UNIVERSITY OF JAFFNA, SRI LANKA

FIRST EXAMINATION FOR MEDICAL DEGREES (1ST) - MARCH 2023

ACADEMIC YEAR 2020/2021

BIOCHEMISTRY PAPER II (44TH AND 43RD BATCHES)

21.03.2023 **Duration: 3 Hours (9.00am to12.00noon)**

Answer all 10 questions.

Marks allotted to each part are indicated in brackets.

Answer Each Question on Separate Answer Books.

1. A 14-year-old girl admitted to a hospital was dehydrated and was having kussmaul respiration. Her mother stated that the girl had been in good health until she developed fever a week back. She subsequently began to complain of undue thirst and hunger. The laboratory findings were as follows:

	Patient	Normal
Plasma glucose ($mgdL^{-1}$)	630	
Plasma β-hydroxybutyrate ($mmolL^{-1}$)	13.0	<0.25
Plasma Acetoacetate ($mmolL^{-1}$)	2.8	0.2
Plasma Sodium bicarbonate ($mmolL^{-1}$)	5.0	20 – 25
Blood Urea Nitrogen (BUN) ($mmolL^{-1}$)	12	2.9 -8.9
Blood pH	7.05	
Urinary Sugar	++++	
Urinary Ketone bodies	++++	

1.1 Name could be the probable defect in this girl? **(10 Marks)**

1.2 Give the biochemical explanations for the changes in blood

1.2.1 glucose **(35 Marks)**

1.2.2 β-hydroxybutyrate and acetoacetate **(20 Marks)**

1.2.3 bicarbonate and pH **(20 Marks)**

1.3 Explain why the concentration of β-hydroxybutyrate was higher than that of acetoacetate. **(15 Marks)**

2. 2.1 Explain the changes that would occur in Type 1 Diabetes mellitus patients in,

2.1.1 Amino acid level. **(20 Marks)**

2.1.2 Blood Urea Nitrogen (BUN) level. **(20 Marks)**

2.1.3 Alterations in the lipid metabolism. **(35 Marks)**

2.2 Give the reactions, which led to the formation of β-hydroxybutyrate and acetoacetate. **(25 Marks)**

3. A 12-year-old girl who had grossly enlarged abdomen and had a history of frequent episodes of weakness, sweating and pallor that were eliminated by eating. Her development had been slow; she sat at the age of one year, walked unassisted at the age of two years and was doing poorly in the school. Physical examination showed enlarged liver and non-palpable spleen and the kidney.

Laboratory investigation revealed, low blood glucose & pH and, high lactate, triglyceride, ketones & free fatty acids. The liver biopsy revealed high glycogen content. Hepatic glycogen structure was normal. The enzyme assay performed on the biopsy tissue revealed very low glucose-6-phosphatase level.

3.1 What could be the probable problem in this girl? **(10 Marks)**

3.2 Comment on the changes in

3.2.1 blood glucose **(25Marks)**

3.2.2 lactate **(20 Marks)**

3.2.3 triglyceride **(15 Marks)**

3.2.4 free fatty acids **(15 Marks)**

3.3 Suggest the modification that could be made to the diet of this girl. **(15 Marks)**

4. Body composition analysis with a bio-impedance body composition analyser of a 45-year old sedentary man weighing 80kg with the height of 160cm had 35% fat (Reference range for body Fat in men is 11-21%). He was referred to a dietician due to his obesity associated joint pain. His fasting plasma glucose level was 120mg dL^{-1}. His blood total cholesterol level was 385 $mgdL^{-1}$. He was a non-vegetarian who consumed beef and mutton thrice a week and one whole egg daily. He was advised to reduce his body weight within six months of time to have a healthy life.

4.1 Calculate the Body Mass Index of this person. **(10 Marks)**

4.2 Calculate his Total Energy Expenditure based on the current BMI. **(20 Marks)**

4.3 Mention the expected ideal weight for his height? **(10 Marks)**

4.5 Calculate the amounts of carbohydrate, fat and protein in grams to be included in his diet plate to have ideal body weight in six months' time while maintaining zero nitrogen balance. **(35 Marks)**

4.6 Outline the dietary advice to control his blood glucose level and to reduce the body fat.

(25 Marks)

5. **5.1** Comment on the advantages of the following dietary modifications in a patient with hypercholesterolaemia and obesity.

5.1.1 Shifting from red meat to lean white meat **(15 Marks)**

5.1.2 Consuming only the egg white while avoiding the egg yolk. **(10 Marks)**

5.1.3 Adding green leaves to the diet. **(20 Marks)**

5.2 **5.2.1** List the different types of immunoglobulin. **(15 Marks)**

5.2.2 Give the principle of electrophoresis. **(15 Marks)**

5.2.3 Compare the serum protein electrophoretic pattern of a normal individual with that of a multiple myeloma by using a super imposed diagram.

(25 Marks)

6. 6.1 A 14-year-old girl, had constipation, oligomenorrhoea, goitre, acanthosis nigricans and dry skin. Her Body Mass Index was 38.5 kg / m^2, body fat was 46.9%. Blood pressure was normal for her age. Ultrasound of the neck showed enlarged thyroid lobes without calcification or vascularity. Her Thyroid profile was as shown below:

	Patient	Normal Range
TSH (mIU L^{-1})	203.19	0.10 - 4.50
FT_4 (ng dL^{-1})	0.29	0.7 - 1.9
Anti-thyroglobulin antibodies (IU L^{-1})	0.90	<115.00
Anti thyroperoxidase antibodies (anti TPO) (IU mL^{-1})	359.4	<34.00

Patient was treated with levothyroxine and, at 2 months of management, she lost 5.5kg of weight with improvement in symptoms and thyroid function tests.

6.1.1 Name the most probable condition. **(10 Marks)**

6.1.2 Explain the above thyroid profile before treatment. **(20 Marks)**

6.1.3 Explain how the treatment led to the reduction in body mass index (BMI). **(25 Marks)**

6.1.4 Explain how thyroid hormone is transported in the blood. **(15 Marks)**

6.2 Diagrammatically show the uptake of LDL by extrahepatic tissues. **(30 Marks)**

7. 7.1 A 58-year-old man, experienced chest pain radiating to the left arm with sweating. The pain disappeared within few hours. Couple of days later the ECG, Troponin T (TnT) and the routine tests were carried out. ECG showed non-specific ST wave changes. The blood test results are as follows:

	Patient	Range
ALT (U L^{-1})	45	4-36
AST (U L^{-1})	90	8-33
Troponin T (μg L^{-1})	0.78	<0.01

7.1.1 Suggest the probable condition. **(10 Marks)**

7.1.2 Explain the above test results. **(20 Marks)**

7.1.3 Diagrammatically show how the serum enzymes and proteins of the patient would have changed immediately after the chest pain. **(20 Marks)**

7.2 Explain why the intake of aspirin is beneficial to this patient. **(30 Marks)**

7.3 Write short notes on glycerol phosphate shuttle. **(20 Marks)**

8. 8.1. A 26-year-old male consulted his doctor complaining of fatigue and lack of energy to perform work. History revealed that he had similar symptoms for the past few years and he is a non-alcoholic and non-smoker. The blood test report of the patient is given below.

The total and differential white cell counts were normal.

	Patient	Normal Range
Haemoglobin (gdL^{-1})	17.1	11.5-18.0
Serum Total Bilirubin ($\mu molL^{-1}$)	9.0	1.71-20.5
ALT ($U\ L^{-1}$)	175	3-55
ALP ($U\ L^{-1}$)	110	80-280
TSH ($mU\ L^{-1}$)	2.3	0.4-4.0
FT_4 ($pmol\ L^{-1}$)	16	9-22
Iron ($\mu mol\ L^{-1}$)	36	5-32
Transferrin ($g\ L^{-1}$)	1.5	2.1-4.0
Ferritin ($\mu g\ L^{-1}$)	670	30-240
Transferrin Saturation (%)	96	20-55

8.1.1 Mention the diagnosis. **(10 Marks)**

8.1.2 Give the biochemical basis for the diagnosis. **(30 Marks)**

8.1.3 Give the biochemical basis for the measurement of other parameters, which do not directly support the diagnosis but had helped to eliminate the other probable conditions. **(30 Marks)**

8.2 **8.2.1** Diagrammatically show and label the different parts of tRNA. **(15 Marks)**

8.2.2 Explain how the structure of tRNA is suited for its function. **(15 Marks)**

9. 9.1 A 11-month-old baby boy showed signs of delayed motor development and was reported to have sand like crystals on the diaper. The baby had compulsive urge to bite his lips and fingers. The mother revealed that she had a brother with similar symptoms. Urinary and serum uric acid levels were abnormally high for the age of the baby.

9.1.1 Name the probable problem in this baby? **(10 Marks)**

9.1.2 Name the enzyme activity measurement may be useful to confirm the condition you suggested? **(10 Marks)**

9.1.3 Give reasons for the hyperuricemia and hyperuricosuria. **(20 Marks)**

9.2 A 75-year-old non-diabetic woman visited her doctor due to numbness and tingling in her arm. She was consuming normal healthy diet without nutrient supplementation. Laboratory results indicated elevated serum methylmalonic acid and due to her aging HCl production was reduced by the gastric mucosa (atrophic gastritis). On investigation, she was diagnosed to have megaloblastic anaemia.

9.2.1 Give reasons for the woman to have the above said problem, even though she has consumed normal healthy diet. **(20 Marks)**

9.2.2 Give the biochemical basis for the

9.2.2.1 elevated methylmalonic acid. **(15 Marks)**

9.2.2.2 megaloblastic anaemia. **(15 Marks)**

9.2.2.3 numbness. **(10 Marks)**

10.10.1 A 40-year-old female of 152cm height and 90kg of weight was presented with intolerance to fatty foods, pain in the right side of the abdomen, yellowish sclera and passage of clay coloured stools. Laboratory investigations were as follows:

		Patient	Normal Range
Serum	Total bilirubin ($\mu molL^{-1}$)	24.0	1.71-20.5
	Direct bilirubin ($\mu molL^{-1}$)	16.0	<5.1
	ALP (IUL^{-1})	800	44-147
	ALT (UL^{-1})	20	4-36
Urine	Colour	Deep Yellow	
	Bilirubin	++	
	Urobilinogen	Absent	
Stool	Stercobilinogen	Absent	

10.1.1 Name the probable cause for the above said observations? **(10 Marks)**

10.1.2 Explain the steps involved in the metabolism of bilirubin and its excretion. **(40 Marks)**

10.1.3 Explain the biochemical basis of the above laboratory findings. **(25 Marks)**

10.2 10.2.1 Give reasons for the fat intolerance. **(10 Marks)**

10.2.2 List the consequences that may occur due to long-term fat intolerance. **(15 Marks)**