KATHMANDU UNIVERSITY
End Semester Examination
July/August 2024

Level : B.Tech.
Year : II
Time : 2 hrs. 30mins.

06 AUG 2024

Course : BIOT 203
Semester : I
F. M. : 55

SECTION "B"

[5Q. × 3 = 15 marks]

Attempt *ANY FIVE* questions.

1. "The chemistry of living organisms is organized around carbon, which accounts for more than half the dry weight of cells." Why do you think carbon compounds were selected for the molecular machinery of cells during the origin and evolution of living organisms? Define 1 dalton. [2+1]

2. Explain the different factors affecting enzyme activity.

3. The formation of functional electron transport chain and oxidative phosphorylation necessitates the participation of both the nuclear and mitochondrial genomes. Discuss.

4. Describe the role of folic acid in the biosynthesis of dTMP. What could be the consequences of folic acid deficiency in pregnant women and in normal humans? [2+1]

5. Here is another quote stuck in my head: "You are what you eat." What components should you ideally include in your diet for a healthy lifestyle? Focus on what is essential to your body.

6. How does the pentose phosphate pathway provide antioxidant defense? Explain.

7. Discuss the intracellular locations and functions of carbamoyl phosphate synthetase I and carbamoyl phosphate synthetase II.

SECTION "C"

[5Q. × 5 = 25 marks]

Attempt *ANY FIVE* questions.

8. Draw the structure of cholesterol. Write down the functions of at least two biologically active molecules derived from cholesterol. How does cholesterol help to generate a semipermeable barrier and regulate membrane fluidity? [1+2+2]

9. Discuss the three-dimensional structure of the B-form of DNA with appropriate illustrations. Write about the contributions of Erwin Chargaff and Rosalind Franklin to elucidating the structure. [3.5+1.5]

10. How does blood glucose regulate insulin secretion by pancreatic beta cells? Explain the mechanism with a labeled figure.

11. Draw the reaction (with the structures of the substrate and the product) catalyzed by a hexokinase. How does the liver hexokinase IV differ in two respects from the muscle hexokinase II? Describe the functions of muscle glycogen and liver glycogen. [2+2+1]

12. What are the functions of the mRNA "cap" and "poly(A) tail"? Discuss the biological roles of miRNA, snRNA, and snoRNA. [2+3]

P.T.O.

13. While coming to take this exam, you saw a black mamba (widely considered the world's deadliest snake) waiting for you beside a tree. Which hormone do you think your body will mainly release to respond to that situation? Explain the physiological and metabolic effects of that hormone on your body.

14. What do you understand by the tertiary and quaternary structures of proteins? Describe utilizing myoglobin and hemoglobin as examples.

SECTION "D"

[2Q. × 7.5 = 15 marks]

Attempt *ANY TWO* questions.

15. Discuss the breakdown and synthesis of glycogen. Explain the mechanism by which liver glycogen phosphorylase acts as a blood glucose sensor. What is the role of glucagon in carbohydrate metabolism? [4+1.5+1.5]

16. Elaborate on the complete catabolism of a glucose molecule under aerobic conditions.

17. With appropriate figures, describe in detail the biosynthesis and oxidation of the fatty acid palmitate (16:0).

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Marks Scored:

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Registration No.:

SECTION "A"

[20Q. × 1 = 20 marks]

Choose and encircle the most appropriate option from each set of choices

1. long noncoding RNAs (lncRNAs):
   a. "Seek & Destroy" target mRNAs.
   b. assist in the processing of pre-mRNAs.
   c. can function as scaffold RNA molecules, holding proteins together.
   d. are involved in the conversion of uridine to pseudouridine in rRNA processing.

2. The carbon atoms of fatty acids are more _____ than those of sugars, and the _____ of triacylglycerols yields more than twice as much energy.
   a. saturated, reduction
   b. unsaturated, oxidation
   c. oxidized, reduction
   d. reduced, oxidation

3. Which of the following statements is NOT true?
   a. An N-glycosidic bond links a base to a pentose in a nucleoside.
   b. Fatty acids destined for mitochondrial oxidation are transiently attached to the hydroxyl group of carnitine.
   c. The occurrence of glycolysis and the TCA cycle in mitochondria facilitates electron flow to the respiratory chain.
   d. During oxidative phosphorylation, proton's entry into the matrix of mitochondria is coupled with the production of ATP.

4. Mitochondrial DNA and chloroplast DNA:
   a. are always linear.
   b. are always circular.
   c. can be circular or linear.
   d. do not have non-coding regions.

5. Which of the following statements is NOT true?
   a. Glutathione is a tripeptide of glutamate, cysteine, and glycine.
   b. The fumarate produced in the urea cycle is also an intermediate of the citric acid cycle.
   c. Transketolase and transaldolase are specific to the nonoxidative phase of the pentose phosphate pathway.
   d. Gluconeogenesis, which occurs mainly in the liver, involves the conversion of pyruvate, fatty acids, glycerol, etc., to glucose.

6. The de novo biosynthesis of purine requires:
   a. Formate, glycine, and aspartate
   b. Fumarate, glycine, and aspartate
   c. Glycine, asparagine, and formate
   d. Glycine, asparagine, and fumarate

7. Glucose breakdown in erythrocytes always terminates in:
   a. lactate b. pyruvate c. acetyl-CoA d. CO_2 and H_2O

8. Which of the following statements is NOT true?
   a. All the enzymes in the pentose phosphate pathway are located in the cytosol.
   b. Pyruvate is an entry point into catabolism for amino acids like cysteine and serine.
   c. Alanine and glutamine are the principal molecules that transport amino groups from extrahepatic tissues to the liver.
   d. Glucose 6-phosphatase, an enzyme responsible for dephosphorylating glucose, is present in liver, muscle, and adipose tissue.

9. As the concentration of CTP increases, the activity of aspartate transcarbamoylase (ATCase) _____.
   a. increases b. decreases c. equals ½ V_{max} d. approaches V_{max}

10. Which of the following statements is NOT true?
   a. S-adenosylmethionine (SAM) is a major methyl group donor and is derived from methionine and ATP.
   b. The large rRNA component of the ribosome performs the peptidyl transferase activity during protein synthesis.
   c. Piwi proteins function at the chromatin level by depositing repressive histone marks to silence transposable element transcription.
   d. Under laboratory conditions in which most of the water is removed from DNA, the crystallographic structure of DNA changes to the Z-form.

11. The output from the TCA cycle for 2 acetyl-CoA molecules oxidized is:
   a. 6 NADPH, 2 $FADH_2$, 2 GTP, and 4 CO_2
   b. 6 NADPH, 3 $FADH_2$, 3 GTP, and 2 CO_2
   c. 6 NADH, 2 $FADH_2$, 2 GTP, and 4 CO_2
   d. 6 NADH, 3 $FADH_2$, 3 GTP, and 2 CO_2

12. Which of the following statements is NOT true?
   a. RNA can catalyze the splicing of introns.
   b. Base pairing between G and U residues is allowed in RNA.
   c. The base-stacking interactions are nonspecific with respect to the identity of the stacked bases.
   d. If denaturation conditions are carefully controlled, regions that are rich in G-C base pairs will denature first.

13. The mitochondrial respiratory chain consists of a series of sequentially acting electron carriers, most of which are integral proteins with _____ capable of accepting and donating either one or two electrons.
   a. prosthetic groups b. glycoprotein spikes
   c. glycosaminoglycans d. associated mitochondrial DNA

14. Which of the following statements is NOT true?
   a. Succinyl-CoA is a product of the oxidation of odd-number fatty acids.
   b. β-oxidation is blocked by malonyl-CoA, which inhibits carnitine acyltransferase I.
   c. Chylomicrons originate from the small intestine and move through the lymphatic system to the blood stream.
   d. During the biosynthesis of cholesterol, polymerization of five 6-carbon isoprene units occurs to form the 30-carbon linear squalene.

15. When you run very fast for a few minutes, your thigh muscles become sore and painful because of:
    a. excess accumulation of pyruvate due to aerobic glycolysis.
    b. excess accumulation of lactate due to anaerobic glycolysis.
    c. excess accumulation of oxaloacetate due to a upregulated TCA cycle.
    d. excess accumulation of acetyl-CoA due to a downregulated TCA cycle.

16. One effect of glucose phosphorylation within cells is to _____ glucose inside the cell.
    a. trap b. import c. release d. dissolve

17. Which of the following statements is NOT true?
    a. In cardiolipin, two phosphatidates share a single glycerol bridge.
    b. Sphingosine is an amino alcohol that contains a long, saturated hydrocarbon chain.
    c. In phosphatidylcholine, the head group is joined to glycerol through a phosphodiester bond.
    d. Phosphatidate (diacylglycerol 3-phosphate) is a key intermediate in the biosynthesis of the other glycerophospholipids.

18. The most abundant protein in mammals is:
    a. Actin b. Keratin c. Myosin d. Collagen

19. Which of the following statements is NOT true?
    a. Plasmodesma provides a path between two plant cells.
    b. All enzymes are proteins, but not all proteins are enzymes.
    c. Erythropoietin is a glycoprotein hormone that stimulates the production of RBCs.
    d. Hemoglobin has four polypeptide subunits held together by noncovalent interactions.

20. In plankton, the free-floating microorganisms at the bottom of the food chain for marine animals, _____ are the chief storage form of metabolic fuel.
    a. fats b. waxes c. diacylglycerols d. monoacylglycerols