UNIVERSITY OF JAFFNA, SRI LANKA

FIRST EXAMINATION FOR MEDICAL DEGREES (1ST) - MARCH 2025

ACADEMIC YEAR 2023/2024

BIOCHEMISTRY PAPER II

(47TH BATCH)

04.03.2026 **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. A17 year-old, female complained of polydipsia & polyuria after a month history of persistent polydipsia and polyuria. This girl was diagnosed with diabetes. For further diagnosis and treatment of her persistent symptoms she consulted a physician. Biochemical profile of the girl was as follows.

Biochemical Profile	Baseline	Normal Range
Glucose (mg/dL)	250	Expected to know
HbA_{1C} (%)	11.1	
C-peptide (ng/mL)	4.13	0.5 to 2.0
Insulin (µIU/mL)	23.12	2-20

For glycaemic control, the patient was started on oral medications (metformin 500 mg BID, i.e. twice a day; glimepiride, a sulfonylurea medication 1 mg QD i.e. once a day).

1.1 Explain the reasons for the following observed levels of the biochemicals.

1.1.1 Glucose **(35 Marks)**

1.1.2 HbA_{1C} **(15 Marks)**

1.1.3 Insulin **(15 Marks)**

1.2 What is C-peptide? **(15 Marks)**

1.3 Calculate the HOmeostatic Model Assessment (HOMA) of this patient. **(15 Marks)**

1.4 Mention the use of calculating HOMA value. **(05 Marks)**

2. **2.1** A 36-year-old male patient was presented with yellowing of skin and eyes for the past 10 days. Additional symptoms included dark-coloured urine, pale stools, fatigue, mild nausea, and loss of appetite. No history of alcohol consumption, smoking, fever, vomiting, abdominal pain, or prior liver disease was reported. The patient was mildly weak with noticeable yellowish discoloration of the skin and sclera. Liver Function Test (LFT) was performed, and the following results were observed.

	Patient	**Normal**
Total Bilirubin (mg/dL)	6.5	Expected to know
Direct Bilirubin (mg/dL)	4.2	00 - 0.4
AST (IU/L)	250	00 - 40
ALT (IU/L)	300	07 - 56
Alkaline Phosphatase (IU/L)	180	44 - 147
Complete Blood Count	normal	
Hepatitis Panel	Negative for Hepatitis A, B, and C	

Ultrasound Abdomen: Fatty liver changes detected, no gallstones or bile duct obstruction.

2.1.1 Give the probable condition of this patient. **(10 Marks)**

2.1.2 Explain the biochemical basis for blood levels of

2.1.2.1 direct bilirubin **(20 Marks)**

2.1.2.2 AST and ALT levels **(10 Marks)**

2.1.2.3 Alkaline phosphatase level **(10 Marks)**

2.1.3 Name the tests that could be performed with the urine to confirm condition. **(15 Marks)**

2.2 **2.2.1** What are isoenzymes. **(05 Marks)**

2.2.2 List examples for three different isoenzymes. **(15 Marks)**

2.2.3 Diagrammatically show the serum electrophoretic pattern of an isoenzyme which is useful for differential diagnosis of the disease. **(15 Marks)**

3 **3.1** An abdominal ultrasound of an alcoholic showed severe fatty infiltration. Give reasons for an alcoholic to have fatty liver. **(35 Marks)**

3.2 Give the causes that may lead to Non-alcoholic fatty liver disease (NAFLD). **(25 Marks)**

3.3 Regarding Familial hypercholesterolemia IIA,

3.3.1 give the biochemical basis of the condition. **(20 Marks)**

3.3.2 diagrammatically show the lipid profile and compare with that of a normal person. **(20 Marks)**

4. **4.1** Explain the modes of actions of

4.1.1 metformin **(15 Marks)**

4.1.2 glimepiride **(25 Marks)**

4.2 One metabolite could be involved in more than one enzyme-catalysed reaction. Illustrate this statement with four reactions for each of the followings and briefly explain the biochemical significance of each reaction

4.2.1 acetyl CoA **(30 Marks)**

4.2.2 pyruvate **(30 Marks)**

5. **5.1** A 55-year-old male bank officer was admitted to the hospital with chest pain. His ECG report was suggestive of myocardial infarction.

5.1.1 List the different serum proteins and enzymes that are useful to confirm that a patient had myocardial infarction. **(20 Marks)**

5.1.2 Diagrammatically show the changes in the serum enzymes and proteins mentioned in **5.1.1.** **(30 Marks)**

5.2 **5.2.1** Give the mode of action of aspirin on the synthesis of eicosanoids. **(15 Marks)**

5.2.2 How does prostacyclin and thromboxane act antagonistically related to thrombosis. **(15 Marks)**

5.2.3 Asthmatic patients are treated with steroidal anti-inflammatory drugs rather than with the non-steroidal anti-inflammatory drugs (NSAID). Explain. **(20 Marks)**

6. **6.1** A six-year-old stunted boy was referred to a hospital with aggressive behaviour and developmental delay. At the age of 3 months the child was quiet and could not hold his head up. He rolled over at eight months, sat without support at twenty months, walked at two years and talked with meaning at 3 years of age. At about one year his hair gradually turned light brown, developed hypopigmentation of the skin and blue eyes. The parents were first cousins and one of the maternal grandfathers was mentally retarded. He could not follow simple instructions and, was unable to read and write alphabetical letters. His other siblings and the parents did not reveal- any abnormality.

The urine ferric chloride test was positive (blue green). Urine and plasma amino-acid thin layer chromatography revealed a high intensity band of phenylalanine.

A low phenylalanine diet could not improve his behaviour although not alleviated the mental retardation. Therefore, the special diet was abandoned and concentrated on social rehabilitation, with the help of the psychologist and community health workers.

6.1.1 Give the probable condition of this patient. **(10 Marks)**

6.1.2 Explain the biochemical defects that would have led to the condition. **(25 Marks)**

6.1.3 Explain why the phenylalanine free diet did not improve the condition. **(10 Marks)**

6.1.4 Explain the biochemical basis for the light hair colour, hypopigmentation of the skin and blue eyes. **(10 Marks)**

6.2 Give the biochemical basis of occurrence of the agglutination of the RBC, if an individual with 'O' blood group is accidentally transfused with 'A' blood group. **(20 Marks)**

6.3 Diagrammatically show the lipid bilayer structure with a labelled diagram and specifically show the distribution of specific proteins. **(25 Marks)**

7. **7.1** Explain the basis of the efficiency of buffering actions of haemoglobin and bicarbonate buffer systems based on their pKa values. **(20 Marks)**

7.2 **7.2.1** List the different extracellular matrix proteins. **(15 Marks)**

7.2.2 Explain how the structure of fibronectin is suited for its function with a labelled diagram. **(30 Marks)**

7.3 **7.3.1** Diagrammatically show the labelled structure of an antibody. **(20 Marks)**

7.3.2 Explain the advantages of having monomeric, dimeric, and polymeric structures for the antibodies. **(15 Marks)**

8. **8.1** A 41-year-old male complaining of awakening with severe, left knee pain, erythema and swelling for 3 days. The pain was "in and all around the joint area. Denied being able to move without his wife's assistance and stayed home without attending to the work. He thought he "overdid it" playing with his kids. The pain persisted throughout the day despite taking NSAID tablets. Pain improved after consuming allopurinol. He had similar episodes of sudden onset pain upon waking in the morning in his right great toe, but thought he stubbed his toe.

8.1.1 What could be the probable condition of this patient. **(10 Marks)**

8.1.2 Explain the biochemical defects that would have led to the occurrence of the condition. **(20 Marks)**

8.1.3 Explain how the allopurinol helped to relieve the pain. **(20 Marks)**

8.2 **8.2.1** Explain acceptable, partially acceptable and unacceptable mutations that are observed in haemoglobin. **(25 Marks)**

8.3 A 42-year-old woman with no known past medical history presented with a chief complaint of increasing fatigue and dizziness for 2 weeks. Her initial laboratory results showed a critically low haemoglobin of 1.4g/dL and severe iron deficiency.

8.3.1 Give reasons for a female to have iron deficiency anaemia. **(15 Marks)**

8.3.2 What confirmatory test would you perform to confirm that a person is with iron deficiency anaemia. **(10 Marks)**

9. **9.1** A 45-year-old male sedentary worker with 170 cm height and was 110 kg weight was instructed to perform aerobic and weight exercises for more than 1 hour per day to improve the muscle strength. He was advised to plan a dietary program to reduce his weight in 1year to bring his BMI to a normal value for his height. He was counselled to have regular meals with 70–75 g of proteins per day and to maintain daily nutritional requirements of approximately 1,800 kcal. He was recommended to consume a low-carbohydrate, low-fat diet and limit high saturated fats. Give reasons for the followings.

9.1.1 Give the current BMI value as well as the expected ideal BMI value. **(15 Marks)**

9.1.2 Recommending aerobic exercise to anaerobic exercise. **(20 Marks)**

9.1.3 Maintaining the protein intake at 70-75g. **(15 Marks)**

9.1.4 Recommending low carbohydrate and low-fat diets limiting unsaturated fats. **(15 Marks)**

9.2 Suggest the foods that can be recommended with low carbohydrate and low-fat diets with limited unsaturated fats. **(20 Marks)**

10. A one-year-old boy was diagnosed with rickets. His phosphate and vitamin D levels were low with elevated levels of alkaline phosphatase and parathyroid hormone. The patient was started on 2000 IU of vitamin D and calcium carbonate 1000 mg daily in addition to iron sulphate 22 mg and Zinc 20 mg daily as recommended by the paediatric endocrinology and nutrition staff. His caught-up the growth. Follow up lab investigation indicated an improvement in vitamin D, phosphate and alkaline phosphatase with normalised PTH level.

10.1 List the different types of rickets. **(10 Marks)**

10.2 Explain the biochemical basis for the changes in the blood levels of

10.2.1 parathyroid hormone **(15 Marks)**

10.2.2 phosphate **(10 Marks)**

10.2.3 alkaline phosphatase **(10 Marks)**

10.3 Give the biochemical basis of administering

10.3.1 calcium carbonate with vitamin D **(35 Marks)**

10.3.2 iron sulphate and zinc **(20 Marks)**