

**The University of Melbourne**  
**Semester One Assessment 2005**

**Department:** Anatomy and Cell Biology  
**Subject Number:** 516-201  
**Subject Title:** Cell Biology: Tissues and Organs

**Exam Duration:** 2 hours

**Reading Time:** 15 minutes

This paper has 5 pages

**Authorized materials:**

None allowed

**Instructions to Invigilators:**

Script Books: 4 x 7 page.  
The examination paper may be removed from the exam room.

**Instructions to Students:**

This examination consists of **four** parts - Part A, B, C and D.

**Answer each part in a separate script book.**

The Subject Number is 516-201. Ensure that you put the Subject Number and your Student Number on all script books used.

ALL 11 questions should be attempted.

Questions 4, 5 and 10 have internal choice.

The value of each question is indicated after the question.

**LABELLED DIAGRAMS** should be used wherever possible.

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**PART A - 45 minutes**

- Q1. Write short notes (no more than six lines in each case) on each of the following topics.  
a) phospholipids  
b) paracrine signalling compared to endocrine signalling  
c) G-Protein – linked receptors  
(9 mins)
- Q2. Draw diagrams to illustrate the difference between passive and active transport of a charged molecule across a cell membrane.  
(3 mins)
- Q3. Explain how a cell can integrate signals from two separate cell surface receptors to control a specific output.  
(3 mins)
- Q4. **Answer either Part a) or Part b)**  
a) Describe the pathway that a secreted protein takes from its translation through to secretion from the cell. In your answer give descriptions of transmembrane and vesicular transport pathways.  
**OR**  
b) Describe the molecular mechanism that regulates progression of the vertebrate cell cycle. Include descriptions of the roles of the two tumour suppressor genes p53 and Rb (Retinoblastoma).  
(20 mins)
- Q5. **Answer either Part a) or Part b)**  
a) Describe how the centrosome organizes microtubules in a cell.  
**OR**  
b) Describe two ways in which F-actin is organized into higher order structures in cells and the roles played by those structures in cell function.  
(10 mins)

## PART B - 25 minutes

Q6. With the aid of labelled diagrams, describe the location, structure and function of tight junctions in epithelial tissues. Include a description of an experiment that highlights the effectiveness of these junctions.

(6 mins)

Q7. Stem cells in tissues are regulated by several different types of molecular signals.

- a) Give three examples of molecular signals that regulate stem cells in tissues.
- b) Using diagrams, describe how one such molecular signalling pathway functions to *regulate changes in gene expression in the responding cell*.
- c) For your chosen pathway, describe a consequence of abnormal signalling in a tissue.

(8 mins)

Q8. What is meant by:

- a) Totipotency?
- b) Unipotency?
- c) Pluripotency?

Give examples of cell types that display each type of potency.

(3 mins)

Q9. The skin, the gut and the lens are examples of tissues where epithelial cells receive signals to undergo differentiation. With the aid of diagrams show the structure of **one** of these tissues and the sequence of differentiation that occurs within it. For your chosen tissue, your diagrams or answer should indicate:

- a) where stem cell division occurs
- b) the direction of movement of the progeny of stem cell divisions
- c) the region where cells differentiate
- d) the region where cells undergo apoptosis
- e) a marker for differentiation (molecular or cell specialisation)
- f) a signalling molecule that is known to be important in regulating proliferation or differentiation.

(8 mins)

**PART C - 25 minutes**

Q10. Answer ONE of the following four Parts a), b), c) or d).

- a) How is the extracellular matrix of loose connective tissue organised and what role do fibroblasts play in its generation?

**Or**

- b) Compact bone is made up of Haversian systems (also called osteons). How is a single Haversian system organised and how are new Haversian systems generated?

**Or**

- c) Consider the structure of an artery and a capillary. How does their structure reflect their function?

**Or**

- d) The small intestine is a part of the gastrointestinal tract specialised for digestion and absorption. How is the basic structure of the gut modified in the small intestine and how do these modifications relate to its function?

(25 mins)

*Continued over page*

**PART D - 25 minutes**

Q11. The tracheal system of the *Drosophila* embryo provides a nice example of morphogenesis by the formation and branching of tubes.

a) Describe how the tracheal system forms, from the appearance of the earliest organ rudiment to the mature system of branching tubes. Discuss the changes in the tracheal cells that are responsible for these morphogenetic changes.

**and**

b) Discuss the roles of genes involved in one aspect of tracheal morphogenesis. State the types of proteins these genes encode and explain how those proteins bring about changes in the tracheal cells that underlie morphogenesis.

(25 mins)

**End of Examination**