Section I: Biochemistry

Q. 1 – Q. 10 carry one mark each.

Q.1 Which pair of amino acid residues can interact in the interior of a protein only through van der Waals forces?

(A) Arg, Thr   (B) Ser, Thr
(C) Glu, His   (D) Val, Leu

Q.2 Okazaki fragments are joined by the enzyme

(A) RNA polymerase   (B) DNA polymerase
(C) DNA ligase   (D) Reverse transcriptase

Q.3 The biosynthetic reactions in a cell mainly take place in

(A) Mitochondria   (B) Lysosomes
(C) Smooth endoplasmic reticulum   (D) Golgi apparatus

Q.4 Colchicine inhibits

(A) DNA replication   (B) Formation of spindle fibers
(C) Condensation of chromosomes   (D) Cytokinesis

Q.5 The active form of Testosterone is

(A) Dihydrotestosterone   (B) Dehydrotestosterone
(C) Dihydroxytestosterone   (D) Dehydroepiandrosterone

Q.6 The sensitivity of a radioimmunoassay depends primarily on

(A) Titer of the antibody   (B) Specificity of the antibody
(C) Specific activity of the ligand   (D) Purity of the antigen

Q.7 In eukaryotes, introns can be found in transcripts which are precursors of

(A) mRNA   (B) rRNA
(C) tRNA   (D) All of the above

Q.8 Homologous recombination can be employed to generate

(A) Transgenic animals   (B) Gene knock-out animals
(C) Site specific mutagenesis   (D) Specific promoter sequences

Q.9 The mode of action of widely used anticancer drug methotrexate is to inhibit

(A) Dihydrofolate reductase   (B) Dihydroorotate dehydrogenase
(C) Carbamoyl phosphate synthase-2   (D) Ribonucleotide reductase

Q.10 For a double stranded DNA which one of the following base-ratios will always be equal to 1?

(A) (A+T)/(G+C) (B) (A+G)/(C+T)
(C) C/T (D) A/G

Q. 11 – Q. 26 carry two marks each

Q.11 Activated fatty acyl groups are transported into the mitochondria by

(A) Coenzyme A (B) Oxaloacetate
(C) Carnitine (D) Citrate

Q.12 A mixture of Cytochrome-C (MW 11.7 KD) and Myoglobin (MW 17.2 KD) are to be separated by polyacrylamide gel electrophoresis. Their isoelectric pH (pI) values are 9.6 and 7.2 respectively. In which direction will each protein migrate at pH 8.5?

(A) Myoglobin will migrate to anode and Cytochrome-C will migrate to cathode
(B) Myoglobin will migrate to cathode and Cytochrome-C will migrate to anode
(C) Both will migrate to anode
(D) Both will migrate to cathode

Q.13 Which one of the following fatty acids will have melting point higher than that of palmitic acid (16:0)?

(A) Myristic acid (14:0) (B) Palmitoleic acid (16:1)
(C) Oleic acid (18:1) (D) Stearic acid (18:0)

Q.14 A diabetes mellitus patient excretes glucose in urine even when kept on a carbohydrate free diet. This is because

(A) Fats are catabolised in liver to form glucose
(B) Amino acids are catabolised in liver to form glucose
(C) Increased production of amino acids
(D) Increased breakdown of glycogen

Q.15 According to the second law of thermodynamics, molecules spontaneously move from region of higher concentration to one of lower concentration. However, sodium ions are present at 143 mM outside the cell and 14 mM inside the cell. Yet sodium cannot pass through the plasma membrane. Transport of sodium into the cell is achieved by

(A) Facilitated diffusion
(B) Release of acetyl choline
(C) Release of norepinephrine
(D) Sodium transporter

16 The choice of the enzyme used in ELISA depends on

(A) Purity of the enzyme
(B) Turnover number
(C) Its absence in biological sample which is being analysed
(D) Its availability in bulk

17 The T cell antigen receptor

(A) Recognises conformational epitopes on the native molecule
(B) Has Ig light chains
(C) Is made up of heavy chain and $\beta 2$ microglobulin
(D) Recognises epitopes on linear peptides associated with MHC determinants

Q.18 The advantage of degeneracy in codons is that

(A) It minimises the deleterious effects of mutations
(B) It provides more flexibility
(C) It helps to code proteins resistant to proteases
(D) It helps to code proteins of very high molecular weight

Q.19 The pKa's of lysine are given below.
$pK_1 (COOH) = 2.2$, $pK_2 (\alpha\text{-}NH_3^+) = 9.0$, $pK_3 (\epsilon\text{-}NH_3^+) = 10.0$
The pI of lysine is

(A) 7.07
(B) 9.50
(C) 6.10
(D) 5.60

Q.20 The molecular weight of a bacterial DNA molecule is 2.64×10^9. The average molecular weight of a nucleotide pair is 660. Assume that the average protein is made up of a chain of 400 amino acid residues. What is the maximum number of proteins that can be coded by the bacterial DNA molecule?

(A) 20000
(B) 3333
(C) 6667
(D) None of the above

Q.21 The coenzymes involved in the formation of Acetyl CoA from Pyruvate are

(A) Thiamine pyrophosphate, Lipoic acid and FAD
(B) Pyridoxyl phosphate, Biotin and FAD
(C) Vitamin B-12, Folic acid and Vitamin C
(D) NADH, Lipoic acid and Vitamin E

Common Data for Questions 22, 23, 24: A restriction fragment, obtained with a type II endonuclease that recognises a six base pair site, was subjected to Maxam-Gilbert sequenc with results as shown in the autoradiogram below.

	G	A+G	C	C+T
3'	—	—		
		—		
				—
		—		
				—
	—	—		
		—		
				—
		—		
	—	—		
		—		
				—
5'			—	—

Q.22   The DNA sequence is

(A) 3'CTAGATAGTATAG5'
(B) 5'CTAGATAGTATAG3'
(C) 3'GATCTATCATATC5'
(D) 5'GATCTATCATATC3'

Q.23   The restriction site is

(A) TAGCTA
     ATCGAT
(B) TAGGTA
     ATCCAT
(C) ATCCAT
     TAGGTA
(D) GATACC
     CTATGG

Q.24   Considering this DNA sequence as a template strand, the sequence of the corresponding mRNA is

(A) 5'CTAGATAGTATAG3'
(B) 3'GATCTATCATATC5'
(C) 3'GAUCUAUCAUAUC5'
(D) 5'CUAGAUAGUAUAG3'

Common Data for Questions 25, 26. The kinetic data for an enzymatic reaction in the presence and absence of inhibitors are plotted in the following figure
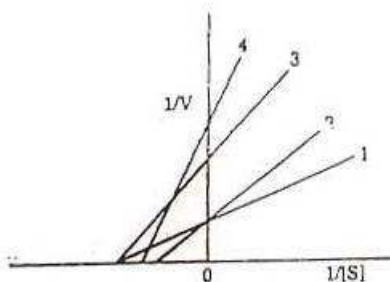
Q.25   Which line represents the kinetics without inhibitor?

(A) Line 1
(B) Line 2
(C) Line 3
(D) Line 4

Q.26   Which line represents kinetics of non-competitive inhibition?

(A) Line 1
(B) Line 2
(C) Line 3
(D) Line 4

Linked Answer Questions: Q27a to Q28b carry two marks each

Statement for Linked Answer Questions 27a & 27b: Transmission at many synapses in central nervous system is mediated by acetyl choline. Acetyl choline is cleaved to acetate and choline by the enzyme acetyl choline esterase which can be inhibited by diisopropyl phosphofluoridate (DIPF).

Q.27a   The mode of action of DIPF is by

(A) Modifying histidine residue
(B) Covalently modifying a crucial serine residue
(C) Inducing a conformational change in the protein
(D) Forming a complex with choline

Q.27b   Based on its mode of action, DIPF is used as

(A) A therapeutic agent to treat neuro degenerative diseases
(B) A nerve gas
(C) As an agonist of acetyl choline
(D) A reagent to determine the N-terminal amino acid

Statement for Linked Answer Questions 28a & 28b: The following fragments are isolated on partial hydrolysis of a nonapeptide X:

Val-Arg-Pro-Gly,   Lys-Phe-Val-Arg,   Ala-Gly-Ser-Lys

Q.28a   The correct sequence of X is

(A) Ala-Gly-Ser-Lys-Ala-Pro-Val-Arg-Gly
(B) Val-Arg-Gly-Lys-Phe-Val-Arg-Ala-Pro
(C) Lys-Phe-Val-Arg-Ala-Gly-Ser-Pro-Gly
(D) Ala-Gly-Ser-Lys-Phe-Val-Arg-Pro-Gly

Q.28b   The number of fragments obtained when X is digested with trypsin is

(A) 0
(B) 2
(C) 3
(D) 4