



UNIVERSITY OF JAFFNA, SRI LANKA
FIRST EXAMINATION FOR MEDICAL DEGREES (1ST) - APRIL 2025
ACADEMIC YEAR 2022/2023

BIOCHEMISTRY PAPER II
(46TH BATCH)

22.04.2025

Time: 3 Hours

Answer all 10 questions.

Marks allotted to each part are indicated in brackets.

Answer Each Question on Separate Answer Books.

1. A 60-year-old woman reported pain in her lower leg, paraesthesia and numbness in the feet and difficulty in walking. On examination, she had signs of severe peripheral neuropathy of the lower legs (absence of reflexes, superficial and deep sensation), several skin lesions compatible with vitiligo. Laboratory tests revealed the following results.

Parameters	Patient	Reference Value
Haemoglobin (mmol/L)	7.0	>7.5
Mean Corpuscular Volume (fl)	105	85-98
Serum Methylcobalamin (pmol/L)	51	145-450
Serum Methylmalonic acid (nmol/L)	3600	<400
Serum Homocysteine (μ mol/L)	49.1	<14

Additionally, the laboratory tests revealed the presence of antibodies against the parietal cells and intrinsic factor. Based on the laboratory findings, hydrocobalamin injection was initiated immediately. Within 4-6 weeks the patient reported that her symptoms gradually reduced and walking capacity improved.

- 1.1 Name the clinical condition of the patient. (10 Marks)
- 1.2 Give the biochemical reasons for the changes in
- 1.2.1 methylmalonic acid and homocysteine levels with a diagram. (35 Marks)
- 1.2.2 mean corpuscular volume and haemoglobin level (20 Marks)
- 1.3 Explain how the presence of antibodies against parietal cells and intrinsic factor would have led to the condition. (35 Marks)

2. A 55-year-old man complained of severe weakness, dizziness, drowsiness, unquenchable thirst and repeated need to urinate. Although he ate all three meals to satisfy his appetite in addition to the snacks, he lost 10kg from his original weight. On admission his blood and urine samples were analysed.

Parameters	Patient	Normal Range
Blood glucose level (mg/dL)	560	
Blood Urea Nitrogen (m/dL)	38	7.0-22.0
Ketone bodies (mM/L)	20	0.0-0.3
Glycosylated Haemoglobin (%)	14	
Creatinine (mg/dL)	2.5	0.7-1.5
Sodium (mM/L)	154	136-145
Potassium (mM/L)	6.5	3.5-5.3
Chloride (mM/L)	90	98-108
Bicarbonate (mM/L)	10	20-32
pH	7.25	
Urine Sugar	4+	
Urine ketone bodies	Very Large Amount	

He was treated with insulin and saline intravenously. By the 4th hour of treatment KCl was added to the IV fluids and 16h later he was active, alert, well hydrated and cheerful, indicating that he felt extremely well.

- 2.1 Give the expected fasting and glycosylated haemoglobin levels of normal persons. (10 Marks)
- 2.2 Give the biochemical basis of the blood levels of the above patient. (40 Marks)
- 2.2.1 Glucose (10 Marks)
- 2.2.2 Glycosylated Haemoglobin (20 Marks)
- 2.2.3 Urea Nitrogen (10 Marks)
- 2.3 Give the biochemical basis of Sugar in urine (10 Marks)
- 2.4 Give the principle of a specific method that is used to estimate the blood glucose level. (10 Marks)

3. 3.1 Answer the questions based on the **Patient Mentioned in Question 2.**

3.1.1 Give the biochemical basis of the blood levels of

3.1.1.1 Ketone bodies (40 Marks)

3.1.1.2 Bicarbonate (15 Marks)

3.1.2 Give the biochemical basis of urine excretion of ketone bodies in the urine.

(10 Marks)

3.1.3 Name two methods that are used to detect ketone bodies in urine.

(10 Marks)

3.2 Explain with a diagram how the 2, 3-Dinitrophenol acts as an uncoupler.

(25 Marks)

4. 4.1 List the different plasma lipoproteins. (10 Marks)

4.2 List the lipoprotein which is not found in the fasting plasma sample of a normal adult. (10 Marks)

4.3 Explain why the said lipoprotein (**Question 4.2**) is absent in the fasting plasma sample. (15 Marks)

4.4 Diagrammatically show the formation and catabolism of the lipoprotein mentioned in **Question 4.2**. (30 Marks)

4.5 Name the condition in which the plasma lipoprotein mentioned in **Question 4.2** is found in the fasting blood sample. (10 Marks)

4.6 Diagrammatically show the plasma lipid profile of a normal person and that of a patient mentioned in **Question 4.5**. (20 Marks)

4.7 Feeding triacylglycerols rich in medium chain fatty acids are useful to the patients mentioned in **Question 4.5**. Explain. (05 Marks)



5. A female patient was admitted to the hospital with fatigue, weakness, pale skin, shortness of breath and rapid heartbeat. Laboratory investigations showed the following results.

Parameters	Patient	Range
Haematocrit (%)	28.2	36.0-46.0
Haemoglobin (g/dL)	8.8	12.0-16.0
Red Blood Cell Count (10^6 /mm ²)	4.0	4.0-5.2
Total Bilirubin (mg/dL)	1.8	0.0-1.0
Direct Bilirubin (mg/dL)	0.3	0.0-0.4
Iron (μ g/dL)	69	50-170
Total Iron Binding Capacity (μ g/dL)	229	250-450
Ferritin (ng/mL)	325	8.0-26
Folate (ng/mL)	7.4	5.4-24.0
Cobalamine (pg/mL)	610	211-911

On investigation the patient had weak bones, stress erythropoiesis and splenomegaly. The bone marrow biopsy and other investigations concluded that the patient had β -thalassemia.

- 5.1 Give the molecular and biochemical basis of β -thalassemia. (25 Marks)
- 5.2 Give the reason for splenomegaly. (10 Marks)
- 5.3 Give the biochemical basis for the changes in the levels of
- 5.3.1 Haematocrit and Red Blood Cell Count. (15 Marks)
- 5.3.2 Bilirubin (20 Marks)
- 5.3.3 Iron, Total Iron Binding Capacity and Ferritin. (15 Marks)
- 5.4 Justify the expected serum level of hepcidin in this patient. (15 Marks)

6. A 22-month-old girl was brought to the hospital with concerns on the shape of her legs and abnormal gait. The child began to walk at 13 months of age. She was born with a normal birth weight. There was no history of genetic diseases in the family. The child had been eating the same diet of the family, with expressed and directly-fed breast milk as she was allergic to formula milk and cow milk. She had minimal exposure to sunlight. On examination, she was active but walked with a waddling gait (an abnormal walking pattern that resembles a duck's walk) and noticeable bilateral symmetrical bowing of her legs. Non-tender swelling was noted over both wrists. Her blood test revealed the following results.

Parameters	Patient	Reference Range
Corrected Serum Calcium (mmol/L)	1.53	2.25–2.75
Serum Phosphate (mmol/L)	1.21	1.10–1.95
Alkaline phosphatase (U/L).	1296	<281
Haemoglobin (g/dL)	11.0	11.0–14.1

Her serum parathyroid hormone level was very high. She was admitted to the hospital and received intravenous calcium gluconate under close observation. Subsequent improvement in serum calcium level on day 3, she was discharged with oral calcium carbonate, calcitriol, and cholecalciferol. She was ensured of adequate sun exposure, for about 30 min / day. Her parents were advised to increase the dietary calcium intake by including the dairy products, such as cheese and yogurt.

- 6.1 What could be the probable problem in the child? (10 Marks)
- 6.2 Explain the observed serum levels of
- 6.2.1 corrected calcium (20 Marks)
 - 6.2.2 parathyroid hormone (15 Marks)
 - 6.2.3 phosphate (15 Marks)
 - 6.2.4 alkaline phosphatase (10 Marks)
- 6.3 Explain the reasons for administering oral calcium carbonate along with calcitriol, and cholecalciferol. (20 Marks)
- 6.4 Give reasons for including cheese and yogurt but not cow's milk. (10 Marks)



7. 7.1 Explain the following conditions and give one example for each.
 - 7.1.1 Autoimmune Diseases (10 Marks)
 - 7.1.2 Immuno-malignant Disorders. (10 Marks)
- 7.2 Write short notes on
 - 7.2.1 Hyaluronic acid and hyaluronidase. (15 Marks)
 - 7.2.2 Phospholipase in snake venom. (15 Marks)
 - 7.2.3 Sulfasalazine and prostaglandins. (10 Marks)
 - 7.2.4 Azidothymidine (Zidovudine) and AIDS (acquired immunodeficiency syndrome). (15 Marks)
 - 7.2.5 Neostigmine and tubocurarine. (15 Marks)
 - 7.2.6 Salting out of proteins. (10 Marks)
8. 8.1 Diagrammatically show the different pathways through which ammonia is detoxified in the body indicating the substrates, enzymes, cofactors and the products. (35 Marks)
- 8.2 Explain the biochemical basis of treating the liver disease patients with
 - 8.2.1 Lactulose. (15 Marks)
 - 8.2.2 Neomycin. (10 Marks)
- 8.3 Compare the kinetics of the mechanism of glucose absorption into the enterocytes and the entry of glucose into the hepatocytes. (20 Marks)
- 8.4 Explain how the phospholipids and cholesterol esters are assimilated in the gastrointestinal system. (20 Marks)
9. 9.1 Explain the basic principle of formulating my plate for a healthy and balanced diet
 - 9.1.1 for a normal person. (20 Marks)
 - 9.1.2 for a diabetic patient. (20 Marks)
- 9.2 9.2.1 Explain the supplementary action of proteins. (15 Marks)
- 9.2.2 Suggest three examples each for diets that could be consumed by the vegetarians and non-vegetarians to meet the supplementary action of proteins (20 Marks)
- 9.3 Explain how the quaternary structure of collagen is formed from its primary structure. (25 Marks)

10. A 3-year-old boy, from an economically poor family, who is elder to his younger sister, who is 2-year-old was referred for investigation of a persistent anaemia and recurrent infection. On examination it was observed that the child was stunted with both height and weight with mild pitting oedema in both legs. His hair was pale and easily pluckable and a soft liver edge was palpable (hepatomegaly). Plasma albumin concentration was 16 g/L and the plasma essential amino acids level was markedly reduced but the non-essential amino acids level was normal. The dietary history revealed that after his first birthday, he was following his family diet, which had mainly, rice and curries made from cassava, breadfruit or jack fruit. He consumed boiled corn or wheat flour 'rotti' for breakfast. However the child had been supplemented with multivitamin pills. The child responded rapidly to re-feeding with a balanced diet.

10.1 Give the probable clinical condition of the child. (10 Marks)

10.2 Based on the information provided explain the biochemical basis for the

10.2.1 plasma albumin and, essential & non-essential amino acid levels.

(20 Marks)

10.2.2 hepatomegaly.

(20 Marks)

10.3 Suggest the foods that could be useful to improve the plasma albumin and essential amino acid levels.

(15 Marks)

10.4 Explain how the recurrent infection would have occurred due to his nutritional status and living condition.

(15 Marks)

10.5 Diagrammatically show the changes in the nitrogen balance. Explain.

(20 Marks)

