



Umanand Prasad School of Medicine & Health Sciences
Department of Basic Sciences
2025

FINAL EXAMINATION PAPER

BIOC 103: MEDICAL BIOCHEMISTRY

Important Instructions to Students:

1. Read the questions, instructions carefully and answer the questions.
2. You are allowed an **extra 10 minutes reading time** (during this time, you are not allowed to write with pen) and **180 minutes (3 Hours) to complete this paper**.
3. Silent, non-programmable calculators are allowed, but not supplied.
4. Write all your answers in the answer booklet provided. If you need extra sheets, please ask from the supervisor. Write your name, course code and student identification number in the answer booklet and in the attendance sheet.
5. This paper contains four (4) sections A, B, C and D. All questions are compulsory to answer **except** section **B** and **D** have **choices**.
6. Write all your answers legibly. The marker has the right to award zero for answers that are not legible.
7. This is a **Closed Book Examination**. The University views plagiarism, cheating and dishonest practice as serious offences and if found, offenders are penalized.

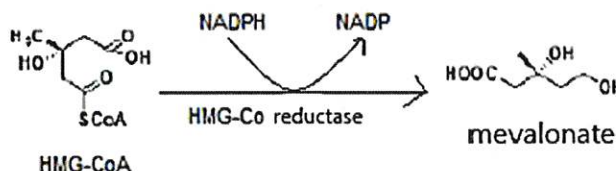
Examination Paper Content (Format):

<u>Section</u>	<u>Question</u>	<u>Content</u>	<u>Marks</u>	<u>Suggested Time</u>
A	1-50	Multiple Choice (50)	50	60 minutes
B	51-57	Short Answer Questions (Choose Any Five out of Seven)	30	30 minutes
C	58-59	Case Studies (2)	20	30 minutes
D	60-66	Long Answer Questions (Choose Any Five out of Seven)	100	60 minutes
		TOTAL	200	180 Minutes

Section A. Multiple Choice Questions and ALL are Mandatory. (1 mark each)

Write the appropriate answer in your answer sheet.

- 1. A 50-year-old female presents to her primary care doctor with fatigue and tingling/numbness in her extremities (bilateral). Examination reveals a beefy red and fissured tongue. Further evaluation reveals a low Glutathione reductase activity in the red blood cells. Which of the following vitamin deficiencies could have caused her symptoms?**
 - A. Vitamin B2 deficiency
 - B. Niacin deficiency
 - C. Vitamin C deficiency
 - D. Biotin deficiency
- 2. Which ONE of the following is most responsible for the maintenance of protein secondary structure?**
 - A. van der Waals forces
 - B. Hydrogen bonds
 - C. Disulfide cross-links
 - D. Salt bridges
- 3. A three-year-old boy was brought unconscious into emergency room. Blood gases were performed pH 7.26, PCO_2 54 mmHg, HCO_3^- 38 mmol/l, Base excess +14 mmol/l, this patient demonstrates:**
 - A. Metabolic alkalosis
 - B. Metabolic acidosis
 - C. Respiratory acidosis
 - D. Respiratory alkalosis
- 4. The following reaction is catalyzed by a transaminase, which belongs to the group of:**
 - A. hydrolases
 - B. transferases
 - C. lyases
 - D. ligases
- 5. Statins are drugs that inhibit HMG-CoA reductase (hydroxymethylglutaryl-CoA reductase), the key enzyme in cholesterol biosynthesis, which catalyzes the conversion of HMG-CoA to mevalonate.**



What kind of inhibition is that of statins over HMG-CoA reductase?

- A. allosteric
- B. competitive
- C. non-competitive
- D. competitive

6. Glucose-6-phosphatase is not present in:

- A. Liver and kidneys
- B. Kidneys and muscles
- C. Kidneys and adipose tissue
- D. Muscles and adipose tissue

7. Conversion of glucose to glucose-6- phosphate in human liver is by:

- A. Hexokinase only
- B. Glucokinase only
- C. Hexokinase and glucokinase
- D. Glucose-6-phosphate dehydrogenase

8. Excessive secretion of Adrenocorticotrophic hormone (ACTH) causes:

- A. Cushing's syndrome
- B. Addison's disease
- C. Myxoedema
- D. Thyrotoxicosis

9. Which of the following goes across the membrane in the process of diffusion?

- A. water
- B. gases
- C. glucose
- D. None of the above

10. Primary structure of a protein explain:

- A. the order of amino acids
- B. location of disulphide bonds
- C. loop regions of proteins
- D. the ways of protein folding

11. A lipoprotein directly proportional to the highest risk of coronary atherosclerosis is:

- A. VLDL
- B. IDL
- C. LDL
- D. HDL

12. Trypsinogen is converted to active Trypsin by:

- A. HCl
- B. Bile salts
- C. Ca^{++}
- D. Enterokinase

13. Cholesterol is an essential component of membranes because:

- A. participates in some systems of cotransport
- B. protects its integrity
- C. facilitates the incorporation of some proteins
- D. acts regulating its fluidity

14. The secondary sexual characters in females is effected by:

- A. Estrogens
- B. Gluco corticoids
- C. Thyroxin
- D. None of these

15. Characteristic finding in Gaucher's disease is:

- A. Night blindness
- B. Renal failure
- C. Hepatosplenomegaly
- D. Deafness

16. An important finding in Neimann-Pick disease is:

- A. Leukopenia
- B. Cardiac enlargement
- C. Corneal opacity
- D. Hepatosplenomegaly

17. An inborn error, maple syrup urine disease is due to deficiency of the enzyme:

- A. Isovaleryl-CoA hydrogenase
- B. Phenylalanine hydroxylase
- C. Adenosyl transferase
- D. alpha-Ketoacid decarboxylase

18. Increased reabsorption of water from the kidney is the major consequence of which of the following hormones?

- A. Cortisol
- B. Insulin
- C. Vasopressin
- D. Aldosterone

19. Which of the following statements about nucleic acid is most correct?

- A. Both pentose nucleic acid and deoxypentose nucleic acid contain the same pyrimidines
- B. Both pentose nucleic acid and deoxypentose nucleic acid contain the same purines
- C. RNA contains cytosine and thymine
- D. DNA and RNA are hydrolysed by weak alkali

20. The characteristic of hyperparathyroidism is:

- A. low serum calcium
- B. high serum phosphorous
- C. low serum calcium and high serum phosphorous
- D. high serum calcium and low serum phosphate

21. Which one of the following statements is incorrect?

- A. Insulin increases glucose phosphorylation
- B. Insulin increases glycolysis
- C. Insulin augments HMP shunt
- D. Insulin promotes gluconeogenesis

22. A patient of chronic alcoholism may present a thiamine deficiency (B1 vitamin), because alcohol inhibits its intestinal absorption. In this case the functioning of which enzyme would be impaired?

- A. glutamate dehydrogenase
- B. pyruvate dehydrogenase
- C. succinate dehydrogenase
- D. isocitrate dehydrogenase

- 23. Which of the following Krebs cycle enzymes is located in the internal mitochondrial membrane?**
- A. malate dehydrogenase
 - B. isocitrate dehydrogenase
 - C. succinate dehydrogenase
 - D. α -ketoglutarate dehydrogenase
- 24. In physiological jaundice of new-born, due to less availability of substrate and immature enzyme system, there is an impaired formation of soluble, non-toxic form of bilirubin which is:**
- A. Bilirubin sulphate
 - B. Bilirubin phosphate
 - C. Bilirubin diglucuronate
 - D. Bilirubin acetate
- 25. Oils are more fluid than other fats because they contain:**
- A. less cholesterol
 - B. more phospholipids
 - C. more unsaturated fatty acids
 - D. less triglycerides
- 26. A 35-year-old man has been fasting for religious reason for several days. His brain has reduced its need for glucose by using which of the following substances as an alternate source of energy?**
- A. Beta carotene
 - B. Beta hydroxy butyrate
 - C. Glycerol
 - D. Alanine
- 27. The main regulatory enzyme in fatty acid synthesis is:**
- A. carnitine palmitoyl transferase I
 - B. acyl CoA synthetase (thiokinase)
 - C. pyruvate dehydrogenase
 - D. acetyl-CoA carboxylase
- 28. In humans the largest portion of amino nitrogen is excreted as:**
- A. uric acid
 - B. creatinine
 - C. urea
 - D. glutamine
- 29. On a patient showing hyperuricemia it is advisable to lower consumption of:**
- A. dairy products
 - B. fats
 - C. beef
 - D. eggs
- 30. Pyruvate dehydrogenase is activated when:**
- A. there is an increase in the concentration of acetyl-CoA
 - B. it is dephosphorylated
 - C. there is an increase in the concentration of pyruvate
 - D. the Krebs cycle is activated

31. Insulin inhibits the secretion of glucagon because:

- A. when glycemia increases there is less glucagon secretion
- B. it allows saving gluconeogenic substrates
- C. it is no longer needed to liberate glucose from the liver
- D. alpha cells have receptors for insulin

32. Insulin promotes glycolysis in hepatocytes because it promotes dephosphorylation of:

- A. Glucokinase
- B. phosphofructokinase I
- C. phosphofructokinase II
- D. glyceraldehyde-3-phosphate dehydrogenase

33. During physical exercise there is an increase in the production of lactate that follows an increase in the concentration of:

- A. ATP
- B. pyruvate
- C. NADH
- D. Creatine

34. Anaemia can occur due to a diet lacking:

- A. pyridoxine
- B. folic acid
- C. linoleic acid
- D. tocopherols

35. Pancreatic lipase:

- A. exerts its action in the interface lipid-water
- B. is stimulated by bile salts
- C. cannot function on lipids that are not in micelles
- D. hydrolyzes fatty acids from the diet

36. A significant decrease in the cholesterol intake might affect its metabolism because of:

- A. a decrease in its excretion
- B. an increase in its endogenous synthesis
- C. a decrease in its utilization for synthesis of bile salts
- D. a decrease in its incorporation to cell membranes

37. During compensation of respiratory alkalosis, all the following changes occur except

- A. Decreased secretion of hydrogen ions by renal tubules
- B. Increased excretion of sodium in urine
- C. Increased excretion of bicarbonate in urine
- D. Increased excretion of ammonia in urine

38. The conversion of pyruvate to acetyl CoA and CO₂:

- A. is reversible
- B. involves the participation of lipoic acid
- C. depends on the coenzyme biotin
- D. occurs in the cytosol

- 39. Which bond is present in the primary structure of protein?**
- A. Ester
 - B. Hydrogen
 - C. Ionic bond
 - D. Peptide
- 40. The exclusive function of iron in the body is confined to the process of**
- A. Muscular contraction
 - E. Nerve excitation
 - F. Cellular respiration
 - G. Blood coagulation
- 41. Retinoic acid participates in the synthesis of:**
- A. Iodopsin
 - B. Rhodopsin
 - C. Glycoprotein
 - D. Cardiolipin
- 42. In cystic fibrosis, the pancreatic ducts become obstructed by viscous mucus. Consequently digestion of which of the following substances would be most impaired?**
- A. Starch
 - B. lipids
 - C. Glycogen
 - D. Cellulose
- 43. The anti-obesity drug Orlistat inhibits**
- A. Pancreatic lipase
 - B. Lipoprotein lipase
 - C. Hormone-sensitive lipase
 - D. Phospholipase
- 44. Which of the following is an example of epimers?**
- A. Mannose & Glucose
 - B. Glucose & Ribose
 - C. Galactose & Mannose
 - D. Glucose & Galactose
- 45. What is the enzyme responsible for the breakdown of triglycerides into fatty acids and mono-acylglycerol in the intestine?**
- A. Pancreatic lipase
 - B. Lipoprotein lipase
 - C. Hormone-sensitive lipase
 - D. Phospholipase
- 46. Cyclization of glucose occurs due to reaction between which two groups?**
- A. C1 keto group and C6 OH group
 - B. C1 aldehyde group and C2 OH group
 - C. C5 OH group and C1 aldehyde group
 - D. C2 keto group and C4 OH group

47. Breakdown of heme produces:

- A. Bilirubin
- B. Biliverdin
- C. Urobilin
- D. Stercobilin

48. Which one of the following statements concerning glucose metabolism is correct?

- A The conversion of Glucose to lactate occurs only in the R.B.C
- B Glucose enters most cells by a mechanism in which Na^+ and glucose are co-transported
- C Pyruvate kinase catalyses an irreversible reaction
- D An elevated level of insulin leads to a decreased level of fructose 2, 6-bisphosphate in hepatocyte

49. The digestive enzymes of cellular compounds are confined to

- A Lysosomes
- B Ribosomes
- C Peroxisomes
- D Polysomes

50. The enzyme DNA ligase

- A Introduces superhelical twists
- B Connects the end of two DNA chains
- C Unwinds the double helix
- D Synthesises RNA primers

Section B: Short answer questions. (Word limit 80-100words approx.). Answer any Five (5) questions. (6 marks each)

- 51. G6PD deficiency is one the most common enzymatic disorder affecting red blood cells. Explain the normal function of G6PD enzyme (use biochemical reactions). Discuss G6PD deficiency.
- 52. Name any one liver function test and its significance.
- 53. Discuss the metabolic fates of glucose and explain how pyruvate undergoes complete oxidation in the body.
- 54. Discuss the physiological functions, importance, and deficiency diseases of Vitamin A and Vitamin C in the human body
- 55. Write a note on Wilsons disease (causes, symptoms and treatment).
- 56. Assuming complete dissociation, calculate the pH of the following solutions:
(a) 0.004M HCl (b) 0.006M NaOH (c) 0.004M KOH
- 57. Differentiate the following terms:
 - A. Respiratory acidosis and Metabolic acidosis
 - B. mRNA, tRNA, and rRNA
 - C. Insulin and Glucagon
 - D. Dehydration and hypovolemia
 - E. Integral and peripheral protein

Section C: Case Studies: (10 marks each)

58. Case Study 1

A 45-year-old male with a known history of **Type 1 Diabetes Mellitus** and **Chronic Kidney Disease (CKD)** presents to the hospital with **oliguria for the past three weeks** and **generalized muscle weakness for one day**. He has been **non-compliant with his anti-diabetic medications**.

His vital signs are as follows:

- Blood Pressure: 150/95 mmHg
- Heart Rate: 92 bpm
- Respiratory Rate: 19 breaths/min
- Temperature: 36.8 °C
- SpO₂: 98% on room air
- Capillary Blood Glucose: 19 mmol/L (random)

Serum Electrolyte Results:

- Sodium: 130 mEq/L
- Potassium: 6.5 mEq/L
- Calcium: 1.84 mEq/L
- Chloride: 95 mEq/L
- Magnesium: 2.6 mEq/L
- Bicarbonate: 29 mEq/L

Questions:

- Analyze the clinical scenario and identify the underlying electrolyte abnormalities or imbalances in this patient.
- Outline the risk factors that may have predisposed this patient to the development of hyperkalemia.
- Explain the pathophysiological mechanisms by which the identified risk factors contribute to hyperkalemia in this case.
- Suggest any additional laboratory or diagnostic tests that would be appropriate for further evaluation of this patient, providing justification for your recommendations.
- Discuss the diagnosis and management strategies for hyperkalemia in this clinical context.

59. Case Study 2

A 53-year-old female presents to the clinic with complaints of increased **thirst and frequent urination** for past 4 months. She also mentions feeling tired and experiencing occasional **blurry vision**. She has a background history of **hypertension**. She mentions her father has diabetes but is unsure of the type of diabetes.

Vitals signs: BMI 34 kg/m², BP 140/90 mmHg, P 89 bpm, RR 19 breaths/min, Temp 37 °C, SpO₂ 99% in RA, CBG 13 mmol (random). Urine dipstick revealed glucose (1+) and negative for ketones. The physician suspects diabetes, requests for an HbA_{1c} test and starts oral hypoglycemic drugs for this patient. During the follow up clinic, the random capillary blood glucose was within normal range, however, HbA_{1c} was 7%.

- Justify the diagnosis if this patient has type 1 or type 2 diabetes mellitus.
- Explain what changes occur in the hormonal regulation of carbohydrate metabolism in the type of diabetes mellitus most likely diagnosed in this patient?

Section D: Long Essay Questions (Word Limit 350 words each question approx.).

Answer any five (5) questions from the following: (20 marks each)

- 60.** Describe the steps of the TCA cycle, including enzymes, intermediates, and energy yield.
- 61.** Clarify the role of Calcium and Sodium in maintaining physiological balance within the body. How do imbalances in these electrolytes affect bodily functions?
- 62.** Describe the structure of DNA and explain the process of replication, transcription, and translation.
- 63.** Explain the process of biological oxidation, emphasizing its role in energy production. Detail the key reactions involved and the importance of electron carriers in this process.
- 64.** Illustrate by giving any one suitable example how the enzymes accelerate and inhibitors slow down the rate of the biochemical reactions in living organisms? Draw neat and well labelled diagram of catalysed and uncatalyzed reaction to show the Gibbs free energy difference.
- 65.** With the help of a diagram, describe in detail about the “Fluid Mosaic model” of plasma membrane. Also explain the role of any four components consisting the cell membrane.
- 66.** Explain how amino acids are classified according to polarity and charge. How is this related to the biochemical basis of sickle cell disease? Explain causes and clinical manifestation for this.

*******THE END*******