UNIVERSITY
OF SKÖVDE

School of Bioscience

WRITTEN EXAMINATION

Course Biochemistry

Examination Supervised written examination

Course code Ke314G | Credits for written examination 3

Date 2025-03-03 | Examination time 14.15-18.30

Examination responsible Patric Nilsson/Mikael Ejdebäck

Teachers concerned

Aid at the exam/appendices: Calculator

Other: all answers must be given in the exam sheet. Answers on extra/additional sheets will not be considered.

Instructions

- ☐ Take a new sheet of paper for each teacher.
- ☐ Take a new sheet of paper when starting a new question.
- ☒ 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: To pass the exam, all learning objectives require the grade E or higher. To pass a learning objective, 50% correct answers are required

F<25 <= E < 30 <= D < 35 <= C < 40 <= B < 45 <= A

Examination results should be made public within 18 working days

Good luck!

Total number of pages

Course code: KE314G
Date: 2025-03-03
Location: G203

Important information regarding the exam:

The supervised written exam examines two objectives in total:

- describe the metabolism of carbohydrates, proteins and fats, and its regulation and integration, (40p in total)
- be able to describe the role of proteins as catalysts and perform enzyme kinetic analyses and calculations (10p in total)

To pass the supervised written exam, both learning objectives require the grade E or higher. To pass a learning objective, at least 50 % correct answers are required.

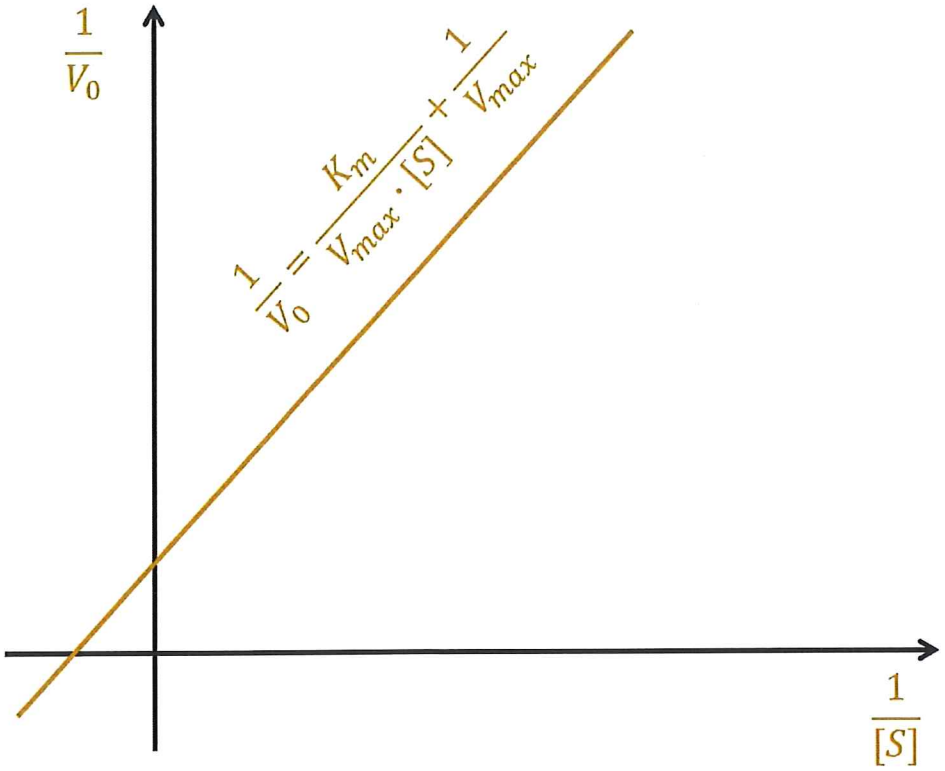
Important things to keep in mind while writing the exam: The teacher who corrects the exam is not a mind-reader. This means that you need to show every step in your calculations and all information required for a complete graph, otherwise it is very difficult or even impossible to follow your line of thinking. In the end, this will make a huge difference in the number of points you get on a question if you, by chance, make a simple mistake. It is strongly recommended that you make a flow-chart with all steps required to solve a question before you jump into your calculations.

All answers and calculations should be given in this exam sheet. No additional or extra sheets are allowed. Answers given on an extra sheet will not be considered.

Most importantly, believe in yourself. There are no surprises in this exam. We have talked about all the things over and over again.

Good luck

Patric and Mikael

Learning objective: be able to describe the role of proteins as catalysts and perform enzyme kinetic analyses and calculations. To pass the learning objective, 50% correct answers are required. (5 out of 10p is required)		
1	Based on the figure below (a Lineweaver-Burk plot), explain how you, mathematically, can derive V_{max} and K_M 	5

2	The enzyme Commission number (EC number) is a numerical classification scheme for enzymes based on the chemical reactions they catalyze. According to this system there are 7 main classes a) Which ones	1.75
	b) Exemplify each class with an enzyme	1,75
3	Explain how citrate synthase (in Krebs cycle) is allosterically regulated	1.5

Learning objective: describe the metabolism of carbohydrates, proteins and fats, and its regulation and integration. To pass the learning objective, 50% correct answers are required. (20 out of 40p is required)		
4	During glycogenesis, glucose is converted into branched polysaccharide, glycogen. This question is focused on the different steps in glycogenesis a) In one of the first steps during glycogenesis, glucose-6-phopsphate is converted to the precursor molecule of glycogen by the activity of phosphoglucomutase. What is the name of this precursor molecule?	0.5
	b) In the next step, the precursor in question (a) is fused with another molecule, which?	0.5
	c) What is the name of the molecule formed when the precursor in question (a) is fused with the molecule in question (b)?	0.5
	d) Explain the role of pyrophosphate in glycogenesis?	1
	e) What is the name of the protein that is required to connect molecules of the molecule in question (c)?	0.5
	f) After the initial steps in question (e), the activity of two important enzymes is required. What are the names of these two enzymes?	1
	g) The enzymes in question (f) connect the molecules synthesized in question (c) by making different bonds. Which bonds are specific for the two enzymes in question (f)?	1

	h) The conversion of glucose to glucose-6-phosphate requires the activity of glucokinase (in the liver). Explain how the activity of glucokinase is regulated allosterically and hormonally	3
5	In biochemistry, all metabolic pathways lead to the Krebs cycle and the generation of most of the NADH and $FADH_2$. NADH and $FADH_2$ in turn, deliver the electrons to the electron transport chain. This question pinpoints different aspect of the Krebs-cycle and the electron transport chain. a) In which steps are NAD+ reduced to NADH in Krebs cycle?	1,5
	b) In which step is FAD reduced to $FADH_2$?	1
	c) In which step is ATP Produced?	1

	d) In addition to, NADH and $FADH_2$ there are several important electron carriers/transporters in the electron transport chain contributing to the formation of ATP. Which ones?	1
	e) Explain how the Pyruvate dehydrogenase complex is regulated by the PDH kinase and the PDH phosphatase	3,5
6	During β-oxidation, long fatty acids are oxidized in several rounds. For each round it undergoes β-oxidation, the carbon chain of the fatty acid becomes 2 carbons shorter a) β-oxidation involves 4 steps, Which ones?	2

	If a 14-carbon saturated fatty acid undergoes β-oxidation b) How many rounds of beta-oxidation does it undergo?	0,5
	c) How many NADH are generated in total (the NADHs generated in the Krebs-cycle from acetyl-CoA should be included)?	0.5
	d) How many $FADH_2$ are generated in total (the $FADH_2$s generated in the Krebs-cycle from acetyl-CoA should be included)?	0.5
	e) How many acetyl-CoA molecules are generated?	0.5
	f) How many ATP are generated in total from a 14-carbon saturated fatty acid (you can exclude the ATP needed to trap the fatty acid)?	3

	g) Explain how the mobilization of free fatty acids from triglycerides (in adipocytes) are hormonally regulated by glucagon, epinephrine, and norepinephrine. Your answer should also involve the key second messengers participating the mobilization.	4
7	This question is associated with different aspects of nitrogen metabolism (amino acid catabolism and anabolism). a) Two amino acids are strictly ketogenic, Which ones?	1
	b) Four amino acids are considered to be glucogenic and ketogenic. Name two of them	1
	c) Amino acids can by synthesized from derivates of the pentose-phosphate pathway, glycolysis as well as the citric acid cycle. Give one example from each pathway.	1

8	This question is associated with transamination and oxidative deamination a) Explain the role of pyridoxal pyrophosphate in transamination	2
	b) Explain oxidative deamination?	2

	c) Why are high levels of NH_4^+ dangerous? In other words, why is it important to regulate and keep the levels of NH_4^+ low?	1
	d) Which metabolic pathway is responsible for metabolizing the ammonium ion?	1
9	As a result of endurance training, a number of cardiovascular adaptions will occur. a) Which ones?	2
	b) There are five major classes of second messengers involved in the transfer of information during exercise important. Name four classes and give one example from each class.	2