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Examination paper for Bi3016 Molecular Cell Biology

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Examination date: 5th June 2018

Examination time (from-to): 09.00-13.00 (four hours)

Permitted examination support material: None

Other information:

Language: English

Number of pages (front page excluded):   2

Number of pages enclosed:

Question 1

Gene expression in multicellular eukaryotes is regulated by various mechanisms which ensure correct spatiotemporal expression of gene products in the cells.

    a. Describe the most common methods a cell uses to turn off or reduce the expression of a gene. (40%)

    b. Explain the mechanisms that prevent a transcription factor for inappropriately influencing the transcription of adjacent genes. How can this cross-talk between control regions of neighbor genes be avoided? (20 %)

    c. Explain how differentiated cells maintain their identity and how cell memory is established and maintained? (40 %)

Question 2

Intracellular signal transduction regulates and coordinates a number of important processes in the cell, such as cell division and responses to extracellular signals.

    a. Many signaling proteins in cells act as molecular switches, where they change between an active and inactive form. Describe the two most common molecular switches in cells and explain how they operate. (30 %)

    b. Intracellular signaling pathways often incorporate positive and negative feedback regulation. Explain how they operate and describe each of them (positive and negative) by using examples taken from the curriculum. (40 %)

    c. Calmodulin has several important regulatory functions in cells. Describe how it operates in the cell and explain its regulation of the CaM-kinase. (30 %)

Question 3

   a. Regulated proteolysis (the degradation of proteins) is important during the metaphase to anaphase transition in mitosis. Describe the actions of the anaphase promoting complex (APC/C) and explain why it is such an important player. (40 %)

   b. Programmed cell death through apoptosis is a carefully regulated process, which ensures that damaged or surplus cells are destroyed and removed. Explain the principles of apoptosis and describe the extrinsic pathway. (60 %)

Question 4

   a. Retinoblastoma is a rare human cancer commonly affecting young children. Explain how the *Rb* gene was identified and describe how it can cause cancer.

   b. In humans the cadherins constitute a large and diverse protein family that regulate and facilitates interactions between cells. Explain how they mediate cell-cell interactions and how they in certain cases may contribute to cancer progression.

   c. Cancer cells often have an increased glycolysis to fuel cell division and growth. Explain how mutations in genes coupled to the PI3-kinase/Akt/mTOR pathway can drive cancer growth.

Question 5

Define / explain 4 of the 5 the following words and terminologies and give a short description of their function, max 200 words for each answer.

   a. Genomic imprinting
   b. CRISPR
   c. Map kinase
   d. Kinesin
   e. Cyclin-dependent kinase (Cdk)

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