

POSTGRADUATE INSTITUTE OF MEDICINE
UNIVERSITY OF COLOMBO

POSTGRADUATE DIPLOMA IN MOLECULAR MEDICINE
(SEMESTER I) EXAMINATION – AUGUST, 2009

Date : 26th August 2009

Time : 9.00 a.m. – 12.00 noon

SEQ PAPER I
(FOUNDATION MODULE)

Answer all **six (06)** questions.

Answer each question in a separate answer book.

1.

- 1.1. Draw a labelled diagram of a cross section of an artery. (20 marks)
- 1.2. Describe the role of platelets in haemostasis. (50 marks)
- 1.3. Describe the carriage of carbon dioxide from tissues to the lung. (30 marks)

2.

- 2.1. Define glomerular filtration rate (GFR). (10 marks)
- 2.2. Explain the physiological basis of low urine output following a moderate haemorrhage. (30 marks)
- 2.3. Describe briefly how the structure of the ureter is adapted to the function of transport of urine to the bladder. (30 marks)
- 2.4. Describe the pathway of pain arising from a ureter. (30 marks)

Contd.../2-

3.
 - 3.1. List the different cells in the pancreas and their secretions. (20 marks)
 - 3.2. Explain the secretion of hydrochloric acid by the stomach. (30 marks)
 - 3.3. Explain the changes that occur in the uterus during a menstrual cycle with reference to the relevant hormones. (50 marks)
4.
 - 4.1. Outline the differences between Gram positive and Gram negative bacterial cell walls. (20 marks)
 - 4.2. Write a short note on the transfer of genetic material between bacteria by conjugation. (30 marks)
 - 4.3. Outline briefly the different methods by which a laboratory diagnosis of a viral infection can be made. (30 marks)
 - 4.4. Describe briefly the general properties of fungi. (20 marks)
5.
 - 5.1. During myocardial infarction, blood flow to a particular region of the myocardium is obstructed.
 - 5.1.1. Name the process that supplies energy to those myocardial cells during the early stages of infarction. (05 marks)
 - 5.1.2. Explain the production of lactic acid by the affected myocardial cells. (20 marks)
 - 5.2. Explain the biochemical reason for the hypoglycaemia that follows excessive consumption of alcohol while fasting. (25 marks)
 - 5.3. List the biochemical functions of NADPH. (25 marks)
 - 5.4. How is glycogen metabolism regulated in skeletal muscle during a "fight or flight" situation? (25 marks)

6.

- 6.1. Describe briefly the microscopic structure of a liver lobule. (30 marks)
- 6.2. Trace the anatomical pathway of bile salts from the liver cells to the lumen of the duodenum. (15 marks)
- 6.3. Explain the regulation of cholesterol metabolism in hepatic tissues. (30 marks)
- 6.4. Explain the role of glutamate in amino acid metabolism. (25 marks)

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SEQ PAPER II
(Cell and Molecular Biology Module)

Date : 27th August 2009

Time : 9.00 a.m. – 12.00 noon

Answer all **six (06)** questions.

Answer each question in a separate answer book.

1.

1.1 Describe the process of preparation of a karyotype from a sample of human peripheral blood. (80 marks)

1.2 Write the karyotypes of five (05) numerical chromosome anomalies in the Female gender. (10 marks)

1.3 List five (05) clinical features of one of the conditions stated in 1.2. (10 marks)

2.

2.1 Explain how the structural features of hyaluronic acid are suited for its biological functions in the knee joint. (30 marks)

2.2 Discuss the principle of protein separation by gel filtration chromatography. (30 marks)

2.3 Explain the morphological and biochemical events that occur during apoptosis. (40 marks)

3.

3.1 List the steps involved in the synthesis and secretion of a secretory protein. (40 marks)

3.2 To study the differential global gene expression in a squamous cell carcinoma of the lung, a clinician isolated a few cancerous cells using a laser capture microdissection. He also isolated squamous epithelial cells of lung. Explain how he could prepare and label array materials from the samples he isolated for a DNA microarray experiment. (60 marks)

4.

4.1. You have a plasmid, pTet in your laboratory. When transformed into *E. coli*, pTet confers resistance to the antibiotic tetracycline (tet).

When complete digestion of the plasmid is performed with the enzymes *Xba*I and *Ssp*I in the manner given below, the following fragments were obtained (sizes given in kilo base – kb).

<i>Xba</i> I	<i>Xba</i> I+ <i>Ssp</i> I
4.5	1.4
	3.1

You also find that cloning your favourite gene into the *Xba*I site(s) causes loss of tetracycline resistance and cloning into the *Ssp*I site(s) prevents the plasmid from replicating.

4.1.1. What is the total size of the plasmid? (05 marks)

4.1.2. Draw a simple restriction map of the pTet plasmid indicating the locations of the Tet^R gene and origin of replication in relation to the restriction sites(s) (*Xba*I and *Ssp*I). (20 marks)

4.1.3. If you decide to clone your favourite gene into the *Xba*I site, do you think it is important to treat the cleaved pTet plasmid with the enzyme Calf Intestinal Phosphatase (CIP) before cloning? Briefly explain your answer. (20 marks)

4.1.4. If you clone your favourite gene into the *Ssp*I site, transform into tetracycline sensitive *E. coli* competent cells and plate on LB agar + tet, what would you expect to see and why? (05 marks)

4.2. Explain the importance of the following in an expression vector.

4.2.1. Promoter (20 marks)

4.2.2. Reporter (20 marks)

4.2.3. Terminator (10 marks)

Contd...../3-

5. In a family of three children the youngest boy is diagnosed as having sickle cell anaemia. You have been asked to carry out a DNA based assay on the other two children to detect whether they are carriers of the disease.

Describe three DNA based methods that you can use. What are the advantages and disadvantage of each method? (100 marks)

6.

- 6.1 "Studies have shown that mutations in the gene encoding Topoisomerase I in yeast cells effect the grow rate but is not lethal. However, mutations in the gene encoding Topoisomerase II are lethal". Discuss these observations. (50 marks)

- 6.2 The human genome consists of more than 50% of non- coding DNA.

6.2.1. List six (06) different types of non- coding DNA present in the human genome. (25 marks)

6.2.2. What characteristic features of non-coding DNA allow them to be used in human DNA fingerprinting. (25 marks)

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POSTGRADUATE DIPLOMA IN MOLECULAR MEDICINE (SEMESTER I) EXAMINATION – AUGUST, 2009

Date : 28th August 2009

Time : 9.00 a.m. – 12.00 noon

SEQ PAPER III
(IMMUNOLOGY MODULE)

Answer all **six (06)** questions.

Answer each question in a separate answer book

1.
 - 1.1. Draw a clearly labelled diagram to show the basic structure of an immunoglobulin. (20 marks)
 - 1.2. Describe the different types of immunoglobulin deficiencies. (30 marks)
 - 1.3. Describe the role of IgE in hypersensitivity reactions. (25 marks)
 - 1.4. Compare the primary and secondary immune responses. (25 marks)

2.
 - 2.1. Compare the functions of Th₁ and Th₂ cells in adaptive immunity. (20 marks)
 - 2.2. Describe the role of antibody directed cellular cytotoxic (ADCC) reaction in viral infection. (30 marks)
 - 2.3. Describe briefly T cell-B cell discordance. (15 marks)
 - 2.4. Describe the role of molecular mimicry in autoimmunity giving examples. (20 marks)
 - 2.5. Describe briefly pleiotropism in cytokines. (15 marks)

Contd.../2-

3.

- 3.1. Describe the use of ELISPOT assay in the assessment of CD8 T cell effector functions. (20 marks)
- 3.2. Describe transmembrane signaling associated with tyrosine kinase. (30 marks)
- 3.3. Describe the functions of the following –
 - 3.3.1. IP₃ system (15 marks)
 - 3.3.2. Tap transporter (15 marks)
- 3.4. Describe the role of adhesion molecules in immune cell migration. (20 marks)

4.

- 4.1. Define immune surveillance. (10 marks)
- 4.2. Describe how immune-editing can be used in tumour immunotherapy. (20 marks)
- 4.3. Describe the role of immune corrective therapy in controlling tumour metastasis. (30 marks)
- 4.4. Explain the therapeutic basis of using stem cells in cancer immunotherapy. (30 marks)
- 4.5. List the steps in producing a CD8 T cell clone. (10 marks)

5.

- 5.1. What are cytokines ? (10 marks)
- 5.2. Describe the cytokine-activated intracellular signaling pathway for transcriptional activation. (30 marks)
- 5.3. Describe the effects of cytokines on the balance between tumour growth and tumour regression. (30 marks)
- 5.4. Explain the term redundancy in cytokines. (30 marks)