

Examination

Biochemistry and Molecular Biology (KBB032) (2018)

Date and place: Wednesday, October 31, 08.30, “M”

Teachers: Christer Larsson 772 3806 / Joakim Norbeck 772 3838

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, and how many are formed from 1 mole of glucose in this pathway? Which are the key enzymes in terms of rate regulation of glycolysis? Name **one** inhibitor and **one** activator of glycolytic rate including the target enzyme. (10p)

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. (6p)
- A) Which end products are formed by pyruvate dehydrogenase?
 - B) Which end products are formed after one turn of the TCA cycle?
 - C) α -ketoglutarate dehydrogenase is considered as a very important enzyme in the TCA cycle. Why? Suggest a reason why this enzyme is very important.

4. Describe in which process/pathway the following enzymes are active and the reaction catalysed. (8p)

Isocitrate lyase

Fructose-1,6-bisphosphatase

Ribulose-1,5-bisphosphate carboxylase (Rubisco)

Glycogenin

5. Which are the two most important functions of the pentose phosphate pathway? (4p)

6. Photosynthesis is a very important process for life on earth. (4p)

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?

7. Ethanol fermentation is a redox neutral process yet ethanol is more reduced than glucose, how can this be explained? (2p)

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

- a) β -oxidation
- b) Anaerobic respiration
- c) Feed-back inhibition
- d) Gluconeogenesis
- e) Second messenger
- f) Endosymbiont theory
- g) Essential amino acid
- h) Futile cycle
- i) Nitrogen fixation
- j) P/O-ratio

Code: _____

9. Below is a sequence of a nucleic acid:

AGTAGCCACTTGG

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

b. Write the complementary strand in the 5' to 3' direction. (2 p)

10. What is the role of histone proteins in eukaryotic cells? (2 p)

11. DNA-polymerase I and DNA-polymerase III are both involved in replication of DNA. Which two functions are common to them, and what functions are unique to each of these enzymes? (4 p)

12. What is a telomere? In which organisms do they occur and what function do they serve? (3 p)

13. Base Excision Repair (BER) is a mechanism to repair DNA. Which are the steps involved in this process and what protein functions are involved? (3 p)

14. Which three sequence elements must be present on a plasmid to make it useful for cloning? (3 p)

15. Describe how transcriptional initiation is accomplished in E.coli? Your answer should include the sequence elements on DNA and the proteins involved in the process. (3 p).

16. Which processes and modifications occur as part of the synthesis and maturation of an mRNA molecule in eukaryots? Start your description at the stage when RNA-polymerase approaches the end of the gene. Finish your description when the mRNA is exported from the nucleus. (4 p).

17. There are four high energy bonds consumed for each amino acid added to a growing protein chain. Which are the three steps that consume this energy, and what occurs at each of them? Your answer should include the proteins involved in the process and the molecule contributing the high energy bonds. (6 p)

18. The lactose operon of *E. coli* provides an excellent example of how gene regulation is accomplished.

a. Describe what an operon is, and how the lactose operon is organized with regards to relevant sequence elements. (3 p)

b. Describe the two mechanisms governing expression of the lactose operon mRNA levels in relation to the presence of glucose and lactose in the growth medium. (4 p)

19. Below are twelve terms. Provide a brief (1-2 sentences) description for each of them. (1 p/term = 12 p total)

- a. S-phase
- b. Helicase
- c. Topoisomerase
- d. Reverse transcriptase
- e. Microarray
- f. Signal peptide
- g. Shine-Dalgarno sequence
- h. Wobble hypothesis
- i. Formyl-methionine
- j. Transposon

k. RNAi

l. Primase