UNIVERSITI KUALA LUMPUR
INSTITUTE OF MEDICAL SCIENCE TECHNOLOGY

FINAL EXAMINATION

MARCH 2025 SEMESTER

COURSE CODE	:	HDB10603
COURSE TITLE	:	HUMAN BIOCHEMISTRY
PROGRAMME NAME	:	BACHELOR OF BIOMEDICAL SCIENCE (HONOURS)
DATE	:	30 JUNE 2025
TIME	:	2:00PM - 5:00PM
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. This question paper consist of TWO sections.
4. Answer ALL questions for Section A.
5. Section B consist of four questions. Answer THREE (3) questions only.
6. Please write your answer on the answer booklet provided.
7. Please answer all questions in English only.
8. Please answer MCQ/EMQ questions using OMR sheet. ☐ *Tick if applicable*
9. Refer to the attached Formula/ Appendies. ☐ *Tick if applicable*

SECTION A (Total: 40 marks)

Answer ALL questions.

Please use the answer booklet provided.

1. Which of the following represent the Michaelis-Menten constant (Km)?

   A. The enzyme concentration at saturation.

   B. The maximum rate of reaction (Vmax).

   C. The temperature at which the enzyme works best.

   D. The substrate concentration at ½ Vmax.

2. Choose the key difference between an allosteric activator and a competitive inhibitor.

   A. Both bind to the active site, but activators enhance catalysis.

   B. Allosteric activators denature the enzyme.

   C. Allosteric activators bind to a regulatory site, while competitive inhibitors bind to the active site.

   D. Competitive inhibitors are always irreversible.

3. Which type of kinetic curve is typically observed for allosteric enzymes?

   A. Hyperbolic (Michaelis-Menten).

   B. Sigmoidal (S-shaped).

   C. Exponential.

   D. Linear.

4. Which of the following is a characteristic of an allosteric enzyme?

   A. It only works at extremely high temperatures.

   B. It has multiple active sites that function independently.

   C. Its activity is regulated by binding of effector molecules at a site other than the active site.

   D. It binds covalently to its substrate.

5. Which of the following is the primary role of adipose tissue in metabolism?

   A. Synthesizing bile acids.

   B. Synthesizing leptin hormone.

   C. Synthesizing amino acids.

   D. Synthesizing cholesterol.

6. Which of the following best describes the Cori Cycle?

   A. Breakdown of fatty acids into ketone bodies.

   B. Recycling of lactate from muscles to glucose in the liver.

   C. Synthesis of proteins from amino acids.

   D. Conversion of glucose to glycogen in the liver.

7. Predict the effect on enzyme activity when the pH changes from the optimal pH of 7 to pH 3.

   A. Vmax increases.

   B. It denatures.

   C. Km decreases.

   D. It becomes more active.

8. Choose the primary product of purine degradation in humans.

   A. β-Alanine

   B. Uric acid

   C. Allantoin

   D. Ammonia

9. In which part of the cell does glycolysis occur?

   A. Nucleus

   B. Cytoplasm

   C. Mitochondria

   D. Endoplasmic reticulum

10. Choose the effect of non-competitive inhibition on an enzyme's Vmax.

    A. Increases.

    B. Decreases.

    C. Depends on pH.

    D. Stays the same.

11. Which of the following changes typically occurs in enzyme kinetics due to an allosteric activator?

    A. Increases Km.

    B. Shifts the enzyme kinetic curve to the right.

    C. Shifts the enzyme kinetic curve to the left.

    D. Decreases Vmax.

12. Which enzyme is responsible for the rate-limiting step of glycolysis?

    A. Hexokinase

    B. Aldolase

    C. Pyruvate kinase

    D. Phosphofructokinase-1 (PFK-1)

13. What is the net ATP yield from one molecule of glucose in aerobic glycolysis?

    A. 2 ATP

    B. 6 ATP

    C. 8 ATP

    D. 4 ATP

14. Which of the following is an allosteric inhibitor of phosphofructokinase-1 (PFK-1)?

    A. Fructose-2,6-bisphosphate

    B. ADP

    C. AMP

    D. ATP

15. The Cori cycle involves the conversion of _____.

    A. pyruvate to acetyl-CoA in mitochondria

    B. glycogen to glucose-1-phosphate in muscles

    C. lactate to glucose in the liver and glucose to lactate in muscles

    D. glucose to glycogen in the liver

16. Which hormone stimulates glycogenolysis in the liver?

    A. Leptin

    B. Ghrelin

    C. Glucagon

    D. Insulin

17. Which enzyme is responsible for the de novo synthesis of pyrimidine nucleotides?

    A. Carbamoyl phosphate synthetase II (CPS II)

    B. Ribonucleotide reductase

    C. Adenine phosphoribosyltransferase (APRT)

    D. Hypoxanthine-guanine phosphoribosyltransferase (HGPRT)

18. Which organ is the primary regulator of metabolic integration, balancing glucose, and amino acid metabolism?

    A. Kidney

    B. Pancrease

    C. Liver

    D. Small intestine

19. During critical illness, which metabolic pathway is activated to provide glucose to the kidney?

    A. Glycolysis

    B. Lipogenesis

    C. Gluconeogenesis

    D. Glycogen synthesis

20. Which hormone promotes the breakdown of glycogen into glucose during stress?

    A. Epinephrine

    B. Glucagon

    C. Insulin

    D. Norepinephrine

21. Which metabolic state is characterized by high insulin levels and excess glucose storage as fat?

    A. Exercise state

    B. Ketogenic state

    C. Fasting state

    D. Fed state

22. In the Lineweaver-Burk plot, the y-intercept represents _____.

    A. 1/Vmax

    B. - 1/Vmax

    C. - 1/Km

    D. 1/Km

23. Which of the following is an example of positive allosteric regulation?

    A. Competitive inhibition of succinate dehydrogenase by malonate.

    B. O_2 binding to hemoglobin and increasing its affinity for more O_2.

    C. ATP inhibiting phosphofructokinase-1 (PFK-1) in glycolysis.

    D. Feedback inhibition of threonine dehydratase by isoleucine.

24. Which of the following is true about allosteric inhibitors?

A. They permanently denature the enzyme.

B. They bind to a regulatory site and stabilize the T (tense) state of the enzyme.

C. They increase enzyme activity by stabilizing the R (relaxed) state.

D. They bind directly to the active site and block substrate binding.

25. "Muscle tissues convert glucose into lactic acid". This process is termed as _____.

A. gluconeogenesis

B. anaerobic glycolysis

C. aerobic glycolysis

D. oxidative phosphorylation

26. The term substrate is define as _____.

A. the molecule that does not fit into an enzyme and has no effect on the enzyme

B. the molecule that binds to an enzyme at the active site, causes the enzyme to carry out task

C. the molecule that binds to a place other than the active site and caused the enzyme to carry out a task

D. a water molecule that breaks down monomers

27. The bond that joined two monosaccharides molecules is called _____.

A. phosphodiester bond

B. peptide bond

C. hydrogen bond

D. glycosidic bond

28. Which of the followings is NOT a carbohydrate?

    A. Insulin

    B. Lactose

    C. Starch

    D. Oligosaccarides

29. Urea cycle converts _____.

    A. keto acids into amino acids

    B. amino acids into keto acids

    C. ammonia into a less toxic form

    D. ammonia into a more toxic form

30. "A researcher inhibits carnitine palmitoyltransferase I (CPT I) in a hepatocyte culture." Which downstream metabolic process will be most directly impaired?

    A. Glycolysis.

    B. Gluconeogenesis.

    C. Ketogenesis.

    D. Glycogenolysis.

31. Which of the following best explains how the Cori cycle contributes to metabolic integration during anaerobic exercise?

    A. It facilitates the breakdown of ketones for energy.

    B. It promotes protein catabolism in muscles for gluconeogenesis.

    C. It allows lactate from muscles to be converted to glucose in the liver.

    D. It provides ATP to muscles through glycogen breakdown.

32. Which of the following illustrates a correct regulatory relationship in metabolic integration?

A. High insulin levels stimulate hormone-sensitive lipase.

B. Insulin promotes glycolysis and lipogenesis in liver cells.

C. Glucagon stimulates glycogen synthesis in hepatocytes.

D. Cortisol acutely suppresses gluconeogenesis in the liver.

33. During prolonged starvation, which tissue adapts by using ketone bodies instead of glucose, thereby sparing muscle protein?

A. Brain.

B. Red blood cells.

C. Liver.

D. Skeletal muscle.

34. A patient is on a high-protein, low-carbohydrate diet. Which metabolic adaptation would be expected after two weeks?

A. Patient body will have increased insulin secretion and enhanced glycolysis.

B. Patient body will suppressed gluconeogenesis and increased glycogen synthesis.

C. Patient body will have increased protein synthesis and reduced lipolysis.

D. Patient body will have increased gluconeogenesis and ketone body production.

35. A patient with easy bruising, prolonged bleeding time, and a history of antibiotic overuse may be deficient in which vitamin?

A. Vitamin B3 – due to impaired NAD+ synthesis.

B. Vitamin K – due to reduced gut flora synthesis.

C. Vitamin A – due to hepatic dysfunction.

D. Vitamin D – due to fat malabsorption.

36. Which of the following best describes the metabolic state during the early fasting phase (6–24 hours after a meal)?

A. Gluconeogenesis from amino acids is the sole glucose source.

B. Lipolysis and ketogenesis are maximized.

C. Glycogenolysis maintains blood glucose levels.

D. Glycogenesis predominates to store excess glucose.

37. Which factor will typically affect enzyme activity?
I. Substrate concentration.
II. Temperature.
III. pH.
IV. Active binding site of the enzyme.

A. I and II.

B. II and III.

C. I, II, III and IV.

D. I, II and III.

38. A deficiency in which vitamin would most directly impair calcium and phosphate homeostasis, leading to bone deformities in children?

A. Vitamin E.

B. Vitamin D.

C. Vitamin B2.

D. Vitamin K.

39. Which of the following best explains the reasons of untreated Type 1 diabetics experience metabolic acidosis?

A. Increased ketogenesis due to unregulated lipolysis.

B. Impaired insulin action promotes anaerobic glycolysis.

C. Increased glucose utilization raises lactic acid levels.

D. Excessive glycogenolysis leads to acid accumulation.

40. "A patient develops night blindness and dry eyes. Lab tests show low serum retinol." Which metabolic process is most directly affected?

A. Conversion of tryptophan to serotonin.

B. Regeneration of 11-cis-retinal for phototransduction.

C. Conversion of methylmalonyl-CoA to succinyl-CoA.

D. Formation of thrombin from prothrombin.

SECTION B (Total: 60 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

Evaluate the limitations of the Michaelis-Menten model when applied to allosteric enzymes by incorporating allosteric concepts to improve the understanding of enzyme behavior under physiological conditions.

(20 marks)

Question 2

Describe how carbohydrate metabolism is integrated across the liver, muscle, and adipose tissue during the transition from the fed state to the fasted state. The answer should include the roles of key hormones, tissue-specific enzymes, and metabolic pathways, and explain how glycogen metabolism, glycolysis, and gluconeogenesis are coordinated to meet the energy needs of the body.

(20 marks)

Question 3

Answer below questions:

(a) Explain which steps in glycolysis are physiologically irreversible, including the significance of their irreversibility in regulating the pathway.

(15 marks)

(b) Most metabolic pathways are relatively long and appear to be very complex. For example, there are ten individual chemical reactions in glycolysis from converting glucose to pyruvate. Suggest reasons for this complexity.

(5 marks)

Question 4

Answer below questions:

(a) Discuss how the Michaelis-Menten theory and allosteric regulation differ in describing enzyme kinetics.

(14 marks)

(b) Explain how do these differences reflect the structural and functional characteristics of enzymes in metabolic pathways.

(6 marks)

END OF EXAMINATION PAPER