UNIVERSITI KUALA LUMPUR
INSTITUTE OF MEDICAL SCIENCE TECHNOLOGY

FINAL EXAMINATION

OCTOBER 2025 SEMESTER

COURSE CODE	:	HDD11103
COURSE TITLE	:	BIOCHEMISTRY
PROGRAMME NAME	:	DIPLOMA OF MEDICAL LABORATORY TECHNOLOGY
DATE	:	28 JANUARY 2026
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. Section A consist 25 MCQ or EMQ questions. Answer ALL questions.
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*

THERE ARE 13 PAGES OF QUESTIONS INCLUDING THIS PAGE

SECTION A (Total: 25 marks)

Answer ALL questions.

Please use the objective answer sheet provided.

1. The backbone of a DNA molecule consists of _____.

   A. nitrogenous bases

   B. alternating sugars and nitrogenous bases

   C. five carbon sugars

   D. alternating phosphate and sugar groups

2. Regardless of how a signal is initiated, the ligand-binding event is propagated via second messengers or protein recruitment. Which of the following statements explain the final biochemical outcome of these binding events?

   A. A protein at the top of an intracellular signaling pathway is activated.

   B. A protein at the bottom of an intracellular signaling pathway is activated.

   C. A protein at the top of an extracellular signaling pathway is activated.

   D. A protein in the middle of an intracellular signaling pathway is activated.

3. Which of the following statements about the free energy change (ΔG) in a biochemical reaction is **CORRECT**?

   A. In an exergonic reaction, ΔG is positive.

   B. The standard free energy change when reactants are present in concentrations of 1.0 mol/L and the pH is 7.0 is represented as ΔG_0.

   C. If ΔG is 0, the reaction is essentially irreversible.

   D. If ΔG is negative, the reaction proceeds spontaneously with a loss of free energy.

4. ATP _____.

   A. is needed in the body to drive exergonic reactions

   B. contains three high-energy phosphate bonds

   C. functions in the body as a complex with Mg^{2+}

   D. is used as an energy store in the body

5. _____ is a non-reducing sugar.

   A. Sucrose

   B. Lactose

   C. Glucose

   D. Cellobiose

6. Which of the following statements explain the strength of hydrogen bonds compared with covalent bonds?

   A. Hydrogen bonds are much stronger than covalent bonds.

   B. Hydrogen bonds are much weaker than covalent bonds.

   C. Hydrogen bonds and covalent bonds have similar strengths.

   D. The strength of both hydrogen bonds and covalent bonds cannot be measured.

7. The subcellular site of the breakdown of long-chain fatty acids to acetyl-CoA via β-oxidation is the _____.

   A. endoplasmic reticulum

   B. cytosol

   C. mitochondrial intermembrane space

   D. matrix of the mitochondria

8. Which of the following statements about the fed and fasting metabolic states is **CORRECT**?

   A. In the fasting state, glucagon acts to increase the synthesis of glycogen from glucose.

   B. In the fasting state, glucagon acts to increase the activity of lipoprotein lipase in adipose tissue.

   C. In the fed state, insulin acts to increase the breakdown of glycogen to maintain blood glucose.

   D. In the fed state, there is decreased secretion of insulin in response to increased glucose in the blood.

9. Glycolytic intermediates such as pyruvate and 3-phophoglycerate can be converted into amino acids and other metabolites. This means that, the glycolysis is _____.

   A. anaplerotic

   B. catabolic

   C. anabolic

   D. amphibolic

10. Which of the following components enable cells to respond to a specific extracellular signaling molecule?

   A. Ion channels

   B. Membrane glycolipid

   C. Plasma lipid bilayer

   D. Receptors

11. _____ model is the recent model that is being used to describe enzyme action.

    A. Lock and key

    B. Induced fit

    C. Activated fit

    D. Fluid mosaic

12. _____ of the DNA duplex causes the molecule to have a net negative charge at physiological pH.

    A. Phosphate groups

    B. Ribose

    C. Adenine monophosphate

    D. Deoxyribose

13. The breakdown of one molecule of a C16 fully saturated fatty acid (palmitic acid) by β-oxidation leads to the formation of _____ molecules.

    A. 7 $FADH_2$, 7 NADH and 8 acetyl CoA

    B. 7 $FADH_2$, 7 NADH and 7 acetyl CoA

    C. 8 $FADH_2$, 8 NADH and 8 acetyl CoA

    D. 8 $FADH_2$, 8 NADH and 7 acetyl CoA

14. Carnitine is needed for fatty acid oxidation because _____.

    A. long-chain acyl-CoA (activated fatty acids) is needed to enter the mitochondrial matrix to be oxidized but cannot cross the outer mitochondrial membrane. Transfer of the acyl group from CoA to carnitine enables translocation to occur

    B. it prevents the breakdown of long chain fatty acyl CoA in the mitochondrial intermembrane space

    C. it is a cofactor for acyl-CoA synthetase, which activates fatty acids for breakdown

    D. long-chain acyl-CoA (activated fatty acids) is needed to enter the mitochondrial intermembrane space to be oxidized but cannot cross the inner mitochondrial membrane. Transfer of the acyl group from CoA to carnitine enables translocation to occur

15. The "lock and key" model of enzyme action illustrates that a particular enzyme molecule _____.

    A. interacts with a specific type of substrate molecule

    B. reacts at identical rates under all conditions

    C. may be destroyed and resynthesized several times

    D. forms a permanent enzyme-substrate complex

16. Which of the following statements about glycolysis and gluconeogenesis is **CORRECT**?

    A. There are distinct gluconeogenesis pathways in the liver and muscle.

    B. All the reactions of glycolysis are freely reversible for gluconeogenesis.

    C. Glycolysis can proceed only in the absence of oxygen.

    D. Glycolysis is a catabolic pathway, while gluconeogenesis is an anabolic pathway.

17. The maximum number of hydrogen bonds that a single water molecule can form is _____.

A. 4

B. 1

C. 2

D. 3

18. Which of the following statements about the First Law of Thermodynamics are **TRUE**?

I. Total energy of a system, including its surroundings, remains constant.
II. Within the total system, energy is neither lost nor gained during any change.
III. Energy may be transferred from one part of the system to another.
IV. Energy may be transformed into another system.

A. I, II and III only

B. I and II only

C. I and IV only

D. I and III only

19. _____ is a hydrophobic compound.

A. Table salt

B. Sugar

C. Phosphate ester

D. Cholesterol

20. Which of the following components are found in RNA?
    I. Phosphate group
    II. Deoxyribose
    III. Ribose
    IV. Cytidine and thymine

    A. II and IV only

    B. I, II, III and IV

    C. I and II only

    D. I and III only

21. Which of the following lipids contain phosphate in its structure?

    A. Cholesterol

    B. Cerebroside

    C. Diacylglycerol

    D. Sphingomyelin

22. Which metabolic process is known as 'central pathway' because of its role in both catabolism and anabolism?

    A. Pentose phosphate pathway

    B. Gluconeogenesis pathway

    C. Phosphogluconate pathway

    D. Tricarboxylic acid pathway

23. A 40-year-old man has been fasting completely for one week, drinking water only. A blood sample is obtained at the end of this fasting period. Which of the following substances is expected to increase most in his blood?

    A. Glucose

    B. Ketone bodies

    C. Insulin

    D. Glucagon

24. Which of the following properties is/are **TRUE** about enzymes?

I. Unstable
II. Catalytic power
III. Specificity
IV. Regulation

A. III and IV only

B. I and II only

C. II, III and IV only

D. I, II, III and IV

25. Calculate the pH of 1 x 10^{-3} M NaOH in pure water.

A. pH 3

B. pH 8

C. pH 11

D. pH 10

SECTION B (Total: 75 marks)

Answer THREE (3) questions only.

Please use the answer booklet provided.

Question 1

Answer all of the following questions.

(a) Determine **TWO (2)** primary molecules that link anabolic and catabolic reactions.

(2 marks)

(b) Discuss the hormonal and metabolic changes that occur during the early fasting state, focusing on glucose homeostasis and fuel utilization.

(10 marks)

(c) Identify the effects of insulin and epinephrine on the following pathways:

i. Glycogen breakdown
ii. Glycogen synthesis
iii. Glycolysis
iv. Fatty acids synthesis
v. Fatty acids storage

(10 marks)

(d) Describe **THREE (3)** characteristics of a patient with Type I diabetes.

(3 marks)

Question 2

Answer all of the following questions.

(a) State **FIVE (5)** main functions of lipids.

(5 marks)

(b) Differentiate between fatty acids, triglycerides, and steroids in terms of their structures and functions.

(9 marks)

(c) Define the term 'second messengers'.

(2 marks)

(d) List **THREE (3)** examples of second messenger.

(3 marks)

(e) Briefly summarize the mechanism by which second messengers mediate intracellular signal transduction.

(6 marks)

Question 3

Answer all of the following questions.

(a) Describe the structure of deoxyribonucleic acids.

(5 marks)

(b) Outline **FIVE (5)** differences between deoxyribonucleic acids and ribonucleic acids.

(10 marks)

(c) Explain how allopurinol prevents the formation of uric acid.

(10 marks)

Question 4

Answer all of the following questions.

(a) Describe the chemical and physical properties of water.

(8 marks)

(b) Calculate the pH of an acetic acid solution where the concentration of acetic acid is 2 mM and the concentration of sodium acetate is 20 mM. The pK_a of acetic acid is 4.76.

(5 marks)

(c) A solution at pH 7 contains a weak acid, HA. Given the pK_a of the acid is 6.5, determine the ratio of [A]:[HA].

(6 marks)

(d) Explain how an acetic acid-sodium acetate buffer resist changes in pH when small amounts of acid or base are added.

(6 marks)

END OF EXAMINATION PAPER