

COPY

THE UNIVERSITY OF MELBOURNE

SEMESTER 1 ASSESSMENT , 2002

DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY

521-213 – INTEGRATED BIOMEDICAL SCIENCE I
PAPER A

COMMON CONTENT EXAM(S) No

EXAM DURATION: Two (2) Hours

READING TIME: Fifteen (15) Minutes

THIS PAPER HAS 5 PAGES

Authorized Materials:

No specific materials are authorized.
Calculators are permitted but not required.

Instructions to Invigilators:

Please supply SIX (6) 6-page examination books.

Instructions to Students:

This exam paper consists of **TWO** (2) sections.
Attempt **THREE** (3) questions from each section.
EACH question should be answered in a **SEPARATE** examination book.
Use a **pen** and write legibly.
The total number of marks for this examination: 120.
This examination **equals 35%** of the total marks for this subject.

This paper may be lodged with the Baillieu Library

USE A SEPARATE ANSWER BOOKLET FOR EACH QUESTION

SECTION A - Protein structure and function

Answer **THREE** of the following five questions

QUESTION 1

- a. Define the primary, secondary and tertiary structures of proteins.
- b. Describe how simple combinations of secondary structure can be combined to form motifs. Give examples where appropriate.
- c. Describe the three main classes of domains that have been identified in proteins.

(20 marks)

QUESTION 2

- a. Describe the use of gel electrophoresis and isoelectric focussing to detect specific proteins in a mixture and show how these two approaches can be combined with other techniques to identify individual proteins in complex mixtures.
- b. Briefly describe how proteins can be purified and how their three-dimensional structure can be determined.

(20 marks)

QUESTION 3

- a. For an enzyme-catalyzed reaction draw diagrams to show:
 - i. The rate of production of product as a function of time
 - ii. The dependence of the initial rate of an enzyme catalyzed reaction on enzyme concentration
 - iii. The dependence of the initial rate of an enzyme on substrate concentrationLabel your axes carefully and comment on the relationships you have drawn.
- b. Describe the different classes of enzymes, their importance, and the mechanisms used by enzymes to reduce the activation energy of chemical reactions.

(20 marks)

USE A SEPARATE ANSWER BOOKLET FOR EACH QUESTION

SECTION A - Protein structure and function (continued)

QUESTION 4.

a. Describe the separate effects of the ligands H^+ , CO_2 and 2,3 bis-phosphoglycerate on oxygen binding by hemoglobin. Use diagrams to illustrate your answer.

b. **EITHER:**

Discuss the physiological significance of these ligands with respect to oxygen metabolism under different conditions.

OR

Discuss a proposed mechanism for the effects of these ligands on the oxygen binding curve for hemoglobin. Include experimental evidence where appropriate.

(20 marks)

QUESTION 5.

Describe the structure and functions of the different classes (isotypes) of antibodies.

(20 marks)

USE A SEPARATE ANSWER BOOKLET FOR EACH QUESTION

SECTION B - Membranes, cell structure and function

Answer **THREE** of the following five questions

QUESTION 1.

Consider three types of proteins:

- a protein that regulates transcription of nuclear genes
- a protein that is secreted from the cell
- an integral plasma membrane protein

For **all three** types of proteins compare and contrast:

- a. the site of protein synthesis
- b. the route followed by the protein from the site of synthesis to its final destination
- c. how the protein crosses the membranes of organelles encountered along this route

Use diagrams to assist your explanations.

(20 marks)

QUESTION 2.

Many functions of the cytoskeleton involve:

- changes in the length of cytoskeletal filaments and/or
 - movements of whole filaments with respect to other cellular structures
- a. Briefly outline the molecular basis for **both** changes in length **and** relative movements of **both** actin filaments **and** microtubules
and
 - b. **In each case** (i.e. changes in length **and** relative movement of actin filaments **and** microtubules), give an example of a **cellular process** in which these cytoskeletal changes are involved

Use diagrams to assist your explanations.

(20 marks)

USE A SEPARATE ANSWER BOOKLET FOR EACH QUESTION

SECTION B - Membranes, cell structure and function (continued)

QUESTION 3

What sort of microscopical method(s) would you use if you wished to obtain answers to the following questions?

- How fast does a phagocyte move in cell culture?
- Which cell types in the brain synthesize the protein vimentin?
- What is the diameter of a microtubule in a nerve cell axon?

In each case, state:

- a. which type of microscope you would use
- b. the method of illumination and/or staining
- c. why that combination of microscopical techniques is used in preference to others

(20 marks)

QUESTION 4.

Explain when and how the definitive orientation of an integral plasma membrane protein within the membrane is first established and why its orientation does not change as it is transported to its final destination. Use diagrams to assist your explanations.

(20 marks)

QUESTION 5

- a. Use clearly labeled diagrams to describe the structure and function of the mitochondrial cytochrome c reductase in oxidative phosphorylation.
- b. In molecular terms, what are the critical features determining the efficiency of electron transfer between reactive groups in the mitochondrial electron transfer chain?

(15 marks)

(5 marks)

END OF EXAMINATION