TAMPERE UNIVERSITY, Faculty of Medicine & Health Technology

ORGANELLES & THEIR INTERACTIONS

BTK4331

RESIT (II) EXAMINATION 2019

Time: 3 Hours

Wednesday 20 November: time and place as advised by University Examinations Service.

- *Answer all questions in Section A, all questions in Section B and ONE question in Section C*
- *Each section carries one-third of the total marks*
- *In Section A all 10 questions carry equal marks. In questions with multiple choice format, the number of correct answers is as indicated, or is left open. Read each such question carefully.*
- *In Section B all 3 questions carry equal marks.*

Use clear diagrams to illustrate your answers, where appropriate.

SECTION A

1. Estimate the molecular weight of a Drosophila polytene chromosome. (Show your working).

2. Which of the following proteins is (or are) involved in shaping the higher-order structure of the actin microfilament network in the eukaryotic cell:

(a) filamin
(b) α-actinin
(c) vinculin
(d) flagellin

3. Name one human disease or class of diseases caused by a defect in a structural component of the nucleus.

4. Microtubule plus- and minus-ends are so-called because:

(a) they always grow from the plus end and shorten from the minus end
(b) the plus-end carries positive charges and the minus-end negative charges
(c) motor proteins always move towards the plus-end
(d) none of these reasons

5. Which ONE of the following statements about SNARES is correct:

(a) Two classes of v-SNARE can interact to promote membrane fusion.
(b) All SNARE-mediated vesicle and organelle fusion is heterotypic.
(c) SNARE complexes are disassembled by NSF.
(d) Mitochondrial fusion is brought about by a specific class of SNARES.

6. Distinguish between: importins, exportins, karyopherins and nucleoporins.

7. Which ONE of the following statements about the Mia40 protein import pathway is correct:

(a) The Mia40 protein import pathway does not depend on the TOM complex in any way.
(b) Mia40 acts as a donor of acetyl groups to proteins destined for the intermembrane space.
(c) The reoxidation of the cysteine groups of Mia40 passes electrons to the mitochondrial electron transport chain.
(d) Electrons are passed from the mitochondrial electron transport chain to Mia40, to break internal disulfide bridges of proteins imported to the intermembrane space.

8. Name one molecular technique that can be used to answer EACH of the following:

(a) the copy number per cell of mtDNA
(b) the morphology of mitochondrial cristae in *Chlamydomonas reinhardtii*
(c) the identity of the gene products required for mitochondrial protein import in *C. elegans*.
(d) the kinetics of mitochondrial hyperfusion in HeLa cells

9. Name a bacterial homologue of (a) tubulin (b) actin and (c) an intermediate filament protein.

10. Protein delivery into the ER is driven by ATP-dependent cycles of binding of which of the following molecular chaperones:

(a) mitochondrial Hsp70
(b) Hsp60
(c) cytosolic Hsp70
(d) BiP

END OF SECTION A

SECTION B

Answer each question. A maximum of 200 words (and/or clear diagrams), is usually sufficient to answer each question.

11. What is a scramblase and why is it necessary?

12. Many genes found in the mtDNA of *Reclimonas* are said to have migrated to the nucleus in the course of evolution of yeast and animals (Alberts, p. 801). What are the genes in question, and explain how would you test this proposition.

13. The malaria parasite *Plasmodium* has two organelle genomes. In bullet point format, state their major features, evolutionary origins and physiological functions.

END OF SECTION B

SECTION C

Write an essay on ONE of the following topics (no more than ~3000 words):

14. What would be required to engineer all of the mtDNA-encoded proteins for nuclear/cytoplasmic expression instead, and what would be the advantages and disadvantages of doing this? Why has it never actually happened in the course of eukaryote evolution?

15. Select one key metabolite found in mitochondria and discuss what is known about its synthesis, degradation, biological uses, transport and pathology, both inside and, if appropriate, outside of mitochondria.