**Roll No. .....**

| Question Booklet Number |
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**O. M. R. Serial No.**

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# M. Sc. (Biochemistry) (Second Semester) EXAMINATION, 2025-26

## (New Syllabus Effective from 2023)

## BIOENERGETICS AND INTERMEDIARY METABOLISM

| Paper Code | | | | | | | | |
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| Questions Booklet Series |
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| B |

*Time : 1:30 Hours* ] [ *Maximum Marks : 75*

**Instructions to the Examinee :**

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. All questions carry equal marks.
3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

**परीक्षार्थियों के लिए निर्देश :**

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।
3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

**(Remaining instructions on the last page)** **(शेष निर्देश अन्तिम पृष्ठ पर)**

*(Only for Rough Work)*

1. The end products of β-oxidation are :
   (A) Pyruvate and NADH
   (B) Acetyl-CoA, $FADH_2$ and NADH
   (C) Lactate and ATP
   (D) Glucose and ADP

2. In the TCA cycle, which of the following combines with Acetyl-CoA to form a 6 carbon compound ?
   (A) Oxaloacetate
   (B) Fumarate
   (C) Pyruvate
   (D) Malate

3. What is the precursor of triglyceride biosynthesis ?
   (A) Acetyl-CoA
   (B) Glycerol-3-phosphate
   (C) Malonyl-CoA
   (D) Pyruvate

4. The backbone of sphingolipids is :
   (A) Glycerol
   (B) Sphingosine
   (C) Ceramide
   (D) Cholesterol

5. Which of the following is NOT a phospholipid ?
   (A) Phosphatidylcholine
   (B) Phosphatidylserine
   (C) Sphingomyelin
   (D) Triacylglycerol

6. Steroid hormones are synthesized from :
   (A) Fatty acids
   (B) Glycerol
   (C) Cholesterol
   (D) Glucose

7. Which organelle is primarily involved in steroid hormone biosynthesis ?
   (A) Nucleus
   (B) Cytosol
   (C) Smooth endoplasmic reticulum
   (D) Golgi apparatus

8. Deficiency of 21-hydroxylase leads to impaired synthesis of :
   (A) Androgens
   (B) Estrogens
   (C) Cortisol and aldosterone
   (D) Cholesterol

9. Ketone bodies are produced primarily in the :
   (A) Brain
   (B) Liver
   (C) Kidney
   (D) Muscle

10. Which of the following is NOT a ketone body ?

(A) Acetoacetate

(B) β-hydroxybutyrate

(C) Acetone

(D) Acetyl-CoA

11. The enzyme responsible for converting HMG-CoA to acetoacetate is :

(A) HMG-CoA reductase

(B) HMG-CoA synthase

(C) HMG-CoA lyase

(D) Acetoacetate dehydrogenase

12. Ketogenesis occurs under which condition ?

(A) High carbohydrate diet

(B) Fed state

(C) Fasting/starvation

(D) Insulin overdose

13. Glucagon is released from :

(A) Muscle

(B) Pancreas

(C) Kidneys

(D) Epithelial tissues

14. Where does oxidative phosphorylation take place ?

(A) Ribosomes

(B) Nucleus

(C) Mitochondria

(D) Cell membrane

15. The major site of cholesterol synthesis is the :

(A) Kidney

(B) Liver

(C) Brain

(D) Muscle

16. Fatty acid synthase is a :

(A) Single-function enzyme

(B) Multienzyme complex

(C) Membrane receptor

(D) Transferase

17. The first step in cholesterol biosynthesis is :

(A) Formation of mevalonate

(B) Condensation of acetyl-CoA molecules

(C) Production of lanosterol

(D) Conversion of cholesterol to bile acids

18. Acetyl CoA is a ..... carbon compound.

(A) 1

(B) 2

(C) 3

(D) 4

19. NADP in its reduced form is :

(A) NAD

(B) NADH

(C) NADPH

(D) DPH

20. Which of the following are the end products of the complete combustion of glucose ?

(A) $CO_2$ and starch

(B) Fructose and lactose

(C) $H_2O$ and mannose

(D) $CO_2$ and $H_2O$

21. What is the breakdown of glucose to pyruvic acid known as ?

(A) Respiration

(B) Glycolysis

(C) Combustion

(D) Hydrolysis

22. Acetyl CoA is formed from pyruvate by ..... reaction.

(A) Dehydration

(B) Reduction

(C) Oxidative decarboxylation

(D) Dephosphorylation

23. ATP synthesis is powered by :

(A) Coenzyme motive force

(B) cAMP

(C) Proton gradient

(D) GTP hydrolysis

24. 3-phosphoglycerate is not the metabolic precursor for :

(A) Serine

(B) Glycine

(C) Cysteine

(D) Arginine

25. Pyruvate is the precursor for :

(A) Valine

(B) Glutamate

(C) Serine

(D) Proline

26. Precursor of glycine is :

(A) Proline

(B) Glutamine

(C) Serine

(D) Glutamate

27. Which of the following is a non-essential amino acid ?

(A) Methionine

(B) Threonine

(C) Lysine

(D) Glutamate

28. Which of the following gives rise to alanine and isoleucine ?

(A) Pyruvate

(B) Glutamate

(C) Aspartate

(D) Serine

29. Which of the following is not an aromatic amino acid ?

(A) Phenylalanine

(B) Tyrosine

(C) Tryptophan

(D) Lysine

30. Phosphoribosyl pyrophosphate is derived from :

(A) Ribose 5-phosphate

(B) Erythrose 4-phosphate

(C) Glucose

(D) Fructose

31. Which of the following is an important cellular reducing agent ?

(A) Glutathione

(B) Glycine

(C) Arginine

(D) Porphyrin

32. What is the main function of the pentose phosphate pathway ?

(A) Supply $NADP^+$

(B) Supply NADH

(C) Supply energy

(D) Supply pentoses and NADPH

33. In the electron transport chain, each pair of electron donated by NADH releases sufficient energy to produce :

(A) 0.5 ATP

(B) 1.5 ATP

(C) 2.5 ATP

(D) 3.5 ATP

34. Albinism is a disorder caused by a deficiency in which enzyme ?

(A) Phenylalanine hydroxylase

(B) Tyrosinase

(C) Tryptophan hydroxylase

(D) Histidine hydroxylase

35. GTP is a :

(A) Nucleoside

(B) Nucleotide

(C) Vitamin

(D) Nucleic acid

36. Salvage pathway is used in the synthesis of :

(A) Amino acid

(B) Carbohydrate

(C) Nucleotide

(D) Fatty acid

37. Which of the following is an essential fatty acid ?

(A) Palmitic acid

(B) Oleic acid

(C) Stearic acid

(D) Linolenic acid

38. Coenzyme Q (ubiquinone) acts as an electron carrier between :

(A) Complex IV and ATP synthase

(B) Complex I/II and Complex III

(C) Complex III and IV

(D) Complex I and II only

39. Which component of the electron transport chain transfers electrons to oxygen ?

(A) Complex II

(B) Complex III

(C) Complex IV

(D) Coenzyme Q

40. Identify the 5-carbon metabolite.

(A) Citrate

(B) $\alpha$-ketoglutarate

(C) Succinate

(D) Malate

41. Cytochromes are characterized by the presence of :

(A) Copper ions

(B) Flavin mononucleotide

(C) Iron-containing heme groups

(D) Manganese centers

42. Which cytochrome has the highest redox potential ?

(A) Cytochrome b

(B) Cytochrome cl

(C) Cytochrome a

(D) Cytochrome a3

43. Which part of the mitochondria accumulates protons during electron transport ?

(A) Mitochondrial matrix

(B) Intermembrane space

(C) Outer mitochondrial membrane

(D) Inner membrane

44. ATP synthase is composed of which two major components ?

(A) F0 and F1

(B) A and B subunits

(C) NADH and $FADH_2$

(D) CoQ and Cyt c

45. How many carbon atoms does oxaloacetate contain ?

(A) 3

(B) 2

(C) 4

(D) 1

46. Kreb Cycle is ..... in nature.

(A) Anabolic

(B) Catabolic

(C) Amphibolic

(D) None of the above

47. 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

48. Which technique is commonly used to isolate individual mitochondrial complexes ?

(A) PCR

(B) Gel electrophoresis

(C) Differential centrifugation

(D) Ultracentrifugation with detergent treatment

49. Reconstitution of the respiratory chain can be achieved by using :

(A) Organic solvents

(B) Artificial lipid vesicles (liposomes)

(C) Urea solutions

(D) Nucleotides

50. The goal of reconstitution experiments in mitochondria is to :

(A) destroy the proton gradient

(B) study DNA replication

(C) rebuild and study electron transport in isolation

(D) measure lipid content

51. Which of the following is an example of an exergonic reaction ?

(A) Glucose + ATP $\rightarrow$ Glucose-6-P

(B) ATP $\rightarrow$ ADP + Pi

(C) $NAD^+ + H^+ \rightarrow NADH$

(D) ADP + Pi $\rightarrow$ ATP

52. The second law of thermodynamics states :

(A) Energy can be converted from one form to another.

(B) In any energy transformation, energy is conserved.

(C) Every energy transfer increases the entropy of the universe.

(D) Total energy of a system remains constant.

53. Which thermodynamic parameter determines whether a reaction is spontaneous ?

(A) Enthalpy ($\Delta H$)

(B) Entropy ($\Delta S$)

(C) Temperature (T)

(D) Gibbs free energy ($\Delta G$)

54. In a closed biological system, energy :

(A) is constantly created

(B) is lost as heat

(C) is recycled

(D) follows the first law of thermodynamics

55. A reaction with a large positive $\Delta G$ will proceed if :

(A) Reactants are in excess

(B) Coupled to an exergonic reaction

(C) Temperature is reduced

(D) Catalyzed by an enzyme

56. ATP is considered a high-energy molecule because :

(A) It has a high enthalpy.

(B) It releases a large amount of heat.

(C) It has unstable phospho-anhydride bonds.

(D) It has a high redox potential.

57. The hydrolysis of ATP to ADP releases approximately

(A) – 7.3 kcal/mol

(B) + 7.3 kcal/mol

(C) – 3.5 kcal/mol

(D) – 15 kcal/mol

58. Which of the following can regenerate ATP from ADP ?

(A) Phosphoenolpyruvate

(B) AMP

(C) Glucose

(D) UTP

59. Redox reactions involve :

(A) Transfer of phosphate groups

(B) Transfer of protons

(C) Transfer of electrons

(D) Transfer of oxygen

60. Oxidation is defined as :

(A) Gain of electrons

(B) Gain of hydrogen

(C) Loss of electrons

(D) Loss of oxygen

61. $NAD^+$ is reduced to NADH during :

(A) Glycolysis

(B) Photosynthesis

(C) Protein synthesis

(D) ATP hydrolysis

62. The final electron acceptor in aerobic respiration is :

(A) $CO_2$

(B) $NAD^+$

(C) $O_2$

(D) ATP

63. A molecule with a more positive redox potential :

(A) is a better electron donor.

(B) is a better electron acceptor.

(C) has more energy.

(D) is unstable.

64. Cytochromes are involved in :

(A) Hydrolysis

(B) Oxidative phosphorylation

(C) Glycolysis

(D) Transamination

65. Which component of the electron transport chain donates electrons to complex III ?

(A) NADH

(B) $FADH_2$

(C) Cytochrome c

(D) Coenzyme Q (ubiquinone)

66. ATP synthase produces ATP using energy from :

(A) Substrate-level phosphorylation

(B) Electron flow

(C) Proton gradient

(D) Glycolysis

67. Which of the following is a mobile electron carrier in the ETC ?

(A) NADH dehydrogenase

(B) Coenzyme Q

(C) Complex IV

(D) ATP synthase

68. In which process is substrate-level phosphorylation observed ?

(A) Electron transport chain

(B) Glycolysis

(C) Light reaction of photosynthesis

(D) Transcription

69. In anaerobic conditions, pyruvate is converted into :

(A) Acetyl-CoA

(B) Oxaloacetate

(C) Lactate

(D) Citrate

70. Glycolysis occurs in the :

(A) Mitochondria

(B) Cytoplasm

(C) Nucleus

(D) Golgi body

71. Fructose 2,6-bisphosphate :

(A) Inhibits glycolysis

(B) Activates gluconeogenesis

(C) Activates PFK-1

(D) Inhibits hexokinase

72. Which enzyme is feedback inhibited by its product, glucose-6-phosphate ?

(A) Hexokinase

(B) PFK-1

(C) Enolase

(D) Pyruvate kinase

73. Which of the following decreases PFK-1 activity ?

(A) Low ATP

(B) High AMP

(C) High citrate

(D) High F-2,6-BP

74. The energy donor in substrate-level phosphorylation is :

(A) NADH

(B) High-energy phosphate compound

(C) FAD

(D) Acetyl-CoA

75. Which enzyme catalyzes substrate-level phosphorylation in glycolysis ?

(A) G3P dehydrogenase

(B) Hexokinase

(C) Phosphoglycerate kinase

(D) Aldolase

76. TCA cycle occurs in the :

(A) Cytoplasm

(B) Inner mitochondrial membrane

(C) Mitochondrial matrix

(D) Nucleus

77. Main purpose of oxidative phosphorylation is :

(A) Breakdown of glucose

(B) Generation of NADH

(C) Formation of ATP using electron transport

(D) Storage of oxygen

78. What is produced when oxygen accepts electrons in the ETS ?

(A) Hydrogen ions

(B) Water

(C) $CO_2$

(D) ATP

79. Which electron transport system complex is not a proton pump ?

(A) Complex I

(B) Complex II

(C) Complex III

(D) Complex IV

80. How many protons are needed to synthesize one ATP molecule (approx.) ?

(A) 1

(B) 2

(C) 3-4

(D) 6

81. Cytochrome c transfers electrons from :

(A) Complex I to II

(B) Complex II to IV

(C) Complex III to IV

(D) Complex I to III

82. Pyruvate dehydrogenase complex converts pyruvate into :

(A) Oxaloacetate

(B) Lactate

(C) Acetyl-CoA

(D) Citrate

83. Glycogen is primarily stored in :

(A) Brain and liver

(B) Muscle and adipose tissue

(C) Liver and muscle

(D) Kidney and heart

84. The branching enzyme in glycogenesis introduces :

(A) $\alpha$-1,4 linkages

(B) $\beta$-1,4 linkages

(C) $\alpha$-1,6 linkages

(D) $\beta$-1,6 linkages

85. Which enzyme is responsible for breaking $\alpha$-1,6-branches during glycogenolysis ?

(A) Glycogen phosphorylase

(B) Debranching enzyme

(C) Hexokinase

(D) Glucose-6-phosphatase

86. In the liver, glycogen breakdown contributes to :

(A) ATP production in muscle

(B) Release of free glucose into blood

(C) Storage of triglycerides

(D) Synthesis of DNA

87. Which anticancer drug inhibits dihydrofolate reductase ?

(A) 5-Fluorouracil

(B) Azathioprine

(C) Allopurinol

(D) Methotrexate

88. Hydrolysis of lactose yields :

(A) D-galactose and D-glucose

(B) D-glucose and D-glucose

(C) D-galactose and D-fructose

(D) D-fructose and D-glucose

89. Trimethoprim selectively inhibits :

(A) Human DNA polymerase

(B) Bacterial folate synthesis

(C) Human thymidylate synthase

(D) Bacterial RNA polymerase

90. Which enzyme is deficient in Lesch-Nyhan syndrome ?

(A) Adenosine deaminase

(B) PRPP synthetase

(C) Xanthine oxidase

(D) HGPRT

91. Hyperuricemia and gout are primarily due to excess :

(A) Hypoxanthine

(B) Urea

(C) Uric acid

(D) Xanthine

92. Severe combined immunodeficiency (SCID) can result from deficiency of :

(A) Thymidylate synthase

(B) Adenosine deaminase

(C) HGPRT

(D) Xanthine oxidase

93. In oleic acid, the double bond is placed between ..... .

(A) C6-C7

(B) C7-C8

(C) C8-C9

(D) C9-C10

94. Which one of the following vitamins is a precursor of FAD ?

(A) Vitamin B1

(B) Vitamin B2

(C) Vitamin B3

(D) Vitamin B5

95. How many rounds of β-oxidation are necessary to metabolize myristic fatty acid (14 : 0) ?

(A) 4

(B) 5

(C) 6

(D) 12

96. The *de novo* fatty acid synthesis occurs in which compartment of animal cells ?

(A) Mitochondria

(B) Peroxisome

(C) Endoplasmic reticulum.

(D) Cytosol

97. Which genetic disorder is associated with dysfunction of peroxisomes ?

(A) Parkinson's disease

(B) Down's syndrome

(C) Zellweger syndrome

(D) Bubble Boy syndrome

98. Which organ is the primary site of fatty acid biosynthesis ?

(A) Muscle

(B) Liver

(C) Kidney

(D) Brain

99. What is the immediate precursor of malonyl-CoA in fatty acid biosynthesis ?

(A) Acetyl-CoA

(B) Succinyl-CoA

(C) Propionyl-CoA

(D) Pyruvate

100. Which coenzyme is required for fatty acid synthase activity ?

(A) NADH

(B) FAD

(C) NADPH

(D) None of the above

*(Only for Rough Work)*

4. Four alternative answers are mentioned for each question as—A, B, C & D in the booklet. The candidate has to choose the correct answer and mark the same in the OMR Answer-Sheet as per the direction :

**Example :**

**Question :**

Q. 1 (A) ● (C) (D)
Q. 2 (A) (B) ● (D)
Q. 3 (A) ● (C) (D)

Illegible answers with cutting and over-writing or half filled circle will be cancelled.

5. Each question carries equal marks. Marks will be awarded according to the number of correct answers you have.
6. All answers are to be given on OMR Answer Sheet only. Answers given anywhere other than the place specified in the answer sheet will not be considered valid.
7. Before writing anything on the OMR Answer Sheet, all the instructions given in it should be read carefully.
8. After the completion of the examination candidates should leave the examination hall only after providing their OMR Answer Sheet to the invigilator. Candidate can carry their Question Booklet.
9. There will be no negative marking.
10. Rough work, if any, should be done on the blank pages provided for the purpose in the booklet.
11. To bring and use of log-book, calculator, pager and cellular phone in examination hall is prohibited.
12. In case of any difference found in English and Hindi version of the question, the English version of the question will be held authentic.

**Impt. :** On opening the question booklet, first check that all the pages of the question booklet are printed properly. If there is any discrepancy in the question Booklet, then after showing it to the invigilator, get another question Booklet of the same series.

4. प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार सम्भावित उत्तर—A, B, C एवं D हैं। परीक्षार्थी को उन चारों विकल्पों में से सही उत्तर छाँटना है। उत्तर को OMR आन्सर-शीट में सम्बन्धित प्रश्न संख्या में निम्न प्रकार भरना है :

**उदाहरण :**

**प्रश्न :**

प्रश्न 1 (A) ● (C) (D)
प्रश्न 2 (A) (B) ● (D)
प्रश्न 3 (A) ● (C) (D)

अपठनीय उत्तर या ऐसे उत्तर जिन्हें काटा या बदला गया है, या गोले में आधा भरकर दिया गया, उन्हें निरस्त कर दिया जाएगा।

5. प्रत्येक प्रश्न के अंक समान हैं। आपके जितने उत्तर सही होंगे, उन्हीं के अनुसार अंक प्रदान किये जायेंगे।
6. सभी उत्तर केवल ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर ही दिये जाने हैं। उत्तर-पत्रक में निर्धारित स्थान के अलावा अन्यत्र कहीं पर दिया गया उत्तर मान्य नहीं होगा।
7. ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर कुछ भी लिखने से पूर्व उसमें दिये गये सभी अनुदेशों को सावधानीपूर्वक पढ़ लिया जाये।
8. परीक्षा समाप्ति के उपरान्त परीक्षार्थी कक्ष निरीक्षक को अपनी OMR Answer Sheet उपलब्ध कराने के बाद ही परीक्षा कक्ष से प्रस्थान करें। परीक्षार्थी अपने साथ प्रश्न-पुस्तिका ले जा सकते हैं।
9. निगेटिव मार्किंग नहीं है।
10. कोई भी रफ कार्य, प्रश्न-पुस्तिका के अन्त में, रफ-कार्य के लिए दिए खाली पेज पर ही किया जाना चाहिए।
11. परीक्षा-कक्ष में लॉग-बुक, कैलकुलेटर, पेजर तथा सेल्युलर फोन ले जाना तथा उसका उपयोग करना वर्जित है।
12. प्रश्न के हिन्दी एवं अंग्रेजी रूपान्तरण में भिन्नता होने की दशा में प्रश्न का अंग्रेजी रूपान्तरण ही मान्य होगा।

**महत्वपूर्ण :** प्रश्नपुस्तिका खोलने पर प्रथमतः जाँच कर देख लें कि प्रश्न-पुस्तिका के सभी पृष्ठ भलीभाँति छपे हुए हैं। यदि प्रश्नपुस्तिका में कोई कमी हो, तो कक्षनिरीक्षक को दिखाकर उसी सिरीज की दूसरी प्रश्न-पुस्तिका प्राप्त कर लें।