UNIVERSITY OF JAFFNA, SRI LANKA

FIRST EXAMINATION FOR MEDICAL DEGREES (2ND) - JULY 2025
ACADEMIC YEAR 2022/2023

BIOCHEMISTRY PAPER II
(45TH BATCH)

22.07.2025 **3 Hours (9.00 am to 12.00 noon)**

Answer all 10 questions.

Marks allotted to each part are indicated in brackets.

Answer Each Question on Separate Answer Books.

1. **1.1** A 23-year-old female sedentary worker with 170cm height and 45kg body weight consumed 615 kcal of energy /day with the carbohydrate: protein: fat in the ratios of 10: 20: 1.5.

1.1.1 Calculate her BMI. **(20 Marks)**

1.1.2 What should be her optimum BMI. **(10 Marks)**

1.2 **1.2.1** What could be the optimum energy requirement of a female of her age. **(20 Marks)**

1.2.2 Comment on her consumption of carbohydrate: protein: fat in the ratios of 10: 20: 1.5. **(20 Marks)**

1.3 Give the dietary advice to the female to adjust the BMI to a normal value. **(30 Marks)**

2. **2.1** Explain the functions of the following elements in enhancing cellular antioxidant functions.

2.1.1 Copper **(20 Marks)**

2.1.1 Selenium **(25 Marks)**

2.2 List the biochemical tests for the differential diagnosis of iron deficiency and vitamin B_6 deficiency nutritional anaemias with reasons. **(25 Marks)**

2.3 **2.3.1** List 5 characteristics of adaptive immune system. **(15 Marks)**

2.3.2 Draw the serum protein electrophoretic patterns of a normal person and compare with that of a multiple myeloma patient. **(15 Marks)**

3. A 26-year-old female was diagnosed with type 1 diabetes mellitus at her age of 2 years. She could not be aroused from an afternoon and was brought to the hospital. Her breath had the fruity odour of acetone. Analysis of blood samples showed the pH of 7.08, glucose level of 648mg/dL and elevated level of blood ketone body. Further her urine contained glucose and ketone bodies. Immediately she was given insulin injection with isotonic saline. When the patient became conscious, on inquiry she mentioned that she could not take her regular insulin dose during the past three days due to the financial constraints.

3.1 Give the biochemical basis of

3.1.1 elevated blood glucose level. **(40 Marks)**

3.1.2 elevated blood ketone body level and ketone body excretion in urine. **(30 Marks)**

3.1.3 decreased blood pH. **(15 Marks)**

3.2 Name two tests that are used to detect the ketone bodies in the urine. **(15 Marks)**

4. A 54-year-old female with 172cm height and 90kg body weight had a history of elevated blood pressure. Her lipid profile results were as follows:

Triacylglycerol	300mg/dL
Total cholesterol	420mg/dL
LDL cholesterol	356 mg/dL
HDL cholesterol	32mg/dL

4.1 What are the expected normal ranges of serum,

4.1.1 Triacylglycerol level. **(10 Marks)**

4.1.2 LDL cholesterol level. **(10 Marks)**

4.1.3 LDL to HDL ratio. **(10 Marks)**

4.2 Explain how the elevated levels of the lipids can lead to atherosclerosis. **(45 Marks)**

4.3 Diagrammatically show the lipid profile of the patient with dyslipidemia comparing of that with that of a normal person. **(25 Marks)**

5. A 3-weeks-old female infant began vomiting at 3rd day of birth, usually within 30 min after breastfeeding. Her abdomen became distended, and she became irritable and cried frequently. Mother has noticed the yellow discolouration of the sclera and the child was taken to a paediatrician. The doctor too noticed the enlargement of the liver (hepatomegaly) in addition to jaundice. Further he explained the possibility of developing a premature cataract in the future. The doctor ordered the liver and kidney function tests. The report showed reducing sugar in the urine but not glucose. The liver function test showed an increase in serum bilirubin level in addition to several serum enzymes.

5.1 What could be the probable problem in the patient? **(10 Marks)**

5.2 Which enzyme/ enzymes deficiency/ deficiencies would have led to the problem mentioned in **Question 5.1**. **(20 Marks)**

5.3 Justify the enlargement of the liver. **(15 Marks)**

5.4 Give the reasons for the risk of developing cataract to this infant. **(35 Marks)**

5.5 Give the principle of the method that is used to detect the reducing sugar in the urine. **(20 Marks)**

6. A 4-year-old girl whose height and weight are below 20th percentile for girls of the same age. She is listless, getting tired easily and complains of loss of appetite and shortness of breath on exertion. Her complexion is slate grey and appeared pale. Initial laboratory studies revealed decreased RBC count with a haemoglobin level of 6.29g/dL. Additional haematological studies revealed β^+-thalassemia.

6.1 Give the molecular basis and the development of β^+-thalassemia. **(20 Marks)**

6.2 Give reasons for the occurrence of anaemia in β^+-thalassemia patients. **(30 Marks)**

6.3 Explain why the prevalence of α-thalassemia is not detected commonly. **(15 Marks)**

6.4 Justify why the survival rate of β^+-thalassemia patients are more than that of α-thalassemia patients. **(35 Marks)**

7. **7.1** The patient mentioned in **Question 4** experienced 'a tight pressure-like band of pain' across her chest following a heated argument with her neighbour associated with shortness of breath and sweating. After 5h of retrosternal chest pain she was admitted to the Hospital. In the Emergency Unit her ECG showed dynamic changes. Her blood sample was sent to the lab for different tests including the serum enzymes and proteins.

7.1.1 Diagrammatically show the changes in the serum proteins and the enzymes of the lady. **(25 Marks)**

7.1.2 Which of the enzymes mentioned in **Question 7.1.1** have isoenzymes that have clinical importance for differential diagnosis of the disease conditions. **(20 Marks)**

7.1.3 Which isoenzyme fraction/s is/are expected to be elevated in this patient? **(15 Marks)**

7.2 List how the isoenzymes differ in their properties. **(20 Marks)**

7.3 Proteolytic enzymes are secreted as zymogens and activated in the intestine. Explain with examples. **(20 Marks)**

8. **8.1** To the patient mentioned in **Question 7.1** the doctor has prescribed 150mg of acetylsalicylic acid to be taken daily. In her recent visit to her cardiologist, she requested whether if she can avoid the acetylsalicylic acid as she no longer has chest pain. The doctor advised her to continue with the medication to avoid the another heart attack. Justify the doctor's advice. **(35 Marks)**

8.2 **8.2.1** List the different proteins present in the thin filament of the muscle protein. **(20 Marks)**

8.2.2 Diagrammatically show the arrangements and explain the structure of the thin filament. **(25 Marks)**

8.3 Explain why the cholesterol esterification changes the shape of HDL. **(20 Marks)**

9. **9.1** A 34-year-old male has been an alcoholic for the past 10 years, had a marked decrease in appetite. He was in early congestive heart failure. He also had polyneuropathy, triad of paralysis of eye movements (opthalmoplegia), ataxia and confusion with apathy. Intravenous thiamine was initiated at a dose of 100mg/day (compared to an 100mg/day of RDA).

9.1.1 Name the probable condition of the patient. **(10 Marks)**

9.1.2 Write the reactions that are affected by the nutrient deficiencies with the substrates, products and cofactors. **(40 Marks)**

9.1.3 Give the biochemical basis for the occurrence of polyneuropathy. **(25 Marks)**

9.2 Explain with a diagram how the $FADH_2$ produced at the succinate dehydrogenase step produces 2ATP in the respiratory chain. **(25 Marks)**

10. **10.1** Explain how the kidney regulates the blood pH under respiratory acidosis. **(30 Marks)**

10.2 10.2.1 List the different enzymes/protein deficiencies that can cause phenylketonuria. **(25 Marks)**

10.2.2 Explain with a diagram how the deficiencies mentioned in **Question 10.2.1** can lead to phenylketonuria. **(25 Marks)**

10.3 Compare the structures and function of amylose with glycogen. **(20 Marks)**