3%)
b. Explain the mechanism of resistance of *P. falciparum* to the drug. (3%)
- 15) There are several bacterial components and pathways that are targets of antibiotics. What is targeted by penicillin, rifampin and tetracycline? (3%)