

Test Paper Code: BT

Time: 3 Hours

Max. Marks: 300

DO NOT BREAK THE SEALS ON THIS BOOKLET. AWAIT INSTRUCTIONS FROM THE INVIGILATOR.

**INSTRUCTIONS:****A. General:**

1. This Question Booklet is your Question Paper.
2. This Question Booklet contains **32** pages and has 100 questions.
3. The Question Booklet **Code** is printed on the right-hand top corner of this page.
4. The Question Booklet contains blank spaces for your rough work. No additional sheets will be provided for rough work.
5. **Clip board, log tables, slide rule, calculator, cellular phone, pager and electronic gadgets in any form are NOT allowed.**
6. Write your **Name and Roll Number** in the space provided at the bottom.
7. All answers are to be marked only on the machine gradable Objective Response Sheet (**ORS**) provided, as per the instructions therein.
8. The Question Booklet along with the Objective Response Sheet (**ORS**) must be handed over to the Invigilator before leaving the examination hall.

**B. Filling-in the ORS:**

9. Write your Roll Number in the boxes provided on the upper left-hand-side of the **ORS** and darken the appropriate bubble under each digit of your Roll Number using a **HB pencil**.
10. On the right-hand-side of the ORS, write the Code of the Question Booklet received by you in the box provided, with ball-point pen, and darken the appropriate bubble with **HB pencil**.
11. On the lower-left-hand-side of the **ORS**, write your Name, Roll Number, Name of the Test Centre and put your signature in the appropriate box with ball-point pen. Do not write these anywhere else.

**C. Marking of Answers on the ORS:**

12. Each question has **4 choices** for its answer: (A), (B), (C) and (D). Only **ONE** of them is the correct answer.
13. On the right-hand-side of **ORS**, for each question number, darken with a **HB Pencil**, **ONLY** one bubble corresponding to what you consider to be the most appropriate answer, from among the four choices.
14. There will be **negative marking** for wrong answers.

**MARKING SCHEME:**

- (a) For each question, you will be awarded 3 (three) marks, if you have darkened only one bubble corresponding to the correct answer.
- (b) In case you have not darkened any bubble for a question, you will be awarded 0 (zero) mark for that question.
- (c) In all other cases, you will be awarded -1 (minus one) mark for the question.

Name .....

Roll Number

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SEAL

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1. In a chemical synapse, receptors for neurotransmitters are found on
  - (A) presynaptic membranes
  - (B) postsynaptic membranes
  - (C) synaptic vesicles
  - (D) myelin sheaths enveloping axons
  
2. During an allergic immune response, histamine is released from
  - (A) B lymphocytes
  - (B) T lymphocytes
  - (C) mast cells
  - (D) special Lymphocytes that also secrete IgE
  
3. Prostaglandins are biologically active molecules that are
  - (A) monocyclic
  - (B) bicyclic
  - (C) tricyclic
  - (D) polycyclic
  
4. When animal cells are placed in a hypotonic solution such as distilled water, they swell and burst due to
  - (A) diffusion
  - (B) osmosis
  - (C) active transport
  - (D) pinocytosis
  
5. Identify the hormone secreted by the pituitary gland that causes the smooth muscle of the uterus to contract during parturition in mammals.
  - (A) Vasopressin
  - (B) Oxytocin
  - (C) Prolactin
  - (D) Gonadotropins

6. How many antigen-binding sites does a pentameric IgM molecule contain?
- (A) Two  
(B) Five  
(C) Ten  
(D) Fifteen
7. Identify the character that is lost by an animal cell when it gets transformed into a cancer cell.
- (A) Differentiation  
(B) Contact inhibition  
(C) Regeneration  
(D) Totipotency
8. The correct match between **Group I** and **Group II** is

<b>Group I</b>	<b>Group II</b>
P. Nucleotide	1. Ascorbic acid
Q. Amino acid	2. Adenosine triphosphate
R. Fatty acid	3. Aspartic acid
S. Vitamin	4. Gluconic acid
	5. Palmitic acid
	6. Uric acid

- (A) P-6, Q-3, R-4, S-1  
(B) P-2, Q-3, R-5, S-4  
(C) P-2, Q-3, R-5, S-1  
(D) P-6, Q-4, R-3, S-1

9. The correct match between **Group I** and **Group II** is

<b>Group I</b>	<b>Group II</b>
P. Neurotransmitter	1. Acetylcholine
Q. Hormone	2. Papain
R. Second messenger	3. Interferon
S. Enzyme	4. Streptomycin
	5. cAMP
	6. Ecdysone

- (A) P-1, Q-6, R-5, S-2
- (B) P-6, Q-5, R-3, S-2
- (C) P-3, Q-6, R-1, S-4
- (D) P-1, Q-3, R-5, S-2

10. Enzymes catalyze chemical reactions by

- (A) decreasing the activation energy
- (B) increasing the activation energy
- (C) providing a buffering effect
- (D) regulating the concentration of substrates at optimal temperature and pH

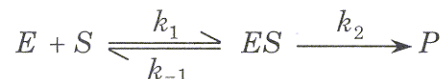
11. In a typical ecosystem, biomagnification occurs at the highest level in

- (A) primary producers
- (B) secondary producers
- (C) primary consumers
- (D) secondary consumers

12. Western blot is used for the identification of
- (A) monosaccharides
  - (B) RNA
  - (C) DNA
  - (D) proteins
13. Which of the following does **NOT** form the basis of an antigen-antibody binding?
- (A) Hydrogen bond
  - (B) Ionic interactions
  - (C) Covalent bond
  - (D) Hydrophobic interactions
14. Myoglobin contains multiple distinct epitopes but only a single copy of each epitope. Identify the condition under which antigen-antibody precipitation reaction would occur.
- (A) When monoclonal antibody is used
  - (B) When specific polyclonal antiserum is used
  - (C) When monovalent Fab fragments are used
  - (D) When any of the above conditions are fulfilled
15. According to the taxonomical classifications of humans,
- (A) *Homo* refers to genus and *sapiens* the species
  - (B) *Homo* refers to family and *sapiens* the genus
  - (C) *Homo* refers to order and *sapiens* the family
  - (D) *Homo* refers to class and *sapiens* the sub-class

16. The optical rotation of a solution of D-glucose is  $+52.7^\circ$ . Which of the following statements applies to this solution?
- (A) It is a mixture of two forms of D-glucose and both forms exhibit the same specific optical rotation
  - (B) It has only one form of D-glucose and all molecules have the same specific optical rotation
  - (C) It is a mixture of two forms of D-glucose, each of which has different specific optical rotation
  - (D) It is a mixture of large number of D-glucose forms, each of which has different specific optical rotation
17. The decreasing order of the melting points of the following fatty acids is
- P. Stearic acid, 18:0
  - Q. *Cis*-oleic acid, 18:1
  - R. *Trans*-oleic acid, 18:1
  - S. Linolenic acid, 18:3
- (A)  $P > Q > R > S$
  - (B)  $P > R > Q > S$
  - (C)  $S > R > Q > P$
  - (D)  $S > Q > R > P$
18. Consider the following four statements:
- P. The solubility of a protein is lowest at its isoelectric point
  - Q. At low ionic strengths, solubility of a protein increases with increasing salt concentration
  - R. Tyrosine, tryptophan and phenylalanine have aromatic side chains capable of forming hydrogen bonds
  - S. Oxygen binding to hemoglobin decreases when pH is increased from 7.2 to 7.6
- Of these statements,
- (A) only P and Q are correct
  - (B) P, Q and S are correct
  - (C) all are correct
  - (D) only Q is correct

19. For the enzyme catalyzed reaction



$k_m$  is an indicator of the affinity of enzyme to the substrate

- (A) when  $k_2 \ll k_{-1}$
- (B) when  $k_2 \gg k_{-1}$
- (C) when  $k_2 = k_{-1}$
- (D) irrespective of the mutual relationship of the rate constants
20. Which of the following statements is FALSE?
- (A) Nitrogen fixation by the nitrogenase complex requires eight electrons
- (B) Conversion of nitrogen to ammonia ( $N_2 + 3H_2 \rightarrow 2NH_3$ ) is an endergonic process
- (C) Certain free living aerobic bacteria are also capable of nitrogen fixation
- (D) The nitrogen fixing nitrogenase complex is oxygen-labile
21. Which of the following is **NOT** an allosteric modulator of hemoglobin?
- (A) Carbon dioxide
- (B)  $H^+$
- (C) 2,3-Bisphosphoglycerate
- (D) Carbon monoxide
22. Relative to the inter-membrane space, the mitochondrial matrix is
- (A) alkaline and has negative membrane potential
- (B) acidic and has negative membrane potential
- (C) alkaline and has positive membrane potential
- (D) acidic and has positive membrane potential

23. Among the following, the strongest oxidant is
- (A) P680.Chl<sup>+</sup>
  - (B) H<sub>2</sub>O
  - (C) P680.Chl<sup>\*</sup>
  - (D) P700
24. One of the carbon atoms of glucose is <sup>14</sup>C-labeled. If none of the TCA cycle intermediates are <sup>14</sup>C-labeled after glycolysis and one cycle of Krebs cycle, the carbon atom of glucose that was labeled is
- (A) C1
  - (B) C6
  - (C) C2
  - (D) C3
25. Which of the following statements relating to microtubules is **NOT** correct?
- (A) The plus-end of microtubule is the fast-growing end
  - (B) Addition of short fragments of microtubules enhances polymerization
  - (C) A microtubule with GDP-cap enters the shrinkage phase (catastrophe)
  - (D) Critical concentration for polymerization is same for both plus- and minus-ends
26. Treadmilling of actin filaments refers to
- (A) net assembly at both plus- and minus-ends
  - (B) net assembly at plus-end and net disassembly at minus-end
  - (C) net disassembly at plus-end and net assembly at plus-end
  - (D) net disassembly at both plus- and minus-ends



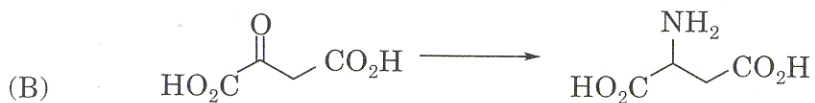
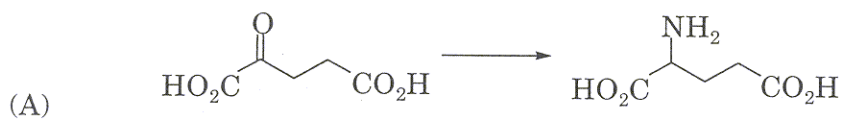
27. Which of the following vitamins becomes part of a high-energy metabolite in the cell?

- (A) Thiamine
- (B) Riboflavin
- (C) Pantothenate
- (D) Folate

28. Which of the following four is involved in cell cycle control?

- (A) Proteolysis of cyclins
- (B) Phosphorylation of cyclins
- (C) Proteolysis of cyclin-dependent kinases
- (D) Dephosphorylation of cyclins

29. Which of the following is the key reaction linking carbon and nitrogen cycles?



30. The most effective enzyme-catalyzed reaction is the one in which
- (A)  $k_{\text{cat}} = 1.4 \times 10^4 \text{ sec}^{-1}$  and  $k_{\text{m}} = 9 \times 10^{-5}$
  - (B)  $k_{\text{cat}} = 1.4 \times 10^5 \text{ sec}^{-1}$  and  $k_{\text{m}} = 9 \times 10^{-5}$
  - (C)  $k_{\text{cat}} = 1.4 \times 10^3 \text{ sec}^{-1}$  and  $k_{\text{m}} = 9 \times 10^{-5}$
  - (D)  $k_{\text{cat}} = 1.4 \times 10^4 \text{ sec}^{-1}$  and  $k_{\text{m}} = 9 \times 10^{-4}$
31. The deoxyribonucleotides in a DNA strand are linked together covalently through
- (A) 5'-hydroxyl group of one sugar and 5'-phosphate group of the next
  - (B) 2'-hydroxyl group of one sugar and 3'-hydroxyl group of the next
  - (C) 3'-hydroxyl group of one sugar and 5'-phosphate group of the next
  - (D) 5'-hydroxyl group of one sugar and 3'-hydroxyl group of the next
32. sno-RNAs
- (A) process and chemically modify ribosomal RNAs
  - (B) are involved in telomere synthesis
  - (C) are involved in splicing pre-mRNA
  - (D) form the basic structure of ribosome
33. How many bands would you expect if a pentameric sample of IgM containing  $\beta$ -mercaptoethanol is subjected to SDS-PAGE?
- (A) 2
  - (B) 3
  - (C) 5
  - (D) 6

34. In DNA-gel retardation assay, which of the following complexes that are formed is analyzed?
- (A) DNA-RNA complex
  - (B) DNA-DNA complex
  - (C) RNA-protein complex
  - (D) DNA-protein complex
35. The TATA<sup>A</sup>/TA<sup>A</sup>/T sequence, present in the eukaryotic promoter, is recognized and initially bound by which of the following transcription factors?
- (A) TFIIA
  - (B) TFIIB
  - (C) TFIID
  - (D) TFIIH
36. The backbone of peptidoglycan present in the bacterial cell wall is a polysaccharide consisting of repeating units of
- (A) N-acetylgalactosamine – N-acetylmuramic acid
  - (B) N-acetylgalactosamine – N-acetylneuraminic acid
  - (C) N-acetylglucosamine – N-acetylmuramic acid
  - (D) N-acetylglucosamine – N-acetylneuraminic acid
37. Which of the following statements is true with respect to the influenza virus?
- (A) Hemagglutinin present in the virus envelope is involved in attachment of the virus to sialic acid residues of the host cell surface
  - (B) Hemagglutinin present in the virus envelope is involved in the attachment of the virus to N-acetylglucosamine residues of the host cell surface
  - (C) Hemagglutinin proteins form tetramers that project out from viral surface
  - (D) Hemagglutinin is not a glycoprotein

38. Which one of the following causes pneumonia?
- (A) *Helicobacter pylori*
  - (B) *Hemophilus influenzae*
  - (C) *Vibrio fischeri*
  - (D) *Naegleria fowleri*
39. Choose the right combination from the following statements with respect to proof reading activity during DNA replication.
- P. DNA polymerase activity is involved
  - Q. DNA topoisomerase I activity is involved
  - R. 3' → 5'-exonuclease activity is involved
  - S. 5' → 3'-exonuclease activity is involved
- (A) PQ
  - (B) PR
  - (C) PS
  - (D) QR
40. Which one of the following movements of phospholipids is catalyzed by the phospholipid translocators in the eukaryotic cell membrane?
- (A) Lateral
  - (B) Flexion
  - (C) Flip-flop
  - (D) Rotation

41. Baculovirus vectors are used to transfer genes into
- (A) mammalian cells
  - (B) plant cells
  - (C) insect cells
  - (D) bacterial cells
42. Choose the right combination from the following statements with respect to the amino acid activation during protein biosynthesis.
- P. A single aminoacyl-tRNA synthetase can catalyze the coupling of all amino acids to appropriate tRNAs
  - Q. The energy during the activation step is provided through GTP hydrolysis
  - R. The energy during the activation step is provided through ATP hydrolysis
  - S. The aminoacyl-tRNA synthetase catalyzed reaction attaches amino acid to the 3'-end of the tRNA.
- (A) PR
  - (B) PS
  - (C) QS
  - (D) RS

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Space for rough work

43. The correct match between **Group I** and **Group II** is

- | <b>Group I</b>         | <b>Group II</b>   |
|------------------------|---|
| P. DNA ligase          | 1. Unwinds dsDNA into ssDNA   |
| Q. DNA primase         | 2. Synthesizes small DNA fragments as primers                                     |
| R. DNA topoisomerase I | 3. Joins 3'-OH and 5'-phosphate ends of DNA                                       |
| S. DNA helicase        | 4. Produces a transient single strand break in the phosphodiester backbone of DNA |
|                        | 5. Synthesizes RNA primers  |
|                        | 6. Converts ssDNA into dsDNA  |
- (A) P-3, Q-2, R-6, S-1
- (B) P-3, Q-5, R-4, S-1
- (C) P-5, Q-2, R-1, S-3
- (D) P-4, Q-2, R-3, S-6

44. Which of the following statements is **NOT** correct with respect to elongation step of prokaryotic protein biosynthesis?

- (A) fMet-tRNA<sub>f</sub> is recognized by EF-Tu-GTP
- (B) Binary complex of EF-Tu-GTP binds aminoacyl-tRNA to form a ternary complex
- (C) Binary complex EF-Tu-GDP is inactive
- (D) Kirromycin is an antibiotic that inhibits the function of EF-Tu

45. If the ionization energy of H is 13.59 eV, then the ionization energy of  $\text{He}^+$  will be
- (A) 13.59 eV
  - (B) 27.18 eV
  - (C)  $(13.59)^2$  eV
  - (D) 54.36 eV
46. In a  $\text{CO}_2$  molecule the number of translational, rotational and vibrational degrees of freedom, respectively, is
- (A) 3, 2, 4
  - (B) 3, 4, 2
  - (C) 3, 3, 3
  - (D) 4, 3, 2
47. The molecule which is IR inactive and Raman active is
- (A) HCl
  - (B)  $\text{N}_2$
  - (C)  $\text{SO}_2$
  - (D)  $\text{CO}_2$
48. Which of the following axis of symmetry does the tetragonal crystal possess?
- (A) Two fold
  - (B) Three fold
  - (C) Six fold
  - (D) Four fold

49. For which of the following reactions  $\Delta H = \Delta U$
- (A)  $\text{N}_2 + \text{O}_2 \rightarrow 2\text{NO}$
  - (B)  $\text{C} + \frac{1}{2} \text{O}_2 \rightarrow \text{CO}$
  - (C)  $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
  - (D)  $\text{N}_2\text{O}_4 + \frac{1}{2} \text{O}_2 \rightarrow \text{N}_2\text{O}_5$
50. Assuming that  $\Delta H_{\text{vap}}$  is  $540 \text{ kcal g}^{-1}$ , what would be the  $\Delta S$  accompanying the evaporation of one mole of water at  $100^\circ\text{C}$ ?
- (A)  $540 \text{ cal g}^{-1}$
  - (B)  $25 \text{ cal K}^{-1}\text{mol}^{-1}$
  - (C)  $1.45 \text{ cal K}^{-1}\text{mol}^{-1}$
  - (D)  $26.06 \text{ cal K}^{-1}\text{mol}^{-1}$
51. For a reaction  $2\text{A} + \text{B} \rightarrow \text{P}$ , by doubling the initial concentration of both the reactants the rate increases by a factor of 8, whereas by doubling the concentration of B alone the rate increases two times. The rate law for the reaction is
- (A)  $\frac{d[\text{P}]}{dt} = k[\text{A}][\text{B}]^2$
  - (B)  $\frac{d[\text{P}]}{dt} = k[\text{A}][\text{B}]$
  - (C)  $\frac{d[\text{P}]}{dt} = k[\text{A}]^2[\text{B}]$
  - (D)  $\frac{d[\text{P}]}{dt} = k[\text{A}]^2[\text{B}]^0$