Roll No. .....

Question Booklet Number

O. M. R. Serial No.

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

(Old Syllabus Effective from 2022)

(Only Back Paper Students)

BACTERIAL METABOLISM AND PHYSIOLOGY

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. In oxidative phosphorylation, electrons finally reduce :

(A) CO_2 to glucose

(B) NAD^+ to NADH

(C) FAD to $FADH_2$

(D) Oxygen to water

2. Rotational catalysis is powered by :

(A) Proton translocation

(B) Electron transport directly

(C) Oxygen binding

(D) NADH oxidation

3. Net ATP yield per glucose in Entner-Doudoroff pathway is :

(A) 1

(B) 2

(C) 3

(D) 4

4. The chemiosmotic theory was proposed by :

(A) Peter Mitchell

(B) Hans Krebs

(C) Albert Szent-Györgyi

(D) Paul Boyer

5. ATP synthase uses :

(A) Proton motive force

(B) Substrate-level phosphorylation

(C) NADPH

(D) Oxygen

6. The final electron acceptor in aerobic respiration is :

(A) CO_2

(B) NAD+

(C) FAD

(D) Oxygen

7. The enzyme producing NADH from malate in TCA cycle is :

(A) Citrate synthase

(B) Succinate dehydrogenase

(C) Malate dehydrogenase

(D) Pyruvate kinase

8. The first step of Krebs cycle is catalyzed by :

(A) Citrate synthase

(B) Isocitrate dehydrogenase

(C) Succinate dehydrogenase

(D) Malate dehydrogenase

9. Net ATP yield per glucose in glycolysis is :

(A) 30

(B) 4

(C) 32

(D) 2

10. The Entner-Duodoroff pathway is an alternative to :

(A) PPP

(B) Krebs cycle

(C) Glycolysis

(D) Fermentation

11. The oxygen-evolving complex requires :

(A) Mn^{2+} ions

(B) Fe^{2+} ions

(C) Cu^{2+} ions

(D) Zn^{2+} ions

12. The Entner-Duodoroff pathway is found mainly in :

(A) Pseudomonas

(B) *E. coli*

(C) Yeast

(D) Cyanobacteria

13. The Pentose Phosphate Pathway (PPP) occurs in the :

(A) Nucleus

(B) Mitochondria

(C) Chloroplast

(D) Cytoplasm

14. In methylotrophic bactria utilizing the serine pathway, how is formaldehyde primarily assimilated into biomass ?

(A) By direct condensation with ribulose-5-phosphate

(B) By combination with glycine to form serine

(C) By reducing to methane

(D) By complete oxidation to CO_2

15. The first enzyme of glycolysis is :

(A) Pyurvate kinase

(B) Phosphofructokinase

(C) Hexookinase

(D) Aldolase

16. Carbon monoxide (CO) dehydrogenase is the key enzyme for :

(A) The Calvin cycle

(B) The Wood-Ljungdahl pathway

(C) Iron oxidation

(D) Nitrification

17. The splitting of water in photosynthesis is catalyzed by :

(A) Oxygen-evolving

(B) Rubisco

(C) ATP synthase

(D) Ferredoxin

18. What distinguishes "mixotrphs" from pure chemolithoautrophs ?

(A) Mixotrophs can use both inorganic and organic carbon sources.

(B) Mixotrophs only use light.

(C) Mixotrophs cannot fix CO_2

(D) Mixotrophs produce methane.

19. Why is the "Reverse Electron Flow" necessary for many chemolithotrophs ?

(A) To make ATP.

(B) To generate NAD(P)H for CO_2 fixation.

(C) To get rid of excess electrons.

(D) To move toward a light source.

20. To fix 3 molecules of CO_2 into one net molecule of G3P, how many ATP are required in total ?

(A) 3

(B) 6

(C) 9

(D) 12

21. Methanogens belong to which domain of life?

(A) Bacteria

(B) Eukarya

(C) Archaea

(D) Protozoa

22. A bacterium uses H_2S as an electron donor and lives in total darkness at the bottom of the ocean. It is a :

(A) Photoautotroph

(B) Chemoorganotroph

(C) Chemolithoautotroph

(D) Photoheterotroph

23. If you inhibit the enzyme phosphoglycerate kinase, which stage of the Calvin cycle is directly blocked ?

(A) Carboxylation

(B) Reduction

(C) Regeneration

(D) Light capture

24. In the "regeneration" phase of the Calvin cycle, what is being regenerated ?

(A) ATP

(B) NADPH

(C) Ribulose-1, 5-bisphosphate (RuBP)

(D) Glucose

25. The Calvin cycle requires :

(A) NADPH only

(B) ATP only

(C) ATP and NADPH

(D) Oxygen

26. The main product of anoxygenic photophosphorylation is :

(A) ATP

(B) NADPH

(C) Oxygen

(D) CO_2

27. Non-cyclic photophosphorylation produces :

(A) Only ATP

(B) ATP and NADPH

(C) Only NADPH

(D) ATP, NADPH, and $FADH_2$

28. In the Calvin cycle, how many molecules of 3-phosphoglycerate (3-PGA) are produced from one molecule of CO_2 ?

(A) One

(B) Two

(C) Three

(D) Six

29. Which stage of the Calvin cycle involves the enzyme RubisCO ?

(A) Reduction phase

(B) Regeneration phase

(C) Carboxylation phase

(D) Photorespiration phase

30. The Z-scheme represents :

(A) Flow of protons

(B) Flow of electrons through photosystems

(C) Flow of ATP

(D) Flow of CO_2

31. The key regulatory enzyme of the reductive TCA cycle is :

(A) Citrate synthase

(B) ATP-citrate lyase

(C) Isocitrate dehydrogenase

(D) Succinate dehydrogenase

32. In the reductive TCA cycle, why is the reaction catalyzed by alpha-ketoglutarate synthase considered a "regulatory bottleneck" ?

(A) It requires O_2, which is absent in these organisms.

(B) It is only found in plants.

(C) It produces too much ATP, causing feedback inhibition.

(D) It is a highly endergonic ferredoxin-dependent carboxylation that determines the rate of the entire cycle.

33. Which pathway is used by some autotrophs to fix CO_2 by reversing the steps of the Krebs cycle ?

(A) Calvin Cycle

(B) Reductive TCA Cycle

(C) Acetyl-CoA Pathway

(D) Glycolysis

34. In oxygenic photosynthesis, the electron donor is :

(A) H_2O

(B) H_2S

(C) Fe^{2+}

(D) Glucose

35. Which pigment is specifically found in anoxygenic phototrophs but not in plants ?

(A) Chlorophyll

(B) Bacteriochlorophyll

(C) Phycobiliproteins

(D) Carotenoids

36. If a cell's internal glucose concentration is 10mM and the external is 2mM, which mechanism must it use to take up more glucose ?

(A) Simple diffusion

(B) Facilitated diffusion

(C) Active transport

(D) Osmosis

37. What is the most critical factor determining the direction of nutrient flow in facilitated diffusion ?

(A) The size of the protein.

(B) The concentration gradient of the nutrient.

(C) The amount of ATP in the cell.

(D) The presence of light.

38. Which of the following is an example of an "antiporter" ?

(A) Transport of Na^+ out and H^+ in.

(B) Transport of lactose and H^+ in together.

(C) Transport of glucose via PTS.

(D) Diffusion of water through aquaporins.

39. Which system would be most efficient for a bacteria living in an extremely nutrient-poor environment ?

(A) Passive diffusion

(B) Facilitated diffusion

(C) ABC transport

(D) Simple osmosis

40. Group translocation is mainly found in :

(A) Fungi

(B) Bacteria

(C) Algae

(D) Plants

41. In bacteriorhodopsin-mediated transport, the energy source is :

(A) Chemical (ATP)

(B) Electromagnetic (Light)

(C) Kinetic (Rotation)

(D) Thermal (Heat)

42. Which statement best differentiates primary *vs*. secondary active transport ?

(A) Primary uses light; Secondary uses ATP.

(B) Primary is passive; Secondary is active.

(C) Primary is for ions; Secondary is for sugars only.

(D) Primary uses ATP directly; Secondary uses ion gradients.

43. What is the significance of the "binding protein" in a gram-negative ABC transport system ?

(A) It sits in the cytoplasm to store nutrients.

(B) It resides in the periplasm to capture and deliver solutes to the pore.

(C) It breaks down ATP.

(D) It acts as a light sensor.

44. Compare facilitated diffusion and active transport. What do they have in common ?

(A) Both use energy (ATP).

(B) Both require specific transmembrane proteins.

(C) Both result in the modification of the solute.

(D) Both can concentrate solutes against a gradient.

45. A symport system moves two substances :

(A) In opposite directions

(B) Without a membrane protein

(C) Only if one is a metal ion

(D) In the same direction

46. In active transport, molecules move :

(A) Against the concentration gradient

(B) Along the concentration gradient

(C) Only through lipid bilayers

(D) Without the use of energy

47. Which transport mechanism is most likely to be used for a highly non-polar gas like O_2 ?

(A) ABC transport

(B) Facilitated diffusion

(C) Passive diffusion

(D) Group translocation

48. Facilitated diffusion differs from passive diffusion in that it :

(A) Requires ATP

(B) Uses specific carrier proteins and exhibits saturation kinetics

(C) Moves solutes against the gradient

(D) Is only found in viruses

49. Siderophores are specialized molecules secreted by microbes specifically to scavenge and transport :

(A) Glucose

(B) Phosphate

(C) Magnesium

(D) Ferric iron

50. The Phosphotransferase System (PTS) is a form of group translocation where the sugar is :

(A) Oxidized during transport

(B) Chemically modified (phosphorylated) as it crosses the membrane

(C) Reduced to an alcohol

(D) Bound to a siderophore

51. Myxobacteria coordinate movement via :

(A) Social motility

(B) ATP synthase

(C) Rubisco

(D) Nitrogenase

52. Anaerobes can be cultivated using :

(A) High oxygen chambers

(B) Shaking incubators

(C) Anaerobic jars with gas packs

(D) UV light

53. Autoinducer produced by Gram-positive bacteria :

(A) Oligopeptides

(B) AHLS

(C) ROS

(D) ATP

54. Quorum sensing regulates :

(A) ROS detoxification

(B) ATP synthesis

(C) Virulence, biofilm formation

(D) CO_2 fixation

55. Myxobacteria exhibit :

(A) Oxygen detoxification

(B) Multicellular fruiting body formation

(C) ATP synthesis

(D) CO_2 fixation

56. Donnan equilibrium is important in :

(A) Bacterial cell physiology

(B) Photosynthesis

(C) Nitrogen fixation

(D) Fermentation

57. Multicellular coordination in microbes enhances :

(A) ROS detoxification

(B) ATP yield

(C) Survival under stress

(D) CO_2 fixation

58. Biofilm formation is an example of :

(A) Multicellular organization

(B) ATP synthesis

(C) ROS detoxification

(D) CO_2 fixation

59. Bioluminescence in Vibrio fischeri is controlled by :

(A) pho regulon

(B) nif operon

(C) trp operon

(D) Lux operon

60. Quorum sensing involves :

(A) ATP synthesis

(B) Cell-to-cell communication via autoinducers

(C) ROS detoxification

(D) CO_2 fixation

61. Acidophiles thrive at :

(A) pH < 3

(B) pH 7

(C) pH > 9

(D) pH 5-7

62. Donnan equilibrium describes :

(A) CO_2 fixation

(B) ATP synthesis

(C) ROS detoxification

(D) Ion distribution across semipermeable membranes

63. Heat shock proteins function as :

(A) Proton pumps

(B) Molecular chaperones

(C) ROS scavengers

(D) ATP synthase

64. Psychrophiles adapt by :

(A) Unsaturated fatty acids in membranes

(B) Saturated fatty acids in membranes

(C) ROS scavengers

(D) Rubisco

65. Oxygen toxicity arises due to :

(A) Reactive oxygen species (ROS)

(B) High CO_2

(C) Low ATP

(D) High NADPH

66. Halophiles thrive in :

(A) High CO_2

(B) Low oxygen

(C) High salt concentrations

(D) Low ATP

67. Halophiles adapt by accumulating :

(A) CO_2

(B) ATP

(C) Oxygen

(D) Compatible solutes (e.g., K^+, glycine betaine)

68. Alkaliphiles maintain pH balance by :

(A) ATP synthase

(B) Proton pumps

(C) Na^+/H^+ antiporters

(D) Catalase

69. Catalase converts :

(A) $H_2O_2 \rightarrow H_2O + O_2$

(B) $O_2 \rightarrow H_2O_2$

(C) $OH^- \rightarrow O_2$

(D) $NADH \rightarrow NAD^+$

70. The Pho regulon is activated under :

(A) Nitrogen starvation

(B) Phosphate starvation

(C) Oxygen starvation

(D) ATP excess

71. Nitrogenase activity is highest under :

(A) High oxygen, high NH_4^+

(B) Low oxygen, low NH_4^+

(C) High CO_2

(D) High ATP

72. Cyanobacteria protect nitrogenase by :

(A) Heterocyst formation

(B) Leghemoglobin

(C) Myoglobin

(D) Cytochrome c oxidase

73. Dissimilative nitrate reduction also known as :

(A) Sulphur assimilation

(B) Nitrogen fixation

(C) Ammonia assimilation

(D) Denitrification

74. Dissimilative nitrate reduction converts nitrate to :

(A) Nitrogen gas for energy generation

(B) Ammonia for biosynthesis

(C) CO_2

(D) Oxygen

75. Post-translational modification of nitrogenase is triggered by :

(A) Oxygen absence

(B) Ammonia availability

(C) CO_2 excess

(D) ATP hydrolysis

76. nifA gene encodes :

(A) Positive regulator of nif operon

(B) Negative regulator

(C) Structural protein

(D) Electron carrier

77. Route I of ammonia assimilation involves :

(A) Nitrite reductase

(B) Glutamine synthetase

(C) Glutamate dehydrogenase

(D) Nitrate reductase

78. Nitrogenase activity is regulated post-translationally by :

(A) ADP-ribosylation

(B) Phosphorylation

(C) Methylation

(D) Acetylation

79. Route II of ammonia assimilation is more energy demanding because :

(A) Requires ATP and NADPH

(B) Requires only NADH

(C) Requires only ATP

(D) Requires only NH_3

80. Nitrogenase is oxygen-sensitive because :

(A) CO_2 is released

(B) ATP is hydrolyzed

(C) NADPH is consumed

(D) Fe-S clusters are inactivated

81. Nitrogenase activity is protected from oxygen by :

(A) Leghemoglobin

(B) Hemoglobin

(C) Myoglobin

(D) Cytochrome oxidase

82. The Pho regulon controls :

(A) Glycolysis

(B) Nitrogen fixation

(C) Sulphur assimilation

(D) Phosphate assimilation

83. Glutamate synthase catalyzes :

(A) Pyruvate → Lactate

(B) Glutamine + α-ketoglutarate → 2 Glutamate

(C) Citrate → Isocitrate

(D) Succinate → Fumarate

84. Denitrification decreases :

(A) Soil fertility

(B) Oxygen levels

(C) ATP yield

(D) CO_2 levels

85. Sulphur assimilation is essential for :

(A) CO_2 fixation

(B) ATP synthesis

(C) Cysteine and methionine synthesis

(D) Oxygen transport

86. APS reductase converts :

(A) APS → Sulfate

(B) APS → Sulfite

(C) APS → Sulfur

(D) APS → H_2S

87. Ammonia assimilation is important for :

(A) Amino acid biosynthesis

(B) ATP synthesis

(C) Oxygen transport

(D) CO_2 fixation

88. Denitrification occurs under :

(A) High oxygen

(B) Aerobic conditions

(C) Anaerobic conditions

(D) High ATP

89. Nitrogenase is inhibited by :

(A) Oxygen

(B) CO_2

(C) ATP

(D) Ammonia

90. The enzyme responsible for biological nitrogen fixation is :

(A) Ammonia monooxygenase

(B) Nitrate reductase

(C) Nitrite reductase

(D) Nitrogenase

91. In glycolysis, ATP is generated by substrate-level phosphorylation at :

(A) Phosphoglycerate kinase

(B) Hexokinase

(C) Phosphofructokinase

(D) Enolase

92. The enzyme Rubisco is regulated by :

(A) ATP only

(B) Oxygen only

(C) CO_2 and Mg^{2+} concentration

(D) NADH

93. Each 120° rotation of γ-subunit of ATP synthase produces :

(A) 1 ATP

(B) 2 ATP

(C) 3 ATP

(D) 4 ATP

94. Under aerobic conditions, pyruvate enters :

(A) Krebs cycle via acetyl-CoA

(B) Fermentation

(C) PPP

(D) Glyoxylate cycle

95. Homofermentative lactic acid bacteria produce :

(A) Lactic acid + CO_2

(B) Lactic acid + ethanol

(C) Only lactic acid

(D) Ethanol only

96. ATP synthase consists of two main parts :

(A) F_0 and F_1

(B) F_1 and F_2

(C) α and β only

(D) γ and δ only

97. The enzyme lactate dehydrogenase functions under :

(A) High ATP yield

(B) Aerobic conditions

(C) High oxygen tension

(D) Anaerobic conditions

98. The enzyme producing $FADH_2$ in Krebs cycle is :

(A) Citrate synthase

(B) Malate dehydrogenase

(C) Isocitrate dehydrogenase

(D) Succinate dehydrogenase

99. The second unique enzyme of glyoxylate cycle is :

(A) Succinate dehydrogenase

(B) Pyruvate kinase

(C) Isocitrate dehydrogenase

(D) Malate synthase

100. Glyoxylate cycle is important for :

(A) Growth on acetate

(B) Growth on glucose

(C) Growth on ethanol

(D) Growth on lactate

(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।