



**INDIAN INSTITUTE OF SCIENCE
BANGALORE - 560012**

ENTRANCE TEST FOR ADMISSIONS - 2009

**Program : Research
Entrance Paper : Biological Sciences
Paper Code : BC**

**Day & Date
SUNDAY, 26TH APRIL 2009**

**Time
9.00 A.M. TO 12.00 NOON**

GENERAL INSTRUCTIONS

1. This question paper consists of 100 multiple choice questions and carries a total of 100 marks, one mark for each question.
2. Answers to all questions should be marked in the OMR sheet provided.
3. For each question darken (fill) the appropriate bubble on the OMR sheet to indicate your answer.
4. Use only HB pencils to darken the bubbles/answers
5. Darken only one bubble per question. If you mark more than one bubble to answer a question, it will be evaluated as incorrect
6. If you wish to change your answer, please erase the existing mark completely before filling in the other bubble
7. There is no negative marking for wrong answers.
8. Candidates are required to fill in the required fields on the answer sheet attached.

BIOLOGICAL SCIENCES

1. Which test is commonly used to identify a reducing sugar?
 - (A) Iodine test
 - (B) Benedict's test
 - (C) Biuret test
 - (D) Emulsion test
2. Which process does NOT occur in mitochondria?
 - (A) fatty acid biosynthesis
 - (B) protein synthesis
 - (C) β -oxidation
 - (D) DNA synthesis
3. Using site-directed mutagenesis, four mutants were generated. Which mutant has the largest difference in the number of atoms compared to the wild type?
 - (A) Ser \rightarrow Cys
 - (B) Tyr \rightarrow Phe
 - (C) Lys \rightarrow Ala
 - (D) Arg \rightarrow Lys
4. The major storage polysaccharide of mammals is found in highest amounts in which organ?
 - (A) Kidney
 - (B) Liver
 - (C) Spleen
 - (D) Pancreas
5. From the following sets, pick the one that contains exclusively hydrophobic amino acids
 - (A) Asp, Glu, Lys, Arg, Ser
 - (B) Arg, Phe, Tyr, Trp, Asn
 - (C) Ala, Ile, Leu, Phe, Val
 - (D) Ala, Arg, Phe, Leu, Tyr

6. An enzyme (Molecular weight = 5,500 Da) has a concentration of 93.5 g/liter and maximum velocity of $0.875 \text{ M}^{-1} \text{ Sec}^{-1}$. What is the specificity constant for the enzyme and substrate if K_M is 0.438 M?
- (A) $22.54 \text{ M}^{-1} \text{ Sec}^{-1}$
(B) $117.5 \text{ M}^{-1} \text{ Sec}^{-1}$
(C) $6.52 \text{ M}^{-1} \text{ Sec}^{-1}$
(D) $225.4 \text{ M}^{-1} \text{ Sec}^{-1}$
7. Which one of the following statements about a circular double stranded DNA genome having 21% adenosine is TRUE?
- (A) It has 10.5% guanosine
(B) It has 29% guanosine
(C) It has 21% guanosine
(D) It has 58% guanosine
8. The peptide, Ala-Arg-Gln-Met-Thr-Trp-Lys-Val, was digested with cyanogen bromide to produce
- (A) Ala-Arg-Gln-Met + Thr-Trp-Lys-Val
(B) Ala-Arg-Gln-Met-Thr-Trp + Lys-Val
(C) Ala-Arg + Gln-Met-Thr-Trp-Lys-Val
(D) Ala-Arg-Gln + Met-Thr-Trp-Lys-Val
9. Deficiency of which vitamin causes inefficient collagen hydroxylation?
- (A) Vitamin C
(B) Vitamin A
(C) Vitamin B9
(D) Vitamin B1
10. Statins reduce cholesterol levels by inhibiting which enzyme?
- (A) NADPH oxidase
(B) HMG-CoA reductase
(C) HMG-CoA synthetase
(D) Mevalonate kinase
11. Which enzyme is involved in non-template dependent nucleic acid synthesis?
- (A) DNA polymerase 3
(B) DNA polymerase 1
(C) RNA polymerase
(D) poly (A) polymerase

12. Telomerase adds 6 nucleotide repeats to the ends of chromosomes called telomeres. The telomeric repeat sequence of *Tetrahymena* is TTGGGG. The telomeric repeat sequence of yeast is GTGTGT. Propagation of *Tetrahymena* chromosomes in yeast will result in extension as follows
- (A) TTGGGG TTGGGG TTGGGG
 - (B) GTGTGT GTGTGT GTGTGT
 - (C) GTGTGT TTGGGG GTGTGT
 - (D) TTGGGG GTGTGT TTGGGG
13. If one λ phage particle infects a cell lysogenic for λ , which of the following will probably happen?
- (A) λ DNA will circularize but will not replicate
 - (B) Cell will die
 - (C) λ prophage will be excised
 - (D) λ DNA will not be injected
14. The stringency of hybridization of two strands of DNA can be increased by
- (A) increasing the salt concentration
 - (B) decreasing the DNA concentration
 - (C) increasing the temperature
 - (D) addition of inert components such as polyethylene glycol
15. Three polypeptides (A, B and C) whose masses are 55 kDa, 50 kDa and 75 kDa with pI of 6.5, 7.0 and 8.0, respectively, were subjected to standard reducing SDS-PAGE. The order of their separation from top to bottom would be
- (A) A, B and C
 - (B) B, A and C
 - (C) A, C and B
 - (D) C, A and B
16. In a sequencing reaction, the dATP was left out of the tube to which ddATP was added. What would be the consequence?
- (A) No DNA synthesis would occur
 - (B) Synthesis would always stop at the position at which the first A was incorporated
 - (C) Synthesis would terminate randomly regardless of the nucleotide incorporated
 - (D) Normal DNA synthesis would occur

17. Which part of chromatin contains genes that are being expressed?
- (A) Euchromatin
 - (B) Centromere
 - (C) Heterochromatin
 - (D) Telomere
18. The time required for two replication forks traveling in opposite directions to traverse the entire *E. coli* chromosome at 37°C is 40 min, regardless of the culture conditions. However, in a rich medium, the cells divide every 20 min. Which of the following statements is true for cells growing in rich medium?
- (A) Half the daughter cells are nonviable.
 - (B) There is an average of four replication forks per chromosome.
 - (C) There is an average of six replication forks per chromosome.
 - (D) One fourth of the daughter cells are non-viable.
19. Bacterial genomes undergo compaction due to the action of which of the following?
- (A) Helicase
 - (B) Ligase
 - (C) Condensins
 - (D) Histone like proteins
20. Rho-dependent transcription termination involves
- (A) Rho binding to stem-loop structure in RNA
 - (B) Rho binding to nascent RNA and then contacting paused RNA polymerase
 - (C) Rho binding termination sites in DNA and creating a block to RNA polymerase
 - (D) Rho binding tightly to unstructured RNA and inhibiting translation
21. Which one of the following enzymes is responsible for class switch recombination during immunoglobulin generation?
- (A) Activation-induced deaminase
 - (B) RAG
 - (C) Telomerase
 - (D) MRN complex

22. Which one of the events occur very early during T cell activation?
- (A) IL-2 production
 - (B) High affinity IL-2 receptor expression
 - (C) Rise in cytosolic calcium
 - (D) Production of granzymes
23. Which cell surface receptor is directly required for anti-viral immunity?
- (A) IL-2 receptor
 - (B) IL-4 receptor
 - (C) TNF-alpha receptor
 - (D) Interferon-alpha/beta receptor
24. Hormone treatment often results in a decreased response to subsequent treatment with the same hormone. This is due to
- (A) decrease in the synthesis of receptors
 - (B) increase in degradation of the hormone
 - (C) decrease in the surface receptors accompanied by decrease in signal transduction
 - (D) decrease in the affinity between hormone and receptor
25. Which hormone binds to intracellular receptors?
- (A) Insulin
 - (B) Growth Hormone
 - (C) Tri-iodothyronine
 - (D) Thyroid Stimulating Hormone
26. Which receptor is an ion channel?
- (A) Acetylcholine receptor
 - (B) EGF receptor
 - (C) Corticosteroid receptor
 - (D) Growth hormone receptor
27. Which one of the following is NOT implicit in the primary structure of a protein?
- (A) Covalent bonds in the side chains
 - (B) Covalent bonds involving hydrogen atoms
 - (C) Covalent bonds between sulphur atoms
 - (D) Covalent bonds at the amino and carboxyl ends of the polypeptide

28. The rate constant of a reaction increases by a factor of 1.23 when the temperature is increased from 20°C to 27°C. What is the activation energy of the reaction?
- (A) 216 kJ
 - (B) 21.6 kJ
 - (C) 2.16 kJ
 - (D) 0.216 kJ
29. Let us consider a sphere of certain radius and a cone of same radius. The height of the cone is twice the diameter of its base. What is the relationship between volumes of sphere (S) and cone (C)?
- (A) $S > C$
 - (B) $C > S$
 - (C) $S = C$
 - (D) No definite relationship exists between S and C.
30. An individual performs a certain task correctly 90% of the time. What is the probability that if there are two such individuals who function independently, at least one of them will perform the task correctly?
- (A) 99.99%
 - (B) 99.9%
 - (C) 99%
 - (D) 90%
31. There are two single stranded DNA of 10 nucleotides each. What is the probability that they form a double stranded DNA with all the 10 base pairs in Watson-Crick pairing?
- (A) $(1/4)^{10}$
 - (B) $(1/10)^4$
 - (C) $(1/4)^5$
 - (D) $(1/5)^4$

32. A Michaelis-Menten enzyme with sugar isomerase activity was purified from a species of *Streptomyces*. The steady state parameters were measured for several different sugars.

Sugar	K_M (in M)	K_{cat} (in Sec^{-1})
Arabinose	5×10^{-3}	20
Xylose	1×10^{-3}	10
Ribose	1×10^{-1}	100
Glucose	5×10^{-4}	50

Which sugar is used up the fastest when it is present at low concentrations?

- (A) Glucose
 - (B) Arabinose
 - (C) Ribose
 - (D) Xylose
33. When a DNA molecule is heated, the strands come apart. Which one of the following is the possible explanation for strand separation?
- (A) The solubility of adenine and guanine is greatly decreased at high temperature and solubility of the deoxyribose is unchanged.
 - (B) The energy of thermal vibrations is greater than the energy of the weak bonds stabilizing the double stranded structure.
 - (C) The solubility of the bases is unchanged, but the solubility of the deoxyribose is increased.
 - (D) The solubility of the bases is greatly increased at high temperature.
34. When Glutamine at the sixth position in the β -chain of the human hemoglobin is replaced by Valine
- (A) secondary structures are significantly altered
 - (B) tertiary structure is significantly altered
 - (C) quaternary structure is significantly altered
 - (D) no significant structural change takes place
35. Which factor secreted by the hypothalamus serves as the neurosecretory link for the control of reproduction in mammals?
- (A) GHRH
 - (B) GnRH
 - (C) CRH
 - (D) TRH

36. The presence of metal ions in a protein solution can be found by
- (A) atomic absorption spectroscopy
 - (B) infrared spectroscopy
 - (C) thin layer chromatography
 - (D) fluorescence spectroscopy
37. How many chlorine atoms surround a sodium atom in sodium chloride?
- (A) 4
 - (B) 6
 - (C) 8
 - (D) 12
38. Vibrational spectra of molecules correspond to
- (A) ultraviolet radiation
 - (B) visible radiation
 - (C) infrared radiation
 - (D) microwaves
39. Optical density of 1 means
- (A) 1% of the incident light is absorbed
 - (B) 10% of the incident light is transmitted
 - (C) 10% of the incident light is absorbed
 - (D) 90% of the incident light is transmitted
40. Which parameter is NOT necessary when finding the equilibrium potential of an ion using the Nernst equation?
- (A) The temperature
 - (B) The ratio of external and internal ion concentrations
 - (C) The charge of the ion
 - (D) The permeability of the ion channel
41. N-linked glycosylation can occur in a protein containing
- (A) Asn-Thr-Thr-Gly
 - (B) Asn-Asn-Asn-Gly
 - (C) Glu-Asn-Thr-Gly
 - (D) Ser-Ser-Ser-Gly

42. In which cellular compartment does membrane protein biogenesis initiate?
- (A) Rough endoplasmic reticulum
 - (B) Golgi
 - (C) Smooth endoplasmic reticulum
 - (D) Endosomes
43. The inverted repeat sequence in a single stranded DNA forms
- (A) G-quatrets
 - (B) cruciform DNA
 - (C) hairpin DNA
 - (D) triplex DNA
44. Triskelions are components of
- (A) ribosomes
 - (B) proteasomes
 - (C) clathrins
 - (D) integrins
45. In order for H-Ras to be functional, it needs to associate with the cell membrane. This process involves which post-translational modification?
- (A) Glycosylation
 - (B) Hydroxylation
 - (C) Farnesylation
 - (D) Dephosphorylation
46. Molecules that pass through a cell membrane most easily are
- (A) small and hydrophobic
 - (B) large and polar
 - (C) ions
 - (D) monosaccharides
47. The resting membrane potential has a positive charge on the outside of the membrane. The most important contributor to this positive charge is the
- (A) outward movement of K^+
 - (B) inward movement of Cl^-
 - (C) action of the Na^+/K^+ ATPase pump
 - (D) high permeability of Na^+ across the membrane

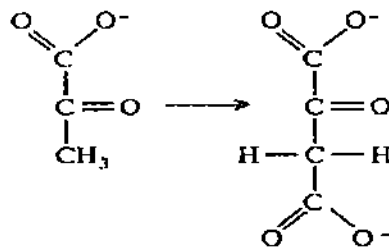
48. The unique sugar which is conserved in Gram-negative bacteria is

- (A) teichoic acid
- (B) galactose
- (C) 3-deoxy-D-manno-hyaluronic acid
- (D) 3-deoxy-D-manno-octulosonic acid

49. A solution containing Aspartic acid (pI=2.98), Glycine (pI=5.97), Threonine (pI=6.53), Leucine (pI=5.98) and Lysine (pI=9.74) in 50 mM citrate buffer pH 3.0 was applied to a cation exchange column equilibrated with the same buffer and fractions collected. The order of elution of these amino acids from the column is

- (A) Lysine, Threonine, Leucine, Glycine, Aspartic acid
- (B) Aspartic acid, Threonine, Glycine, Leucine, Lysine
- (C) Aspartic acid, Glycine, Leucine, Threonine, Lysine
- (D) Aspartic acid, Threonine, Leucine, Glycine, Lysine

50. The co-enzyme involved in the following reaction is



- (A) Pyridoxal phosphate
- (B) Vitamin B12
- (C) Biotin
- (D) Thiamine pyrophosphate

51. A second order reaction of the type $A+B \rightarrow P$ was carried out in a solution that was initially 0.05 M in A and 0.08 M in B. After 1.0 hour, the concentration of A had fallen to 0.02 M. The half-life of A is

- (A) 7380 Sec
- (B) 2560 Sec
- (C) 3690 Sec
- (D) 5120 Sec

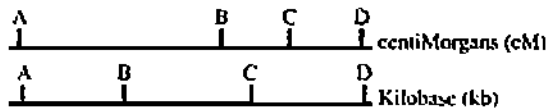
52. In the presence of a compound X, protein synthesis can initiate, but only di-peptides are formed that remain bound to the ribosome. Therefore, compound X affects eukaryotic protein synthesis by blocking
- (A) the activity of elongation factors
 - (B) the activation of amino acids
 - (C) the recognition of stop signals
 - (D) the formation of peptide bonds
53. Which of the following are ketone bodies?
- (A) Acetoacetate and beta-hydroxybutyrate
 - (B) Lecithin and acetaldehyde
 - (C) Beta-hydroxyacyl coenzyme A and beta-ketoacyl coenzyme A
 - (D) Acetyl coA and propionyl coA
54. A patient with type I diabetes mellitus would have
- (A) increased production of fatty acids from glucose in liver
 - (B) decreased conversion of fatty acids to ketone bodies
 - (C) increased stores of triacylglycerol in adipose tissue
 - (D) increased production of acetone
55. If a patient is deficient in pyruvate kinase, how many net moles of ATP would be generated upon conversion of 1 mol of glucose to pyruvate?
- (A) 0
 - (B) 1
 - (C) 2
 - (D) 4
56. If aminopterin, a potent inhibitor of dihydrofolate reductase, is added to a culture of growing cells, which major biosynthetic process will be inhibited first?
- (A) Carbohydrate synthesis
 - (B) Lipid synthesis
 - (C) DNA synthesis
 - (D) RNA synthesis
57. Oil starts smelling bad after being stored for a long time. This is due to
- (A) a process of de-adaptation in our sense of smell
 - (B) glycolysis
 - (C) sedimentation
 - (D) oxidation

58. All secretory proteins in mammalian cells contain a
- (A) signal sequence for translocation into the lumen of the endoplasmic reticulum
 - (B) cleavage site for a specific caspase
 - (C) membrane anchor signal
 - (D) motif for tyrosine phosphorylation
59. A mammalian cell typically has 1.2 meters of double stranded DNA when completely outstretched. The total time to duplicate the DNA is 5 hours. If the rate of duplication is 16 μ meters/min, how many origins of replication will be formed?
- (A) 250
 - (B) 15000
 - (C) 1
 - (D) 500
60. A mutant of *E. coli* with a heat-sensitive DNA ligase (25°C permissive, 37°C non-permissive) has been used to show that DNA synthesis is discontinuous. Examination of DNA replication in the presence of [^3H]-Thymidine in the mutant would demonstrate the accumulation of short segments of
- (A) unlabeled DNA at 25°C and at 37°C
 - (B) unlabeled DNA at 25°C but not at 37°C
 - (C) radioactive DNA at 37°C but not at 25°C
 - (D) radioactive DNA at 25°C but not at 37°C
61. Upon activation of the translational machinery in a cell, 2000 amino acids are joined together to form a protein molecule. What changes will occur with the synthesis of this protein molecule?
- (A) The entropy of 2000 amino acid molecules will increase
 - (B) The entropy of 2000 amino acid molecules will decrease
 - (C) The entropy of the universe will decrease
 - (D) The entropy of 2000 amino acid molecules will decrease and the entropy of the universe will increase
62. The diffusion coefficient for a molecule at very low concentrations in a non-interacting solvent depends upon
- (A) the shape of the molecule
 - (B) the viscosity and shape of the molecule
 - (C) viscosity, shape and temperature
 - (D) independent of these parameters at infinite dilution

63. Membranes with unsaturated fatty acids are more flexible and fluid because
- (A) unsaturated fatty acids pack closely together to form ordered arrays
 - (B) unsaturated fatty acids bend at the double bond (*cis*) preventing close packing
 - (C) saturated fatty acids have a "kink" that produces more fluid aggregates
 - (D) unsaturated fatty acids have *cis* double bonds that prevent formation of stable bilayers
64. A pulse chase experiment is used to measure the half life of a protein inside a bacterial cell. Which of the following isotopically labeled compounds is best suited for the experiment?
- (A) Water with O¹⁸
 - (B) Methionine with S³⁵
 - (C) Phosphotyrosine with P³²
 - (D) Ammonium acetate with N¹⁵
65. The Ramachandran map was calculated assuming which of the following?
- (A) Non bonded atoms in a polypeptide cannot come closer than the sum of their van der Waals radii
 - (B) Non bonded atoms in a polypeptide cannot come closer than the sum of their covalent radii
 - (C) Non bonded atoms in a polypeptide can come closer than a distance greater than in (B) but less than in (A)
 - (D) Non bonded atoms in a polypeptide cannot come closer than 5 Angstroms
66. The ratio of the average mass of an amino acid to the average mass of a nucleotide is approximately
- (A) 1
 - (B) 2
 - (C) 3
 - (D) 4
67. The net charge of the dipeptide Glu-Lys at physiological pH is
- (A) 0
 - (B) 1
 - (C) 2
 - (D) -1

68. Absorbance of 0.02 mM ATP solution at 260 nm with a cuvette having a path length of 0.5 cm is 0.154. The molar absorption coefficient of ATP is
- (A) 15400
 (B) 7700
 (C) 770
 (D) 1540
69. Considering the thickness of cellular membrane, roughly how many residues would you expect in a transmembrane α -helix?
- (A) 5
 (B) 10
 (C) 20
 (D) 40
70. Xeroderma pigmentosum is caused due to defect in which of the following DNA repair pathways?
- (A) Homologous recombination
 (B) Mismatch repair
 (C) Nucleotide excision repair
 (D) Nonhomologous end joining

71.



The figure above shows the locations of four genes on the genetic map of an organism; the lower panel shows the locations of the same four genes on a physical map derived from the nucleotide sequence of the DNA of that organism. What is the reason for the maps to be NOT identical?

- (A) There is no relationship between the position of genes in a genetic map and their positions on the DNA
 (B) Recombination frequencies per kb of DNA are not uniform throughout a chromosome
 (C) The farther apart two genes are, the more likely they are to recombine
 (D) The closer two genes are, the more likely they are to recombine

72. Mutations in Glyoxylate amino-transferase enzyme leads to primary hyperoxaluria Type 1, a rare genetic disease in which calcium oxalate "stones" accumulate in the kidney. The mutation mapped at the N-terminus of the enzyme altered 'Gly' to 'Arg'. The biochemical analysis indicates that the mutant enzyme is expressed and folded properly. The phenotype associated with such patients is due to
- (A) mutation leading to dimerization of the enzyme
 - (B) turnover rate of mutant enzyme is increased
 - (C) mutant phenotype not directly linked to the enzyme
 - (D) mutation leading to mistargeting of the protein
73. In an operon, positively controlled gene expression occurs because
- (A) repressor is inactivated by activator binding to initiate transcription
 - (B) RNA polymerase is able to bind to the promoter and transcribe the gene on its own
 - (C) activator is needed for high level transcription initiation
 - (D) repressor removal facilitates RNAP binding to the promoter to facilitate transcription
74. Location of a gene in a genome to a narrow region can be found out by
- (A) generalized transduction
 - (B) conjugation mapping
 - (C) specialized transduction
 - (D) transpositional insertion
75. A mother and a father, both Cystic Fibrosis (CF) carriers, have two children who do not suffer from CF. The chance of a third pregnancy producing a child with the disease is
- (A) 25%
 - (B) 33.33%
 - (C) 50%
 - (D) 100%
76. Evidence indicating that chloroplasts were originally free-living prokaryotes that subsequently evolved a symbiotic relationship with a eukaryotic host includes all of the following EXCEPT
- (A) similarities in structure between chloroplasts and prokaryotes
 - (B) presence of circular DNA in chloroplasts and prokaryotes
 - (C) susceptibility of chloroplasts to prokaryotic protein synthesis inhibitors
 - (D) ability of chloroplast to synthesize all their own proteins

77. Which technique is commonly used to study epigenetic alterations?
- (A) Electrophoretic mobility shift assay
 - (B) Chromatin immunoprecipitation
 - (C) Isoelectric focussing
 - (D) Western blotting
78. A point mutation in a newly identified receptor tyrosine kinase renders it constitutively active. Which of the following is NOT true?
- (A) It is a gain-of-function mutation
 - (B) Mutant kinase can function in a ligand-independent fashion
 - (C) It can contribute to carcinogenesis
 - (D) The mutation is recessive
79. The cross between a mutant mother and a normal father gives rise to offspring that are all mutant; the reciprocal cross gives rise to offspring that are all normal. This means that the mutation is likely to be
- (A) in the mitochondrial genome
 - (B) in the nuclear genome
 - (C) dominant
 - (D) recessive
80. Fruit flies have a diploid number of 8 and honey bees have a diploid number of 32 chromosomes. Assuming no crossing over takes place in these two species, the genetic variation among offsprings from the same two parents is likely to be
- (A) same in both the species
 - (B) more in fruit flies than in honey bees
 - (C) more in honey bees than in fruit flies
 - (D) cannot be determined from the information given
81. Which cellular processes produce the carbon dioxide that is exhaled?
- (A) Electron transport system and glycolysis
 - (B) Electron transport system and citric acid cycle
 - (C) Citric acid cycle and glycolysis
 - (D) Glycolysis and gluconeogenesis
82. Which enzyme is involved in epigenetic inheritance?
- (A) Mitogen activated protein kinase
 - (B) Acetyl coenzyme A carboxylase
 - (C) Telomerase
 - (D) Histone methyl transferase

83. Which of the following is an enterovirus?
- (A) Foot and mouth disease virus
 - (B) Hepatitis C virus
 - (C) Rotavirus
 - (D) Coxsackie virus
84. What is the broad mechanism of action of the anti-viral drug Ribavirin?
- (A) It interferes with viral protein synthesis
 - (B) It interferes with processing of viral poly-proteins
 - (C) It interferes with duplication of viral genetic material
 - (D) It blocks the binding of virus to receptors on host cells
85. Mating type switching process that occurs in yeast is an example of which of the following?
- (A) Alternative splicing
 - (B) Change in feedback loop
 - (C) Change in DNA methylation pattern
 - (D) Change in physical rearrangement of the genome
86. Which one of the pairings is correct?
- | | |
|--------------------------------|------------------------------------|
| 1 <i>E.coli</i> | i spore formation |
| 2 <i>Staphylococcus aureus</i> | ii obligate intracellular parasite |
| 3 <i>Chlamydia</i> | iii lipopolysaccharide |
| 4 <i>Clostridium</i> | iv lipoteichoic acid |
- (A) 1-iii, 2-iv, 3-ii, 4-i
 - (B) 1-iii, 2-ii, 3-iv, 4-i
 - (C) 1-i, 2-iii, 3-iv, 4-ii
 - (D) 1-iv, 2-i, 3-iii, 4-ii
87. If there are 1000 cells per ml in the middle of the log phase, and the generation time of the cells is 30 min, how many cells will be there 2 hours later?
- (A) 2000
 - (B) 8000
 - (C) 10000000
 - (D) 16000

88. Somatic mutation of immunoglobulin genes accounts for
- (A) allelic exclusion
 - (B) class switching from IgM to IgG
 - (C) affinity maturation
 - (D) increased expression of the Ig gene
89. Which of the following is NOT involved in photorespiration?
- (A) Rubisco
 - (B) Peroxisome
 - (C) PEP carboxylase
 - (D) Mitochondria
90. Which one of the following statements is correct?
- (A) Helper T cells express surface CD8 marker
 - (B) Cytotoxic T cells express surface CD4 marker
 - (C) Helper T cells express surface IgG
 - (D) Cytotoxic T cells express surface CD8 marker
91. In population A, each woman bears exactly two female children born at maternal ages 20 and 25. Population B is the same, except that the children are born when the mother is 25 and 30. Assuming that these are the only differences between A and B, when the sizes of the two populations are monitored over time, we will find that
- (A) both are stationary
 - (B) both grow at the same rate
 - (C) A grows faster than B
 - (D) B grows faster than A
92. Consider the function $y = x(x^3 - 343) / (x - 7)$. As x takes values very close to 7 what is the value of y ?
- (A) Indeterminate or infinity
 - (B) 0
 - (C) 7
 - (D) 1029

93. Two trains of same length running at the same speed of 80 kilometers per hour in opposite directions in parallel tracks cross each other in 9 seconds. What is the length of the trains?
- (A) 100 meters
 - (B) 200 meters
 - (C) 400 meters
 - (D) 800 meters
94. Which one of the following statements concerning photosynthesis is correct?
- (A) Cyclic photophosphorylation produces neither oxygen nor NADPH
 - (B) The site of the light reactions is the stroma of the chloroplast
 - (C) Light is absorbed by chlorophyll during Calvin cycle
 - (D) FADH and ATP are generated during the light reaction to power the Calvin cycle
95. The transfer of maternal IgG to the fetus is mediated by
- (A) IgG transporters in the placenta
 - (B) passive diffusion across the placenta
 - (C) special type of Fc receptor that is expressed in the placenta
 - (D) active diffusion across the placenta
96. A sign is hammered into a tree 2 m above the tree's base. If the tree is 10 m tall and elongates 1 m each year, how high will the sign be after 10 years?
- (A) 12 m
 - (B) 4 m
 - (C) 2 m
 - (D) 7 m
97. Photoautotrophs require which of the following to sustain their growth?
- (A) Light and simple carbohydrates
 - (B) Light and oxygen
 - (C) Simple carbohydrates and oxygen
 - (D) Light and carbon dioxide
98. Which of the following is NOT a property of the mammalian signal recognition particle (SRP)?
- (A) It targets nascent secretory polypeptides to the rough endoplasmic reticulum
 - (B) It binds to the signal sequences of secretory proteins
 - (C) It contains both RNA and several proteins
 - (D) It contains a signal peptidase activity

99. A characteristic property of stem cells is

- (A) metastasis
- (B) terminal differentiation
- (C) self-renewal
- (D) senescence

100. Which of the following is NOT a cell death mechanism?

- (A) apoptosis
- (B) endocytosis
- (C) necrosis
- (D) autophagy

End of question paper