PRIMARY EXAMINATION

CELL BIOLOGY & BIOCHEMISTRY

Wednesday 3 December 2003
Time allowed: Two hours

INSTRUCTIONS TO CANDIDATES
There are six sections in this paper.
Each section is worth 30 marks, and should take about 30 minutes to complete.
Candidates are required to complete the compulsory question and THREE of the other five sections.
If a candidate attempts more than three of the five optional sections, only the first three sections will be marked.

Section 1. This section is COMPULSORY. This section is worth thirty (30) marks.

1. The incidence of type 2 diabetes is increasing around the world. Currently, in Australia it is estimated that between 5-10% of the population has the disease. Discuss the implications of this epidemic. In your answer you should discuss the main features of type 2 diabetes, how insulin resistance may arise and the molecular mechanisms underlying the long-term complications of diabetes.

Candidates should answer THREE (3) of the following five (5) sections. Each section is worth a total of 30 marks.

Section 2. Each question in this section is worth six (6) marks.

2. Define body mass index (BMI). Discuss how BMI is used to define overweight and obese. What are the limitations of BMI?
3. What are n-3 and n-6 fatty acids? Contrast the roles of these two classes of fatty acids in the inflammatory response.
4. Define essential and non-essential amino acids. Which groups within the community are most at risk of protein deficiency? How is this likely to impact on their general and oral health?
5. Explain why the oral cavity is susceptible to deficiencies of the B-group vitamins a) niacin, and b) folate.
6. Thiamin deficiency is one of the most common vitamin deficiencies in Australia. Describe the likely mechanisms whereby thiamin deficiency may lead to the severe neurological changes that characterise Wernicke-Korsakoff syndrome.

TURN THE PAGE OVER FOR SECTION 3 – 6.

Section 3. Each question in this section is worth ten (10) marks.

7. Discuss the role of *p*53 in normal cells and explain why mutations in *p*53 are commonly found in oral cancers.

8. Discuss the **technical** advantages and disadvantages of using embryonic stem cells to regenerate tissue lost in diseases such as Parkinson's disease or Type 1 diabetes.

9. Discuss the roles of cyclins and cyclin-dependent kinases in the regulation of the cell cycle.

Section 4. Each question in this section is worth ten (10) marks.

10. Draw a simple diagram to illustrate how a hormone binding to a typical tyrosine kinase type receptor leads to the activation of ras. Why are mutations in ras commonly found in oral cancers?

11. a) Describe how NO is generated in **endothelial** cells.

    b) Why is the production of NO by cells of the immune system in response to periodontal disease both beneficial and potentially harmful to the patient?

12. Give an overview of the prostaglandin synthesis pathway. Discuss why the development of COX-2 inhibitors has led to improved management of chronic pain.

Section 5. Marks for questions in this section are listed below.

13. Discuss why the energy yield of anaerobic glycolysis is only about 5% of that achieved when glucose is fully oxidised. (6 marks)

14. Draw a diagram to illustrate the major fates of glucose IN THE LIVER immediately after a meal. (6 marks)

15. Give an overview of the role of the pentose phosphate pathway in the generation of the reactive oxygen species that phagocytes use to kill invading bacteria. (6 marks)

16. Draw a diagram to illustrate the major changes that occur in liver, adipose tissue and muscle in response to a serious injury. (12 marks)

Section 6. Each question in this section is worth ten (10) marks.

17. Draw a diagram to illustrate the main features of a typical eukaryotic gene. How is the gene transcribed to produce a mature mRNA?

18. Outline the process by which children with severe combined immunodeficiency syndrome (SCIDs) have been treated with gene therapy. Has this treatment been successful?

19. Describe how the polymerase chain reaction (PCR) may be used to detect very small amounts of DNA or RNA (eg. a viral infection, transformed cells in a leukaemia patient in remission).

End of paper