

COPY

THE UNIVERSITY OF MELBOURNE

SEMESTER 1 ASSESSMENT, 2004

DEPARTMENT OF BIOCHEMISTRY AND MOLECULAR BIOLOGY

521-305 – BIOCHEMISTRY OF METABOLISM AND NUTRITION

COMMON CONTENT EXAM(S)	No
EXAM DURATION:	Three Hours
READING TIME:	Fifteen (15) Minutes

THIS PAPER HAS 4 PAGES

Authorized Materials:

No specific materials are authorized.

Instructions to Invigilators:

Please supply **SEVEN** (7) 12-page Examination Script Booklets.

Instructions to Students:

This exam paper consists of **SEVEN** (7) questions.

Attempt **ALL** questions.

EACH question should be answered in a **SEPARATE** examination booklet.

The total number of marks for this examination is **180**

This examination **equals 80%** of the total marks for this subject.

This paper may be lodged with the Baillieu Library

ATTEMPT ALL QUESTIONS

Question 1 (32 marks)

(START A NEW BOOKLET)

- (a) Signal Transducer and Activator of Transcription-3 (STAT3) positively regulates proopiomelanocortin (POMC) expression. What is the role of leptin and the leptin receptor in the regulation of POMC? What is the importance of POMC expression in the control of weight?

(20 marks)

- (b) Suppressor of Cytokine Signalling-3 (SOCS3) expression is also positively regulated by STAT3. It has been proposed that inappropriately high levels of SOCS3 expression may lead to leptin resistance and obesity. Why might elevated expression levels of SOCS3 lead to leptin resistance?

(12 marks)

Question 2 (32 marks)

(START A NEW BOOKLET)

The fatty acyl composition (i.e. the degree of saturation of the acyl chains) of dietary triacylglycerol can significantly contribute to risk for developing heart disease. Present *TWO different* hypotheses that might explain this association. Present a justification for each hypothesis that is consistent with current understanding of blood lipid metabolism.

(32 marks)

Question 3 (32 marks)

(START A NEW BOOKLET)

Answer ONE of the following two parts.

EITHER

- (a) In Type 2 diabetes the tissues that do not require insulin for uptake of glucose are those most affected by high blood glucose levels. Describe the biochemical consequences of hyperglycemia and the major tissues affected. How can these effects be minimized through appropriate dietary therapy?

(32 marks)

OR

- (b) In Type 2 diabetes, the hyperglycemia is caused both by an inability of insulin to activate glucose uptake into muscle and adipose tissue and by an inability of insulin to suppress glucose synthesis in the liver. By use of a diagram identify the key enzymes involved in glucose utilization and glucose production and discuss the mechanisms by which insulin and the insulin antagonists normally regulate glucose synthesis in the liver.

(32 marks)

continued next page...

Question 4 (25 marks)

(START A NEW BOOKLET)

Answer **ONE** of the following two parts.

EITHER

- (a) Explain in detail the mechanism by which Vitamin E acts as an antioxidant in humans. **(10 marks)**

and

- (b) Describe the other major mechanisms by which animal cells are protected from oxidative damage. **(15 marks)**

(Total = 25 marks)

OR

- (a) Describe how and why the Q cycle generates superoxide. **(12 marks)**

and

- (b) Explain with examples how diet and exercise can modify the extent of superoxide production by mitochondria. **(7 marks)**

and

- (c) Comment on the consequences of inappropriate accumulation of ferrous ions in cells. **(6 marks)**

(Total 25 marks)

Question 5 (25 minutes)

(START A NEW BOOKLET)

- (a) Briefly describe the structure and function of the family of ubiquitin protein ligases (E3s). **(5 marks)**

- (b) Briefly compare protein degradation by the lysosomal pathway and the ubiquitin-proteasome system, highlighting the differences between the two. **(5 marks)**

- (c) Food deprivation causes a number of changes in gene expression in muscle. Discuss the major changes of relevance to protein metabolism. **(5 marks)**

- (d) Discuss the role of glucocorticoids such as cortisol or dexamethasone on muscle protein metabolism using as examples a fasted rat model and inactivity in humans. **(5 marks)**

- (e) Cancer cachexia, fasting and muscle inactivity all cause increased degradation of muscle. What are the triggers for muscle wasting under these conditions and what features of muscle wasting (atrophy) are common to each of them? **(5 marks)**

Question 6 (20 marks)

(START A NEW BOOKLET)

Plant sterols and stanols have been reported as a means to lower serum and tissue cholesterol levels in healthy persons.

- (a) Describe the normal control mechanisms regulating cholesterol absorption from the gastrointestinal tract into the blood stream.

(5 marks)

- (b) Discuss the two mechanisms by which plant sterols and stanols are thought to affect the uptake of cholesterol from the small intestine.

(10 marks)

- (c) Briefly describe the genetic defect that has been observed in sitosterolemic families and discuss whether this could provide an explanation for the cholesterol and plant sterol levels observed in affected individuals.

(5 marks)

Question 7 (14 marks)

(START A NEW BOOKLET)

Describe the key intracellular signalling events that are initiated by:

- (a) gastrin binding to its receptor in ECL cells.

and

- (b) histamine binding to its receptor in parietal cells.

END OF EXAMINATION