

Department of Biology

Examination in Bi3016 Molecular Cell Biology

Contact person during exam:

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Date: 11. December 2015

Number of hours: 4

Permitted aids: none

All of the five main questions count as equal (20%).

Each question (1-5) must be started on a new page.

Language: English

Total number of pages: 3 (including cover page)

Attachments: 0

Kontrollert av:

Dato

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NOTICE THAT THE QUESTIONS 1-5 ARE WEIGHTED EQUALLY (20 %), BUT SINGLE QUESTIONS MIGHT BE WEIGHTED DIFFERENTLY (INDICATED IN %). IF NO WEIGHTING IS GIVEN THE SUB-QUESTIONS ARE WEIGHED EQUALLY. PLEASE START ANSWERING EACH QUESTION (1-5) ON A NEW SHEET OF PAPER.

Question 1

Both eukaryote cells and bacteria have several types of non-coding RNAs that have important gene regulatory functions or are part of the cells defense against virus.

- a. Explain the principle behind RNA interference (RNAi) and how this process can regulate gene expression? (40 %)
- b. What function has long non-coding RNA (lncRNA) during X-chromosome inactivation in humans? (20 %)
- c. Bacteria and archeobacteria have developed a specific RNA-guided defense system against DNA viruses (bacteriophages). Explain the functioning of this defense system and how it protects the cells against virus infections. (40 %)

Question 2.

In humans the G-protein coupled receptors (GPCRs) constitute the largest family of cell surface receptors and they mediate a wide variety of extracellular signals.

- a. Explain how GPCRs activate G-proteins and describe how the cell can terminate signal transmission from the receptor and G-protein. (40 %)
- b. Cyclic-AMP (cAMP) is an important second messenger in cells and can among other things regulate gene expression. Explain how activation of GPCRs can regulate the production of cAMP and how this can induce gene expression. (40 %)
- c. A-kinase anchor proteins (AKAPs) are involved in regulation of cAMP production. What are the functions of the AKAP proteins and how can they regulate the local concentration of cAMP in the cell? (20 %)

Question 3.

Microtubules have important functions in the cell and determine the localization of organelles, direct intracellular transport and produce the mitotic spindle which segregates chromosomes during cell division.

- a. Describe the structure of a microtubule and explain what we mean by a plus and minus end.
- b. Explain the factors that determine the stability of microtubules and describe the process known as dynamic instability.
- c. Which two main classes of motor proteins move along microtubules, and in what direction do they move, against plus or minus end? Describe briefly the principle behind motor protein locomotion.

Question 4.

The cell cycle is regulated by various control mechanisms that ensure that each essential process of the cycle, such as DNA replication or mitosis, is completed before the next step in the cycle is initiated.

- a. Describe briefly the various steps in the cell cycle and mention which factors (external and internal) that determine cell cycle progression.
- b. Explain how cyclins and cyclin-dependent kinases (Cdks) through positive and negative feedback loops control the cell cycle.
- c. What is a mitogen, and how can mitogen stimulation of a cell result in cell cycle initiation / cell division?

Question 5.

Define / explain 4 of the 5 the following words and terminologies and give a short description of their function.

- a. Caspase
- b. Cadherin
- c. Tumor suppressor gene
- d. Notch mediated lateral inhibition
- e. Morphogen.

Use figures where appropriate to explain your answers, (questions 1-5).