

Examination

Biochemistry and Molecular Biology (KBB032) (2017)

Date and place: Wednesday, October 25, 08.30, “M”

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Aids: Chalmers approved calculator

”Grade limits”: 50% = 3; 65% = 4; 80% = 5

Code.....

1. Glycolysis is one of the most central metabolic pathways in a cell. Which end products are formed from 1 mole of glucose in this pathway? Key enzymes of the pathway are considered to be Hexokinase, Phosphofructokinase and Pyruvate kinase, respectively. Describe the reactions carried out by each of these enzymes. (6p)

2. Formation of ATP via oxidative phosphorylation is an extremely important process in the cell. (6p)
- A) Describe the process that “liberates energy” and which factors that determines the amount of energy “liberated”
 - B) What is the “force” used by ATP:ase for formation of ATP, which are the components constituting this force?
 - C) Explain briefly the difference between substrate level phosphorylation and oxidative phosphorylation.

3. Complete oxidation of glucose not only involves glycolysis but also Pyruvate dehydrogenase as well as the TCA cycle. (5p)

A) Describe the reaction carried out by pyruvate dehydrogenase.

B) What molecule is entering the TCA cycle and what end products are formed after one “turn” of the cycle?

4. Describe in which process/pathway the following enzymes are active and the reaction catalysed. (10p)

UDP-glucosepyrophosphorylase

Isocitrate lyase

Fructose-1,6-bisphosphatase

Glutamate dehydrogenase

Ribulose-1,5-bisphosphate carboxylase (Rubisco)

5. Which are the two most important functions of the pentose phosphate pathway? Glucose-6 phosphate dehydrogenase is a key enzyme of this pathway, describe the reaction catalysed by this enzyme. (6p)

6. Photosynthesis is a very important process for life on earth. (7p)

A) What is the “energy source” that drives this process?

B) How is ATP generated?

C) Which products, apart from ATP, are produced during non-cyclic photosynthesis?

D) Which product is formed during cyclic photosynthesis?

7. Explain (with one or two sentences) what is meant by the following expressions. (10p)

- a) β -oxidation
- b) Anaerobic respiration
- c) Allosteric regulation
- d) Symport
- e) Second messenger
- f) Endosymbiont theory
- g) Essential amino acid
- h) Futile cycle
- i) Nitrogen fixation
- j) Autotroph

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8. The DNA of Eukaryots is organized as complexes with several proteins. Provide a brief description of the structure of these complexes and also include which proteins are required for the organization of the DNA. (4 p)

9. Which are the four major phases of the eukaryotic cell cycle and what characterizes them on the level of DNA-content/cell? (4 p)

10. The replication fork forms in order to allow copying of both strands of DNA. Provide a brief overview of how it functions. Your answer should include the DNA-level (with direction 5'/3') and also the proteins involved (make sure to list ALL the enzymatic functions required). (10 p)

11. Below is a sequence of nucleotides.

GATGGCCATCG

a. Is it DNA or RNA? Motivate your answer. (1 p)

b. What would be the complimentary sequence (written in correct direction)? (1 p)

12. Which are the three classes of RNA directly involved in protein synthesis? Your answer should include the name of each, and also a brief description of its function in the process. (3 p)

13. Which are the steps involved in making a mature eukaryotic mRNA? Start your description with the RNA-polymerase approaching the end of a gene, finish with the mRNA being exported from the nucleus. (3 p)

14. For each amino acid added to a growing protein on the ribosome, there are four high energy bonds used. Give a brief description of the processes in which the energy is used, don't forget to indicate in which form the energy is used. (6 p)

15. Explain how the presence of glucose and lactose regulate the expression of mRNA from the lactose (lac) operon in E.coli. Your answer should include (i) what is an operon, (ii) the role of relevant proteins, metabolites and sequences on the DNA and (iii) how the expression levels of the lactose operon mRNA varies with the different carbon sources. (6 p)

16. The following terms have all been described in your lectures, provide a brief explanation for each of them and why they are important (1 p/term, total 12 points):

- a. Transposon
- b. Photolyase
- c. Telomerase
- d. Shine-Dalgarno sequence
- e. Microarray
- f. Sigma factor
- g. Dideoxy-nucleotide
- h. Signal peptide
- i. Wobble hypothesis
- j. Mediator-complex

k. Reverse transcriptase

l. Anticodon