

# 66

QUESTION PAPER  
SERIES CODE

## A

Registration No. :

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Centre of Exam. :

Name of Candidate :

Signature of Invigilator

### COMBINED ENTRANCE EXAMINATION, 2013

M.Sc. BIOTECHNOLOGY

[ Field of Study Code : BIT ]

Time Allowed : 3 hours

Maximum Marks : 240

#### INSTRUCTIONS FOR CANDIDATES

Candidates must read carefully the following instructions before attempting the Question Paper :

- (i) Write your Name and Registration Number in the space provided for the purpose on the top of this Question Paper and in the Answer Sheet.
- (ii) **Please darken the appropriate Circle of Question Paper Series Code on the Answer Sheet.**
- (iii) The Question Paper is divided into two Parts : Part—A and Part—B. Both Parts have multiple-choice questions. All answers are to be entered in the Answer Sheet provided with the Question Paper for the purpose by darkening the correct choice, i.e., (a) or (b) or (c) or (d) with BALLPOINT PEN only against each question in the corresponding circle.
- (iv) Part—A consists of 60 questions and all are compulsory. Answer all the questions in the Answer Sheet provided for the purpose. Each correct answer carries 1 mark. **There will be negative marking and ½ mark will be deducted for each wrong answer.**
- (v) Part—B consists of 100 questions consisting Biological and Physical Sciences. **Answer any 60 questions.** Each correct answer carries 3 marks. **There will be negative marking and 1 mark will be deducted for each wrong answer.**  
In case any candidate answers more than the required 60 questions, the first 60 questions attempted will be evaluated.
- (vi) Answer written by the candidates inside the Question Paper will not be evaluated.
- (vii) Calculators and Log Tables may be used.
- (viii) Pages at the end have been provided for Rough Work.
- (ix) Return the Question Paper and Answer Sheet to the Invigilator at the end of the Entrance Examination. **DO NOT FOLD THE ANSWER SHEET.**

#### INSTRUCTIONS FOR MARKING ANSWERS

1. Use only Blue/Black Ballpoint Pen (do not use pencil) to darken the appropriate Circle.
2. Please darken the whole Circle.
3. Darken **ONLY ONE CIRCLE** for each question as shown in example below :

Wrong ● (b) (c) ●	Wrong ● (b) (c) (d) ●	Wrong ● (b) (c) (d) ●	Wrong ● (b) (c) ●	Correct ● (a) (b) (c) ●
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4. Once marked, no change in the answer is allowed.
5. Please do not make any stray marks on the Answer Sheet.
6. Please do not do any rough work on the Answer Sheet.
7. Mark your answer only in the appropriate space against the number corresponding to the question.
8. **Ensure that you have darkened the appropriate Circle of Question Paper Series Code on the Answer Sheet.**



**PART—A**

Answer all questions

1. Endodermis in plants is modified parenchyma tissue. Which of the following combinations of molecules depicts composition of its cell wall material?
  - (a) Cellulose, pectin, hemicellulose
  - (b) Cellulose, pectin, hemicellulose, cutin
  - (c) Cellulose, pectin, hemicellulose, lignin
  - (d) Cellulose, pectin, hemicellulose, suberin
  
2. Endosperm contains
  - (a) one nucleus per cell
  - (b) two nuclei per cell
  - (c) three nuclei per cell
  - (d) four nuclei per cell
  
3. Which one of the following is a synthetic auxin?
  - (a) IAA
  - (b) GA
  - (c) IBA
  - (d) NAA
  
4. One of the important consequences of geographical isolation is
  - (a) preventing speciation
  - (b) speciation through reproductive isolation
  - (c) random creation of new species
  - (d) no change in the isolated fauna
  
5. Bacterial growth in the logarithmic/exponential phase is expressed as a power of 2, i.e.,  $2^n$ . If the value of  $n$  is 11, then what would be the number of cells in the culture?
  - (a) 1100
  - (b) 1024
  - (c) 512
  - (d) 2048

6. Protein synthesis will be inhibited by chloramphenicol in
- (a) chloroplasts, mitochondria, *E. coli*
  - (b) chloroplasts, mitochondria, yeast cells
  - (c) chloroplasts, mitochondria, amoebae
  - (d) chloroplasts, mitochondria, lymphocytes
7. Which urinary pathogen 'swarms' across agar surfaces and may cause bladder and renal calculi (stones)?
- (a) *Citrobacter freundii*
  - (b) *Enterobacter aerogenes*
  - (c) *Proteus mirabilis*
  - (d) *Klebsiella oxytoca*
8. Which of the following is **not** true about bacterial sporulation?
- (a) Sporulation occurs in response to nutritional deprivation or stress
  - (b) It is representative of bacterial cell differentiation
  - (c) Sporulation leads to increase in bacterial numbers
  - (d) Spores are tolerant to desiccation, heat and ultraviolet radiations
9. Hydroxyproline and hydroxylysine are rare amino acids. These are found in
- (a) haemoglobin
  - (b) casein
  - (c) collagen
  - (d) keratin
10. The final electron acceptor in non-cyclic photophosphorylation is
- (a)  $\text{NADP}^+$
  - (b) ATP
  - (c)  $\text{O}_2$
  - (d) cytochrome c
11. Which of the following properties of water make it an ideal solvent in biological systems?
- (a) High heat capacity, high heat of vaporization, high heat of fusion, high surface tension
  - (b) Low heat capacity, high heat of vaporization, low heat of fusion, high surface tension
  - (c) High heat capacity, low heat of vaporization, high heat of fusion, low surface tension
  - (d) Low heat capacity, low heat of vaporization, low heat of fusion, low surface tension

12. Entropy follows the order
- (a) gas > liquid > solid
  - (b) solid > liquid > gas
  - (c) solid > gas > liquid
  - (d) solid = gas = liquid
13. — is the structural and functional unit of the nervous system.
- (a) Glial cell
  - (b) Axon
  - (c) Neuron
  - (d) Synapse
14. Jejunum is
- (a) the upper part of the small intestine
  - (b) the central part of the small intestine
  - (c) the lower part of the small intestine
  - (d) the upper part of the large intestine
15. A shark's blood is isotonic to the surrounding seawater due to reabsorption of which of the following compounds?
- (a) Ammonia
  - (b) Uric acid
  - (c) NaCl
  - (d) Urea
16. The correct sequence of spermatogenetic stages in a mature human testis is
- (a) spermatogonia—spermatocyte—spermatid—sperms
  - (b) spermatid—spermatocyte—spermatogonia—sperms
  - (c) spermatogonia—spermatid—spermatocyte—sperms
  - (d) spermatocyte—spermatogonia—spermatid—sperms

17. "All biological catalysts are proteins." The statement is no more valid because of the discovery of
- (a) ribonucleases
  - (b) ribozymes
  - (c) abzymes
  - (d) zymases
18. The necessary ingredients for DNA synthesis are mixed together in a test tube. The DNA polymerase is from *Thermus aquaticus* and the template is from a human cell. The DNA synthesized would be
- (a) most similar to human DNA
  - (b) most similar to *T. aquaticus* DNA
  - (c) a mixture of *T. aquaticus* and human DNA
  - (d) most similar to human RNA
19. A group of genes which are transcribed together as a unit is called
- (a) promoter
  - (b) operon
  - (c) operator
  - (d) repressor
20. Which of the following statements is **not** correct with respect to DNA replication?
- (a) RNA primer is required for both leading and lagging strand syntheses
  - (b) The synthesis of lagging strand begins after the synthesis of the leading strand
  - (c) Okazaki fragments are formed both in eukaryotic as well as prokaryotic DNA replication
  - (d) The 3' —OH end of either DNA or RNA can function as primer for DNA polymerase

21. The entropy during formation of hydrogen bonding in *ortho*-hydroxybenzoic acid and in *para*-hydroxybenzoic acid will, respectively
- (a) increase and decrease
  - (b) decrease and decrease
  - (c) increase and increase
  - (d) decrease and increase
22. Which of the following molecules has a dipole moment?
- (a)  $\text{CS}_2$
  - (b)  $\text{CO}_2$
  - (c)  $\text{CHCl}_3$
  - (d)  $\text{CH}_2\text{Cl}_2$
23.  $\text{S}_{\text{N}}1$  reaction is favored by
- (a) non-polar solvents
  - (b) more number of alkyl groups on the carbon atom attached to the halogen atom
  - (c) small groups on the carbon atom attached to the halogen atom
  - (d) more number of phenyl groups on the carbon atom attached to the halogen atom
24. Which of the following molecules has the lowest bond length between two carbons?
- (a) Ethane
  - (b) Cyclohexane
  - (c) Benzene
  - (d) Ethylene
25. Which energy state of molecules is affected by microwave radiation?
- (a) Nuclear
  - (b) Vibrational
  - (c) Electronic
  - (d) Rotational

26. Which one of the following will undergo bromoform reaction?
- (a) Benzaldehyde
  - (b) Crotonaldehyde
  - (c) Ethanol
  - (d) Tertiary butanol
27. Which one of the following aromatic electrophilic substitutions is fully reversible?
- (a) Nitration
  - (b) Friedel-Crafts alkylation
  - (c) Sulfonation
  - (d) Halogenation
28. Nitration of bromobenzene leads to the formation of
- (a) *ortho*-bromonitrobenzene and *para*-bromonitrobenzene
  - (b) *meta*-bromonitrobenzene only
  - (c) *meta*-bromonitrobenzene and *para*-bromonitrobenzene
  - (d) Both (a) and (b)
29. Which one of the following compounds shows trigonal bipyramidal structure?
- (a)  $\text{CH}_4$
  - (b)  $\text{PCl}_5$
  - (c)  $\text{NH}_3$
  - (d)  $\text{F}_2\text{O}$
30. Which one of the following is the correct order of acidity?
- (a)  $\text{HNO}_3 > \text{HCl} > \text{H}_2\text{SO}_4 > \text{CH}_3\text{COOH}$
  - (b)  $\text{CH}_3\text{COOH} > \text{H}_2\text{SO}_4 > \text{HNO}_3 > \text{HCl}$
  - (c)  $\text{H}_2\text{SO}_4 > \text{HNO}_3 > \text{HCl} > \text{CH}_3\text{COOH}$
  - (d)  $\text{H}_2\text{SO}_4 > \text{CH}_3\text{COOH} > \text{HNO}_3 > \text{HCl}$



31. The Edman reagent reacts on
- (a) the N-terminal amino acid of a peptide
  - (b) the C-terminal amino acid of a peptide
  - (c) both the terminal amino acids of a peptide
  - (d) aromatic amino acids, selectively
32. An example of a colloidal gel wherein liquid is dispersed in solid is
- (a) milk
  - (b) cheese
  - (c) mist
  - (d) paint
33. Which compound upon ozonolysis will give a diketone?
- (a) 1,3-Butadiene
  - (b) 2,3-Dimethyl but-2-ene
  - (c) 2-Methyl but-2-ene
  - (d) But-2-ene
34. The compound having the same number for oxidation state and covalency is
- (a)  $\text{PtCl}_2 \cdot (\text{H}_2\text{O})_2$
  - (b)  $[\text{AlCl}(\text{H}_2\text{O})_5]^{2+}$
  - (c)  $\text{K}_3[\text{Fe}(\text{CN})_6]$
  - (d)  $\text{CuSO}_4 \cdot (\text{H}_2\text{O})_5$
35. Which one of the following solutions would show the highest depression of freezing point?
- (a) 0.1 M LiCl in water
  - (b) 0.1 M  $\text{LaCl}_3$  in water
  - (c) 0.1 M  $\text{MgCl}_2$  in water
  - (d) 0.1 M NaBr in water

36. Cells divide every 2 hours in a reactor. If at time  $t = 0$ , the cell count is  $10^5$  cells/mL, then the time required for the cell count to reach  $10^8$  cells/mL is approximately
- (a) 10 hours
  - (b) 15 hours
  - (c) 20 hours
  - (d) 25 hours
37. If  $\sin x = \frac{1}{2}$  and  $\frac{\pi}{2} < x < \pi$ , then the value of  $\cos x$  is
- (a)  $\frac{\sqrt{3}}{2}$
  - (b)  $-\frac{\sqrt{3}}{2}$
  - (c)  $\frac{\sqrt{3}}{4}$
  - (d)  $\frac{1}{2}$
38. In the expansion of  $\left(x - \frac{1}{x}\right)^4$ , the constant term is
- (a) 4
  - (b) 6
  - (c) 8
  - (d) 12
39.  $\int e^x [f(x) + f'(x)] dx$  is equal to
- (a)  $e^x f(x) + C$
  - (b)  $e^x \{f(x) + f'(x)\} + C$
  - (c)  $e^x \{f(x) + C\}$
  - (d)  $e^x f(x) + f(x) + C$
40. The number of solutions of  $x + 2y = 5$ ,  $2x + 4y = 10$  is
- (a) zero
  - (b) unique
  - (c) finite but not unique
  - (d) infinite

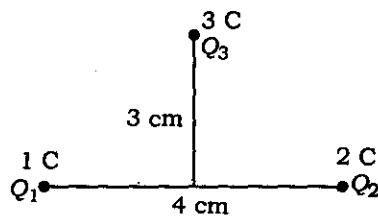
41. Let  $f: \{1, 2, 3, 4, 5\} \rightarrow \{a, b, c, d\}$  be a function. Which of the following statements is true?
- (a)  $f$  can be one-one function
  - (b)  $f$  is onto function
  - (c)  $f$  cannot be one-one function
  - (d)  $f$  cannot be onto function
42. The period of the function  $\cos x + \cos\left(\frac{x}{2}\right) + \cos\left(\frac{x}{3}\right)$  is
- (a)  $2\pi$
  - (b)  $4\pi$
  - (c)  $6\pi$
  - (d)  $12\pi$
43. Consider two unit circles (with radius one) whose centres are at  $(0, 0)$ ,  $(0, 2)$ . The number of common tangents to these circles is
- (a) 0
  - (b) 1
  - (c) 2
  - (d) 3
44. If  $\sin x + \sin y + \sin z = 3$  for some  $x, y, z$ , then  $\cos x + \cos y + \cos z$  is equal to
- (a) 0
  - (b) 1
  - (c) 2
  - (d) 3
45. The function  $f(x) = |x|$  is
- (a) continuous but not differentiable in  $\mathbb{R}$
  - (b) continuous and differentiable in  $\mathbb{R}$
  - (c) not continuous but differentiable in  $\mathbb{R}$
  - (d) neither continuous nor differentiable in  $\mathbb{R}$
46. The pressure of the gas in a constant volume gas thermometer is 80 cm of mercury in melting ice at 1 atm. When the bulb is placed in a liquid, the pressure becomes 160 cm of mercury. The temperature of the liquid is
- (a) 546.30 K
  - (b) 536.20 K
  - (c) 526.10 K
  - (d) 516.05 K

47. Two point charges  $+10\ \mu\text{C}$  and  $+20\ \mu\text{C}$  are placed at a separation of 2 cm. The electric potential due to the pair at the middle point of the line joining the two charges is (take,  $1/(4\pi\epsilon_0) = 9 \times 10^9\ \text{Nm}^2\text{C}^{-2}$ )
- (a) 9 MV
  - (b) 13.5 MV
  - (c) 27 MV
  - (d) 54 MV
48. Two capacitors of capacitance  $10\ \mu\text{F}$  and  $20\ \mu\text{F}$  are joined in series and connected to a battery 30 V. Then the charge on each capacitor is
- (a)  $50\ \mu\text{C}$
  - (b)  $75\ \mu\text{C}$
  - (c)  $100\ \mu\text{C}$
  - (d)  $200\ \mu\text{C}$
49. The centre of a wheel rolling on a plane surface moves with a speed  $u_0$ . A particle on the rim of the wheel at the same level as the centre will be moving at speed of
- (a) zero
  - (b)  $u_0$
  - (c)  $u_0\sqrt{2}$
  - (d)  $2u_0$
50. Two satellites *A* and *B* move round the earth in the same orbit. If the mass of *B* is twice the mass of *A*, then
- (a) the speeds of *A* and *B* are equal
  - (b) the potential energy of earth + *A* is same as that of earth + *B*
  - (c) the kinetic energies of *A* and *B* are equal
  - (d) the total energy of earth + *A* is same as that of earth + *B*
51. A ball of 1 kg dropped from a height of 3 m rebounds only 2.5 m after hitting the ground. The amount of energy converted to heat is
- (a) about 1 J
  - (b) about 1.5 J
  - (c) about 2 J
  - (d) more than 2 J

52. Two simple pendulums are of length 40 cm and 160 cm respectively. Then what is the ratio of their time periods?

- (a) 1 : 1
- (b) 1 : 2
- (c) 1 : 3
- (d) 1 : 4

53. Three unequal charges  $Q_1$ ,  $Q_2$  and  $Q_3$  are kept as shown in the figure. The magnitude of the electric field due to charges  $Q_1$  and  $Q_2$  at  $Q_3$  is



- (a) 9
- (b) 6
- (c) 1/12
- (d) 3/25

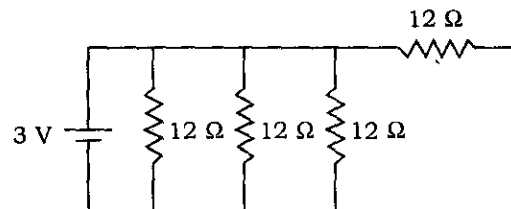
54. The energy of the first excited state of quantum harmonic oscillator is

- (a)  $h/2\pi$
- (b)  $h/6\pi$
- (c)  $3h/4\pi$
- (d)  $5h/4\pi$

55. A projectile is launched at an angle of  $30^\circ$  from the horizontal with an initial velocity of  $v$ . The ratio of the initial velocity to the velocity of the projectile when it reaches its maximum height is

- (a) 1 : 1
- (b) 2 : 1
- (c) 3 : 1
- (d)  $2 : \sqrt{3}$

56. 1374 identical balls are taken each weighing 25.2 g and the volume of water displaced by them is 33.3 litres. A proper estimate of the density is
- 1040 kg/m<sup>3</sup>
  - 1039.7 kg/m<sup>3</sup>
  - 1039.78 kg/m<sup>3</sup>
  - 1039.784 kg/m<sup>3</sup>
57. An object of mass 20 g is thrown vertically upward at 10 m/s. The work done by the force of gravity during the time the object is going up (till the time it reaches a maximum height) is
- zero
  - 1 J
  - 1 J
  - not possible to calculate
58. A battery of 2 V and internal resistance 0.5 Ω is connected across a resistance of 9.5 Ω. How many electrons cross through a cross-section of the resistance in 1 second? (Charge of one electron is  $1.6 \times 10^{-19}$  C)
- $125 \times 10^{19}$  C
  - $1.25 \times 10^{19}$  C
  - $125 \times 10^{18}$  C
  - $1.25 \times 10^{18}$  C
59. The current supplied by the battery in the circuit as shown in the figure is



- 3 A
  - 2 A
  - 1 A
  - 0 A
60. If the potential across a 100 Ω resistor is 5 V, then the current flowing through the resistor is
- 0.20 A
  - 0.10 A
  - 0.05 A
  - 0.025 A

**PART—B**

Answer *any sixty* questions

- 61.** The characteristics of Phaeophyta (brown algae) are
- (a) fucoxanthin, filamentous thalloid plant body, laminarin
  - (b) chlorophyll *b*, unicellular, starch
  - (c) fucoxanthin, unicellular, starch
  - (d) chlorophyll *b*, thalloid filamentous, laminarin
- 62.** Some anatomical and morphological features of angiosperms are listed below :
- (i) Reticulate venation, (ii) Parallel venation, (iii) Rings of vascular bundles, (iv) Scattered vascular bundles, (v) Vascular bundle with cambium, (vi) Vascular bundle without cambium, (vii) Flower with distinct petals and sepals, (viii) Flower with no distinct petals and sepals
- Which one of the following combinations of features would monocotyledons have?
- (a) i, iii, vi, viii
  - (b) ii, iv, vi, viii
  - (c) i, iii, v, vii
  - (d) ii, iii, vi, vii
- 63.** 80 g of a forest soil sample was heated at 110 °C to constant dry soil mass of 60 g. It was then heated repeatedly to red-hot in a crucible. The mass of the soil was now found to be 30 g. What is the content of water and organic matter of forest soil?
- (a) Water 20 g, organic matter 50 g
  - (b) Water 50 g, organic matter 20 g
  - (c) Water 60 g, organic matter 30 g
  - (d) Water 20 g, organic matter 30 g
- 64.** The alkaloid vinblastine which is used to treat leukemia is extracted from
- (a) *Atropa belladonna*
  - (b) *Rauwolfia serpentina*
  - (c) *Papaver somniferum*
  - (d) *Catharanthus roseus*
- 65.** Infectious RNA and infectious proteins are, respectively, referred to as
- (a) viroids and prions
  - (b) viroids and viruses
  - (c) prions and pathogens
  - (d) viruses and pathogens

66. The characteristic features of pteridophytes are
- haploid sporophyte, vascular tissues, diploid spores
  - haploid sporophyte, vascular tissues, haploid spores
  - diploid sporophyte, vascular tissues, haploid spores
  - diploid sporophyte, vascular tissues, diploid spores
67. Periderm serves as secondary protective tissue against desiccation and mechanical injuries in woody plants and it is formed by the activity of
- phellem
  - pericycle
  - phelloderm
  - phellogen
68. The most common type of embryo sac (*Pogonatum* type) in angiosperms consists of
- one egg cell, two synergid cells, two antipodal cells and two central cells
  - one egg cell, two synergid cells, three antipodal cells and one central cell
  - two egg cells, one synergid cell, three antipodal cells and two central cells
  - two egg cells, two synergid cells, two antipodal cells and one central cell
69. The photon absorption and subsequent transfer of energy towards the reaction centre during photosynthesis can be given as
- chlorophyll *a* → chlorophyll *b* → carotenoids → P680
  - P680 → carotenoids → chlorophyll *a* → chlorophyll *b*
  - carotenoids → chlorophyll *b* → chlorophyll *a* → P680
  - chlorophyll *b* → chlorophyll *a* → carotenoids → P680
70. The volume of a bacterial cell is  $10^{-2}$  cubic micron. How many cells would be present in a cylinder of 5 mL?
- $5 \times 10^8$
  - $5 \times 10^{10}$
  - $5 \times 10^{12}$
  - $5 \times 10^{14}$
71. Stability of low copy number plasmid in bacterial cells is ensured by
- maintenance of precise copy number before cell division
  - cell division occurring only after replication of plasmid is completed
  - synchronous replication of plasmid and chromosome
  - coordination of replication and partitioning of plasmid



72. Some bacterial pathogens have become resistant to penicillin because
- (a) they have acquired effective drug efflux systems
  - (b) the drug is sequestered by penicillin-binding protein
  - (c) alternate penicillin-binding proteins that do not bind to penicillin come into play
  - (d) selective mutation increases the concentration of intracellular penicillin-binding protein
73. Incompatibility among plasmids within the bacterial cell happens
- (a) when two plasmids with different *ori* hamper replication of one another
  - (b) when two plasmids compete for the same diffusible molecule for replication
  - (c) when two plasmids share the same diffusible molecule for copy number control
  - (d) when two plasmids have different *cis* elements that are essential for replication
74. The basal body of flagella has a small central rod inserted into a system of rings and in Gram-positive bacteria this consists of
- (a) L, P, S and M rings
  - (b) P, S and M rings
  - (c) L and P rings
  - (d) S and M rings
75. The carboxysomes of photosynthetic and chemoautotrophic bacteria contain mainly
- (a) malate dehydrogenase
  - (b) cellulase
  - (c) ribulose biphosphate carboxylase
  - (d) alkaline phosphatase
76. *Gluconobacter* and *Acetobacter* are used in industry for the production of ethanol. However, *Gluconobacter* is popularly known as 'underoxidizer' as it
- (a) oxidizes only a very small amount of ethanol to acetic acid
  - (b) does not oxidize acetic acid further to carbon dioxide
  - (c) converts some amount of acetic acid to ethanol
  - (d) also oxidizes acetic acid further to carbon dioxide

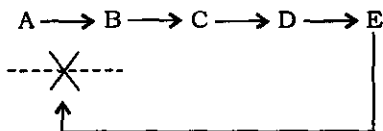
- 77.** Platyhelminthes have characteristic features such as
- (a) triploblastic, radial symmetry, segmented, acoelomate
  - (b) diploblastic, bilateral symmetry, unsegmented, coelomate
  - (c) triploblastic, coelomate, radial symmetry, unsegmented
  - (d) triploblastic, acoelomate, bilateral symmetry, unsegmented
- 78.** A poikilothermic organism living in the Arctic would have, compared to one living in the temperate climate zone, a plasma membrane richer in
- (a) cholesterol
  - (b) long-chain fatty acids
  - (c) protein
  - (d) unsaturated fatty acids
- 79.** Which of the following types of lipid is present abundantly in the membrane of a cell?
- (a) Sulpholipids
  - (b) Glycerophospholipids
  - (c) Galactolipids.
  - (d) Sphingolipids
- 80.** Which of the following is diploid?
- (a) Primary polar body
  - (b) Secondary polar body
  - (c) Spermatid
  - (d) Primary spermatocyte

- 81.** Contractile vacuoles in some protists pump water out of the cell as the surrounding environment is
- (a) hypertonic
  - (b) hypotonic
  - (c) isotonic
  - (d) toxic
- 82.** Which one of the following is **not** a characteristic of cancer cells?
- (a) Reduced cell adhesion
  - (b) Disorganization of cytoskeleton
  - (c) Presence of predominant GM3 ganglioside
  - (d) Decrease in negative surface charge of cell membranes
- 83.** Proteins synthesized by the rough ER are meant
- (a) for transporting to various organelles
  - (b) to build more membranes in the cell
  - (c) to digest food in lysosomes
  - (d) to be exported from the cell
- 84.** In testes, high concentration of testosterone is maintained through its secretion by
- (a) Mast cells
  - (b) Sertoli cells
  - (c) Leydig's cells
  - (d) Epithelial cells

85. A distinct class of cysteine proteases that mediates apoptosis is that of
- (a) cysteinases
  - (b) caspases
  - (c) sulphhydryl hydrolases
  - (d) lysosomal hydrolases
86. Purity of an enzyme at various stages of purification can be best measured by
- (a) total enzyme activity
  - (b) percent recovery of the enzyme
  - (c) total protein
  - (d) specific activity of the enzyme
87. The correct order for the electronegativity of the elements listed below is
- (a)  $S > N > O > C > H$
  - (b)  $O > N > S > C > H$
  - (c)  $N > O > S > C > H$
  - (d)  $C > O > H > N > S$
88. In mitochondria, protons would accumulate in the
- (a) outer membrane
  - (b) inner membrane
  - (c) intermembrane space
  - (d) matrix
89. The total energy released by the conversion of glucose to ethanol during alcoholic fermentation in yeast is 210 kJ per mole. The alcoholic fermentation yields 2 ATP. The energy contained in 2 ATP molecules is 61.2 kJ. The efficiency of transfer of energy during this fermentation is approximately
- (a) 39%
  - (b) 49%
  - (c) 29%
  - (d) 59%

90. In a bilayer cell membrane, lipid molecules are packed in such a way that
- (a) the hydrophilic tails are sandwiched between all the hydrophobic heads
  - (b) the hydrophilic heads are sandwiched between all the hydrophilic tails
  - (c) the hydrophobic tails are sandwiched between hydrophilic heads
  - (d) the hydrophobic heads are sandwiched between hydrophilic tails
91. In the third stage of aerobic respiration, the final acceptor of electrons from glucose is
- (a) water
  - (b) hydrogen
  - (c) oxygen
  - (d) cytochrome  $aa_3$
92. Which among the following arrangements of the protein estimation methods is from the least to the most sensitive technique?
- (a) Biuret method; UV-spectrophotometric method; Lowry's method; Bradford method
  - (b) UV-spectrophotometric method; Biuret method; Lowry's method; Bradford method
  - (c) Biuret method; UV-spectrophotometric method; Bradford method; Lowry's method
  - (d) UV-spectrophotometric method; Biuret method; Bradford method; Lowry's method
93. Which of the following amino acids is encoded by six different codons?
- (a) Alanine
  - (b) Glycine
  - (c) Serine
  - (d) Threonine
94. Which of the following molecules helps a protein to fold correctly in eukaryotes?
- (a) GroEL
  - (b) Hsp90
  - (c) Protofoldins
  - (d) GroES

95. Which of the following configurations is **not** common to protein structures?
- Alpha helix
  - Beta helix
  - Alpha sheet
  - Beta sheet
96. Polyalanine is a synthetic polypeptide whose concentration in aqueous solution could be determined directly (i.e., without using any reagents) on a UV-visible spectrophotometer at a wavelength of
- 220 nm
  - 260 nm
  - 280 nm
  - 325 nm
97. Which of the following is **not** a glycosphingolipid?
- Cerebroside
  - Ganglioside
  - Globoside
  - Sphingomyelin
98. When a compound with a chiral molecule is synthesized in the laboratory, it yields both L- and D-forms. However, in living organisms only particular forms are present. The form of molecules that does **not** exist in living organisms is
- D-glucose
  - L-glucose
  - L-amino acids
  - D-amino acids
99. Which type of inhibition does the following example represent?



- Competitive inhibition
- Feedback inhibition
- Sequential inhibition
- Cumulative inhibition

100. In 2-D gel electrophoresis, the first dimension is based on the principle of

- (a) isoelectric focusing
- (b) high-voltage electrophoresis
- (c) SDS-PAGE
- (d) urea-PAGE

101. Match the following :

- |                           |   |
|---------------------------|---|
| (A) Zero-order reaction   | (i) litre <sup>2</sup> mole <sup>-2</sup> sec <sup>-1</sup> |
| (B) First-order reaction  | (ii) litre mole <sup>-1</sup> sec <sup>-1</sup>             |
| (C) Second-order reaction | (iii) sec <sup>-1</sup>                                     |
| (D) Third-order reaction  | (iv) mole litre <sup>-1</sup> sec <sup>-1</sup>             |

(a) A B C D  
i ii iii iv

(b) A B C D  
iv iii ii i

(c) A B C D  
ii iii iv i

(d) A B C D  
iv ii iii i

102. If  $\Delta G$  is negative

- (a) the reaction is in equilibrium
- (b) the reaction is spontaneous
- (c) the reaction does not occur in forward direction
- (d) the reaction may occur in forward or reverse direction

103. Which of the following is an incorrect statement?

- (a) All proteins destined for the peroxisomal matrix bind to a cytosolic receptor
- (b) I-cell disease is associated with impaired transport of proteins into the peroxisomal matrix
- (c) Peroxisomal targeting sequence may be C-terminal PTS1 or N-terminal PTS2
- (d) Peroxisomal targeting sequence is non-cleavable

- 104.** Which among the following would be the best technique to separate a protein that binds strongly to its substrate analog?
- (a) Gel filtration
  - (b) Cation-exchange chromatography
  - (c) Affinity chromatography
  - (d) Anion-exchange chromatography
- 105.** Which of the following enzymes would be considered an exonuclease, an enzyme with the ability to remove incorrectly incorporated nucleotides during replication?
- (a) DNase-I
  - (b) Uridine *N*-glycosylase
  - (c) DNA polymerase
  - (d) dNTPase
- 106.** Which of the following is/are responsible for degeneracy of a genetic code?
- (a) First nucleotide of a codon
  - (b) Second nucleotide of a codon
  - (c) Third nucleotide of a codon
  - (d) Second and third nucleotides of a codon
- 107.** The RNA polymerase core enzyme of a bacterium consists of all of the following, *except*
- (a)  $\alpha$  subunit
  - (b)  $\beta$  subunit
  - (c)  $\beta'$  subunit
  - (d)  $\sigma$  factor
- 108.** Which of the following can be used as a sequence similarity tool?
- (a) PHYLIP
  - (b) PYMOL
  - (c) RASMOL
  - (d) BLAST



109. The composition of different nucleotides from DNA molecules of various organisms was analyzed and the result is given below in the form of percent of different nucleotides :

Sample	A	C	G	T
1	35	15	15	35
2	20	30	30	20
3	28	24	24	28
4	35	20	30	15

Nucleotide composition of which of the following samples suggests that the DNA is a single-stranded molecule?

- (a) 1  
(b) 2  
(c) 3  
(d) 4
110. Which of the following is a limitation for Hardy-Weinberg equilibrium?  
(a) Lack of mutation  
(b) One allele has selective advantage over the other  
(c) No inbreeding  
(d) Large population size
111. Which of the following molecules is dubbed as the second genetic code?  
(a) rRNA  
(b) Aminoacyl tRNA synthetase  
(c) mRNA  
(d) tRNA
112. Which of the following DNA sequences is likely to be the site for a restriction endonuclease?  
(a) GTCGAC  
(b) GTTCCA  
(c) ATTTAA  
(d) GCGGGC
113. Which of the following RNA species is least stable in a cell?  
(a) mRNA  
(b) tRNA  
(c) rRNA  
(d) snoRNA

114. Geeta has a paternal uncle with hemophilia B, an X-linked recessive disease. Her risk of having a child with hemophilia B is best described as
- (a) near 100%
  - (b) near 0%
  - (c) 50% for all male children
  - (d) 50% for all children
115. Colchicine-treated cells are arrested in
- (a) S phase
  - (b) prophase
  - (c) G<sub>1</sub> phase
  - (d) metaphase
116. — can be viewed as a 'reversible nuclease' that creates either a transient single-strand break or a transient double-strand break.
- (a) S1 nuclease
  - (b) Topoisomerase
  - (c) DNA endonuclease
  - (d) RNase H
117. Which of the following is **not** true in Griffith's experiment?
- (a) After coinjecting heat-killed smooth *S. pneumoniae* along with live rough *S. pneumoniae* into a mouse, the mouse died
  - (b) Genetic material is heat and protease stable
  - (c) Genetic material does not get destroyed with the death of the cell
  - (d) Genetic material is sensitive to RNase treatment
118. In the preparation of an SDS-polyacrylamide, which of the following acts/act as the polymerizing agent(s)?
- (a) SDS
  - (b) TEMED and SDS
  - (c) Ammonium persulphate
  - (d) Bisacrylamide and ammonium persulphate
119. Which of the following is the correct order, from smallest to largest number of base pairs?
- (a) Plasmid, transposon, chromosomal DNA
  - (b) Chromosomal DNA, transposon, plasmid
  - (c) Transposon, plasmid, chromosomal DNA
  - (d) Plasmid, chromosomal DNA, transposon

120. Histocompatibility antigens in mouse and humans are encoded by
- H-3 complex in mice and HLA complex in humans
  - HLA complex in mice and H-3 complex in humans
  - H-2 complex in mice and HLA complex in humans
  - HLA complex in mice and H-2 complex in humans
121. The half-life of  $^{64}\text{Cu}$  is 12.83 hours. How much time would it take to reach the disintegration rate of  $100 \text{ min}^{-1}$  from  $500 \text{ min}^{-1}$ ?
- 0.054 hour
  - 0.13 hour
  - 28.5 hours
  - 29.7 hours
122. de Broglie wavelength of an electron moving with a velocity of  $5.3 \times 10^6 \text{ m/s}$  (mass of electron =  $9.1 \times 10^{-31} \text{ kg}$  and Planck's constant =  $6.6 \times 10^{-34} \text{ J.s}$ ) is
- 0.0137 Å
  - 0.137 Å
  - 1.37 Å
  - 13.7 Å
123. A mixture contains 10 mL of 0.1 M disodium hydrogen phosphate and 20 mL of 0.1 M monopotassium hydrogen phosphate. The final concentration of phosphate in the solution is
- 0.33 M
  - 0.66 M
  - 0.5 M
  - 0.1 M
124. In two different zero-order reactions  $A \rightarrow P_1$  and  $B \rightarrow P_2$ , the rate of conversion of A into product is twice that of B converted into product. If 30% of B is converted into  $P_2$  in 30 minutes, then what will be the amount of A reacted at the same time?
- 15%
  - 30%
  - 45%
  - 60%
125. The number of nitrogen molecules in a one litre flask at  $27^\circ\text{C}$  and  $7.6 \times 10^{-3} \text{ mm}$  of Hg pressure is
- $2.4 \times 10^{17}$
  - $2.4 \times 10^{15}$
  - $4.5 \times 10^{17}$
  - $4.5 \times 10^{15}$
126. If 10 mL of a 1 M solution of barium hydroxide is diluted into 100 mL, then how many millimoles of the compound would be present in the solution?
- 0.1
  - 1
  - 10
  - 100

127. If 10 moles of ideal gas expand by two times in volume at atmospheric pressure and 300 K temperature, the change in entropy (in J/K) would be
- (a) 57.63 (b) 5.763  
(c) 25.02 (d) 166.28
128. A protein of molecular weight 55000 Da contains 0.20% Mn by mass. What is the number of Mn atoms present in the protein?
- (a) One (b) Two  
(c) Three (d) Four
129. If hydrogen iodide decomposes at an activation energy of  $290 \text{ kJ mol}^{-1}$  at  $307^\circ\text{C}$ , then the fraction of molecules having energy equal to the activation energy would be
- (a)  $e^{-60}$  (b)  $e^{60}$   
(c)  $e^{-113}$  (d)  $e^{113}$
130. The pH of a buffer solution obtained by mixing equal volumes of 0.2 mole of hydrazine and 0.1 mole of hydrazine hydrochloride in a final volume of 100 mL will be (dissociation constant of hydrazine is  $3 \times 10^{-6} \text{ M}$ )
- (a) 5.22 (b) 5.82  
(c) 8.78 (d) 8.18
131. The weight of oxygen that will react with 2 g of calcium to produce calcium oxide (atomic weight of Ca = 40 and that of O = 16), considering complete conversion, is
- (a) 5 g (b) 2 g  
(c) 0.8 g (d) 0.5 g
132. At  $25^\circ\text{C}$ , the specific conductance of a 0.01 M aqueous solution of acetic acid is  $0.163 \text{ mS m}^{-1}$ . The molar conductance at infinite dilution is  $390 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$ . What is the degree of dissociation of the acid?
- (a) 0.017 (b) 0.0417  
(c) 0.174 (d) 0.163

133. If the IR spectrum of a solution of substituted benzoic acid shows a strong H-bonding vibrational transition which disappears upon dilution, then the compound could be  
 (a) *ortho*-hydroxybenzoic acid      (b) *ortho*-methoxybenzoic acid  
 (c) *para*-hydroxybenzoic acid      (d) *para*-methoxybenzoic acid
134. A gas expands by 11 L against an average pressure of 2 atm at 300 K. The work done by the gas (in joules) is  
 (a) 2228.6      (b) 6600  
 (c) 1114.3      (d) 557.15
135. A current of 4.0 amperes deposits 0.8 g of sodium when passed through molten NaCl for 20 minutes. The electrochemical equivalent of sodium is  
 (a)  $1.0 \times 10^{-2}$  g/C      (b)  $2.5 \times 10^{-1}$  g/C  
 (c)  $4.16 \times 10^{-4}$  g/C      (d)  $1.67 \times 10^{-4}$  g/C
136. How many grams of iodine are present in a solution which requires 20 mL of 0.11 N  $\text{Na}_2\text{S}_2\text{O}_3$  to react with it, in the reaction  $\text{S}_2\text{O}_3^{2-} + \text{I}_2 \rightarrow \text{S}_4\text{O}_6^{2-} + 2\text{I}^-$ ?  
 (Molecular weight of iodine = 254)  
 (a) 2.54 g      (b) 5.58 g  
 (c) 0.279 g      (d) 12.7 g
137. Halogenated organic liquid insulators are  
 (a) silicones      (b) silicates  
 (c) esters      (d) Askarels
138. When hydrogen is used as fuel in a hydrogen-oxygen fuel cell, the electrode is made of  
 (a) an alloy of palladium and silver  
 (b) aluminum  
 (c) iron  
 (d) cadmium
139. If the maximum concentration of  $\text{PbCl}_2$  in water is 0.01 M at 25 °C, then its maximum concentration in 0.1 M NaCl would be  
 (a)  $2 \times 10^{-3}$  M  
 (b)  $1 \times 10^{-4}$  M  
 (c)  $1.6 \times 10^{-2}$  M  
 (d)  $4 \times 10^{-4}$  M

140. The optically active molecule from the following is

- (a)  $\text{Cl}_2\text{CHCH}_3$  (b)  $\text{CH}_3\text{CH}(\text{C}_2\text{H}_5)\text{OH}$   
(c)  $\text{CH}_3\text{CH}(\text{CH}_3)\text{OH}$  (d)  $\text{CH}_3\text{CH}(\text{CH}_3)\text{Cl}$

141. 20% cells in a mixed bacterial population are resistant to ampicillin. The cells are plated and individual colonies (each representing a single cell) are checked for ampicillin resistance. The probability that if 10 colonies are tested and none shows resistance to antibiotic is approximately

- (a) zero (b) 0.2  
(c) 0.1 (d) 0.3

142. If the  $2 \times 2$  matrix  $A = \begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix}$  and  $2A + 3B = \begin{bmatrix} 0 & 1 \\ 5 & 2 \end{bmatrix}$ , then  $B$  is equal to

- (a)  $\begin{bmatrix} -2 & -1 \\ 1 & -2 \end{bmatrix}$  (b)  $\begin{bmatrix} 2 & 1 \\ 1 & -2 \end{bmatrix}$   
(c)  $\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$  (d)  $\begin{bmatrix} 2 & -1 \\ 1 & -2 \end{bmatrix}$

143. The values of  $a$  and  $b$  such that the function defined by

$$f(x) = \begin{cases} 5, & x \leq 2 \\ ax + b, & 2 < x < 10 \\ 21, & x \geq 10 \end{cases}$$

is continuous are

- (a) 2 and 1 respectively (b) -2 and -1 respectively  
(c) 1 and 2 respectively (d) -2 and 1 respectively

144. The differential equation  $x \frac{dy}{dx} - y = 0$  represents

- (a) a set of concentric circles  
(b) a set of parabolas with vertex at (0, 0)  
(c) a set of straight lines passing through the origin  
(d) a set of parallel straight lines

145. Let  $\alpha, \beta$  be the roots of  $x^2 + ax + b = 0$ . Then  $\alpha^2, \beta^2$  are the roots of
- (a)  $x^2 + (2b - a^2)x + b^2 = 0$       (b)  $x^2 + a^2x + b^2 = 0$   
(c)  $x^2 - a^2x + b^2 = 0$       (d)  $x^2 + 2bx + b^2 = 0$
146. If  $A$  is a  $3 \times 3$  matrix and  $\det(5A) = k(\det(A))$ , then  $k$  is equal to
- (a) 5      (b) 25  
(c) 125      (d) 625
147. The value of  $\lim_{x \rightarrow 0} \frac{\sin^3 x - x^3}{x \cos x}$  is
- (a) 0      (b) 1  
(c) infinity      (d) None of the above
148. The maximum value that the polynomial  $x^3 - x$  can take in the interval  $[-2, 2]$  is
- (a)  $\frac{2}{3\sqrt{3}}$       (b) 6  
(c)  $\frac{-2}{3\sqrt{3}}$       (d) None of the above
149. The value of  $x$  such that the vectors  $\hat{i} + \hat{j}$  and  $3\hat{i} + x\hat{j}$  are perpendicular is
- (a) 9      (b) 1  
(c) -1      (d) -3
150. A particle is moving in a circle of radius  $R$  with constant speed. The time period of the particle is  $T$ . In a time period from  $t = 0$  to  $t = T/6$ , it will have an average velocity of
- (a)  $2\pi R/T$       (b)  $3R/T$   
(c)  $6R/T$       (d)  $2R/T$

151. A ball of mass  $m$  is attached to one end of a very light rod of length  $l$ , the other end of which is hinged so that it can rotate freely. What minimum velocity  $v$  should be imparted to the ball when it is at the bottommost position so that it can complete the vertical circle?
- (a)  $\sqrt{gl}$  (b)  $\sqrt{5gl}$   
(c)  $\sqrt{3gl}$  (d)  $\sqrt{2gl}$
152. The magnitude of the potential energy per unit mass of the object at the surface of the earth is  $E$ . Then the escape velocity of the object is
- (a)  $\sqrt{E}$  (b)  $\sqrt{2E}$   
(c)  $4E^2$  (d)  $E/2$
153. The speed of transverse wave in a string of density  $100 \text{ kg/m}^3$  and area of cross-section  $10 \text{ mm}^2$  under a tension of  $10^3 \text{ N}$  is
- (a)  $100 \text{ m/s}$  (b)  $1000 \text{ m/s}$   
(c)  $200 \text{ m/s}$  (d)  $2000 \text{ m/s}$
154. String 1 has twice the length, twice the thickness, twice the tension and twice the density of another string 2. The relation between the fundamental frequency as of 1 and 2 is
- (a)  $f_1 = 2f_2$  (b)  $f_1 = 4f_2$   
(c)  $f_2 = 2f_1$  (d)  $f_1 = f_2$
155. If 2 moles of an ideal mono-atomic gas at temperature  $T_0$  are mixed with 4 moles of another ideal mono-atomic gas at temperature  $2T_0$ , then the temperature of the mixture is
- (a)  $\frac{5}{3}T_0$  (b)  $\frac{3}{2}T_0$   
(c)  $\frac{4}{3}T_0$  (d)  $\frac{5}{4}T_0$
156. A gas at pressure  $P_0$  is contained in a vessel. If the masses of all the molecules are halved and their speeds doubled, the resulting pressure would be
- (a)  $4P_0$  (b)  $2P_0$   
(c)  $P_0$  (d)  $P_0/2$



157. From a concave mirror of focal length  $f$ , image (assume virtual) is 2 times larger. Then the object distance from the mirror is
- (a)  $f/2$
  - (b)  $3f/2$
  - (c)  $f/4$
  - (d)  $4f/3$
158. In an Atwood machine, the two masses are 450 g and 550 g. If the acceleration due to gravity is  $g = 10 \text{ m/s}^2$ , the acceleration of the masses is
- (a)  $9.8 \text{ m/s}^2$
  - (b)  $10 \text{ m/s}^2$
  - (c)  $1.0 \text{ m/s}^2$
  - (d)  $0.5 \text{ m/s}^2$
159. Carnot engine  $A$  operates between the temperatures of  $T_H = 600 \text{ K}$  and  $T_L = 300 \text{ K}$ , while Carnot engine  $B$  between the temperatures of  $T_H = 500 \text{ K}$  and  $T_L = 200 \text{ K}$ . If the efficiencies of the two engines are  $\eta_A$  and  $\eta_B$ , which of the following statements is true?
- (a)  $\eta_A > \eta_B$
  - (b)  $\eta_A < \eta_B$
  - (c)  $\eta_A = \eta_B$
  - (d)  $\eta_A$  may be greater or less than  $\eta_B$  depending on the nature of the working substance used in the two engines
160. Three corners of a square have equal charges  $+1 \text{ C}$  on them. The electric field at the centre will be
- (a) zero
  - (b) along the diagonal and towards the empty corner
  - (c) along the diagonal and away from the empty corner
  - (d) parallel to one of the sides

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SPACE FOR ROUGH WORK

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