NORGES IDRETTSHØGSKOLE

BACHELOR I TRENING, HELSE OG PRESTASJON 2020/2023

INDIVIDUAL WRITTEN HOMEEXAM (RE-EXAM)

IN

THP 301- CELL BIOLOGY

Start of exam*:* **Tuesday February 14, 2023 at 10.00 a.m**

Final deadline: **Tuesday February 14, 2023 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.

Question 1

Topic- What is Cellular / Molecular Exercise Physiology?

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 if possible, 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). (17 marks)

Question 2

Topic- Cellular / Molecular Regulators of Resistance Exercise and Hypertrophy

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. (2 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. (20 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. (5 marks)

b) Describe what is currently known about how DNA methylation may be involved in regulating the response and adaptation to aerobic exercise. For example, what does aerobic exercise do to DNA methylation across the entire genome, what overarching molecular pathways demonstrate altered DNA methylation following acute aerobic exercise or chronic exercise training. Note- you can also use examples from diseased/aged/patient groups given there are only a few studies investigating healthy young adults. (10 Marks)

c) Describe what is currently known about how DNA methylation may be involved in regulating the response and adaptation to resistance exercise. Discuss what is

meant by muscle possessing an **epigenetic 'memory'** referring to original research studies in your answer. Note- you do not need to discuss cell memory or myonuclei retention in your answer as this is not an epigenetic modification. (15 Marks)