HÖGSKOLAN
I SKÖVDE

TENTAMEN

Course Cell Biology

Sub-course

Course code bv108g

Credits for written examination 5.5

Date 2024-01-11

Examination time 08.30-12.30

Examination responsible Henrik Thilander

Teachers concerned

Aid at the exam/appendices Dictionary

Other

Instructions

- ☐ Take a new sheet of paper for each teacher.
- ☒ All answers are written in the exam.
- ☐ Write only on one side of the paper.
- ☒ Write your name and personal ID No. on all pages you hand in.
- ☐ Use page numbering.
- ☒ Don´t use a red pen.
- ☒ Mark answered questions with a cross on the cover sheet.

Grade points

The written examination will exam course objective 1-4. To pass the exam **all objectives** must be passed and to pass an objective you need ≥50% of the objective's score. If one or multiple objectives are graded fail (F) the written exam will receive the grade fail (F). If all objectives are passed, the total score of the exam will result in grade A-E according to this:

E: total score ≥50%
D: total score ≥60%
C: total score ≥70%
B: total score ≥80%
A: total score ≥90%

Examination results should be made public within 18 working days

Good luck!

Instructions

- Make sure that your answers are easy to understand and that they are written in a concise way. Make sure that the information is given in a logical order and is easy to follow.
- It is much easier to correct your exam in a fair way if you do not just write a lot of text but instead divide your answer in paragraphs and for-example give headings to the different paragraphs. If your answers are not easy to follow this will probably result in few points.
- Make sure that it is easy to read your handwriting. If it is not possible to read some parts of your answer you will automatically get 0 p on the whole question.
- If you make figures, be sure that these show exactly what you want them to show.
- Do not write things that is not relevant for the question. If you write non-relevant information just for show-off this can result in minus-points.
- If you are supposed to give a specific number of examples "extra" examples will not be corrected.
- If you need more space for answering a questions in the exam use the back-side of the paper belonging to the question.
- Make sure that you have written your name and social security number on **each** page!

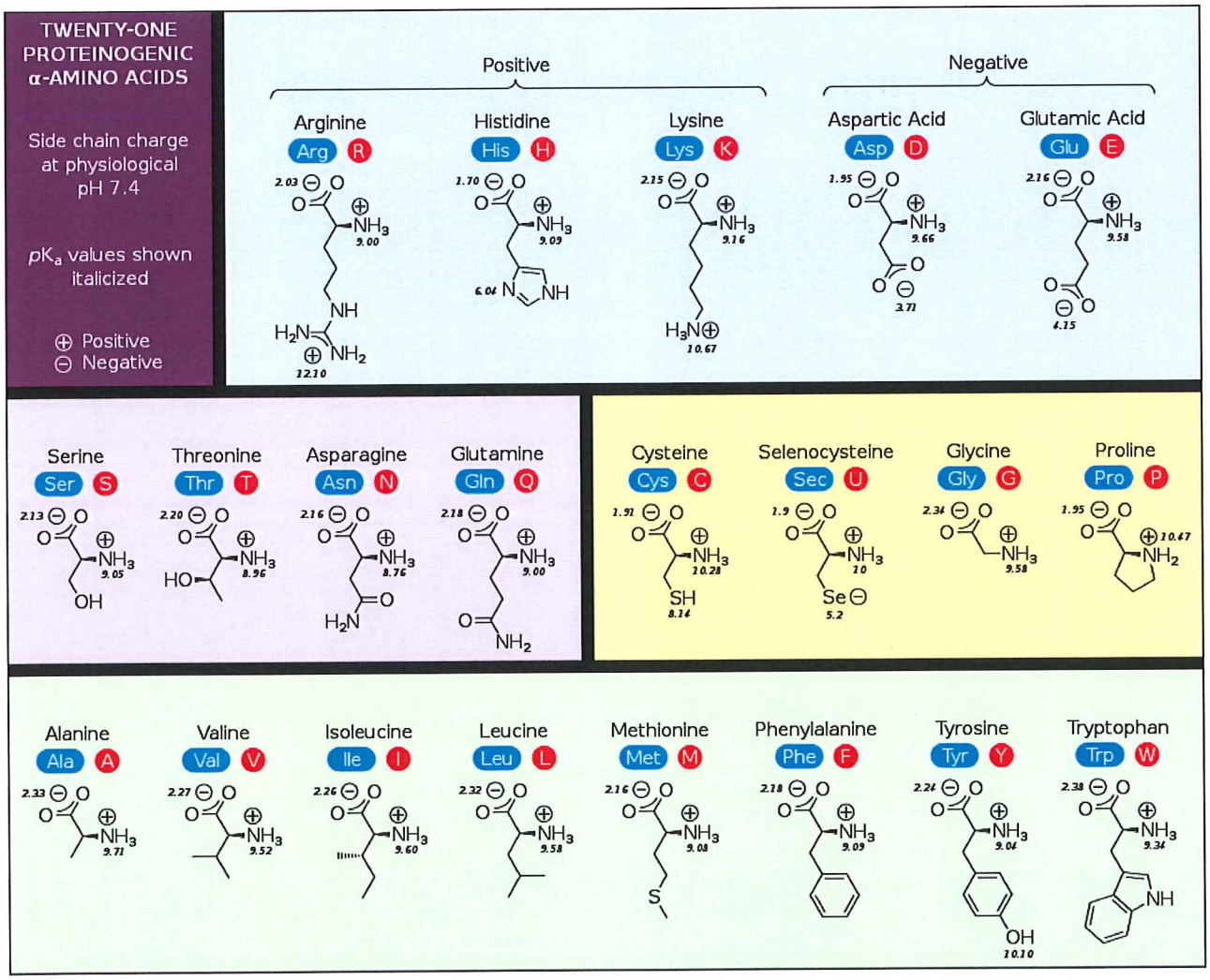
Good luck!

/Henrik

Name		Personal ID	

1. The tertiary structure of a protein can be held in place by different chemical bonds between the amino acids' sidechains. Name three types of bonds and give an example of two amino acids that can form the specific bond. Use the figure below as help to identify the amino acids. Both the name and the amino acids has to be correct for points. **(1 p for each chemical bond and amino acids that is entirely correct. Max 3 p)**

Chemical bond	Amino acid 1	Amino acid 2



Name		Personal ID	

2. What are phagocytosis and pinocytosis, respectively, and briefly explain their mechanisms of action. **(2 p)**

3. Briefly explain the following: **(2p)**
   a. Autophagy

   b. Hypotonic solution

   c. How unsaturated fatty acids affect the membrane fluidity

   d. Glycoprotein

4. Give a chemically and detailed explanation to why oxygen (O_2) can pass freely across the cell membrane while glucose cannot. **(3p)**

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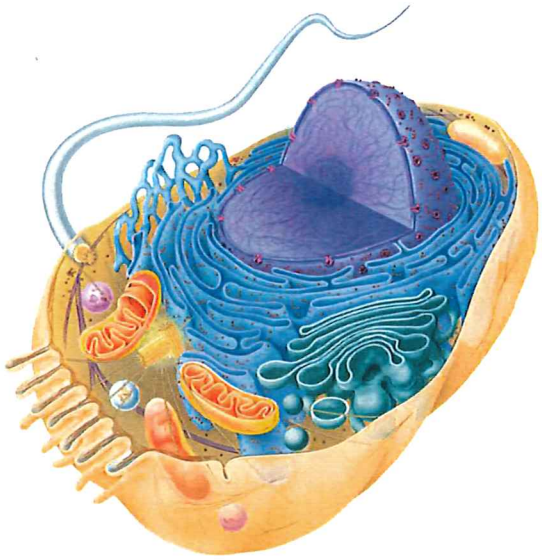
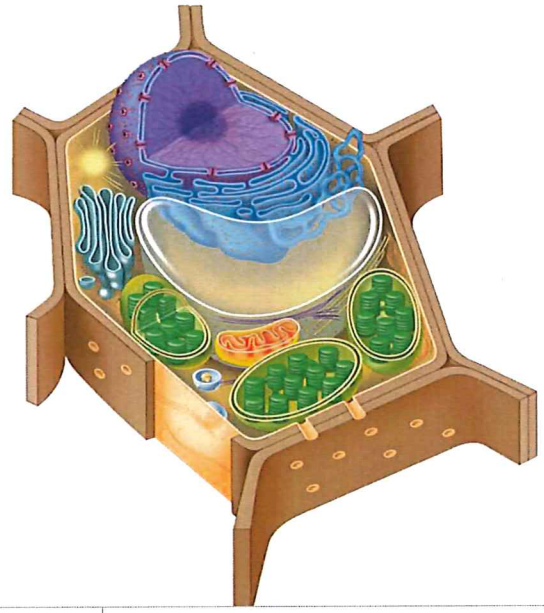
Name		Personal ID	

5. Which of the following cell structures can be found in animal, plant and prokaryotic cells, respectively? Mark your answers in the table below. **(0.5 p for each cell structure that is entirely correct. Max 0.5*8 p)**

Cell structure	Animal cell	Plant cell	Prokaryotic cell
Cell membrane			
Nucleus			
Chloroplasts			
Cell wall			
Endoplasmic reticulum			
Cytoskeleton			
Mitochondria			
Ribosomes			

6. In the table below you find six descriptions of cell structures (A-F). **(6 p)**
   - Name the cell structure that correspond to the description in the table
   - Mark where the cell structure is located in the cell/cells by drawing an arrow pointing at the structure. Do not forget to label the arrow/arrows with A-F.





Cell structure	Description	Structure name
A	Storage of water, organic- and inorganic substances.	
B	Involved in cell division, contains two centrioles and organizes microtubules.	
C	Manufacture proteins to be secreted or attached to membranes.	
D	Contains hydrolytic enzymes and assists in phagocytosis	
E	Responsible for cellular respiration and production of ATP.	
F	Give cells rigidity, strength and protect them against mechanical stress	

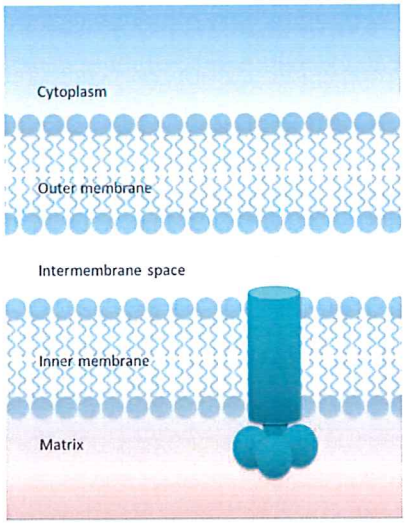
Name		Personal ID	

7. Serum albumin is a protein secreted by hepatocytes (liver cells). Give a detailed explanation of the cell's production of this protein, and your explanation has to include where the protein is produced, how the protein is transported in the cell, organelles or structures involved and how the protein is secreted. **(4 p)**

8. What is the function of the light reaction in chloroplasts? **(1 p)**

9. Briefly explain the function of the following terms/components. **(2 p)**
   a. Coenzyme A
   b. NAD^+
   c. Glycolysis
   d. Catabolism

10. The majority of the ATP molecules are produced in the mitochondrion using a specific enzyme. What is the name of the enzyme and explain how the enzyme can generate ATP. You can use the figure on the right to draw and explain this process. **(3 p)**



Name		Personal ID	

11. Name in order and briefly explain the three stages of cell signaling. **(3 p)**

12. A cell uses both transmembrane receptors and intracellular receptors. **Draw and explain** the difference between a transmembrane receptor and an intracellular receptor. Do only include information about the two points described below. **(4 p)**
    - Where are the different receptors located and what is the purpose with the location?
    - What types of signals do the receptors detect and what kind of chemical properties has the different signals?

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Answer the following six questions by making a circle around the correct alternative.

13. What is the second messenger in this pathway? Epinephrine → G-protein-linked receptor → G-protein → adenylyl cyclase → cAMP **(0.5 p)**
    a. G-protein-linked receptor.
    b. G-protein.
    c. GTP.
    d. adenylyl cyclase.
    e. cAMP.

14. What is the role of phosphatases in cell signaling? **(0.5 p)**
    a. Phosphatases facilitate receptor internalization.
    b. Phosphatases are not involved in cell signaling.
    c. Phosphatases activate signaling pathways.
    d. Phosphatases amplify the signal strength.
    e. Phosphatases dephosphorylate proteins.

15. When epinephrine binds to cardiac (heart) muscle cells, it speeds their contraction. When it binds to muscle cells of the small intestine, it inhibits their contraction. How can the same hormone have different effects on muscle cells? **(0.5 p)**
    a. Cardiac cells have more receptors for epinephrine than do intestinal cells.
    b. Epinephrine circulates to the heart first and thus is in higher concentration around cardiac cells.
    c. The two types of muscle cells have different signal-transduction pathways for epinephrine and thus have different cellular responses.
    d. Cardiac muscle is stronger than intestinal muscle and thus has a stronger response to epinephrine.
    e. Epinephrine binds to G-protein-linked receptors in cardiac cells, and these receptors always increase a response to the signal. Epinephrine binds to tyrosine-kinase receptors in intestinal cells, and these receptors always inhibit a response to the signal.

16. What is a ligand? **(0.5 p)**
    a. An intracellular signaling molecule influencing the production of cyclic AMP.
    b. A small membrane-bound protein generating important signals within the cell.
    c. An enzyme that hydrolyzes GTP to GDP.
    d. A molecule that attaches to a receptor, triggering changes within the cell.
    e. A secreted hydrophobic molecule.

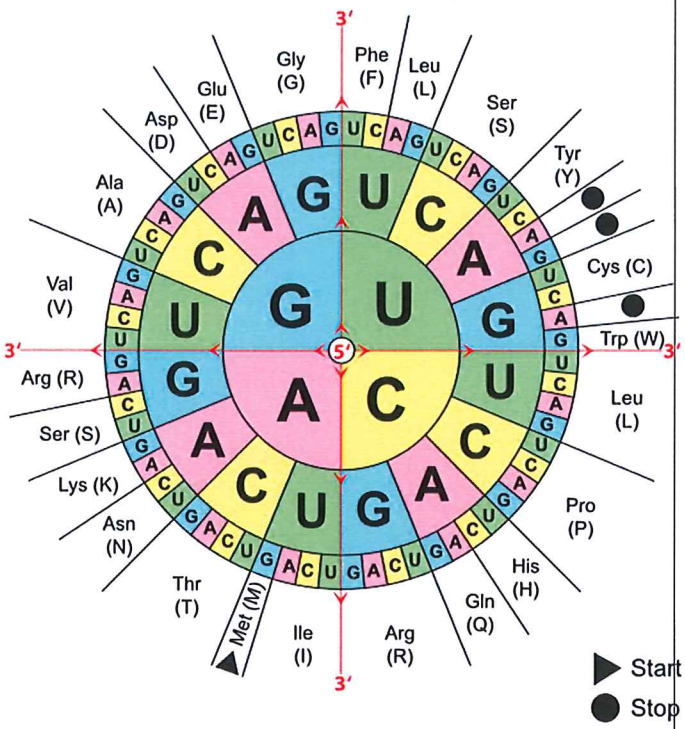
17. Once phosphorylated, the intracellular segment of a receptor tyrosine kinase? **(0.5 p)**
    a. Allows docking of intracellular proteins involved in signal transduction.
    b. Terminates intracellular signaling cascades.
    c. Activates adenylate cyclase.
    d. Causes dissociation of the ligand from an allosteric binding site.
    e. Initiates the breakdown of extracellular matrix proteins.

18. When a cell releases a signal molecule into the environment and a number of cells in the immediate vicinity respond, this type of signaling is? **(0.5 p)**
    a. Paracrine signaling.
    b. Typical of hormones.
    c. Autocrine signaling.
    d. Endocrine signaling.
    e. Synaptic signaling.

Name		Personal ID	

19. You have the following DNA-strands. A gene is activated (the template DNA is marked in blue) and will generate a mRNA which will in its turn generate a protein.
5′-CGGACAAGTCATGTTTTATATTAGCAAATGTTGAGTACGTTAGGCA-3′
3′-GCCT**GTTCAGTACAAAATATAATCGTTTACAACTCAT**GCAATCCGT-5′

Write the correct mRNA sequence (label the ends correctly) as well as the amino acid sequence that will be generated. **(5p)**



20. Human mRNA can be modified in a process called alternative splicing. Explain in detail what alternative splicing is. **(2p)**

21. Briefly explain the function of the following terms/components **(3 p)**
    a. Silent mutation

    b. Promoter

    c. Poly-A tail

    d. Ribozyme

    e. Anticodon

    f. Coupled transcription and translation