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JNUEE: Question Papers (2010-2012) Rs.40/-

ENTRANCE EXAMINATION, 2012

M.Sc. LIFE SCIENCES

[Field of Study Code : SLSM (225)]

273

Time Allowed : 3 hours

Maximum Marks : 100

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 30 questions and all are compulsory.
- (v) Part—B contains 107 questions. **Answer any 70 questions.**
In case any candidate answers more than the required 70 questions, the first 70 questions attempted will be evaluated.
- (vi) Each correct answer carries 1 mark. **There will be negative marking and $\frac{1}{2}$ mark will be deducted for each wrong answer.**
- (vii) Answer written by the candidates inside the Question Paper will not be evaluated.
- (viii) Calculators and Log Tables may be used.
- (ix) Pages at the end have been provided for Rough Work.
- (x) 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	Wrong	Wrong	Wrong	Correct
<input type="radio"/> (b) <input type="radio"/> (c) <input type="radio"/>	<input checked="" type="radio"/> (b) <input type="radio"/> (c) <input type="radio"/> (d)	<input checked="" type="radio"/> (b) <input type="radio"/> (c) <input checked="" type="radio"/> (d)	<input checked="" type="radio"/> (b) <input type="radio"/> (c) <input type="radio"/>	<input type="radio"/> (a) <input type="radio"/> (b) <input type="radio"/> (c) <input checked="" type="radio"/>

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. The root-mean-square speed of molecules of mass m in an ideal gas at temperature T is
 - (a) 0
 - (b) $\sqrt{2kT/m}$
 - (c) $\sqrt{3kT/m}$
 - (d) $\sqrt{8kT/m}$
2. In the diamond structure of elemental carbon, the nearest neighbour of each carbon atom lies at the corners of a
 - (a) square
 - (b) hexagon
 - (c) cube
 - (d) tetrahedron
3. A spring of force constant k is stretched to a certain distance. It takes twice as much work to stretch a second spring by half of this distance. The force constant of the second spring is
 - (a) k
 - (b) $2k$
 - (c) $4k$
 - (d) $8k$
4. Which one of the following is closest to the mass of helium atom?
 - (a) $6.023 \times 10^{23} \text{ g}$
 - (b) $6.023 \times 10^{-23} \text{ g}$
 - (c) $1.6 \times 10^{-23} \text{ g}$
 - (d) $3.2 \times 10^{-24} \text{ g}$
5. The pH of an aqueous solution is 3. What is its pOH?
 - (a) 4
 - (b) 3
 - (c) 10
 - (d) 11

6. How many covalent bonds can an atomic sulphur form?
- (a) 2 or 3
 - (b) 4 or 5
 - (c) 6 or 7
 - (d) 2, 4 or 6
7. If $\tan^{-1} 2x + \tan^{-1} 3x = \pi/4$, then the positive solution of x is
- (a) $1/6$
 - (b) $2/3$
 - (c) $3/4$
 - (d) $1/8$
8. The hypotenuse of a right-angled triangle is 6 cm more than twice the shortest side and the third side is 2 cm less than the hypotenuse; the sides of the triangle are
- (a) 4, 6, 8
 - (b) 3, 4, 5
 - (c) 10, 24, 26
 - (d) 5, 12, 13
9. Which one of the following two numbers has a sum of 26 and the largest product?
- (a) 10, 16
 - (b) 11, 15
 - (c) 12, 14
 - (d) 13, 13
10. The Nobel Prize, for the development of *in vitro* fertilization was awarded to
- (a) Robert Edwards
 - (b) Ralph Steinmann
 - (c) Elizabeth H. Blackburn
 - (d) Osamu Shimomura

11. The major oxygen assimilation process for plants is
 - (a) photosynthesis
 - (b) photorespiration
 - (c) respiration
 - (d) transpiration
12. *Agrobacterium* is most commonly found
 - (a) in the stem of plants
 - (b) in the rhizosphere
 - (c) within roots
 - (d) on the leaves
13. If the distance between a radiation source and a radiation detector is quadrupled, the exposure is ideally
 - (a) decreased by a factor of 4
 - (b) increased by a factor of 4
 - (c) decreased by a factor of 16
 - (d) increased by a factor of 16
14. Flow of blood in the heart of *Herdmania* alternately changes direction due to
 - (a) absence of valves
 - (b) shape of the heart
 - (c) large number of valves
 - (d) presence of circular muscle bands
15. Which one of the following lacks a backbone?
 - (a) Alligator
 - (b) Baby Panda
 - (c) Eagle
 - (d) Jellyfish

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16. A person decides to live on milk, bread and eggs. He would suffer from
- (a) night blindness
 - (b) rickets
 - (c) scurvy
 - (d) beri-beri
17. Which of the following represents electromagnetic spectrum in terms of increasing photon energy?
- (a) Radio waves, infrared, visible light, UV, X-rays
 - (b) UV, X-rays, microwaves, infrared radiation, radio waves
 - (c) Visible light, UV, X-rays, radio waves, infrared
 - (d) Radio waves, UV, X-rays, visible light, infrared
18. The first protein to be completely sequenced was
- (a) cytochrome c
 - (b) insulin
 - (c) lysozyme
 - (d) hemoglobin
19. Which one of the following represents the form of *Plasmodium* that is released from the erythrocyte by lysis?
- (a) Trophozoite
 - (b) Schizont
 - (c) Merozoite
 - (d) Microgametocyte
20. Which one of the following does **not** protect body surfaces from pathogens?
- (a) Skin on body
 - (b) Mucus on epithelium lining
 - (c) Gastric acid in stomach
 - (d) Salivary amylase in mouth

21. Each antibody molecule has
- (a) 2 different heavy and 2 different light chains
 - (b) 2 identical heavy and 2 identical light chains
 - (c) 2 identical heavy and 2 different light chains
 - (d) 2 different heavy and 2 identical light chains
22. Histone acetylation is associated with
- (a) transcription activation
 - (b) transcription repression
 - (c) transcription attenuation
 - (d) DNA damage repair
23. The sedimentation coefficients (Svedberg units) for the subunits of the 80S ribosomes are
- (a) 40S and 30S
 - (b) 50S and 20S
 - (c) 40S and 60S
 - (d) 50S and 30S
24. Phosphodiesterase is involved in signal termination at the level of
- (a) primary messenger
 - (b) extracellular receptor site
 - (c) intracellular receptor phosphate-binding site
 - (d) second messenger
25. The passive/facilitative glucose transporter is an example of
- (a) uniport carrier
 - (b) symport carrier
 - (c) antiport carrier
 - (d) ATPase

26. The concentration of carbon dioxide in the blood stimulates the breathing center in the
- (a) lungs
 - (b) cerebrum
 - (c) throat
 - (d) medulla oblongata
27. Mutations can be transmitted to the next generation only if they are present in
- (a) blood cells
 - (b) brain cells
 - (c) germ cells
 - (d) somatic cells
28. Which one of the following is **not** an assumption of the Hardy-Weinberg equilibrium?
- (a) Mating occurs preferentially
 - (b) The size of the population is large
 - (c) There is no migration
 - (d) There are no mutations
29. The establishment of the anterior-posterior or dorsal-ventral body axes is called
- (a) division
 - (b) pattern formation
 - (c) morphogenesis
 - (d) differentiation
30. Which one of the following terms describes organism that thrives in the cold?
- (a) Mesophile
 - (b) Thermophile
 - (c) Aerophile
 - (d) Psychrophile

PART—B

Answer any **seventy** questions

31. The gravitational potential due to solid sphere with mass M and radius R at an internal point ($r < R$) is
- (a) $GM(3R^2 - r^2)/2R^3$
 - (b) $-GM(3R^2 - r^3)/2R^3$
 - (c) $GM(3R^3/3R^2 - r^2)$
 - (d) $-GM(2R^3/3R^2 - r^2)$
32. The current of 2.0 amperes is flowing through a cell of e.m.f. 5.0 volts and internal resistance of 0.5 ohms from a negative to positive electrode. If the potential of the negative electrode is 10 volts, the potential of positive electrode will be
- (a) 14 volts
 - (b) 5 volts
 - (c) 15 volts
 - (d) 16 volts
33. De Broglie hypothesized that the linear momentum and wavelength of a free massive particle are related by which one of the following constants?
- (a) Planck's constant
 - (b) Boltzmann's constant
 - (c) Rydberg's constant
 - (d) Avogadro's constant
34. If ρ is the density of gas and C is the mean-square velocity of the molecules, the mean pressure of the gas is given by
- (a) $P = 1/3\rho C^2$
 - (b) $P = \sqrt{3\rho C^2}$
 - (c) $P = \sqrt{3\rho C^2}/3$
 - (d) $P = \rho C/3$

35. An atom has filled $n=1$ and $n=2$ levels. How many electrons does the atom have?
- (a) 2
 - (b) 10
 - (c) 4
 - (d) 8
36. Differentiation of $\sin(x^2 + 1)$ with respect to x is
- (a) $2x \cos(x^2 + 1)$
 - (b) $3x \cos(2x)$
 - (c) $x \cos(x^2 + 1)$
 - (d) $4x \cos(x^2 + 1)$
37. A cuboid has
- (a) 4 edges
 - (b) 8 edges
 - (c) 12 edges
 - (d) 16 edges
38. A bag contains 3 red and 5 white balls. Two balls are drawn one by one without replacement. The probability of drawing the red balls in both trials is
- (a) $\frac{4}{27}$
 - (b) $\frac{5}{28}$
 - (c) $\frac{3}{28}$
 - (d) $\frac{3}{26}$
39. When 1 L of an ideal gas at 1 atm expands isothermally into vacuum to a final volume of 5 L, the work done in expansion is
- (a) 0
 - (b) 1 litre-atm
 - (c) 4 litre-atm
 - (d) 5 litre-atm

40. The expression for relativistic total energy of a single particle is
- (a) γmc^2
 - (b) $1/\gamma mc^2$
 - (c) γ/mc^2
 - (d) $\gamma c^2/m$
41. Two thin lenses are in contact with each other and the focal length of the combination is 80 cm. If the focal length of one lens is 20 cm, what is the power of the other lens?
- (a) -2D
 - (b) -5D
 - (c) -3.75 D
 - (d) -1.5D
42. Which of the following pairs is responsible for the conduction in intrinsic semiconductors?
- (a) Electrons and positrons
 - (b) Holes and poles
 - (c) Positrons and neutrons
 - (d) Electrons and holes
43. The radio waves are reflected back from which layer of the atmosphere?
- (a) Troposphere
 - (b) Stratosphere
 - (c) Ionosphere
 - (d) Mesosphere
44. Acetic acid has a pK_a of 2×10^{-5} M at 25°C approximately. Approximately what fraction of a 0.1 M solution of acetic acid will be dissociated?
- (a) 100%
 - (b) 50%
 - (c) 10%
 - (d) 1%

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45. Which one of the following is used to prepare Cl_2 gas at room temperature from concentrated HCl ?
- (a) MnO_2
 - (b) H_2S
 - (c) KMnO_4
 - (d) Cr_2O_3
46. Borides are compounds of boron with
- (a) halogens only
 - (b) oxygen only
 - (c) more electronegative elements than itself
 - (d) less electronegative elements than itself
47. Geometric isomers of alkenes are
- (a) diastereomers but not enantiomers
 - (b) enantiomers but not diastereomers
 - (c) diastereomers and enantiomers
 - (d) neither diastereomers nor enantiomers
48. The coordination number of the cation in a body-centered cubic lattice structure of CsCl is
- (a) 4
 - (b) 6
 - (c) 8
 - (d) 14
49. In plants, the auxin is located in
- (a) cell membrane and cytoplasm
 - (b) nuclear membrane
 - (c) outer membrane of chloroplasts only
 - (d) tonoplast

50. Anther or pollen culture produces
- (a) haploid cell cultures
 - (b) diploid cell cultures
 - (c) aneuploid cell cultures
 - (d) polyploid cell cultures
51. 'Golden rice' is enriched in
- (a) vitamin A
 - (b) vitamin C
 - (c) vitamin B₁₂
 - (d) vitamin E
52. A plant hormone involved in defense against insects and microbes is
- (a) auxin
 - (b) salicylic acid
 - (c) ethylene
 - (d) abscisic acid
53. The common food intolerance in babies, Phenylketonuria, is an inherited metabolic disorder. These patients are advised to keep away from foods rich in which one of the following amino acids?
- (a) Phenylalanine
 - (b) Lysine
 - (c) Methionine
 - (d) Leucine
54. If megaspore mother cell of a plant has 24 chromosomes, how many chromosomes will be there in aleurone layers?
- (a) 36
 - (b) 24
 - (c) 12
 - (d) 6

55. 'One-cell rule of stomata development' of dicot plants indicates that
- (a) one epidermal cell develops into both guard cells of stomata
 - (b) one epidermal cell is required for each guard cell of stomata
 - (c) two guard cells of stomata are actually one cell that is divided into two halves
 - (d) there is at least one cell gap between any two stomata
56. *Brassica juncea* is one of the
- (a) haploid species
 - (b) amphidiploid species
 - (c) autopolyploid species
 - (d) aneuploid species
57. Virus-free plants are generally raised from
- (a) apical meristem
 - (b) vascular cambium
 - (c) cork cambium
 - (d) intercalary meristem
58. Carbon dioxide is a greenhouse gas, which means it
- (a) has green colour
 - (b) contributes to global warming
 - (c) is released from greenhouses
 - (d) turns green only under warm conditions
59. A lack of blood glucose would have the greatest effect on
- (a) brain
 - (b) heart
 - (c) liver
 - (d) skeletal muscles

60. During fever breathing becomes faster, because
- (a) fever stimulates the breathing center in the brain
 - (b) oxygen-carrying capacity of RBCs reduces
 - (c) excess oxygen as free radical helps in fighting germs
 - (d) metabolic rate increases at high temperature, which increases the oxygen demand
61. Sensory cells of lateral line sense organ in fishes are innervated with
- (a) spinal nerves only
 - (b) cranial nerves only
 - (c) both spinal as well as cranial nerves
 - (d) nerves only at larval stages
62. Which of the following is a free swimming pelagic colonial form of an animal?
- (a) *Doliolum*
 - (b) *Selpa*
 - (c) *Pyrosoma*
 - (d) *Oikoplura*
63. The process of digestion in human stomach is stimulated by
- (a) sympathetic nervous system
 - (b) parasympathetic nervous system
 - (c) neuromuscular junctions
 - (d) hepatic portal system
64. Calcium phosphate from the body is eliminated through
- (a) large intestine
 - (b) liver
 - (c) kidney
 - (d) skin

65. Functional aspect of solenocytes is
- (a) excretion
 - (b) respiration
 - (c) nerve conduction
 - (d) thermoregulation
66. Oozoids in *Doliolum* represent
- (a) sexual phase
 - (b) asexual phase
 - (c) cystic phase
 - (d) metamorphic phase
67. Ossein protein is found in
- (a) nerve cells
 - (b) bone matrix
 - (c) skeletal muscle
 - (d) hair
68. Skin is connected with muscle through
- (a) areolar tissue
 - (b) adipose tissue
 - (c) connective tissue
 - (d) nervous tissue
69. Specific activity of an enzyme is given by
- (a) units/mg protein
 - (b) units at V_{\max}
 - (c) $V_{\max}/2$
 - (d) units/specific substrate

70. During the rising phase of an action potential,
- (a) voltage-gated K^+ channels open
 - (b) voltage-gated Na^+ channels open
 - (c) voltage-gated K^+ channels close
 - (d) voltage-gated Na^+ channels close
71. Lactose is cleaved into which of the following products?
- (a) 2-galactose
 - (b) 2-fructose
 - (c) 2-glucose
 - (d) 1-galactose and 1-glucose
72. Which of the following is true about the change in enthalpy (ΔH) of a reaction that is spontaneous at room temperature?
- (a) It is equal to $T\Delta S$
 - (b) It is positive and the reaction is exothermic
 - (c) It can be either positive or negative
 - (d) It is negative and the reaction is endothermic
73. For an enzyme reaction, the presence of 5 nM of a reversible inhibitor yields a V_{max} value that is 80% of the value in the absence of the inhibitor. The K_M value is unchanged. What type of inhibition is likely occurring?
- (a) Competitive
 - (b) Uncompetitive
 - (c) Mixed
 - (d) Noncompetitive
74. Branching in glycogen molecule is advantageous, as
- (a) it provides numerous nonreducing ends for easy mobilization of glucose
 - (b) it provides numerous targets for modulation by hexokinase
 - (c) it helps rapid capturing of glucose molecules during glycogen synthesis
 - (d) glycogen synthase is a multisubunit enzyme that can add multiple glucose residues simultaneously

75. Which of the following statements is **wrong** regarding hemoglobin and myoglobin?
- (a) Myoglobin is a monomer while hemoglobin is a tetramer
 - (b) Myoglobin is primarily a reservoir while hemoglobin is a carrier of oxygen
 - (c) Hemoglobin shows cooperative oxygen binding but myoglobin does not
 - (d) Both myoglobin and hemoglobin are produced in the RBC
76. Which one of the following is **not** a phospholipid?
- (a) Cerebroside
 - (b) Lecithin
 - (c) Plasmalogen
 - (d) Sphingomyelin
77. If analysis of the early part of an enzyme-catalyzed reaction shows it to be first-order, this means that the initial substrate concentration was
- (a) approximately equal to the K_M value
 - (b) much less than the K_M value
 - (c) much greater than the K_M value
 - (d) equal to or greater than K_{cat} / K_M
78. Which one of the following cell types produces antibodies?
- (a) T lymphocytes
 - (b) NK cells
 - (c) B lymphocytes
 - (d) Eosinophils
79. The secondary, but not the primary, immune response is based on
- (a) memory
 - (b) the bonus effect of multivalency
 - (c) complement activation
 - (d) clonal selection

80. Which one of the following does **not** prevent graft rejection?
- (a) Tissue matching
 - (b) Blood group matching
 - (c) Taking immune-suppressants
 - (d) Taking anti-histamines
81. Which one of the following is a primary lymphoid organ?
- (a) Lymph node
 - (b) Spleen
 - (c) Thymus
 - (d) Tonsil
82. Which type of antibody is abundant in the yellowish fluid colostrum secreted by mother during the initial days of lactation?
- (a) IgG
 - (b) IgE
 - (c) IgM
 - (d) IgA
83. Which of the following amino acids are more frequently found on the surface of the bacterial cell wall?
- (a) Tryptophan and Alanine
 - (b) Glutamic acid and Tryptophan
 - (c) Leucine and Aspartic acid
 - (d) Lysine and Glutamic acid
84. Which one of the following refers to the addition of microorganisms to the diet in order to provide health benefits beyond basic nutritive value?
- (a) Antibiotics
 - (b) Prebiotics
 - (c) Symbiotics
 - (d) Probiotics

85. The optimum temperature required for the growth of an organism is the one at which
- (a) it grows with the shortest generation time
 - (b) it has the longest time between cell divisions
 - (c) it is near one extreme of its range of tolerated temperatures
 - (d) its enzymes begin to denature
86. Of all the fungi that cause disease in compromised hosts, none are as widely distributed as which of the following species?
- (a) *Candida*
 - (b) *Aspergillus*
 - (c) *Pneumocystis*
 - (d) *Blastomyces*
87. Lysosomes of the cell are where
- (a) lysozyme is synthesized
 - (b) secretory proteins are transported to the surface
 - (c) endocytosed material is degraded
 - (d) glycogen is stored as an energy source
88. A bacterial cell is analyzed for its elemental composition and determined to have a high concentration of potassium ions inside the cell relative to the outside. Several hours later another bacterium of the same strain is analyzed and determined to have the same distribution of potassium ions; high inside to low outside. Which one of the following processes is involved in maintaining this ionic distribution?
- (a) Passive diffusion
 - (b) Facilitated diffusion
 - (c) Active transport
 - (d) Endocytosis
89. Which one of the following drugs acts by inhibiting cell wall synthesis of the microorganisms?
- (a) Vancomycin
 - (b) Gentamicin
 - (c) Amphotericin B
 - (d) Erythromycin

90. Continuous feed fermentation is used to maintain
- (a) temperature
 - (b) water level
 - (c) product concentration
 - (d) substrate concentration
91. An organism that cannot make its own food is called a/an.
- (a) heterotroph
 - (b) chemotroph
 - (c) autotroph
 - (d) producer
92. Which one of the following viruses does **not** encode reverse transcriptase?
- (a) Simian 40 virus
 - (b) Hepatitis B virus
 - (c) Human immunodeficiency virus
 - (d) Cauliflower mosaic virus
93. A cross between Hfr and F⁻ bacterial strain will provide information about the
- (a) relative positions of the genes present on a chromosome
 - (b) absolute positions of the genes present on a chromosome
 - (c) recombination frequencies between the genes present on a chromosome
 - (d) recombination rate between the transferred chromosome and the host chromosome
94. Alkaptonuria is an autosomal recessive disorder. Which one of the following is **not** a possible genotype of the parents of a child diagnosed with alkaptonuria?
- (a) Mother is heterozygous and father is homozygous recessive
 - (b) Mother is homozygous recessive and father is heterozygous
 - (c) Mother is heterozygous for the disease and father is homozygous dominant
 - (d) Mother and father are heterozygous

95. Which of the following chromosomes demonstrates synthesis of ribosomal RNAs?
- (a) Polytene chromosome
 - (b) Lampbrush chromosome
 - (c) Metaphase chromosome
 - (d) Mini chromosome
96. A colour-blind woman with Turner's syndrome (XO) has a colour-blind father and normal mother. The X-chromosome came from
- (a) father
 - (b) mother
 - (c) either of the parents
 - (d) The colour-blind trait is not linked to X-chromosome
97. In mumps, the virus infects
- (a) liver
 - (b) salivary gland
 - (c) tonsil
 - (d) glottis
98. The correct order of sequence during prophase of meiosis-I is
- (a) leptotene-zygotene-pachytene-diplotene
 - (b) leptotene-pachytene-zygotene-diplotene
 - (c) leptotene-pachytene-diplotene-zygotene
 - (d) zygotene-leptotene-pachytene-diplotene
99. Transformation was first demonstrated by
- (a) Frederick Griffiths
 - (b) Avery and McLeod
 - (c) Joshua Lederberg
 - (d) Hershey and Chase

100. The expression of the *trp* operon in *E. coli* is regulated in part by the availability of the amino acid tryptophan. This regulatory process is referred to as
- (a) attenuation
 - (b) nonsense suppression
 - (c) antitermination
 - (d) translational read-through
101. The rate-limiting step of fatty acid synthesis is catalyzed by
- (a) acetyl CoA carboxylase
 - (b) pyruvate dehydrogenase
 - (c) ATP-citrate lyase
 - (d) thiolase
102. Chromosome walking is best described as
- (a) aligning DNA sequences by computer to generate contigs
 - (b) generating a map along a chromosome in a step-by-step manner
 - (c) identifying clones whose inserts overlap to generate a library of clones that covers a given segment of DNA
 - (d) sequencing a genome one clone at a time to ensure that no gaps are present at the end of the project
103. How are proteins able to bind at specific sequences?
- (a) By interacting with the sugar-phosphate backbone
 - (b) By opening up the double helix and forming bonds with the bases
 - (c) By interacting with the bases through histone proteins
 - (d) By interacting with the bases in the major and minor grooves of the double helix
104. Which type of mutation converts a codon specifying an amino acid into a termination codon?
- (a) Nonsense
 - (b) Non-synonymous
 - (c) Read-through
 - (d) Synonymous

105. Which of the following enzymes plays a direct role in the biosynthesis of collagen?
- (a) Prolyl hydroxylase
 - (b) Tyrosine hydroxylase
 - (c) Choline oxidase
 - (d) Monoamine oxidase
106. Passage through pores in the nuclear envelope is restricted primarily to
- (a) proteins, RNA and protein-RNA complexes
 - (b) lipids and glycolipids
 - (c) RNA and protein-carbohydrate complexes
 - (d) DNA and RNA
107. The cytoskeleton includes all of the following, **except**
- (a) myosin filaments
 - (b) intermediate filaments
 - (c) actin filaments
 - (d) microtubules
108. Protein insertion into the mammalian ER membrane is typically
- (a) co-translational
 - (b) post-translational
 - (c) pre-translational
 - (d) quasi-translational
109. A deficiency in glucose-6-phosphate dehydrogenase (G6PD) results in a direct decreased production of which one of the following?
- (a) NAD^+
 - (b) NADH
 - (c) NADP
 - (d) NADPH

110. Radiation can induce single and double strand breaks in DNA. A sample containing plasmid DNA is exposed to ionizing radiation. This irradiated sample was run on an agarose gel. How many bands do you expect to see at the end of the experiment?
- (a) One
 - (b) Two
 - (c) Three
 - (d) Multiple
111. The negative charge on the membrane is due to
- (a) phosphatidylethanolamine
 - (b) phosphatidylcholine
 - (c) phosphatidylserine
 - (d) sphingomyelin
112. Membrane proteins are restricted to their specific domain by
- (a) desmosomes
 - (b) zonula occludens
 - (c) adheren junctions
 - (d) gap junctions
113. The activity in which of the following hormones is most like epinephrine?
- (a) Insulin hormone
 - (b) Glucagon hormone
 - (c) Growth hormone
 - (d) Thyroid hormone
114. Which *Drosophila* genes determine the identification of the segments of the fruit fly larva?
- (a) The gap genes
 - (b) The pair rule genes
 - (c) The segment polarity genes
 - (d) The homeotic selector genes

115. Movement of single cell into the blastocoel is termed as
- (a) ingression
 - (b) involution
 - (c) epiboly
 - (d) delamination
116. Spemann organizer of the amphibians is
- (a) mesodermal in origin
 - (b) endodermal in origin
 - (c) ectodermal in origin
 - (d) epidermal in origin
117. The type of regeneration pattern followed in newt limb is called
- (a) epimorphic
 - (b) morphallactic
 - (c) compensatory
 - (d) stem cell mediated
118. Mouse embryonic stem cells are used in gene inactivation experiments, because they
- (a) can be cloned to give rise to a stable cell line
 - (b) are chimeric and will produce cells heterozygous for the gene
 - (c) are the only mouse cells that can be genetically engineered to inactivate genes
 - (d) are totipotent and can give rise to all types of differentiated cells
119. A mutation results in production of a protein that inhibits the action of other proteins resulting in an abnormal phenotype. The most likely mode of inheritance would be
- (a) autosomal recessive
 - (b) autosomal dominant
 - (c) X-linked recessive
 - (d) mitochondrial

120. Inheritance of the A, B, O blood groups is an example of
- (a) incomplete dominance
 - (b) linkage
 - (c) sex linkage
 - (d) multiple alleles
121. A way to generate different proteins from the same gene is by combining different segments of the initial RNA transcript to make distinct mRNAs. Which one of the following terms defines this process?
- (a) Alternative splicing
 - (b) Self-splicing
 - (c) Premature splicing
 - (d) Protein splicing
122. The concept that species have changed over long periods of time is known as
- (a) ecology
 - (b) embryology
 - (c) spontaneous generation
 - (d) organic evolution
123. All of the members of a particular species that live in one area are called
- (a) biome
 - (b) population
 - (c) community
 - (d) ecosystem
124. An organism that uses energy to produce its own food supply from inorganic compounds is called
- (a) heterotroph
 - (b) consumer
 - (c) detritivore
 - (d) autotroph

125. The repeated movement of water between the earth's surface and the atmosphere is called
- (a) the water cycle
 - (b) the condensation cycle
 - (c) precipitation
 - (d) evaporation
126. During a long period when there is no rainfall, a mountain lion may temporarily leave its usual hunting territory to drink from a farm pond. This behaviour is probably due to
- (a) its need to find different foods to eat
 - (b) the change in an abiotic factor in its environment
 - (c) its need to find a new habitat
 - (d) the change in a biotic factor in its environment
127. Uranium 235 differs from Uranium 238 by
- (a) three protons
 - (b) three neutrons
 - (c) three electrons
 - (d) three isotopes
128. Cofactor for transaminase is
- (a) coenzyme A
 - (b) flavin cofactor
 - (c) tetrahydrofolate
 - (d) pyridoxal phosphate
129. The ability to resolve closely adjacent points as separate and distinct is called
- (a) magnification
 - (b) resolution
 - (c) numerical aperture
 - (d) contrast

130. An amino acid neurotransmitter in the brain, whose primary function is to inhibit the postsynaptic neuron, is
- (a) GABA
 - (b) glutamate
 - (c) orexin
 - (d) adenosine
131. Rearrangement of parts between 2 nonhomologous chromosomes is
- (a) crossing-over
 - (b) reciprocal translocation
 - (c) double trisomic
 - (d) paracentric
132. In humans, the haploid number of chromosomes is 23. How many different types of gamete can arise by independent assortment assuming that no recombination occurs?
- (a) 23^2
 - (b) 4^{23}
 - (c) 2^{23}
 - (d) 23^4
133. A stock solution contains 10 mg/ml of an enzyme. 100 ml of this stock is diluted with 400 ml of buffer. How much of enzyme will be present in 300 μ l of the resulting solution?
- (a) 600 μ g
 - (b) 300 μ g
 - (c) 60 μ g
 - (d) 30 μ g
134. A bacterial cell divides once every minute and takes 1 hour to fill the cup. The time that it would take to fill half the cup is
- (a) 29 minutes
 - (b) 30 minutes
 - (c) 60 minutes
 - (d) 59 minutes

135. The density of concentrated HNO_3 is 1.5 g/cm^3 , which contains 70% by mass of HNO_3 . The molarity of the solution is
- (a) $16.66 \text{ moles litre}^{-1}$
 - (b) $1.666 \text{ moles litre}^{-1}$
 - (c) $33.32 \text{ moles litre}^{-1}$
 - (d) $3.332 \text{ moles litre}^{-1}$
136. Generally, animals cannot digest (hydrolyse) the glycosidic linkages between the glucose molecules in cellulose. How then do cows get enough nutrients from eating grass?
- (a) They have to eat a lot of it
 - (b) Microorganisms in their digestive tracts hydrolyse the cellulose to individual glucose units
 - (c) Cows and other herbivores are exceptions and make some cellulose-digesting enzymes
 - (d) The flat teeth and strong stomach of herbivores break the cellulose fibres, so that the cows get enough nutrition from the cell contents
137. A researcher wants to film the movement of chromosomes during cell division. Which type of microscope, should she choose and why is it the best choice?
- (a) Light microscope because of its high resolving power
 - (b) Transmission electron microscope because of its high magnifying power
 - (c) Scanning electron microscope because of its ability to visualize the surface of the subcellular objects
 - (d) Phase-contrast microscope because the specimen is alive

ENTRANCE EXAMINATION, 2011

M.Sc. LIFE SCIENCES

[Field of Study Code : SLISM (226)]

Time Allowed : 3 hours

Maximum Marks : 100

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 30 questions and all are compulsory.
- (v) Part—B contains 107 questions. Answer any 70 questions.
In case any candidate answers more than the required 70 questions, the first 70 questions attempted will be evaluated.
- (vi) Each correct answer carries 1 mark. There will be negative marking and $\frac{1}{2}$ mark will be deducted for each wrong answer.
- (vii) Answer written by the candidates inside the Question Paper will not be evaluated.
- (viii) Simple Calculators and Log Tables may be used.
- (ix) Pages at the end have been provided for Rough Work.
- (x) 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	Wrong	Wrong	Wrong	Correct
<input type="radio"/> a <input type="radio"/> b <input type="radio"/> c <input type="radio"/> d	<input checked="" type="radio"/> a <input type="radio"/> b <input type="radio"/> c <input type="radio"/> d	<input checked="" type="radio"/> a <input type="radio"/> b <input type="radio"/> c <input checked="" type="radio"/> d	<input type="radio"/> a <input type="radio"/> b <input type="radio"/> c <input checked="" type="radio"/> d	<input type="radio"/> a <input type="radio"/> b <input checked="" type="radio"/> c <input type="radio"/> d

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

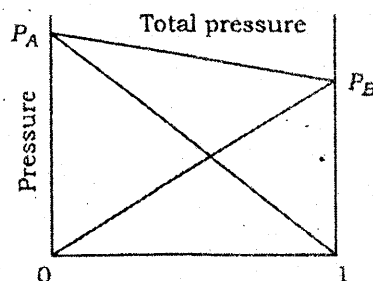
1. Which of the following is **not** considered to be a characteristic of glia?
 - (a) Cell division
 - (b) Electrical impulse propagation along their appendages
 - (c) Macrophagic function
 - (d) They are significantly more in number than neurons
2. Suffocation due to severely deficient oxygen supply in blood is called
 - (a) anoxia
 - (b) asphyxiation
 - (c) noxia
 - (d) normoxia
3. Mosquito larvae breathe through
 - (a) tracheal gills
 - (b) siphons
 - (c) trachea
 - (d) spiracle
4. The most common cells that exhibit amoeboid locomotion in human body are
 - (a) red blood cells when they are in circulation
 - (b) red blood cells when they are in the spleen reservoir
 - (c) white blood cells when they are in circulation
 - (d) white blood cells when they act like tissue macrophages
5. The arthropod animals have
 - (a) closed circulatory system
 - (b) open circulatory system
 - (c) partially closed circulatory system
 - (d) double-circuit circulatory system

6. Periderm comprises of
- (a) cork cells
 - (b) cork + cork cambium
 - (c) cork + cork cambium + living phloem
 - (d) cork + cork cambium + living phloem + secondary xylem
7. Binomial system of nomenclature, now followed universally, was first proposed for plants by
- (a) Aristotle
 - (b) Goethe
 - (c) Linnaeus
 - (d) Darwin
8. Organisms, most similar to each other, belong to the same
- (a) order
 - (b) genus
 - (c) species
 - (d) family
9. Bryophytes are called amphibian plants, because
- (a) they can grow both in wetland and dryland
 - (b) half of their life span is on water and rest half on land
 - (c) their reproductive phase requires water
 - (d) they have both tracheids and vessels
10. Edible part of Litchi is
- (a) fleshy aril
 - (b) endosperm
 - (c) mesocarp
 - (d) endocarp

11. All of the following diseases are caused by bacteria, **except**
- (a) plague
 - (b) yellow fever
 - (c) typhus
 - (d) cholera
12. The final product of anaerobic respiration is
- (a) methanol
 - (b) pyruvate
 - (c) ethanol
 - (d) malate
13. Which among the following is produced by recombinant DNA technology?
- (a) Thyroid-stimulating hormone
 - (b) Follicle-stimulating hormone
 - (c) Insulin
 - (d) Glucagon
14. Which of the following methods will **not** achieve complete sterilization?
- (a) Dry heat : 170 °C, 60 minutes
 - (b) Boiling water : 100 °C, 2 hours
 - (c) Autoclave : 121 °C, 15-20 pounds pressure, 20 minutes
 - (d) Chemical vapour : 127 °C, 20-40 pounds pressure, 20 minutes
15. In prokaryotes, genetic recombination to generate variation occurs during
- (a) meiosis
 - (b) transformation
 - (c) gamete production
 - (d) altering their ploidy

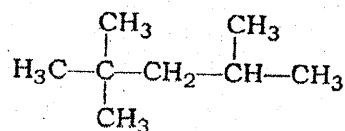
16. Fluorescence microscopy is based on the ability of certain molecules to
- (a) continuously emit light of a constant wavelength
 - (b) absorb light of many different wavelengths
 - (c) absorb light of a given wavelength and then emit light of a longer wavelength
 - (d) absorb light of a given wavelength and then emit light at shorter wavelength
17. Which of the following is present in plant and bacterial cells but **not** in animal cells?
- (a) Centriole
 - (b) Ribosome
 - (c) Cell wall
 - (d) Nucleus
18. The amino acid that is **not** optically active is
- (a) tryptophan
 - (b) methionine
 - (c) proline
 - (d) glycine
19. The assignment of a sugar to the D-configuration is based on its analogy to
- (a) D-glyceraldehyde
 - (b) D-tartaric acid
 - (c) α -D-glucose
 - (d) D-alanine
20. The secondary and tertiary structures of proteins involve the following bonds. Which amongst them is likely to be the most stable?
- (a) Hydrogen bond
 - (b) Disulphide bridge
 - (c) Hydrophobic interaction
 - (d) Electrostatic interaction
21. Bacterial conjugation was first demonstrated by
- (a) Fredrick Griffiths
 - (b) Avery and McLeod
 - (c) Joshua Lederberg
 - (d) Hershey and Chase

22. If the first seven children born to a particular pair of parents are all males, what is the probability that the eighth child will also be a male?
- (a) $1/16$
 (b) $1/64$
 (c) $1/2$
 (d) $1/8$
23. Which of the following is responsible for the genetic variability within a species?
- (a) Mutation
 (b) Selection
 (c) Recombination
 (d) Polyploidy
24. The plot given below represents the total vapour pressure and the two partial vapour pressures of an ideal binary mixture as a function of mole fractions. The X-axis label is missing. What should be the exact function represented on the X-axis?



- (a) Mole fraction of A + Mole fraction of B
 (b) Mole fraction of A - Mole fraction of B
 (c) Mole fraction of A only
 (d) Mole fraction of B only
25. A 10 V solution of H_2O_2 means 1L of this H_2O_2 gives 10 L of O_2 at STP. What is the strength of the H_2O_2 solution in g/L?
- (a) 17
 (b) 3
 (c) 1.5
 (d) 0.7

26. The IUPAC nomenclature for



is

- (a) 1,1-dimethyl-3,3,3-trimethyl propane
- (b) 2-dimethyl-4,4-dimethyl pentane
- (c) 1-tertiary butyl-2-methyl propane
- (d) 2,2,4-trimethyl pentane

27. The dimension of energy is

- (a) $ML^{-1}T^{-2}$
- (b) ML^2T^{-2}
- (c) $M^2L^2T^{-2}$
- (d) MLT^{-2}

28. Which of the following equations is **correct**?

- (a) $C_p - C_v = R$ (Universal gas constant)
- (b) $C_p - C_v = k$ (Boltzmann constant)
- (c) $C_v - C_p = k$ (Boltzmann constant)
- (d) $C_v - C_p = R$ (Universal gas constant)

29. The generation time of a bacterial cell is 30 min. If 4×10^9 cells were produced in 16 hours, how much time would be required to produce 10^9 cells?

- (a) 8 hr
- (b) 12 hr
- (c) 15 hr
- (d) 4 hr

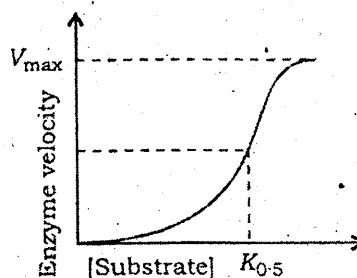
30. In the year 2009, Nobel Prize in Chemistry was awarded to

- (a) Venkatraman Ramakrishnan
- (b) Sarvepalli Radhakrishnan
- (c) Venkatraman Radhakrishnan
- (d) Subramanian Ramakrishnan

PART—B

Answer any **seventy** questions

31. Amino acid that is rarely found in proteins is
- (a) selenocysteine
 - (b) ornithine
 - (c) citrulline
 - (d) carnitine
32. Which amongst the following is **not** the characteristic of enzymes?
- (a) They decrease the activation energy of the reaction
 - (b) They have stereospecificity
 - (c) They are only protein in nature
 - (d) They are generally substrate-specific
33. The following figure shows a typical substrate-activity curve for an allosteric enzyme :



- How will the coordinates $K_{0.5}$ and V_{max} on the curve change upon addition of a positive modulator?
- (a) $K_{0.5}$ will decrease and V_{max} will remain the same
 - (b) Both $K_{0.5}$ and V_{max} will increase
 - (c) Both $K_{0.5}$ and V_{max} will decrease
 - (d) $K_{0.5}$ will increase and V_{max} will remain the same
34. Assume that a bacterium is growing happily at 25 °C. A crazy scientist decides to suddenly shift it to 37 °C. How would the bacterium counter the change in its membrane fluidity?
- (a) By decreasing unsaturated fatty acids
 - (b) By decreasing saturated fatty acids
 - (c) By decreasing both saturated and unsaturated fatty acids
 - (d) By increasing unsaturated fatty acids

35. Uncoupling of oxidative aerobic oxidation by phosphorylation implies that
- (a) the ATPase activity of mitochondria is abolished
 - (b) the mitochondria cease to oxidize succinate
 - (c) ATP formation ceases but respiration continues
 - (d) ATP formation continues but respiration ceases
36. The concentration of glucose in human blood plasma is maintained at about 5 mM. The concentration of free glucose inside muscle cells is much lower. What happens to the glucose upon entry into the cell?
- (a) It gets polymerized
 - (b) It gets phosphorylated to glucose-6-phosphate
 - (c) It is pumped back to the blood
 - (d) It gets incorporated into cell membrane
37. Cytochromes are
- (a) riboflavin-containing nucleotides
 - (b) metal-containing flavoproteins
 - (c) pyridine nucleotides
 - (d) iron-porphyrin proteins
38. Which statement about the tricarboxylic acid cycle is *incorrect*?
- (a) Complete oxidation of one molecule of pyruvate requires five atoms of oxygen
 - (b) Carbohydrate, fat and amino acids can be oxidized by the cycle
 - (c) Acetate can funnel into the cycle only as acetyl CoA
 - (d) The cycle occurs only under anaerobic conditions
39. Which of the following parameters would be considered while calculating the 'specificity constant' of an enzyme?
- (a) k_{cat} / K_m
 - (b) k_{cat}
 - (c) $(k_{-1} + k_{\text{cat}}) / k_1$
 - (d) k_1 / k_{-1}

40. The process of β -oxidation of fatty acids results in
- (a) addition of carbon fragments in the form of acetyl CoA
 - (b) successive dihydroxyacetone phosphate formation
 - (c) removal of 2 carbon fragments in the form of acetyl CoA
 - (d) removal of 2 carbon fragments in the form of acetaldehyde
41. Microtubule-depolymerizing drugs such as colchicines would be expected to
- (a) inhibit mitosis but allow cytokinesis
 - (b) inhibit both mitosis and cytokinesis
 - (c) inhibit cytokinesis but allow mitosis
 - (d) induce formation of multiple contractile rings
42. Centrosome duplication begins as the cell
- (a) enters the S phase
 - (b) enters the G1 phase
 - (c) is half-way in S phase
 - (d) is half-way in G1 phase
43. G-protein-coupled receptors have which of the following structures?
- (a) Helix-turn-helix
 - (b) Coiled-coiled
 - (c) Seven transmembrane helices
 - (d) A helical domain and a globular domain
44. Which of the following methods would you use to visualize a protein in a living cell?
- (a) Expressing the protein as a fusion with the YFP (reporter) and directly visualizing under a fluorescence microscope
 - (b) Expressing the protein as a fusion with β -galactosidase protein (reporter) and visualizing it directly under fluorescence microscope
 - (c) Using a specific antibody (tagged with a fluorescence probe) raised against the protein to directly visualize under fluorescence microscope
 - (d) Directly visualizing the protein (after having over-expressed it) under an electron microscope

W. Imv(e)gLP. Gdn

45. Which of the following is **wrong**?
- (a) cdk4 and cdk6 are the partners of cyclin D
 - (b) cdk1 is the partner of cyclin B
 - (c) cdk4 and cdk1 are the partners of cyclin E
 - (d) cdk2 is the partner of cyclin A
46. While doing an experiment, you observed that a protein present in the plasma membrane is slightly different from its original form synthesized in the endoplasmic reticulum. Where do you think the protein was probably modified?
- (a) In smooth endoplasmic reticulum
 - (b) In mitochondria
 - (c) In Golgi apparatus
 - (d) In nucleus
47. Plasma membrane lipids originate from
- (a) nucleus
 - (b) endoplasmic reticulum
 - (c) mitochondria
 - (d) cytosol
48. Enzymes found in lysosomes include
- (a) lactate dehydrogenase
 - (b) cathepsin
 - (c) epimerase
 - (d) pyruvate kinase
49. Which of the following cells **do not** belong to the category of lymphocytes?
- (a) T cells
 - (b) B cells
 - (c) NK cells
 - (d) Dendritic cells
50. In *Drosophila*, deletion of ultrabithorax gene results in
- (a) a fly with four wings
 - (b) a fly with antenna in place of legs
 - (c) a fly with legs in place of antenna
 - (d) a fly with two pairs of halteres

W. Inulee9/p. 607

51. The following are the statements made with respect to the organizer tissue of the amphibian gastrula :

- (i) The organism consists of pharyngeal endoderm, head mesoderm, notochord and dorsal blastopore lip and functions by secreting proteins like Noggin, Chordin and Follistatin.
- (ii) The organizer is induced by Nieuwkoop centre which is formed by the translocation of the Dishevelled protein to the dorsal side of the egg.
- (iii) The Siamois and Twin proteins in collaboration with transcription factor generated by TGF- β signal can activate the goosecoid gene in the organizer.
- (iv) A gradient of BMP appears to be highest in the dorsal side of the embryo.

Which amongst the above statements hold *true*?

- (a) (i), (ii) and (iii)
- (b) (i) and (ii)
- (c) (i) and (iv)
- (d) (ii) and (iii)

52. In case of morphallactic regeneration, which of the following statements is *true*?

- (a) Dedifferentiation of adult structures to form an undifferentiated mass of cells that then become respecified
- (b) Repatterning of the existing tissue occurs with little new growth
- (c) Differentiated cells divide and maintain their differentiated functions
- (d) Repatterning of the existing tissue occurs with division of stem cells to maintain the original size of the organism

53. During embryogenesis, differentiation of a cell involves processes like specification and determination. In this regard, which of the following statements are *correct*?

- (i) Autonomous specification leads to mosaic development.
 - (ii) Autonomous specification leads to regulative development.
 - (iii) Conditional specification leads to regulative development.
 - (iv) Conditional specification leads to mosaic development.
- (a) (i) and (iii)
 - (b) (ii) and (iv)
 - (c) (i) and (iv)
 - (d) (ii) and (iii)

W. Inu (Eg) P. Goh

54. Movement of a single cell into the blastocoel is termed as
- (a) ingression
 - (b) involution
 - (c) epiboly
 - (d) delamination
55. Which of the following types of neurons in the brain is maximally lost in Alzheimer's patients?
- (a) Cholinergic
 - (b) Cholinoceptive but non-cholinergic
 - (c) Serotonergic
 - (d) Dopaminergic
56. Cerebellectomy will primarily affect
- (a) vision
 - (b) hearing
 - (c) movement
 - (d) thermoregulation
57. The foramen of Panizza is a small opening present in the reptilian
- (a) brain
 - (b) heart
 - (c) liver
 - (d) kidney

58. The Frank-Starling law is associated with
- (a) an intrinsic ability of the heart to adapt to increasing volume of inflowing blood
 - (b) sensory receptors that detect forces applied to cell membranes
 - (c) the rate of heat production by a tissue or organism, usually approximated by oxygen consumption or carbon dioxide production
 - (d) a respiratory reflex that reduces breathing rate in response to overinflation of the lungs
59. The entire body muscles contract and become rigid few hours after the death of an individual. This state of muscle rigidity is called
- (a) muscle hypertrophy
 - (b) muscle atrophy
 - (c) rigor mortis
 - (d) hyperplasia
60. The nephridium found in the invertebrate animals is the functional analogue of
- (a) lungs of vertebrate animals
 - (b) kidney of vertebrate animals
 - (c) gills of invertebrate animals
 - (d) brain of invertebrate animals
61. The magnitude of neuronal responses decreases with repeated non-detrimental stimulation and this phenomenon is called as
- (a) sensitization
 - (b) habituation
 - (c) withdrawal reflex
 - (d) long-term potentiation
62. The amount of total metabolic energy consumed to produce a given amount of force per unit cross-section of muscle tissue to move limbs will be
- (a) more in small animals
 - (b) less in small animals
 - (c) more in large animals
 - (d) independent of body size

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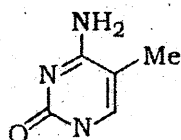
63. In alligators, sex/gender is determined by
- (a) chromosomal composition
 - (b) incubation temperature of the eggs
 - (c) nutritional status of the eggs
 - (d) presence or absence of specific sex-determination factors in the eggs
64. Which of the following **does not** have an open circulatory system?
- (a) Loligo
 - (b) Prawn
 - (c) Frog's tadpole
 - (d) Cockroach
65. The rapid growth of the hypocotyls during seed germination is attributed to
- (a) higher rate of cell division from shoot tip
 - (b) higher rate of cell division from root tip
 - (c) equal rate of cell division from both ends
 - (d) cell size enlargements in the cells between the tips
66. The plant organ which shows very high rate of respiration is
- (a) developing bud
 - (b) leaf
 - (c) root
 - (d) stem
67. You must have noticed that grasses regrow rapidly after grazing by animals. This is primarily due to the activity of
- (a) lateral meristem
 - (b) apical meristem
 - (c) intercalary meristem
 - (d) vascular meristem

68. Actinomorphic flowers have
- (a) no plane of symmetry
 - (b) one plane of symmetry
 - (c) two planes of symmetry
 - (d) three or more planes of symmetry
69. Potato tuber is stem because it contains
- (a) adventitious roots
 - (b) buds on the nodes
 - (c) high food reserve
 - (d) no chlorophyll when grown underground, but produces chlorophyll when exposed to sunlight
70. Arrangement of sepals or petals in floral axis is known as
- (a) phyllotaxy
 - (b) prefoliation
 - (c) aestivation
 - (d) venation
71. Production of fruit without fertilization of ovules is known as
- (a) asexual reproduction
 - (b) sexual reproduction
 - (c) parthenocarpy
 - (d) apomixis
72. Collapsing of the leaves by touching a touch-me-not plant is known as
- (a) geotropism
 - (b) hydrotropism
 - (c) epinasty
 - (d) seismonasty

73. The enzyme that converts nitrogen into ammonia is
- (a) ammonia synthetase
 - (b) nitrogenase
 - (c) dinitro-oxidase
 - (d) transaminase
74. Which of the following elements is **not** an essential micronutrient for plants?
- (a) Calcium
 - (b) Boron
 - (c) Copper
 - (d) Zinc
75. Which of the following has no exception in angiosperm?
- (a) Presence of secondary meristem
 - (b) Autotrophic nutrition
 - (c) Adventitious root formation
 - (d) Double fertilization
76. What would be the number of chromosomes in aleurone layer in a plant in which the synergids have 16 chromosomes?
- (a) 16
 - (b) 32
 - (c) 48
 - (d) 64
77. To complete the synthesis of one molecule of glucose from carbon dioxide, the Calvin cycle should operate
- (a) 1 round
 - (b) 2 rounds
 - (c) 4 rounds
 - (d) 6 rounds
78. In maize/sugarcane, malic acid synthesis during CO_2 -fixation takes place in
- (a) mesophyll cells
 - (b) bundle sheath cells
 - (c) epidermal cells
 - (d) guard cells

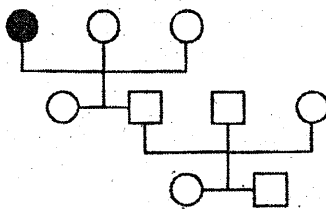
79. The genome of an organism consists of 4×10^{10} base pairs. If the bases are placed end-to-end, the total length of the genome would be
- (a) 0.136 m
 - (b) 1.36 m
 - (c) 13.6 m
 - (d) 136 m
80. A dicentric chromosome is produced when crossing-over takes place in an individual heterozygous for
- (a) duplication
 - (b) deletion
 - (c) paracentric inversion
 - (d) pericentric inversion
81. For the ABO blood types, what phenotypes and ratios are expected from the mating $I_A^i \times I_B^i$?
- (a) 1A : 1B
 - (b) 1AB : 1O
 - (c) 1A : 1B : 1AB : 1O
 - (d) 1A : 1B : 1O
82. Which of the following reagents can cause frameshift mutation?
- (a) Ethyl methyl sulphonate
 - (b) Ethidium bromide
 - (c) Bromodeoxyuridine
 - (d) Aflatoxin
83. The recessive disorder albinism occurs only once in 24000 human births. If the first child of two normally pigmented parents is an albino, the probability that their second child will also be albino is
- (a) 1/2
 - (b) 1/16
 - (c) 1/4
 - (d) 1/8

84. Identical twins were born with a genetic disorder that can be managed by excluding phenylalanine from the diet. Both twins were placed on this diet. However, one twin chose not to follow the diet and was affected. The other twin followed the diet and was not affected. This difference between the twins illustrates that
- exclusion of phenylalanine corrects the genetic defect
 - the manifestation of the genetic disorder is influenced by biochemical factors
 - identical twins do not always have the same phenotype
 - the expressivity of this genetic disorder differs in identical twins
85. The F_2 -progeny from a particular cross exhibits a modified dihybrid ratio of 9 : 7 (instead of 9 : 3 : 3 : 1). What phenotypic ratio would be expected from a test cross of the F_1 -progeny?
- 1 : 2 : 1
 - 1 : 1 : 1 : 1
 - 1 : 3
 - 2 : 2
86. The enzyme that is involved in removing the primer during the DNA replication in *E. coli* is
- DNA polymerase I
 - DNA polymerase II
 - DNA polymerase III
 - DNA polymerase IV
87. The base possessing the following structure is



- 5-methyl cytosine
- 5-methyl thymine
- 2-methyl cytosine
- 5-methyl uracil

88. The pedigree given below shows which inheritance pattern?



- (a) Autosomal recessive
- (b) X-linked recessive
- (c) Autosomal dominant
- (d) X-linked dominant

89. Which of the following organisms can produce ATP without having mitochondria?

- (a) Protozoa
- (b) Lichens
- (c) Viruses
- (d) Bacteria

90. Tetanus toxoid

- (a) is administered for superficial wounds
- (b) is administered only to babies
- (c) confers passive immunity
- (d) is most effective in immunocompromised persons

91. If you cross an F^+ strain with another F^+ strain, which of the following progenies will you obtain?

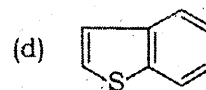
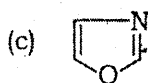
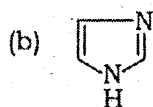
- (a) F^-
- (b) Hfr
- (c) F^+
- (d) Sterile cross

92. Which component of the bacterial cell contains large amount of D-glutamic acid?

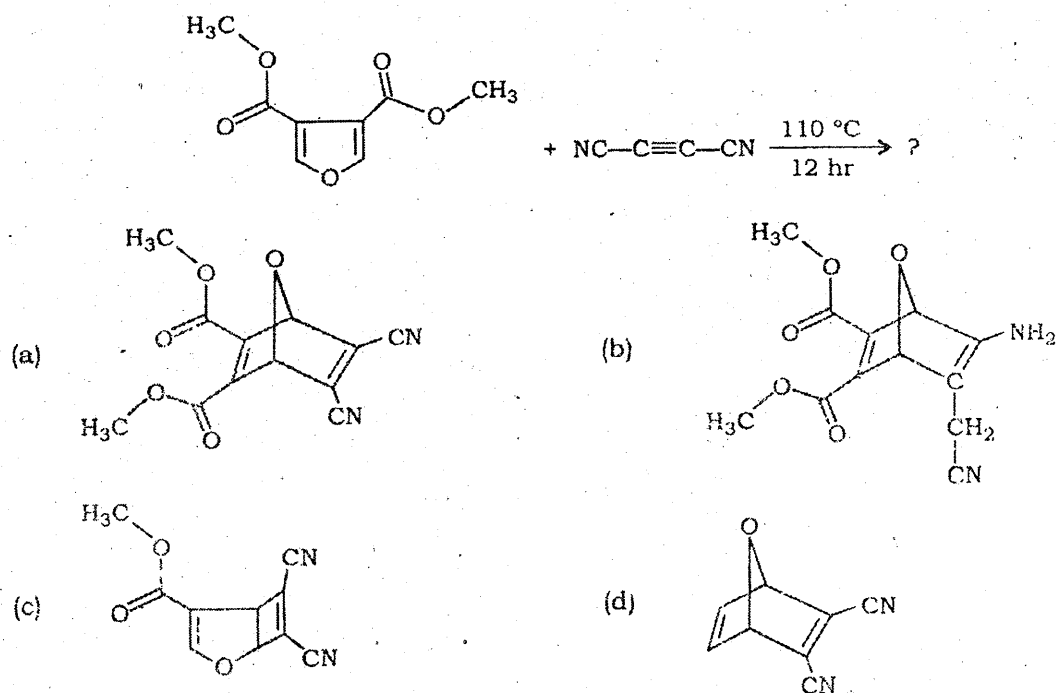
- (a) Plasma membrane
- (b) Cell wall
- (c) Mitochondria inner membrane
- (d) Nuclear envelope

93. *E. coli* cannot pick up Gram stain because their outer membrane layer contains
- (a) glycoprotein
 - (b) peptidoglycan
 - (c) lipoprotein
 - (d) lipopolysaccharide
94. Which of the following statements is **false** concerning a mating between F^+ and F^- cell?
- (a) The F^- cell is converted to an F^+ cell
 - (b) The F^+ cell is converted to an F^- cell
 - (c) Chromosomal genes are rarely transferred
 - (d) Cell-to-cell contact is always necessary
95. Plasmids may be functionally involved in all of the following, **except**
- (a) transduction
 - (b) synthesis of pili
 - (c) transfer of chromosomal genes
 - (d) transfer of drug resistance
96. The endotoxin of Gram -ve bacteria is associated with
- (a) peptidoglycan
 - (b) liposaccharide
 - (c) exopolysaccharide
 - (d) chitin
97. Human pathogens which prefer temperatures close to that of human body are called
- (a) homophiles
 - (b) psychophiles
 - (c) thermophiles
 - (d) mesophiles
98. Shine-Dalgarno sequence
- (a) serves as binding sites for bacterial ribosomes
 - (b) is involved in bacterial transcription
 - (c) serves as recognition site for stopping mRNA synthesis
 - (d) serves as recognition site for termination of translation

99. The absorbance of a 1M tryptophan solution at 280 nm was 5600 when measured using a 1 cm path-length cuvette and an appropriate dilution. What would be the concentration of a peptide solution (containing one tryptophan per peptide) whose absorbance at 280 nm is 0.5 in a cuvette of path-length 5 cm?
- (a) $4.5 \times 10^{-4} M$
 (b) $1.8 \times 10^{-5} M$
 (c) $8.9 \times 10^{-5} M$
 (d) $5 \times 10^{-3} M$
100. The Kiliani-Fischer reaction produced D-glucose and D-mannose from an unknown sugar. The unknown sugar must be
- (a) D-erythrose
 (b) D-arabinose
 (c) D-galactose
 (d) D-fructose
101. Bromomethane, on treatment with sodium metal in dry ether, would give
- (a) methane
 (b) ethane
 (c) propane
 (d) *n*-butane
102. Silicon tetrachloride, on a complete hydrolysis, gives
- (a) SiOH
 (b) Si(OH)₂
 (c) Si(OH)₃
 (d) Si(OH)₄
103. Which of the following is a thiazole?



104. The predominant product in the Diels-Alder reaction given below would be



105. If the change in the value of gravitational constant g at a height h above the surface of the earth is the same as at the depth x below its surface, then

- (a) $x = h^2$
 (b) $x = 2h$
 (c) $x = 0.5h$
 (d) $x = \sqrt{h}$

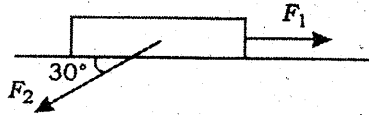
106. A woodpecker is penetrating the tree trunk with a speed of 9 m/sec and stops after making a 3 mm hole. What is the acceleration of the beak (assume constant acceleration)?

- (a) -3 m/s^2
 (b) $-21 \times 10^6 \text{ m/s}^2$
 (c) $-13.5 \times 10^3 \text{ m/s}^2$
 (d) $-27 \times 10^9 \text{ m/s}^2$

107. In Rayleigh-Jeans formula, energy density E_λ is proportional to

- (a) λ^{-4}
 (b) λ^{-3}
 (c) λ^{-5}
 (d) λ^{-2}

108. The following figure shows the forces acting on a block of mass 2 kg. What is the acceleration of the block assuming it is on a frictionless floor?



F_1 is along the axis and F_2 is directed at angle 30° and have magnitude $F_1 = 4 \text{ N}$ and $F_2 = 1 \text{ N}$.

- (a) 4 m/s^2
 - (b) 2 m/s^2
 - (c) 1.56 m/s^2
 - (d) 0.5 m/s^2
109. Half-life of radon is 3.8 days. How long will it take to decay to $1/20$ th of the initial amount?
- (a) 40.22 days
 - (b) 26.78 days
 - (c) 16.46 days
 - (d) 10.68 days
110. The position of a particle moving with respect to time is given by $X = 7.8 + 9.2t - 2t^2$, where X is in meters and t is in seconds. What is the velocity at $t = 2 \text{ sec}$?
- (a) 7.8 m/s
 - (b) 9.2 m/s
 - (c) 1.2 m/s
 - (d) 4 m/s
111. 6000 Indians were tested for A, B, O blood groups, 2527 had the antigen A, 2234 had the antigen B and 1846 had no antigen. How many individuals had both the antigens?
- (a) 760
 - (b) 670
 - (c) 607
 - (d) 706
112. If the equation $x^2 - (p+4)x + 2p + 5 = 0$ has equal roots, the value(s) of p is/are
- (a) 0
 - (b) ± 2
 - (c) ± 1
 - (d) ± 3

113. The sum of the series $5 - \frac{10}{3} + \frac{20}{9} - \frac{40}{27} + \dots$ is
- (a) 0
 - (b) 1
 - (c) -3
 - (d) +3
114. A ball is dropped from a height of 10 m. Each time the ball strikes the ground it bounces vertically to a height that is $\frac{3}{4}$ of the preceding height. The total distance the ball will travel if it is assumed to bounce infinitely, is
- (a) 70 m
 - (b) 705 m
 - (c) 69 m
 - (d) 69.5 m
115. A certain substance cools from 370 K to 330 K in 10 minutes, when the temperature of air is 290 K. The temperature after 40 minutes will be
- (a) 270 K
 - (b) 325 K
 - (c) 300 K
 - (d) 295 K
116. A coin is tossed 3 times. The probability that head occurs an odd number of times is
- (a) $\frac{1}{4}$
 - (b) $\frac{1}{2}$
 - (c) $\frac{1}{6}$
 - (d) $\frac{1}{3}$
117. Which of the following is a Pattern Recognition Receptor (PRR)?
- (a) Lipopolysaccharide
 - (b) Mannose-binding lectin
 - (c) Zymosan
 - (d) Peptidoglycan

118. Which of the following is **true** for epitopes associated with antigen from an exogenous source?
- (a) Presented in association with MHC-I
 - (b) Presented to T helper lymphocytes
 - (c) Presented to T cytotoxic lymphocytes
 - (d) Associated with MHC molecules within the endoplasmic reticulum
119. Which of the following is **not** a characteristic of the inflammatory response against extracellular bacterial infections?
- (a) Increased levels of IgE
 - (b) Swelling caused by release of vasodilators
 - (c) Degranulation of tissue mast cells
 - (d) Phagocytosis by macrophages
120. Which of the following statements regarding haptens and carriers is **true**?
- (a) Haptens are large protein molecules such as BSA
 - (b) Carriers are needed only if one wants to elicit a cell-mediated response
 - (c) It is necessary to immunize with a hapten-carrier complex in order to obtain antibodies directed against the hapten
 - (d) Carriers include small molecules such as dinitrophenol and penicillinic acid
121. At what age does the human thymus reach its maximal size?
- (a) During the first year of life
 - (b) During teenage years (puberty)
 - (c) Between 25-50 years of age
 - (d) After 50 years of age
122. With reference to base composition of double-stranded DNA, which of the following is **not** in conformity with Chargaff's rule?
- (a) $[A] + [T] = [G] + [C]$
 - (b) $[A] + [G] = [T] + [C]$
 - (c) $[A] + [C] = [T] + [G]$
 - (d) $([A] + [G]) / ([T] + [C]) = 1$

123. Which of the following organisms has the highest density of genes per unit length of their genome?
- (a) *Saccharomyces cerevisiae*
 - (b) *Escherichia coli*
 - (c) *Homo sapiens*
 - (d) *Caenorhabditis elegans*
124. Lysogenization of *E. coli* cells by λ phage is maintained by continuous expression of
- (a) *N* gene
 - (b) *cro* gene
 - (c) *ecf* gene
 - (d) *gam* gene
125. If a virus particle contains double-stranded circular DNA of 120000 base pairs, how many phosphorus atoms would be present?
- (a) 60000
 - (b) 120000
 - (c) 240000
 - (d) 360000
126. Which of the following is **not true** of the RNA polymerase II?
- (a) It transcribes mRNAs but not tRNAs
 - (b) It requires a number of general transcription factors for the initiation of transcription
 - (c) It has proofreading activity
 - (d) It is present in both prokaryotes and eukaryotes
127. Which of the following statements regarding mRNA processing is **incorrect**?
- (a) Splicing of mRNAs occurs concurrently with the elongation of transcription
 - (b) mRNAs are capped in the cytosol
 - (c) One precursor RNA might produce multiple mature mRNAs
 - (d) mRNAs with premature stop codons are degraded in the nucleus

128. UV-treated phage was plated on two sets of host bacteria, one which was preexposed to a sub-lethal dose of UV and the other that was unexposed to UV. Viability of phage (scored as plaque-forming units) will be
- (a) the same on both
 - (b) higher on UV-preexposed bacteria
 - (c) higher on UV-unexposed bacteria
 - (d) higher on UV-exposed bacteria only if incubation is done in light
129. The frequency of mutation in a growing population of cells is
- (a) dependent on selection pressure
 - (b) dependent on nutritional conditions
 - (c) dependent on map location of the gene
 - (d) independent of selection pressure and map location
130. Identify the statement that is **incorrect** for the poly-A tail of mRNA.
- (a) Polyadenylation is mediated by an enzyme called poly-A polymerase.
 - (b) Polyadenylation is guided by a signal present in the 3' region of the transcript.
 - (c) The site of polyadenylation is always fixed for an mRNA.
 - (d) The length of poly-A tail is a determining factor for mRNA stability.
131. Which of the following techniques would you use to determine the molecular mass of a biochemically purified multimeric complex of cellular proteins of approximately 2×10^6 daltons in its native state?
- (a) SDS-PAGE
 - (b) Gel filtration
 - (c) Western blotting
 - (d) MALDI/TOF
132. A recombinant plasmid DNA of 5 kb size contains a 1 kb insert cloned at a unique EcoRI site. If 3.3 microgram of the plasmid was completely digested by EcoRI in 33 microlitre volume, approximately, how many molecules of the 1 kb DNA fragment will be generated?
- (a) 1×10^{23}
 - (b) 6×10^{23}
 - (c) 6×10^{11}
 - (d) 0.2×10^{12}

133. Which one of the following methods gives quantitative estimation of a protein in a tissue?
- (a) Extracting the tissue and then doing Western blot analysis
 - (b) Extracting the tissue and then doing ELISA
 - (c) Extracting the tissue and then doing mass spectrometry using MALDI-TOF
 - (d) Direct immunofluorescence analysis using a confocal microscope
134. Transcription start site can be determined by
- (a) Northern blot analysis
 - (b) Microarray analysis
 - (c) Primer extension
 - (d) Southern hybridization
135. Klenow fragment of *E. coli* DNA polymerase is used for making DNA probes. Which amongst the following radioactive nucleotides would be the right choice?
- (a) α - ^{32}P -dATP
 - (b) β - ^{32}P -dATP
 - (c) γ - ^{32}P -dATP
 - (d) γ - ^{32}P -ATP
136. Sets of four atoms in a polypeptide backbone are coplanar. Scanning from the N-terminal towards the C-terminal, these coplanar atoms will be
- (a) 'N-C-C-N
 - (b) C-N-C-C
 - (c) C-C-N-C
 - (d) C-N-N-C
137. Phosphorylation of a biomolecule will generally
- (a) decrease its negative charge
 - (b) decrease its positive charge
 - (c) not influence surface charge
 - (d) increase hydrophobicity

ENTRANCE EXAMINATION, 2010

M.Sc. LIFE SCIENCES

[Field of Study Code : SLSM (226)]

Time Allowed : 3 hours

Maximum Marks : 100

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 30 questions and all are compulsory.
- (v) Part—B contains 100 questions. **Answer any 70 questions.**
In case any candidate answers more than the required 70 questions, the first 70 questions attempted will be evaluated.
- (vi) Each correct answer carries 1 mark. **There will be negative marking and $\frac{1}{2}$ mark will be deducted for each wrong answer.**
- (vii) Answer written by the candidates inside the Question Paper will not be evaluated.
- (viii) Simple Calculators and Log Tables may be used.
- (ix) Pages at the end have been provided for Rough Work.
- (x) 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 :

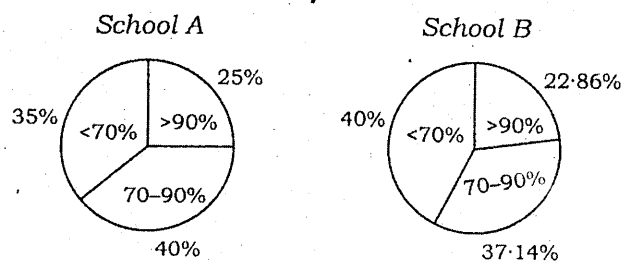
Wrong	Wrong	Wrong	Wrong	Correct
<input checked="" type="radio"/> (b) (c) <input type="radio"/>	<input checked="" type="radio"/> (b) (c) (d)	<input checked="" type="radio"/> (b) (c) (d)	<input checked="" type="radio"/> (b) (c) <input type="radio"/>	(a) (b) (c) <input checked="" type="radio"/>

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. River 'Ganga', also known as National River of India, originates from the Himalayas in Uttarakhand and after traveling several States merges in Bay of Bengal. Approximately how much distance it covers in the journey?
 - (a) 1500 km
 - (b) 2500 km
 - (c) 3500 km
 - (d) 4500 km
2. What is the significance of Republic Day of India which is celebrated every year on 26th January?
 - (a) The Constitution of India was submitted in the Parliament of India in January 26, 1950
 - (b) The Constitution of India came into effect on January 26, 1949
 - (c) The Indian National Congress celebrated this day as Independence Day of India
 - (d) The Colonial Government of India Act, 1935 was replaced by the Constitution of India in January 26, 1950
3. The figure given below represents the results of two schools A and B in CBSE examination and may be read, e.g., in school A, 25% of the students scored more than 90% marks. School B has 30 students more than school A. 140 students from school B scored less than 70% marks. From these facts, choose the correct statement given below the figure :



- (a) Schools A and B have equal number of students scoring more than 90% marks
- (b) School A has more number of students than school B scoring more than 90% marks
- (c) Number of students scoring marks less than 70% are equal in both the schools
- (d) School A has more number of students than school B scoring less than 70% marks

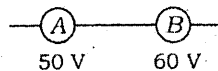
4. When Hari was 9 years old, Shyam's father was 48 years old. Shyam's father was 5 years elder than Ravi. Ravi's daughter Rekha was born when Ravi was 32 years old. As per the above, which of the following statements is true?
- (a) Rekha is elder than Shyam
 - (b) Hari is elder than Rekha
 - (c) Rekha is elder than Hari
 - (d) Shyam is the eldest among all
5. What comes next in the series 3, 7, 13, 27, 53, ...?
- (a) 105
 - (b) 106
 - (c) 107
 - (d) 97
6. The median of the sample 1, 7, 8, 10, 12, 15, 17, 23, 24, 29 is
- (a) 12
 - (b) 15
 - (c) 13.5
 - (d) 14.6
7. Which of the following specifies a nucleotide sequence in DNA to which RNA polymerase binds to initiate transcription?
- (a) Operator
 - (b) Promoter
 - (c) Enhancer
 - (d) Operon
8. The frequency of crossing-over between any two linked genes is
- (a) more likely if they are recessive
 - (b) determined by their relative dominance
 - (c) same as if they were not linked
 - (d) greater the further apart they are
9. Which one of the following is a macronutrient for plants?
- (a) Zinc
 - (b) Manganese
 - (c) Magnesium
 - (d) Cobalt

10. Papaya and date palm produce either male or female flowers in a plant. These kinds of plants are known as
- (a) monoecious
 - (b) dioecious
 - (c) homothallic
 - (d) bisexual
11. The most common method of asexual reproduction in Protozoa is
- (a) conjugation
 - (b) gametangial contact
 - (c) conidiospore production
 - (d) binary fission
12. In the earth atmosphere, nitrogen and oxygen together comprise approximately — of the content.
- (a) 90%
 - (b) 95%
 - (c) 99%
 - (d) < 90%
13. What property of a moving object is constant during the application of a constant force?
- (a) Velocity
 - (b) Acceleration
 - (c) Momentum
 - (d) Speed
14. The ionic product of water is
- (a) $1 \times 10^{-14} M^2$
 - (b) $1 \times 10^{14} M^{-2}$
 - (c) $1 \times 10^{-14} M$
 - (d) $1 \times 10^{14} M$
15. Which one of the following is the weakest acid?
- (a) HI
 - (b) HBr
 - (c) HCl
 - (d) HF

16. From a pack of randomly shuffled 52 cards, you pull 4 cards at a time. What is the probability that you will get one each of spade, heart, club and diamond?
- (a) $4/52$
 (b) $({}^{13}C_1)^4 / {}^{52}C_4$
 (c) ${}^{13}C_4 / {}^{52}C_4$
 (d) $13/52$

17. Which of the equations is correct?
- (a) $\log(M + N + O) = \log M + \log N + \log O$
 (b) $\log_M N = \log_N M$
 (c) $\log(M \times N) = \log M \times \log N$
 (d) $\log(M \times N) = \log M + \log N$

18. Two points A and B are connected with a wire of uniform resistance as shown in the figure below :



According to the figure, which of the following statements is correct?

- (a) Electron released from point A will move towards point B
 (b) Electron released from point B will move towards point A
 (c) Proton released from point A will move towards point B
 (d) Both (b) and (c) are correct
19. If a polypeptide has 400 amino acid residues, what is the approximate mass?
- (a) 44000 KD
 (b) 44 KD
 (c) 4.4 KD
 (d) 0.44 KD
20. Name the way to visualize dihedral angles ϕ against ψ of amino acid residues in protein structure
- (a) Ramachandran plot
 (b) Hydropathy plot
 (c) Zimmermann-Simha plot
 (d) Lineweaver-Burke plot

21. Snakes wave their forked tongue in the air
- (a) to keep the tongue dry
 - (b) to take suspended aerobes
 - (c) to take olfactory samples from the air
 - (d) to grasp food
22. The retina in the human eye is a part of
- (a) peripheral nervous system
 - (b) central nervous system
 - (c) optic nerve
 - (d) ganglionic layer
23. Which of the following is true for human tears?
- (a) Tears have no proteins
 - (b) Tears contain immunoglobulin E
 - (c) Tears contain immunoglobulin A
 - (d) Tears have no anti-pathogenic properties
24. Secondary antibody response is mediated by
- (a) memory B cells
 - (b) plasma B cells
 - (c) helper T cells
 - (d) natural killer cells
25. Mitotic spindle fiber is mainly composed of
- (a) actin
 - (b) myosin
 - (c) tubulin
 - (d) myoglobin

26. Microtubule is involved in
- (a) muscle contraction
 - (b) intracellular trafficking
 - (c) cell division
 - (d) mitochondrial structure
27. In eukaryotic cell, DNA replication takes place during
- (a) S phase
 - (b) G_1 phase
 - (c) G_2 phase
 - (d) M phase
28. ATP is a
- (a) deoxyribonucleotide
 - (b) ribonucleotide
 - (c) nucleic acid
 - (d) ribonucleoside
29. Photosynthesis is a process of converting
- (a) heat energy into chemical energy
 - (b) light energy into heat energy
 - (c) electromagnetic energy into chemical energy
 - (d) light energy into mechanical energy
30. A tiny droplet of water (volume one microliter) may contain
- (a) less than a trillion water molecules
 - (b) between 10^1 – 10^3 trillion water molecules
 - (c) between 10^3 – 10^6 trillion water molecules
 - (d) between 10^6 – 10^9 trillion water molecules

PART—B

Answer *any* **seventy** questions

31. Molality of a solution implies the presence of number of moles
- (a) per kilogram of solvent
 - (b) per kilogram of solution
 - (c) per liter of solution
 - (d) per liter of solvent
32. You are in a trip to desert areas. Which kinds of plants will you see mostly?
- I. Fleshy green stem with spines
 - II. Vivipary germination and pneumatophore roots
 - III. Small stem, leathery leaves and extended root system
 - IV. Big trees with bright and tender leaves
- (a) I and II
 - (b) I and III
 - (c) II and III
 - (d) II and IV
33. Echolocation is
- (a) the study of a specific population of organisms in a given ecological niche
 - (b) the process by which migratory birds locate the landing area
 - (c) the system of understanding ores in mining area
 - (d) the process by which bats know their path while flying at night
34. Choose the one that shows proper hierarchy
- (a) Tissue → Organism → Organ
 - (b) Population → Community → Ecosystem
 - (c) Organism → Biosphere → Ecosystem
 - (d) Population → Biosphere → Ecosystem
35. Limnetic zone of an aquatic habitat indicates
- (a) shallow and muddy water in coastal area
 - (b) an open water system away from coastal area
 - (c) a zone where light does not reach
 - (d) a zone up to which light can penetrate

36. If the incidence of sickle-cell anemia (a recessive trait) in a population is 0.09, what is the frequency of the gene for the trait?
- (a) 0.09
 - (b) 0.3
 - (c) 0.91
 - (d) 0.0081
37. The basic structure of the 5'-cap of the eukaryotic mRNA is
- (a) 5'm7GpppA
 - (b) 5'm7GppA
 - (c) 5'pppm7GpA
 - (d) 5'ppm7GpA
38. Holliday junction is used to explain which of the following pathways?
- (a) Homologous recombination
 - (b) Non-homologous recombination
 - (c) Single-strand break repair
 - (d) Mismatch repair
39. 5S rRNA is transcribed by
- (a) RNA polymerase I
 - (b) RNA polymerase II
 - (c) RNA polymerase III
 - (d) RNA polymerase V
40. Which of the following diseases occurs due to chromosomal non-disjunction during meiosis?
- (a) Huntington disease
 - (b) Down syndrome
 - (c) Prader-Willi syndrome
 - (d) Xeroderma pigmentosum
41. Generally deleterious effects caused by inbreeding are due to
- (a) an increase in genetic variability that disrupts developmental sequences
 - (b) an increase in homozygosity of recessive deleterious alleles
 - (c) an increase in allozygosity of all alleles
 - (d) an increase in the mutation rate

42. In the polytene chromosome of *Drosophila melanogaster*, the bands and the puffs respectively represent
- (a) gene regions and gene expression
 - (b) heterochromatin and euchromatin
 - (c) AT-rich DNA and GC-rich DNA
 - (d) B-DNA and Z-DNA
43. Dosage compensation of the X chromosome in fruit flies occurs by
- (a) the formation of Barr bodies in females
 - (b) the formation of Barr bodies in males
 - (c) hyperactivity of the X chromosome in males
 - (d) reduced activity of the autosomes in males
44. Genetic material of bacteriophage M13 is composed of
- (a) single-stranded RNA
 - (b) single-stranded DNA
 - (c) double-stranded RNA
 - (d) double-stranded DNA
45. Which statement best describes the process of crossing-over?
- (a) It takes place between homologous chromosomes and results in new gene combinations
 - (b) It takes place between homologous chromosomes and results in an increased gene mutation rate
 - (c) It takes place between non-homologous chromosomes and results in an increased gene mutation rate
 - (d) It takes place between non-homologous chromosomes and results in new gene combinations
46. Identify the process that does **not** directly contribute to high-fidelity DNA replication in *E. coli*
- (a) Correct pairing of the nucleotide with its complementary base in the template strand
 - (b) Removal of an incorrect nucleotide at the 3' terminus of the growing chain by the 3'-to-5' proofreading exonuclease activity of the polymerase
 - (c) A conformational change by the polymerase, which introduces a delay that allows an incorrectly bound nucleotide additional time to dissociate before it is added to the growing chain
 - (d) Unwinding of duplex DNA ahead of the replicating fork and removal of the torsional stress

47. From a stretch of DNA having 12 base pairs of nucleotides, what is the maximum number of amino acids it can code for?
- (a) 4
 - (b) 8
 - (c) 20
 - (d) 12^3
48. Which of the following enzymes is primarily involved in replicative DNA synthesis in prokaryotes?
- (a) DNA polymerase I
 - (b) DNA polymerase III
 - (c) DNA polymerase IV
 - (d) DNA polymerase II
49. The ratio of number of RNA molecules present in large and small subunits of human ribosome is
- (a) 1 : 1
 - (b) 1 : 3
 - (c) 3 : 1
 - (d) 2 : 1
50. Which of the following statements regarding chromosomal DNA replication in a cell is correct?
- (a) Half of the newly synthesized DNA at every cell division are made of Okazaki fragments
 - (b) All newly synthesized DNA are made of Okazaki fragments
 - (c) One-fourth of the newly synthesized DNA are made of Okazaki fragments
 - (d) The extent of newly synthesized DNA by Okazaki fragments cannot be estimated
51. Abhishek has constructed a transcriptional fusion between the Trp operon and GFP during his summer project. Under which of the following situations will GFP be expressed?
- (a) When tryptophan is present in the medium
 - (b) Only when tryptophan is absent in the medium
 - (c) Constitutively expressed
 - (d) When tryptophan and phenylalanine are present in the medium

52. In an experiment, 5.94 μg of a 3 kb circular plasmid DNA in 10 μl was completely cleaved at three BamHI sites to produce three equal size DNA fragments. What is the number of initial picomoles of the DNA and the number of picomoles for each of the DNA fragments produced after cleavage?
- (a) 3 and 1
 - (b) 1 and 0.3
 - (c) 3 and 3
 - (d) 1.5 and 1.5
53. Conventional light microscope **cannot** resolve the structure of
- (a) mitochondria
 - (b) nucleus
 - (c) bacteria
 - (d) ribosome
54. Which one of the following statements regarding HIV is **not** true?
- (a) It belongs to the family Retroviridae
 - (b) It is an oncovirus
 - (c) It contains the enzyme reverse transcriptase
 - (d) The virus is present in body fluids
55. Which one of the following statements does **not** hold true of a viroid?
- (a) Viroid affects mostly plants
 - (b) RNA of viroid is circular
 - (c) Viroid possesses about 300–400 nucleotides
 - (d) Viroid encodes RNA-dependent RNA polymerase for replication
56. A bacterial cell that is mostly haploid, but is diploid for some regions of the genome is termed as
- (a) heterodiploid
 - (b) merodiploid
 - (c) pseudodiploid
 - (d) half-diploid

57. Penicillium spores are
- (a) multinucleated and pigmented
 - (b) uninucleated and colourless
 - (c) uninucleated and pigmented
 - (d) multinucleated and colourless
58. Most of the lichens consist of
- (a) green algae and basidiomycetes
 - (b) brown algae and ascomycetes
 - (c) mycorrhizae and plants
 - (d) green algae and ascomycetes
59. Organisms which have spore-forming stage in their life cycle, completely parasite, cell shape is marinated by pellicle and lack special locomotory organelles belong to which phylum of Protozoa?
- (a) Sarcomastigophora
 - (b) Apicomplexa
 - (c) Myxozoa
 - (d) Ciliophora
60. Clamp connections are observed in
- (a) ascomycetes
 - (b) oomycetes
 - (c) basidiomycetes
 - (d) zygomycetes
61. Kingdom of Protista includes
- (a) all unicellular and colonizing eukaryotes and photosynthesizing algae
 - (b) all unicellular and colonizing eukaryotes except some algae and budding yeast
 - (c) all prokaryotes having both sexual and asexual reproduction
 - (d) multicellular eukaryotes and some unicellular algae and budding yeast
62. Science of olericulture deals with
- (a) cultivation of oilseed crops
 - (b) cultivation of cereal crops
 - (c) cultivation of vegetables
 - (d) cultivation of endangered plants

63. Vernacular name is synonym of
- (a) common name
 - (b) genus name
 - (c) species name
 - (d) cultivable variety name
64. The main difference between cereals and millets is
- (a) cereals grow in irrigated land and millets are grown as rain-fed crop
 - (b) cereals are high source of carbohydrate and millets are rich source of protein
 - (c) cereal grains are bigger in size compared to the millet grains
 - (d) while cereals are good for baking, millets are good for making edible powders
65. The plant hormone that primarily involved in promoting cell division is
- (a) auxin
 - (b) cytokinin
 - (c) gibberellin
 - (d) ethylene
66. Cases in which the pollination occurs without opening of flower are called
- (a) protandry
 - (b) chasmogamy
 - (c) cleistogamy
 - (d) adventive embryony
67. Aleurone is the
- (a) inner integument of ovule
 - (b) outer membrane layer of pollen grain
 - (c) outer membrane layer of endosperm
 - (d) allergen present in many tree flowers
68. Which one is **not** correct?
- Meiosis takes place in
- (a) sporophyte
 - (b) gametophyte
 - (c) pollen mother cell
 - (d) megasporophyll

69. In C_4 photosynthesis pathway, the initial CO_2 fixation takes place in the chloroplasts of
- (a) guard cells
 - (b) mesophyll cells
 - (c) bundle sheath cells
 - (d) epithelial cells
70. What is raphide?
- (a) Polymer of carbon
 - (b) Ore rich in phosphorus
 - (c) Seaweed
 - (d) Calcium oxalate/carbonate deposit in some plant cells
71. Cryptochrome is the pigment that absorbs
- (a) red light
 - (b) green light
 - (c) blue light
 - (d) far red light
72. 'Assimilation of minerals' in plants correctly represents the process
- (a) of simple organic molecules getting incorporated into complex organic molecules
 - (b) of reduction of minerals to be a part of structural components
 - (c) of oxidation of minerals to be a part of structural components
 - (d) in which inorganic molecules become organic molecules
73. Stem grafting in monocot plants fails due to the
- (a) lack of vascular cambium
 - (b) presence of parallel venation
 - (c) lack of pith
 - (d) thick epidermal layer
74. Collenchyma cells are
- (a) living and anucleated
 - (b) living and contain nucleus
 - (c) dead cells filled with reserve food
 - (d) dead cells with high level of lignification in the cell wall

75. Oxygen transport to the tissues in insects occurs through
- (a) open circulatory system
 - (b) closed circulatory system
 - (c) tracheal system
 - (d) arteries and capillaries
76. Uricotelic animals excrete nitrogenous waste in the form of
- (a) urea
 - (b) uric acid
 - (c) ammonia
 - (d) urine
77. Body temperature regulatory centre is located in
- (a) cortex
 - (b) cerebellum
 - (c) thalamus
 - (d) hypothalamus
78. Which of the following is in proper order with respect to blood coagulation?
- (a) Fibrin → Fibrinogen → Fibrin clot
 - (b) Prothrombin → Thrombin → Fibrin → Fibrinogen → Fibrin clot
 - (c) Fibrinogen → Fibrin → Fibrin clot
 - (d) Fibrinogen → Prothrombin → Thrombin → Fibrin → Fibrin clot
79. The 'Bundle of His' in the mammalian heart connects
- (a) S-A node to the A-V node
 - (b) A-V node to the Purkinje fibers
 - (c) S-A node to the inter-nodal pathways
 - (d) A-V node to the A-V bundle
80. Which of the following statements about immunity is correct?
- (a) Passive immunity results from acquiring antibodies from someone else
 - (b) Passive immunity results from a vaccination
 - (c) Active immunity occurs when a mother's antibodies cross the placenta
 - (d) Active immunity comes from injecting antibodies developed in a horse

81. The antigen-binding specificity of an antibody is due to
- (a) constant regions of the light chains
 - (b) variable framework regions of the heavy and light chains
 - (c) variable regions of the heavy chains
 - (d) hypervariable regions of both heavy and light chains
82. Of the cell types listed below, which are 'professional phagocytes'?
- (a) Erythrocytes and platelets
 - (b) T cells and B cells
 - (c) Neutrophils and macrophages
 - (d) Endothelial cells and epithelial cells
83. Antibodies are
- (a) cross-linked oligosaccharides of heavy and light chains
 - (b) constant and variable regions of polyglycogen stretch
 - (c) cross-linked fatty acyl esters
 - (d) combinations of polypeptide chains of different lengths
84. In the inflammatory response, the absence of which of the following would prevent all the others from happening?
- (a) Dilation of arterioles
 - (b) Increased permeability of blood vessels
 - (c) Release of histamine
 - (d) Leakage of plasma to the affected area
85. One principal function of complement is to
- (a) mediate the release of histamine
 - (b) bind antibodies attached to cell surfaces and to lyse these cells
 - (c) phagocytize antigens
 - (d) cross-link allergens
86. During ELISA, often secondary antibody linked to reporter enzyme is used. What is the special advantage of having secondary antibody?
- (a) Primary antibody cannot be linked to reporter enzyme
 - (b) Same secondary antibody stock can be used against multiple primary antibodies
 - (c) Using secondary antibody reduces background noise
 - (d) Raising secondary antibody in lab is easier compared to primary antibody

87. Proto-oncogenes are
- (a) oncogenes found in transforming retroviruses
 - (b) oncogenes present in Protozoa
 - (c) genes encoding oncogene-related proteins in extinct organisms
 - (d) cellular genes encoding proteins related to viral oncogenes
88. Centrioles divide during
- (a) interphase
 - (b) prophase
 - (c) prometaphase
 - (d) metaphase
89. Collagen is the most abundant fibrous protein of the extracellular matrix in animal tissues. It contains three long polypeptide chains, where every third amino acid is a/an
- (a) hydroxyproline
 - (b) glycine
 - (c) alanine
 - (d) proline
90. Berthold's experiment demonstrates
- (a) endocrine action
 - (b) exocrine action
 - (c) paracrine action
 - (d) autocrine action
91. Which of the following hormones can affect physiological cell signaling in the mammalian heart?
- (a) Erythropoietin
 - (b) Cardiolipin
 - (c) Renin-angiotensin
 - (d) Melanin
92. The mammalian blood cells are prevented from sticking to one another or to the walls of blood vessels, due to the presence of — in their plasma membranes.
- (a) glycolipid
 - (b) glycocalyx
 - (c) cholesterol
 - (d) phospholipid

93. The strong support provided by bones in vertebrates or woods in tree plants is due to the
- (a) cell wall
 - (b) extracellular matrix present in these tissues
 - (c) cytoskeleton structure
 - (d) unique assembly of constituent cells
94. Which of the following in animal system is equivalent to plant plasmodesmata?
- (a) Gap junction
 - (b) Tight junction
 - (c) Adheren junction
 - (d) Synaptic junction
95. What mediates the transport between endoplasmic reticulum, Golgi apparatus and apoplast?
- (a) Vesicle
 - (b) Cytosol
 - (c) Lysosome
 - (d) Vacuole
96. Which amongst the following statements is correct?
- (a) Both creatine phosphate and glucose-6-phosphate are low-energy compounds
 - (b) Creatine phosphate is a low-energy compound while glucose-6-phosphate is a high-energy compound
 - (c) Both creatine phosphate and glucose-6-phosphate are high-energy compounds
 - (d) Creatine phosphate is a high-energy compound while glucose-6-phosphate is a low-energy compound
97. With increasing concentration of substrate, rate of enzymatic reaction increases (when enzyme is in abundance), because the increased substrate
- (a) helps reducing the activation energy
 - (b) shifts the free energy value to more negative
 - (c) occupies active sites of more enzyme molecules
 - (d) helps increasing the activation energy

98. Phosphoglucomutase converts glucose-1-phosphate to glucose-6-phosphate. At equilibrium, the concentration of glucose-1-phosphate is $4.5 \times 10^{-3} M$ and concentration of glucose-6-phosphate is $9.6 \times 10^{-2} M$. Calculate the K_{eq} of this reaction
- (a) $\ln 21$
 - (b) $\log 21$
 - (c) -21
 - (d) 21
99. Some of the enzymes responsible for converting lipids into carbohydrates are located in
- (a) mitochondria
 - (b) plastids
 - (c) glyoxysomes
 - (d) liposomes
100. Which of the following is reducing sugar?
- (a) Galactose
 - (b) Sucrose
 - (c) Starch
 - (d) Gluconic acid
101. Carbohydrates in the glycoproteins are associated by
- (a) hydrophobic interaction
 - (b) covalent bond
 - (c) hydrogen bond
 - (d) van der Waals force
102. Living organisms obtain energy from food by stepwise
- (a) hydrolysis
 - (b) oxidation
 - (c) reduction
 - (d) synthesis
103. Most disordered form of energy is
- (a) heat energy
 - (b) light energy
 - (c) chemical energy
 - (d) gravitational energy

104. Glycolysis is the name given to the pathway involving the conversion of
- (a) glucose to glucose-6-phosphate
 - (b) glucose to fructose-6-phosphate
 - (c) glycogen to glucose
 - (d) glucose to pyruvate or lactate
105. Bond angles for a trigonal bipyramid molecule are
- (a) 180° , 120°
 - (b) 120° , 109°
 - (c) 90° , 120°
 - (d) 120° , 90°
106. Which of the following amino acids has the highest propensity to form the bends of β -turns in a polypeptide sequence?
- (a) Ile
 - (b) Met
 - (c) Pro
 - (d) Gly
107. The magnetic field lines due to a straight wire carrying current are
- (a) straight
 - (b) circular
 - (c) parabolic
 - (d) elliptical
108. Dry air at sea level has 75.5% N_2 , 23.2% O_2 and 1.3% Ar. The mole fraction of Ar in dry air is
- (a) 1.3
 - (b) 0.13
 - (c) 0.09
 - (d) 0.009
109. Which of the following statements is **incorrect** with reference to the Joule-Thomson coefficient?
- (a) It refers to the fall in temperature as a result of fall in pressure
 - (b) It deals with processes that involve constant enthalpy
 - (c) It refers to adiabatic expansion of gases
 - (d) It is always negative for real gases at normal temperature and pressure

110. The rate of a reaction increased 10-fold upon increasing the reaction temperature from 300 K to 350 K. The activation energy for the reaction is approximately
- (a) 40 kJ mol⁻¹
 - (b) 17 kJ mol⁻¹
 - (c) 2 kJ mol⁻¹
 - (d) 1 kJ mol⁻¹
111. The most probable velocity of a gas at a given temperature is the
- (a) maximum velocity that the molecules of the gas are likely to attain
 - (b) average velocity of the molecules of the gas
 - (c) velocity that the molecules of the gas are most likely to have
 - (d) velocity that the maximum number of molecules of the gas possess
112. In any close-packed arrangement, the number of nearest neighbours for each atom is
- (a) 4
 - (b) 6
 - (c) 8
 - (d) 12
113. The structure of SF₆ molecule can be described by the following hybridization
- (a) sp³d²
 - (b) sp³d³
 - (c) sp³d
 - (d) dsp²
114. Which one of the following substitutions is likely to be of the highest fraction when toluene undergoes nitration?
- (a) Ortho
 - (b) Meta
 - (c) Para
 - (d) Ortho and para
115. Hofmann reaction involving acetamide and alkaline hypobromite results in formation of
- (a) acetic acid
 - (b) acetic anhydride
 - (c) methanol
 - (d) methylamine

116. How many kinds of magnetically equivalent protons are there in $\text{C}_6\text{H}_5\text{NO}_2$?
- (a) 1
 - (b) 2
 - (c) 3
 - (d) 4
117. What is the bond order of NO?
- (a) 2
 - (b) 2.5
 - (c) 3
 - (d) 3.5
118. The formation of ethyl acetate from ethanol and acetic acid at 25°C has an equilibrium constant (K_{eq}) of approximately 1.0. This implies that
- (a) when ethanol and acetic acid are mixed together, then 50% of this would be converted to product
 - (b) when ethanol, acetic acid, ethyl acetate and water are mixed together, then they would be in equilibrium with one another
 - (c) when ethanol and acetic acid are mixed together in molar ratio, then 50% of this would be converted to product
 - (d) when ethanol, acetic acid, ethyl acetate and water are mixed together in molar ratio, then they would be in equilibrium with one another
119. A quantum particle in a box is in the lowest energy (ground) state. If the size of the box is increased, the wavelength and energy of the particle change as
- (a) wavelength shorter, energy larger
 - (b) wavelength longer, energy smaller
 - (c) wavelength shorter, energy smaller
 - (d) wavelength longer, energy larger
120. Experiments have shown that a dark-adapted eye can detect a 0.001 sec duration flash of green light at a power level of only 4×10^{-14} watt. A green photon has 2.5 eV of energy ($1 \text{ eV} = 1.6 \times 10^{-19}$ joule). How many photons are there?
- (a) 40000
 - (b) 4000
 - (c) 10000
 - (d) 100

121. Approximating the potential energy for a covalent bond is to treat it as spring. What is the physical law to describe the bond energy?
- (a) Young's law
 - (b) Hooke's law
 - (c) Coulomb's law
 - (d) Newton's law
122. One mole of helium gas is mixed with 2 moles of neon gas. The total pressure is 2 atm. What are the partial pressures of the gasses?
- (a) 1 atm and 2 atm
 - (b) 2 atm and 1 atm
 - (c) $\frac{1}{2}$ atm and $\frac{4}{3}$ atm
 - (d) $\frac{2}{3}$ atm and $\frac{4}{3}$ atm
123. A fossil bone has a $^{14}\text{C} : ^{12}\text{C}$ ratio that is $\frac{1}{4}$ of the $^{14}\text{C} : ^{12}\text{C}$ ratio in the bone of a living animal. What is the approximate age of the fossil? (Half-life of ^{14}C is 5730 years)
- (a) 11460 years
 - (b) 17190 years
 - (c) 22920 years
 - (d) 45840 years
124. Beginning at time = 0, a constant vertical force is continually applied to a rocket by its engines so that it moves upward. Which of the following statements best describes the rocket's motion?
- (a) Its speed increases, then it is constant after a short time
 - (b) Its acceleration increases proportional to time
 - (c) Its speed increases proportional to time
 - (d) Its acceleration is equal to the acceleration of gravity
125. Cell mass determined at different time points was 1.5 ($t = 0$), 3.0 ($t = T_d$), 6 ($t = 2T_d$), 12 ($t = 3T_d$). What is the shape of the curve that best describes the data point?
- (a) Linear
 - (b) Parabolic
 - (c) Exponential
 - (d) Power law

126. A uniform meter scale balances at 40 cm, when one 50 g and one 10 g are placed on 10 cm and 90 cm mark respectively. What is the weight of the scale?
- (a) 50 g
 - (b) 100 g
 - (c) 70 g
 - (d) 90 g
127. Fill up the gap to maintain the series 0, 0, 3, 20, 115, —, 5033
- (a) 714
 - (b) 2300
 - (c) 400
 - (d) 3200
128. When Cartesian coordinates (x, y, z) are transformed into spherical coordinates (r, θ, ϕ) , then the following correctly represents the relation between the two sets of coordinates
- (a) $x = r \sin \theta \cos \phi$; $y = r \sin \theta \sin \phi$; $z = r \cos \theta$
 - (b) $x = r \sin \theta \sin \phi$; $y = r \sin \theta \sin \phi$; $z = r \cos \theta$
 - (c) $x = r \sin \phi \cos \phi$; $y = r \sin \theta \sin \phi$; $z = r \cos \theta$
 - (d) $x = r \sin \theta \cos \phi$; $y = r \sin \theta \sin \phi$; $z = r \sin \theta$
129. If $A = 2i - j + 3k$ and $B = -i + 2j - k$, then the length of the vector $A + B$ is
- (a) 2
 - (b) $\sqrt{6}$
 - (c) 4
 - (d) 6
130. Given a pair of simultaneous linear equations $a_{11}x + a_{12}y = b$ and $a_{21}x + a_{22}y = b$, we would say that the two equations are
- (a) equivalent
 - (b) homogenous
 - (c) non-homogenous
 - (d) incongruent
