

BACHELOR I TRENING, HELSE OG PRESTASJON 2023/2026

INDIVIDUAL HOME EXAM

IN

THP 301- CELL BIOLOGY

Information

- Start of exam: Friday December 12. 2025 at 10.00 a.m
- Final deadline: Friday December 12. 2025 at 2.00 p.m. in WISEflow
- Answer in English or Norwegian • The submission must be in pdf format.
- Exam results will be available within four weeks from the exam date: 09th of January 2026

Aids: When using AI tools

According to APA-7 in the chapter on AI-generated text, you should briefly describe how you have used the tool. In addition, you should attach a screenshot of your chat as an attachment.

Exam criteria

- There are 4 main questions from 4 of the main topics covered in the Cell Biology Course. Each question contains 2-3 sub-questions (for example a, b and / or c).
- Each main question is worth 25 marks (25 marks x 4 questions = 100 Marks in Total).
- Exam is graded A-F.
- Students should spend approximately 1 hour on each main question (4 hours in total).
- *Any resources ARE allowed to be used in the HOME exam.*
- *All exams will be subject to plagiarism checks.*
- Answers can be in English or Norwegian, although the course is delivered in English (international students enrolled on course, exam questions are therefore in English, therefore the students typically submit in English).

Exam Questions

Question 1

Topic- What is Cellular / Molecular Exercise Physiology and the 'signal transduction theory' of exercise adaptation.

Learning objective: Know-how and explain how exercise creates extracellular signals outside cells that lead to activation of receptors/channels and subsequent intracellular signalling, gene expression and changes in protein levels within cells.

- a) Provide a short definition for: What is 'molecular exercise physiology'? (3 marks)
- b) What is gene transcription (also termed mRNA or gene-expression)? In your answer, briefly explain what process the term gene transcription is describing. (5 marks)
- c) Explain, in order, the stages involved in the overarching molecular response to exercise. From the exercise 'signal' through to changes in the amount of protein produced by the cell. Refer to at least 1 main example for each stage. One example of an exercise 'signal' would be an increase in calcium in the muscle. Therefore, in your answer you may want to explain what causes an increase in this type of exercise 'signal', what are the molecular 'sensors' that detect a change in this signal, and what are the ensuing extracellular/intracellular responses leading to alterations in gene transcription and protein translation. Note- You can use any example of an exercise signal (i.e., you do not have to use calcium). (17 marks)

Question 2

Topic- Molecular Regulation of Adaptation to Resistance Exercise (and Hypertrophy)

Learning objective: Understand, explain and discuss the molecular adaptation to resistance exercise.

- a) List the main molecular pathway or cellular processes involved in 'positively' effecting muscle mass. (3 marks)
- b) List the main pathway/pathways involved in 'negatively' effecting muscle mass. (3 marks)
- c) Describe the mTORC1 pathway and how it activates protein synthesis via its downstream signalling. In your answer then go onto discuss how mTORC1 'senses' mechanical load and how it is thought to convert this mechanical signal (e.g. after resistance exercise in humans or mechanical overload in animal models) into a molecular signal. You should use examples from the research literature, using human resistance exercise studies and/or rodent models (e.g. synergistic ablation) to support your answer. (19 marks)

Question 3

Topic –Molecular Regulation of Endurance Exercise Adaptation

Learning Objective: Understand, explain and discuss the molecular adaptation to endurance exercise.

- a) What are the aerobic exercise 'signals' that activate the molecular 'sensors': CAMKII, AMPK and SIRT1? (3 marks)
- b) Briefly outline the timeline of endurance exercise adaptation in terms of cell/molecular signalling through to physiological and phenotypic changes. For example, describe the main molecular signal(s) & sensors for endurance exercise. Then what happens to the 'master' regulator PGC1-alpha and associated metabolic/mitochondrial genes. Finally, discuss how PGC1-alpha alters gene expression and how these changes cause adaptation to mitochondria and ultimately endurance performance. You need to use examples from at least 2 original research articles to support your answer referring to exercise intensity and how this may affect the above molecular pathways (22 marks).

Question 4

Topic - Epigenetics of Exercise (and muscle memory)

Learning Objective: Understand, explain and discuss the epigenetics of resistance and endurance exercise.

- a) Describe what is currently known about how DNA methylation may be involved in regulating the response and adaptation to high-intensity interval exercise and training (HIIT) and/ or sprint interval exercise/training- SIT). For example, how does HIIT / SIT effect DNA methylation across the entire genome, what molecular gene pathways demonstrate altered DNA methylation following acute and chronic HIIT/ SIT exercise training (5 Marks).
- b) Describe and critically discuss the concept of skeletal muscle possessing an epigenetic “memory.” In your answer, explain what is meant by epigenetic muscle memory and summarise the main research studies that have investigated this phenomenon. Your discussion should outline the study designs, key findings, and interpretations, and consider how these studies collectively support or challenge the role of epigenetics in muscle memory. Higher marks will be awarded for answers that integrate evidence from multiple studies, evaluate temporal patterns such as train–detrain–retrain models, and reflect on broader implications for muscle adaptation across different contexts, including muscle wasting/atrophy, aging, disease, and the use of advanced technologies in this field. (20 Marks)