Examination in Technical Biology (7.5 p)

December 19, 2009, kl 8.00-13.00. Vic 2. Points required to pass the exam 22 p.
Grading: (22-27.5) p = grade 3; (28-34.5) p = grade 4; (35-50) p = grade 5

Note: Hand in your answer in two separate cover paper according to:
A = Questions 1-4
B = Questions 5-13

---

1. a) Why is the intracellular pH reduced more effectively by acetic acid than hydrochloric acid?
    Explain.   (2 p)
    b) What happens to the generation time of the bacterium in 1a? Why?   (1 p)

2. Describe the microbial fate/response when salts or sugars are used as preservatives in food. Explain
    how some microbes adjust to the new environment.   (2 p)

3. Briefly describe how the structure of transfer RNA determines the amino acid specificity throughout
    protein synthesis.   (1 p)

4. When microorganisms are used in biotechnology for industrial purposes, products such as primary
    and secondary metabolites are produced. Explain the difference between them and exemplify each
    kind of metabolite with a product.   (3 p)

---

5. Proteins are constructed of 20 different amino acids. These amino acids can be divided into different
    groups according to the properties of their side chains (the R-group). For each of the following
    groups, write the chemical structure of one representative amino acid: (4 p)
    (a) Acidic amino acids
    (b) Basic amino acids
    (c) Aromatic amino acids
    (d) Aliphatic amino acids

6. Proteins have four levels of structures: primary, secondary, tertiary and quaternary. What are the
    most common secondary structures? Explain how these secondary structures are stabilized by
    different molecular interactions.   (3 p)

7. Protein purification: Describe three common methods for protein separation. Explain briefly why
    proteins can be separated with these methods.   (3 p)

8. For enzymes that follow the Michaelis-Menten kinetics, the reaction rate can be expressed by the Michaelis-Menten equation:

$$V = V_{max}[S] / (K_M + [S]) = k_{cat}[E_{tot}][S] / (K_M + [S])$$

What is the meaning of V_{max} and K_M? (2 p)

9. What is glycolysis? Describe briefly what is metabolized through glycolysis and what energy currency is produced by glycolysis. (3 p)

10. a) Citric Acid Cycle is also called Tricarboxylic Acid Cycle, why? (1 p)
    b) Give the names or structures of two intermediates in Citric Acid Cycle. (2 p)
    c) To what compound is Acetyl-CoA added to start the Citric Acid Cycle? (1 p)

11. During oxidative phosphorylation, NADH and $FADH_2$ are oxidized to NAD^+ and FAD, providing free energy to form ATP from ADP. This process involves a series of electron transport.
    (a) Where does the electron transport take place? (1 p)
    (b) In which protein complex are the electrons finally used to reduce oxygen to water? (1 p)
    (b) Explain how the electron transport from NADH to O_2 is coupled to ATP synthesis. (1 p)

12. Photosynthesis is composed of a Light reaction and a Dark reaction. Describe briefly what happens in the two different reaction processes? (3 p)

13. Enzymes are used in various practical applications. Describe one example of the practical use of enzyme and explain how the enzyme works in the particular application. (2 p)