

Roll No.

Question Booklet Number

O. M. R. Serial No.

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Question Booklet Number

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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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. Which coenzyme is required for fatty acid synthase activity ?
 - (A) NADH
 - (B) FAD
 - (C) NADPH
 - (D) None of the above
2. What is the immediate precursor of malonyl-CoA in fatty acid biosynthesis ?
 - (A) Acetyl-CoA
 - (B) Succinyl-CoA
 - (C) Propionyl-CoA
 - (D) Pyruvate
3. Which organ is the primary site of fatty acid biosynthesis ?
 - (A) Muscle
 - (B) Liver
 - (C) Kidney
 - (D) Brain
4. Which genetic disorder is associated with dysfunction of peroxisomes ?
 - (A) Parkinson's disease
 - (B) Down's syndrome
 - (C) Zellweger syndrome
 - (D) Bubble Boy syndrome
5. The *de novo* fatty acid synthesis occurs in which compartment of animal cells ?
 - (A) Mitochondria
 - (B) Peroxisome
 - (C) Endoplasmic reticulum.
 - (D) Cytosol
6. How many rounds of β -oxidation are necessary to metabolize myristic fatty acid (14 : 0) ?
 - (A) 4
 - (B) 5
 - (C) 6
 - (D) 12
7. Which one of the following vitamins is a precursor of FAD ?
 - (A) Vitamin B1
 - (B) Vitamin B2
 - (C) Vitamin B3
 - (D) Vitamin B5
8. In oleic acid, the double bond is placed between
 - (A) C6-C7
 - (B) C7-C8
 - (C) C8-C9
 - (D) C9-C10
9. Severe combined immunodeficiency (SCID) can result from deficiency of :
 - (A) Thymidylate synthase
 - (B) Adenosine deaminase
 - (C) HGPRT
 - (D) Xanthine oxidase

10. Hyperuricemia and gout are primarily due to excess :
- (A) Hypoxanthine
 - (B) Urea
 - (C) Uric acid
 - (D) Xanthine
11. Which enzyme is deficient in Lesch-Nyhan syndrome ?
- (A) Adenosine deaminase
 - (B) PRPP synthetase
 - (C) Xanthine oxidase
 - (D) HGPRT
12. Trimethoprim selectively inhibits :
- (A) Human DNA polymerase
 - (B) Bacterial folate synthesis
 - (C) Human thymidylate synthase
 - (D) Bacterial RNA polymerase
13. 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
14. Which anticancer drug inhibits dihydrofolate reductase ?
- (A) 5-Fluorouracil
 - (B) Azathioprine
 - (C) Allopurinol
 - (D) Methotrexate
15. 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
16. Which enzyme is responsible for breaking α -1,6-branches during glycogenolysis ?
- (A) Glycogen phosphorylase
 - (B) Debranching enzyme
 - (C) Hexokinase
 - (D) Glucose-6-phosphatase
17. The branching enzyme in glycogenesis introduces :
- (A) α -1,4 linkages
 - (B) β -1,4 linkages
 - (C) α -1,6 linkages
 - (D) β -1,6 linkages
18. Glycogen is primarily stored in :
- (A) Brain and liver
 - (B) Muscle and adipose tissue
 - (C) Liver and muscle
 - (D) Kidney and heart

19. Pyruvate dehydrogenase complex converts pyruvate into :
- (A) Oxaloacetate
 - (B) Lactate
 - (C) Acetyl-CoA
 - (D) Citrate
20. 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
21. How many protons are needed to synthesize one ATP molecule (approx.) ?
- (A) 1
 - (B) 2
 - (C) 3-4
 - (D) 6
22. Which electron transport system complex is not a proton pump ?
- (A) Complex I
 - (B) Complex II
 - (C) Complex III
 - (D) Complex IV
23. What is produced when oxygen accepts electrons in the ETS ?
- (A) Hydrogen ions
 - (B) Water
 - (C) CO₂
 - (D) ATP
24. 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
25. TCA cycle occurs in the :
- (A) Cytoplasm
 - (B) Inner mitochondrial membrane
 - (C) Mitochondrial matrix
 - (D) Nucleus
26. Which enzyme catalyzes substrate-level phosphorylation in glycolysis ?
- (A) G3P dehydrogenase
 - (B) Hexokinase
 - (C) Phosphoglycerate kinase
 - (D) Aldolase

27. The energy donor in substrate-level phosphorylation is :
- (A) NADH
 - (B) High-energy phosphate compound
 - (C) FAD
 - (D) Acetyl-CoA
28. Which of the following decreases PFK-1 activity ?
- (A) Low ATP
 - (B) High AMP
 - (C) High citrate
 - (D) High F-2,6-BP
29. Which enzyme is feedback inhibited by its product, glucose-6-phosphate ?
- (A) Hexokinase
 - (B) PFK-1
 - (C) Enolase
 - (D) Pyruvate kinase
30. Fructose 2,6-bisphosphate :
- (A) Inhibits glycolysis
 - (B) Activates gluconeogenesis
 - (C) Activates PFK-1
 - (D) Inhibits hexokinase
31. Glycolysis occurs in the :
- (A) Mitochondria
 - (B) Cytoplasm
 - (C) Nucleus
 - (D) Golgi body
32. In anaerobic conditions, pyruvate is converted into :
- (A) Acetyl-CoA
 - (B) Oxaloacetate
 - (C) Lactate
 - (D) Citrate
33. In which process is substrate-level phosphorylation observed ?
- (A) Electron transport chain
 - (B) Glycolysis
 - (C) Light reaction of photosynthesis
 - (D) Transcription
34. Which of the following is a mobile electron carrier in the ETC ?
- (A) NADH dehydrogenase
 - (B) Coenzyme Q
 - (C) Complex IV
 - (D) ATP synthase

35. ATP synthase produces ATP using energy from :
- (A) Substrate-level phosphorylation
 - (B) Electron flow
 - (C) Proton gradient
 - (D) Glycolysis
36. Which component of the electron transport chain donates electrons to complex III ?
- (A) NADH
 - (B) FADH₂
 - (C) Cytochrome c
 - (D) Coenzyme Q (ubiquinone)
37. Cytochromes are involved in :
- (A) Hydrolysis
 - (B) Oxidative phosphorylation
 - (C) Glycolysis
 - (D) Transamination
38. 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.
39. The final electron acceptor in aerobic respiration is :
- (A) CO₂
 - (B) NAD⁺
 - (C) O₂
 - (D) ATP
40. NAD⁺ is reduced to NADH during :
- (A) Glycolysis
 - (B) Photosynthesis
 - (C) Protein synthesis
 - (D) ATP hydrolysis
41. Oxidation is defined as :
- (A) Gain of electrons
 - (B) Gain of hydrogen
 - (C) Loss of electrons
 - (D) Loss of oxygen
42. Redox reactions involve :
- (A) Transfer of phosphate groups
 - (B) Transfer of protons
 - (C) Transfer of electrons
 - (D) Transfer of oxygen
43. Which of the following can regenerate ATP from ADP ?
- (A) Phosphoenolpyruvate
 - (B) AMP
 - (C) Glucose
 - (D) UTP

44. 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
45. 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 phosphoanhydride bonds.
 - (D) It has a high redox potential.
46. A reaction with a large positive ΔG will proceed if :
- (A) Reactants are in excess
 - (B) Coupled to an exergonic reaction
 - (C) Temperature is reduced
 - (D) Catalyzed by an enzyme
47. 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
48. Which thermodynamic parameter determines whether a reaction is spontaneous ?
- (A) Enthalpy (ΔH)
 - (B) Entropy (ΔS)
 - (C) Temperature (T)
 - (D) Gibbs free energy (ΔG)
49. 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.
50. Which of the following is an example of an exergonic reaction ?
- (A) $\text{Glucose} + \text{ATP} \rightarrow \text{Glucose-6-P}$
 - (B) $\text{ATP} \rightarrow \text{ADP} + \text{P}_i$
 - (C) $\text{NAD}^+ + \text{H}^+ \rightarrow \text{NADH}$
 - (D) $\text{ADP} + \text{P}_i \rightarrow \text{ATP}$

51. 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
52. Reconstitution of the respiratory chain can be achieved by using :
- (A) Organic solvents
 - (B) Artificial lipid vesicles (liposomes)
 - (C) Urea solutions
 - (D) Nucleotides
53. Which technique is commonly used to isolate individual mitochondrial complexes ?
- (A) PCR
 - (B) Gel electrophoresis
 - (C) Differential centrifugation
 - (D) Ultracentrifugation with detergent treatment
54. 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
55. Krebs Cycle is in nature.
- (A) Anabolic
 - (B) Catabolic
 - (C) Amphibolic
 - (D) None of the above
56. How many carbon atoms does oxaloacetate contain ?
- (A) 3
 - (B) 2
 - (C) 4
 - (D) 1
57. ATP synthase is composed of which two major components ?
- (A) F₀ and F₁
 - (B) A and B subunits
 - (C) NADH and FADH₂
 - (D) CoQ and Cyt c
58. Which part of the mitochondria accumulates protons during electron transport ?
- (A) Mitochondrial matrix
 - (B) Intermembrane space
 - (C) Outer mitochondrial membrane
 - (D) Inner membrane

59. Which cytochrome has the highest redox potential ?
- (A) Cytochrome b
 - (B) Cytochrome c1
 - (C) Cytochrome a
 - (D) Cytochrome a3
60. Cytochromes are characterized by the presence of :
- (A) Copper ions
 - (B) Flavin mononucleotide
 - (C) Iron-containing heme groups
 - (D) Manganese centers
61. Identify the 5-carbon metabolite.
- (A) Citrate
 - (B) α -ketoglutarate
 - (C) Succinate
 - (D) Malate
62. Which component of the electron transport chain transfers electrons to oxygen ?
- (A) Complex II
 - (B) Complex III
 - (C) Complex IV
 - (D) Coenzyme Q
63. 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
64. Which of the following is an essential fatty acid ?
- (A) Palmitic acid
 - (B) Oleic acid
 - (C) Stearic acid
 - (D) Linolenic acid
65. Salvage pathway is used in the synthesis of :
- (A) Amino acid
 - (B) Carbohydrate
 - (C) Nucleotide
 - (D) Fatty acid
66. GTP is a :
- (A) Nucleoside
 - (B) Nucleotide
 - (C) Vitamin
 - (D) Nucleic acid

67. Albinism is a disorder caused by a deficiency in which enzyme ?
- (A) Phenylalanine hydroxylase
 - (B) Tyrosinase
 - (C) Tryptophan hydroxylase
 - (D) Histidine hydroxylase
68. 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
69. What is the main function of the pentose phosphate pathway ?
- (A) Supply NADP^+
 - (B) Supply NADH
 - (C) Supply energy
 - (D) Supply pentoses and NADPH
70. Which of the following is an important cellular reducing agent ?
- (A) Glutathione
 - (B) Glycine
 - (C) Arginine
 - (D) Porphyrin
71. Phosphoribosyl pyrophosphate is derived from :
- (A) Ribose 5-phosphate
 - (B) Erythrose 4-phosphate
 - (C) Glucose
 - (D) Fructose
72. Which of the following is not an aromatic amino acid ?
- (A) Phenylalanine
 - (B) Tyrosine
 - (C) Tryptophan
 - (D) Lysine
73. Which of the following gives rise to alanine and isoleucine ?
- (A) Pyruvate
 - (B) Glutamate
 - (C) Aspartate
 - (D) Serine
74. Which of the following is a non-essential amino acid ?
- (A) Methionine
 - (B) Threonine
 - (C) Lysine
 - (D) Glutamate

75. Precursor of glycine is :
- (A) Proline
 - (B) Glutamine
 - (C) Serine
 - (D) Glutamate
76. Pyruvate is the precursor for :
- (A) Valine
 - (B) Glutamate
 - (C) Serine
 - (D) Proline
77. 3-phosphoglycerate is not the metabolic precursor for :
- (A) Serine
 - (B) Glycine
 - (C) Cysteine
 - (D) Arginine
78. ATP synthesis is powered by :
- (A) Coenzyme motive force
 - (B) cAMP
 - (C) Proton gradient
 - (D) GTP hydrolysis
79. Acetyl CoA is formed from pyruvate by reaction.
- (A) Dehydration
 - (B) Reduction
 - (C) Oxidative decarboxylation
 - (D) Dephosphorylation
80. What is the breakdown of glucose to pyruvic acid known as ?
- (A) Respiration
 - (B) Glycolysis
 - (C) Combustion
 - (D) Hydrolysis
81. Which of the following are the end products of the complete combustion of glucose ?
- (A) CO₂ and starch
 - (B) Fructose and lactose
 - (C) H₂O and mannose
 - (D) CO₂ and H₂O
82. NADP in its reduced form is :
- (A) NAD
 - (B) NADH
 - (C) NADPH
 - (D) DPH
83. Acetyl CoA is a carbon compound.
- (A) 1
 - (B) 2
 - (C) 3
 - (D) 4

84. 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
85. Fatty acid synthase is a :
- (A) Single-function enzyme
 - (B) Multienzyme complex
 - (C) Membrane receptor
 - (D) Transferase
86. The major site of cholesterol synthesis is the :
- (A) Kidney
 - (B) Liver
 - (C) Brain
 - (D) Muscle
87. Where does oxidative phosphorylation take place ?
- (A) Ribosomes
 - (B) Nucleus
 - (C) Mitochondria
 - (D) Cell membrane
88. Glucagon is released from :
- (A) Muscle
 - (B) Pancreas
 - (C) Kidneys
 - (D) Epithelial tissues
89. Ketogenesis occurs under which condition ?
- (A) High carbohydrate diet
 - (B) Fed state
 - (C) Fasting/starvation
 - (D) Insulin overdose
90. 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
91. Which of the following is NOT a ketone body ?
- (A) Acetoacetate
 - (B) β -hydroxybutyrate
 - (C) Acetone
 - (D) Acetyl-CoA

92. Ketone bodies are produced primarily in the :
- (A) Brain
 - (B) Liver
 - (C) Kidney
 - (D) Muscle
93. Deficiency of 21-hydroxylase leads to impaired synthesis of :
- (A) Androgens
 - (B) Estrogens
 - (C) Cortisol and aldosterone
 - (D) Cholesterol
94. Which organelle is primarily involved in steroid hormone biosynthesis ?
- (A) Nucleus
 - (B) Cytosol
 - (C) Smooth endoplasmic reticulum
 - (D) Golgi apparatus
95. Steroid hormones are synthesized from :
- (A) Fatty acids
 - (B) Glycerol
 - (C) Cholesterol
 - (D) Glucose
96. Which of the following is NOT a phospholipid ?
- (A) Phosphatidylcholine
 - (B) Phosphatidylserine
 - (C) Sphingomyelin
 - (D) Triacylglycerol
97. The backbone of sphingolipids is :
- (A) Glycerol
 - (B) Sphingosine
 - (C) Ceramide
 - (D) Cholesterol
98. What is the precursor of triglyceride biosynthesis ?
- (A) Acetyl-CoA
 - (B) Glycerol-3-phosphate
 - (C) Malonyl-CoA
 - (D) Pyruvate
99. 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
100. The end products of β -oxidation are :
- (A) Pyruvate and NADH
 - (B) Acetyl-CoA, FADH₂ and NADH
 - (C) Lactate and ATP
 - (D) Glucose and ADP

(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।