

DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY

521-303 – MOLECULAR ASPECTS OF CELL BIOLOGY

**EXAM DURATION:** Three (3) Hours

**READING TIME:** Fifteen (15) Minutes

**COMMON CONTENT:** No

This paper contributes 80% of the total assessment for 521-303

**THIS PAPER HAS 4 PAGES**

**Authorized Materials:**

No specific materials are authorized.

Calculators are permitted but not required. No other special accessories necessary.

**Instructions to Invigilators:**

Please supply six (6) 6-page Examination Booklets.

**Instructions to Students:**

Attempt **ALL** six (6) questions

Use a SEPARATE script book for **EACH** section

**Total Marks for the paper: 120**

**This paper may be lodged with the Baillieu Library**

**USE A SEPARATE ANSWER BOOKLET FOR EACH QUESTION**

**Question 1 (suggested time 30 minutes)**

(a) Define the function and describe the location of the following components in the eukaryotic cell:

- \*  $\alpha$ -importin
- \* t-SNARE
- \* Tom20
- \* BiP
- \* Nef
- \* Sec63
- \* Hsp60/Cpn60

**(14 marks)**

(b) Explain the role of Sar1 in regulating the assembly and disassembly of COP-II coats. What experimental evidence supports this model? Include in your answer a definition of non-hydrolysable GTP analogs.

**(6 marks)**

**(20 marks total)**

**Question 2 (suggested time 30 minutes)**

(a) In one or two sentences, describe each of the following targeting sequence motifs:

- \* an internalization signal for receptor-mediated endocytosis
- \* an endoplasmic reticulum targeting sequence
- \* an endoplasmic reticulum retention/retrieval sequence
- \* a nuclear localization sequence
- \* a mitochondrial targeting sequence

**(5 marks)**

(b) Describe the experimental strategy used by Schnell and Blobel to identify the protein import (TOC) machinery in the chloroplast outer envelope.

**(7 marks)**

(c) Describe two structural features found in most SNAREs, and explain how these features can be used to identify candidate SNAREs from genome sequence data.

**(8 marks)**

**(20 marks total)**

**USE A SEPARATE ANSWER BOOKLET FOR EACH QUESTION**

**Question 3 (suggested time 30 minutes)**

- (a) Using clearly labeled diagrams, summarize the features conserved in the protein secretion system of prokaryotes (bacteria) and eukaryotes. Include in your answer a brief description for the evolution of the endoplasmic reticulum and the nuclear envelope.

**(10 marks)**

- (b) Describe how GFP has been used experimentally to track cargo in the secretory pathway. Include in your answer the properties of GFP that has made this probe particularly useful.

**(10 marks)**

**(20 marks total)**

**Question 4 (suggested time 30 minutes)**

Briefly discuss **FOUR (4)** of the following seven topics:

- (a) Clathrin/AP2 coats
- (b) Dynein and kinesin motors
- (c) Vesicular tubular clusters (VTC)/intermediate compartment
- (d) Fibronectin
- (e) Integrin receptors and their role in lymphocyte rolling
- (f) The role of N-glycosylation in quality control in the endoplasmic reticulum
- (g) Purification of cellular organelles

**(4 x 5 marks = 20 marks total)**

**USE A SEPARATE ANSWER BOOKLET FOR EACH QUESTION**

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**Question 5 (suggested time 30 minutes)**

Discuss **ONE** (1) of the following two topics:

- (a) The maintenance and the function of apical and basolateral domains of polarized epithelial cells. Include in your answer the mechanism for delivery of newly synthesized apical and basolateral membrane proteins to the plasma membrane and experimental strategies used to analyse these pathways.

**(20 marks)**

**OR**

- (b) The transport of newly synthesized lysosomal enzymes from the endoplasmic reticulum to the lysosome. Include in your answer information on the sorting signals and the trafficking machinery involved in this process.

**(20 marks)**

**Question 6 (suggested time 30 minutes)**

Complete **TWO (2)** only of the following three parts:

- (a) Briefly describe matrix metalloproteinases and discuss how they can be multifunctional contributors to tumour progression.
- (b) Discuss: Ras proteins - different signals from different cellular locations.
- (c) Using a diagram, outline how multiple small GTPases are involved in cytoskeletal organization in fibroblasts. Then use another diagram to show how these GTPases regulate myosin light chain phosphorylation to modulate the assembly and disassembly of stress fibres.

**(2 x10 marks = 20 marks total)**

**END OF EXAMINATION**