UNIVERSITY
OF SKÖVDE

Cover sheet with information to the invigilator

School of Bioscience

Course Biochemistry

Examination Supervised written examination

Course code Ke314G

Credits for written examination 3

Date 2024-01-09

Examination time 8.15-11.30

Available teacher Patric Nilsson

Available on phone number 0702274574

Visiting the examination ☐ Yes, at
☒ No

Aids and other information for invigilators

Calculator ☒ Provided by the University
☒ Student's own calculator
☐ Not allowed

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Instructions to examinations responsible

All examination documents are to be handed in at Reprocentralen.

- **For copying of examination papers** the originals must be handed in no later than 6 workdays before the examination. The number of copies is filled in by Reprocentralen in the field below.
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UNIVERSITY
OF SKÖVDE

School of Bioscience

WRITTEN EXAMINATION

Course Biochemistry

Examination Supervised written examination

Course code Ke314G | Credits for written examination 3

Date 2024-01-09 | Examination time 8.15-11.30

Examination responsible Patric Nilsson/Mikael Ejdebäck

Teachers concerned

Aid at the exam/appendices

Other All answers should be given in the exam sheet. 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 All learning objectives require the grade E or higher. To pass alearning 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

Supervised written examination (Biochemistry)

Course code: KE314G

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

To pass the supervised written exam, all 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 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

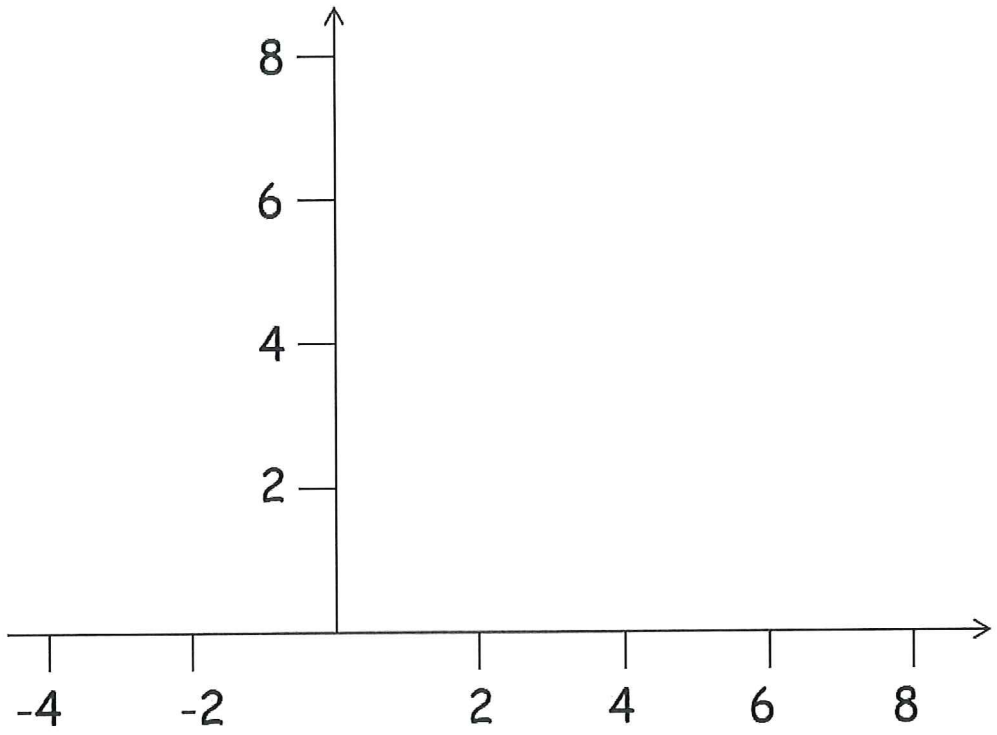
	Learning objective: *be able to describe the role of proteins as catalysts and perform enzyme kinetic analyses and calculations. To pass the learning objective, 50% correct answers are required. (5 out of 10p is required)*	
1	The reaction between nicotinamide mononucleotide and ATP to form nicotinamide-adenine dinucleotide and pyrophosphate is catalysed by the enzyme nicotinamide mononucleotide adenylyltransferase. The following table provides typical data obtained at pH of 4.95. The substrate, S, is nicotinamide mononucleotide and the initial rate, v, is the μmol of nicotinamide-adenine dinucleotide formed in a 1-minute reaction. Use the Lineweaver-Burk plot $$\frac{1}{v} = \frac{K_M + [S]}{V_{max}[S]} = \frac{K_M}{V_{max}} x \frac{1}{[S]} + \frac{1}{V_{max}}$$ For the following data	

[S] (mM)	V (μmol/min)		
0.138	0.148		
0.220	0.171		
0.291	0.234		
0.560	0.324		
0.766	0.390		
1.460	0.490		

to determine

a) Plot the data in the diagram and determine $\mathbf{V_{max}}$ and $\mathbf{K_M}$ for nicotinamide mononucleotide adenylyltransferase. Write the correct variables and units in the table and on both axes in the plot below

6p



b) If you introduce a competitive inhibitor to the system, how would that affect K_M and V_{max}. Also, explain why or why not you would expect any changes to V_{max} and/or K_M. 2p

2	Pyruvate kinase is an enzyme that catalyses the conversion of phospho-enolpyruvate (PEP) to Pyruvate. Explain how this enzyme is allosterically and hormonally regulated	2p

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)*

3.	Long fatty acids undergo β-oxidation to produce energy a) Explain the four steps involved in β-oxidation	4p

	b) How much ATP would you expect from a 16-carbon fatty acid? (1 NADH = 2.5 ATP, 1 FADH2 = 1.5 ATP). Explain your answer.	3p
4.	Animals store glucose as glycogen in a process called *glycogenesis*. Explain a) in detail how glucose, in a step by step process, is converted in to a branched structure we call glycogen. Your answer should include 4 enzymes and all molecules important for the formation of glycogen.	4p

	b) What bonds do we find between the glucose molecules?	1p
	c) Similarly, explain in detail how we can mobilize glucose from glycogen (glycogenolysis). Your answer should include all molecules and 4 enzymes	4p

5.	During pro-longed starvation, we utilize proteins to produce energy Explain a) how we can generate ATP from amino acids (use Alanine as an example)	5p

b) during this process, glutamate is formed and when glutamate is converted to α-ketoglutarate NH_3 forms. Why is NH_3/NH_4^+ toxic? 2p

c) Explain how NH_4^+ is neutralized in the Urea cycle? 4p

6.	Under aerobic conditions, one molecule of glucose is converted to two molecules of pyruvate. Pyruvate is then, in the transition step, converted into Acetyl-CoA. a) Explain how Acetyl-CoA enter the citric acid cycle	1p
	b) Explain each step of the citric acid cycle and highlight where NADH, FADH2, and GTP (quickly converted into ATP) are produced	5p

c) The NADH produced during glycolysis cannot diffuse into the mitochondria. Explain how NADH enters the mitochondria — 2p

d) How much ATP is produced from one glucose molecule (1 NADH=2.5 ATP, 1 FADH2 = 1.5 ATP) — 2p

7.	Explain the signal transduction hypothesis of how cells respond and adapt to endurance training	3p