NORGES IDRETTSHØGSKOLE

BACHELOR I TRENING, HELSE OG PRESTASJON 2020/2022

INDIVIDUAL WRITTEN HOMEEXAM (RE-EXAM)

IN

THP 301- CELL BIOLOGY

Start of exam*:* **Tuesday 15 February 2022 at 10.00 a.m**

Final deadline: **Tuesday 15 February 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.

They should spend approximately 1 hour on each main question (4 hours in total).

Answers in ENGLISH.

Please note: Remember that the submission must be in pdf format.

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 protein translation? In your answer, briefly explain what process the term protein translation is describing and briefly explain the steps that lead to an increase in protein translation following an increase in gene expression (mRNA) (8 marks).

c) Explain, ideally 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 levels. Note- You can use any example of an exercise signal (i.e., you do not have to use calcium). (15 marks).

Question 2

Topic- Cellular / Molecular Regulators of Resistance Exercise and Hypertrophy

a. Describe and explain the 3 key cellular mechanisms that contribute to muscle growth of both developing and mature adult muscle. These include: 1. Hyperplasia, 2. Fusion of satellite Cells and 3. Increased myonuclear domain size (5 marks)?

b. Explain the effects that reduced myostatin-Smad2/3 signalling has on muscle size, strength and quality (7 marks).

c. Describe the mTOR pathway and how it activates protein synthesis via its downstream signalling. In your answer then go onto discuss how mTOR '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. (13 marks)

Question 3

Topic – Cellular / Molecular Regulators of Endurance Exercise

a) What are the aerobic exercise 'signals' that activate the molecular 'sensors': CAMKII, AMPK and SIRT1? (5 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 (20 marks).

Question 4

Topic - Epigenetics of Exercise

a) What is DNA methylation? Describe the process of DNA methylation, and how DNA methylation regulates gene expression (4 marks)

b) Describe what is currently known about how DNA methylation may be involved in regulating the response and adaptation to aerobic and resistance exercise. For example, what does aerobic and resistance exercise do to DNA methylation across the entire genome, what overarching molecular pathways demonstrate altered DNA methylation following acute exercise or chronic exercise training. Note- you can also

use examples from exercised, healthy, diseased, aged/patient groups if required (10 Marks).

c) Describe and discuss what is meant by muscle possessing an **epigenetic 'memory' of exercise and / or muscle growth** referring to what original research studies have demonstrated in the literature to date. Note- you can refer to cell memory or myonuclei retention to support your answer, however this would only be to enable your discussion on epigenetic memory as the main focus of your answer (11 Marks)