NORGES IDRETTSHØGSKOLE

BACHELOR I TRENING, HELSE OG PRESTASJON 2020/2023

INDIVIDUAL WRITTEN HOMEEXAM

IN

THP 301- CELL BIOLOGY

Start of exam*:* **Friday 9 December 2022 at 10.00 a.m**

Final deadline: **Friday 9 December 2022 at 2.00 p.m. in WISEflow**

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.

You 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 in ENGLISH.

Question 1

Topic- What is Cellular / Molecular Exercise Physiology?

a) Provide a short definition for: What is 'molecular exercise physiology'? (2 marks)

b) What is gene transcription (also termed mRNA or gene-expression)? In your answer, briefly describe the process of gene transcription. (6 marks)

c) Define each step in the 'signal transduction hypothesis' for the molecular responses to acute exercise. In your answer, describe and explain the exercise 'signal' through to changes in the amount of protein produced by the cell. Refer to at least one example for each step (17 marks).

Question 2

Topic- Cellular / Molecular Regulators of Resistance Exercise and Hypertrophy

a) List the names of the main molecular pathways involved in 'positively' and 'negatively' effecting muscle mass. (4 marks)

b) Describe how satellite cells contribute to skeletal muscle repair. In your answer, you can describe what a satellite cell is, where it's located in skeletal muscle tissue and how the satellite cell undergoes the cycle of myogenesis to contribute to repair of muscle. (7 marks)

c) Describe the mTOR pathway and how it activates protein synthesis after resistance exercise via its downstream signalling. In your answer, briefly explain the 'upstream' signals that can activate mTOR. Then discuss how mTOR 'senses' mechanical load and how it is thought to convert this mechanical signal 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. (14 marks)

Question 3

Topic – Cellular / Molecular Regulators of Endurance Exercise

a) After a bout of endurance/aerobic exercise list the main molecular 'sensor' for each of these exercise 'signals': 1) Calcium, 2) ADP/AMP levels, 3) ROS and/or NAD/NADH levels. (3 marks)

b) Define autophagy and mitophagy, and briefly describe how these processes might support mitochondrial quantity and reticulum quality after exercise (7 marks).

c) Describe the time-course of molecular responses through to physiological adaption following endurance exercise and training. For example, describe the main molecular signal(s) & sensors for endurance exercise. In your answer you should include the role of the so called 'master' regulator of endurance adaptation, PGC1-alpha, and associated metabolic/mitochondrial genes. You should also discuss how PGC1-alpha alters nuclear and mitochondrial gene expression after exercise and how these changes cause adaptation to mitochondria and ultimately endurance performance. You should use original research articles to support your answer, for example, how exercise intensity and other exercise parameters may affect the above molecular pathways (15 marks).

Question 4

Topic - Epigenetics of Exercise

a) What is epigenetics? Define epigenetics, and list some of the main epigenetic modifications. Finally, briefly describe how the epigenetic modification of DNA methylation regulates gene expression. (5 marks)

b) Describe what is currently known about how DNA methylation may be involved in regulating the response and adaptation to resistance exercise. For example, what does resistance exercise do to DNA methylation across the entire genome, what

overarching molecular pathways demonstrate altered DNA methylation following acute exercise or chronic resistance training. (7 Marks)

c) Skeletal muscle has been proposed to possess an epigenetic memory of earlier exercise. In this context, define what muscle memory is. Describe and discuss studies that have demonstrated epigenetic muscle memory in the literature and discuss potential future implications for the research into epigenetic muscle memory (13 marks).