

116

QUESTION PAPER  
SERIES CODE

D

Registration No. :

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Centre of Exam. :

Name of Candidate :

Signature of Invigilator

## COMBINED ENTRANCE EXAMINATION, 2017

M.Sc. BIOTECHNOLOGY

[ Field of Study Code : BIT ]

Time Allowed : 3 hours

Maximum Marks : 240

## INSTRUCTIONS FOR CANDIDATES

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

- (i) Write your Name and Registration Number in the space provided for the purpose on the top of this Question Paper and in the Answer Sheet.
- (ii) **Please darken the appropriate Circle of Question Paper Series Code on the Answer Sheet.**
- (iii) The Question Paper is divided into two Parts : Part—A and Part—B. Both Parts have multiple-choice questions. All answers are to be entered in the Answer Sheet provided with the Question Paper for the purpose by darkening the correct choice, i.e., (a) or (b) or (c) or (d) with BLUE/BLACK BALLPOINT PEN only against each question in the corresponding circle.
- (iv) Part—A consists of 60 questions and all are compulsory. Answer all the questions in the Answer Sheet provided for the purpose. Each correct answer carries 1 mark. **There will be negative marking and  $\frac{1}{4}$  mark will be deducted for each wrong answer.**
- (v) Part—B consists of 100 questions consisting Biological and Physical Sciences. **Answer any 60 questions.** Each correct answer carries 3 marks. **There will be negative marking and 1 mark will be deducted for each wrong answer.**  
In case any candidate answers more than the required 60 questions, the first 60 questions attempted will be evaluated.
- (vi) Answer written by the candidates inside the Question Paper will not be evaluated.
- (vii) Calculators and Log Tables may be used.
- (viii) Pages at the end have been provided for Rough Work.
- (ix) Return the Question Paper and Answer Sheet to the Invigilator at the end of the Entrance Examination. **DO NOT FOLD THE ANSWER SHEET.**

## INSTRUCTIONS FOR MARKING ANSWERS

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

Wrong	Wrong	Wrong	Wrong	Correct
<input type="radio"/> (b) <input type="radio"/> (c) <input type="radio"/> (d)	<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"/> (d)	<input type="radio"/> (a) <input checked="" type="radio"/> (b) <input 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. The value of  $2+2$  in binary notation is
  - (a) 10
  - (b) 100
  - (c) 1000
  - (d) 10000
2. Which of the following is necessary and sufficient for obtaining a single real solution of the quadratic equation,  $ax^2 + bx + c = 0$ ?
  - (a)  $b^2 > 4ac$
  - (b)  $b^2 < 4ac$
  - (c)  $b^2 = 4ac$
  - (d)  $b^2 = 0$
3. Evaluate the definite integral  $\int_0^1 xe^x dx$ .
  - (a) 0
  - (b) 1
  - (c)  $xe^x - e^x$
  - (d)  $\pi$
4. If for a  $3 \times 3$  matrix  $A$ , we have  $A^T = A^{-1}$ , then which of the following statements is true?
  - (a) The dot product of the vector obtained from the cross-product of any two column vectors of  $A$  and the third column vector (also normalized to unit length) of  $A$  is unity.
  - (b) The dot product of the vector obtained from the cross-product of any two column vectors of  $A$  (normalized to unit length) and the third column vector of  $A$  (also normalized to unit length) is zero.
  - (c) The dot product of any two column vectors of  $A$  (normalized to unit length) is unity.
  - (d) The cross-product of any two column vectors of  $A$  (normalized to unit length) does not exist.
5. If for any two random events  $A$  and  $B$ , the probability of their occurrence is given by  $P(A)$  and  $P(B)$ , then which of the following statements is true?
  - (a)  $P(A) = P(A \cap B) + P(A \cap \bar{B})$
  - (b)  $P(B) = P(A \cap B) + P(A \cap \bar{B})$
  - (c)  $P(A) = P(A \cup B) + P(A \cup \bar{B})$
  - (d)  $P(B) = P(A \cup B) + P(A \cup \bar{B})$

6. A student takes exams in Mathematics, Physics and Chemistry. Of these, the student has a 75% chance of passing in at least one subject, a 50% chance of passing in at least two subjects and a 40% chance of passing in exactly two subjects. What is the chance that the student passes in all three subjects?
- 0%
  - 10%
  - 20%
  - 30%
7. Let  $x + y - z + 4 = 0$  and  $x + y - z + 5 = 0$  be two parallel planes. What is the distance between them?
- $1/\sqrt{3}$
  - $\sqrt{3}$
  - $4/5$
  - $4/\sqrt{5}$
8. If  $\theta$  is an obtuse angle, which one among the following statements is true?
- $\cos \theta < 0$
  - $\sin \theta < 0$
  - $\tan \theta > 0$
  - $\sec \theta < 0$
9. If  $\vec{a}$  and  $\vec{b}$  are two vectors of equal magnitude, such that the angle between them is  $60^\circ$ , and  $\vec{a} \cdot \vec{b} = 8$ . Find the length  $|\vec{a}|$ .
- 2
  - 4
  - 6
  - 8
10. For given two vectors  $\vec{a}$  and  $\vec{b}$ , which of the following statements is **not** true?
- $|\vec{a} + \vec{b}| = \sqrt{|\vec{a}|^2 + |\vec{b}|^2 + 2|\vec{a}||\vec{b}|}$
  - $|\vec{a} - \vec{b}| = \sqrt{|\vec{a}|^2 + |\vec{b}|^2 - 2|\vec{a}||\vec{b}|}$
  - $|\vec{a} + \vec{b}| = \sqrt{|\vec{a}|^2 - |\vec{b}|^2 + 2|\vec{a}||\vec{b}|}$
  - $(\vec{a} + \vec{b}) \cdot (\vec{a} - \vec{b}) = |\vec{a}|^2 - |\vec{b}|^2$

11. A haemocytometer is used to count cells in a culture. This is done by counting the number of cells in each individual square of the haemocytometer. These numbers vary between different squares and can be treated a part of which of the following distributions?
- Normal distribution
  - Binomial distribution
  - Poisson distribution
  - Hypergeometric distribution
12. If you are trying to test for a possible association between hair color (Black, Brown, Blonde) and eye color (Blue, Black, Green), which of the following statistical tests will you use?
- $t$ -test
  - $\chi^2$ -test
  - $F$ -test
  - ANOVA
13. A square matrix with real number entries is added to its transpose. Which of the following will the resultant matrix be?
- Real symmetric matrix
  - Skew-symmetric matrix
  - Hermitian matrix
  - Skew-Hermitian matrix
14. Consider the binary operations  $*$ :  $R \times R \rightarrow R$  and  $\circ$ :  $R \times R \rightarrow R$  defined as  $a * b = |a - b|$  and  $a \circ b = a$  for all  $a, b \in R$ . Which of the following statements is **not** true?
- $*$  is commutative but not associative.
  - $\circ$  is associative but not commutative.
  - $*$  is distributive over  $\circ$ .
  - $\circ$  is distributive over  $*$ .
15. The number of electrons that has to be removed from electrically neutral platinum plate to give it a charge of  $+2.4$  C is (charge of single electron =  $1.6 \times 10^{-19}$  C)
- $1.5 \times 10^{19}$
  - $2.0 \times 10^{19}$
  - $1.5 \times 10^6$
  - $2.0 \times 10^6$

16. A body having a mass of  $M$  starts from rest at the point  $x = 0$ . It accelerates by  $-t^2 + 4t$ . The maximum distance that is covered by the body in the +ve  $x$  direction before moving backwards in the -ve direction is
- $9/4$
  - $9M/4$
  - $2/3$
  - $2M/3$
17. A steel wire having the mass of  $4.0 \times 10^{-3}$  kg and length 0.2 m is put under the tension of 8 N. What will be the speed of transverse waves on the wire?
- $20 \text{ ms}^{-1}$
  - $10 \text{ ms}^{-1}$
  - $5 \text{ ms}^{-1}$
  - $3 \text{ ms}^{-1}$
18. A metallic block weighing 300 gm was placed in the boiling water to raise the temperature to  $100^\circ\text{C}$ . It is then immediately transferred to thermally non-conducting vessel containing 2.2 kg water at  $22^\circ\text{C}$ . If the temperature of the water is raised by  $12^\circ\text{C}$ , calculate the specific heat of the metal.
- $13.33 \text{ kJ kg}^{-1} \text{ K}^{-1}$
  - $13.33 \text{ kJ g}^{-1} \text{ K}^{-1}$
  - $1.33 \text{ kJ kg}^{-1} \text{ K}^{-1}$
  - $1.33 \text{ kJ g}^{-1} \text{ K}^{-1}$
19. A 4 kg collar is attached to a spring of spring constant  $200 \text{ Nm}^{-1}$  on a frictionless horizontal rod. If the collar is displaced from its equilibrium position by 10 cm, what will be the period of oscillation?
- $8.88 \text{ ms}^{-1}$
  - $0.888 \text{ ms}^{-1}$
  - $88.8 \text{ ms}^{-1}$
  - $888.0 \text{ ms}^{-1}$
20. Which of the following is the correct order of basic forces in decreasing strength?
- Strong, Electromagnetic, Weak, Gravitational
  - Electromagnetic, Strong, Weak, Gravitational
  - Strong, Weak, Gravitational, Electromagnetic
  - Weak, Gravitational, Strong, Electromagnetic

21. Which one of the following is **not** correct about Newton's second law of motion?
- (a) It holds good only in inertial frame of reference.
  - (b) It gives a measure of force as the rate of change of momentum.
  - (c) It cannot describe the motion of particles with relativistic velocities.
  - (d) It can describe the motion of a snowflake as it falls to the ground.
22. A ball attains a height of  $h$ , if thrown upward with some initial speed. If the ball is thrown upward by the double of that initial speed, what new maximum height will the ball reach?
- (a)  $2h$
  - (b)  $4h$
  - (c)  $6h$
  - (d)  $8h$
23. What will be the change in entropy of a gas if it expands adiabatically and reversibly?
- (a) It will increase infinitely.
  - (b) It will increase but remain finite.
  - (c) It will decrease.
  - (d) There will be no change.
24. The internal energy of an ideal gas depends upon which of the following?
- (a) Temperature only
  - (b) Temperature and pressure
  - (c) Volume only
  - (d) Volume and temperature

25. Which of the following is **not** correct about the work done by a conservative force?
- (a) The total work done is path-independent.
  - (b) For a cyclic path, the total work done is zero.
  - (c) Force is independent of velocity.
  - (d) The total work done is irreversible.
26. In an explosion, an object of mass  $M$  that was initially at rest splits into two pieces of unequal mass ( $m_1 > m_2$ ). Which of the following is correct?
- (a)  $m_1$  will have greater momentum than  $m_2$ .
  - (b)  $m_1$  will have greater kinetic energy than  $m_2$ .
  - (c)  $m_1$  will have less kinetic energy than  $m_2$ .
  - (d) Both pieces will have the same kinetic energy.
27. A certain volume of a gas at pressure  $P_0$  was compressed to  $1/8$  times its volume. The pressure exerted by the compressed gas will be given by which of the following?
- (a)  $2P_0$
  - (b)  $4P_0$
  - (c)  $8P_0$
  - (d)  $16P_0$
28. In quantum mechanics, which of the following statements is **not always** a characteristic of the 1-D particle wavefunction  $\psi(x)$ ?
- (a)  $|\psi(x)|^2$  is a probability density
  - (b)  $\int_{-\infty}^{+\infty} |\psi(x)|^2 dx = 1$
  - (c)  $\psi(x)$  is a solution of the 1-D stationary Schrödinger equation :  $H\psi(x) = E\psi(x)$ , where  $H$  is the Hamiltonian operator
  - (d) The energy  $E$ , obtained from the Schrödinger equation, belongs to a set of discrete values
29. Which principle or law states that each point on a wavefront may be considered a new wave source?
- (a) Snell's law
  - (b) Fraunhofer principle
  - (c) Huygens' principle
  - (d) There is no such law. The statement above is incorrect.



30. Blood stains are found at the site of a murder. If DNA fingerprinting technique is to be used for identifying the criminal, which of the following is ideal for use?
- (a) Erythrocytes
  - (b) Leucocytes
  - (c) Platelets
  - (d) Serum
31. With reference to the bacterial cell wall, which of the following statements is **correct**?
- (a) Gram +ve bacteria lacks peptidoglycan
  - (b) Gram -ve bacteria lacks peptidoglycan
  - (c) Both Gram +ve and Gram -ve bacteria possess peptidoglycan and the outer membrane
  - (d) Both Gram +ve and Gram -ve bacteria possess peptidoglycan but the Gram +ve bacteria lacks outer membrane
32. The protein complex involved in breakdown of water is
- (a) PS I complex
  - (b) cytochrome B6/f complex
  - (c) manganese stabilizing complex
  - (d) light harvesting complex
33. The isomerism which arises due to the differences in the arrangement of atoms and group in the space is called
- (a) tautomerism
  - (b) nuclear isomerism
  - (c) stereoisomerism
  - (d) metamerism
34. Which of the following techniques is used for quantification of mRNA?
- (a) Real-time PCR
  - (b) Western blotting
  - (c) Gradient PCR
  - (d) Nested PCR

35. Your laboratory has one large window. To find the focal length of a concave mirror, using one of the walls as the screen, the experiment may be performed.
- (a) Near the wall opposite the window
  - (b) On the same wall as the window
  - (c) On the wall adjacent to the window
  - (d) Only on the table as per the laboratory arrangement
36. The signal sensor of a two-component signal transduction system in bacteria is
- (a) histidine kinase
  - (b) serine kinase
  - (c) response regulator
  - (d) repressor
37. Codons that specify the same amino acid often differ in the
- (a) first base
  - (b) second base
  - (c) third base
  - (d) first and second bases
38. The process of using microbes and plants to break down or recycle environmental pollutants is called
- (a) therapeutics
  - (b) bioremediation
  - (c) amplification
  - (d) annealing
39. Statement (S) :
- The process of transpiration and gaseous exchange is regulated by opening and closing of stomata.
- Reason (R) :
- This is possible because the guard cells possess chloroplasts as well as thicker inner walls and thinner outer walls.
- (a) Both (S) and (R) are true. (R) is the correct explanation of (S).
  - (b) Both (S) and (R) are true. But, (R) is not the correct explanation of (S).
  - (c) (S) is true but (R) is false.
  - (d) (S) and (R) are both true, but there is no causal relationship.

40.  $C_4$  photosynthesis is an adaptation to hot, dry conditions in which
- (a)  $CO_2$  is fixed and stored in leaves
  - (b) water is stored in the stem
  - (c) oxygen is stored in the root
  - (d) light energy is stored in the chloroplast
41. It would be possible to develop transgenic plants tolerant to fungal pathogens using gene coding for
- (a) crystal protein (toxin) from *Bacillus thuringiensis*
  - (b) pectinase from *Phaseolus vulgaris*
  - (c) chitinase from *Trichoderma harzianum*
  - (d)  $\beta$ -galactosidase from *Escherichia coli*
42. Identify the correct order of electron transport seen during oxygenic photosynthesis.
- (a)  $Q_B$  to  $Q_A$  to PC
  - (b) Pheophytin to  $Q_A$  to  $Q_B$
  - (c)  $Q_A$  to  $Q_B$  to p680
  - (d) p700 to p680 to PQ pool
43. Phycobiliproteins are present in
- (a) *Rhodobacter*
  - (b) *Pseudomonas*
  - (c) *Xanthomonas*
  - (d) *Nostoc*
44. Which of the following molecules are associated with copper and magnesium respectively?
- (a) Plastocyanin and DNA polymerase
  - (b) Plastoquinone and chlorophyll
  - (c) Cytochrome and DNA polymerase
  - (d) PSI reaction centre protein and chlorophyll

45. When an aldehyde having no  $\alpha$  hydrogen is treated with NaOH solution, a molecule of sodium salt of a carboxylic acid and a molecule of primary alcohol are produced. This reaction is known as
- (a) Claisen condensation
  - (b) Cannizzaro reaction
  - (c) Reimer-Tiemann reaction
  - (d) Fischer synthesis
46. The bond between a fatty acid and glycerol moiety in a phospholipid is known as
- (a) amide bond
  - (b) ester bond
  - (c) hydrogen bond
  - (d) ionic bond
47. Which one of the following amino acids possesses a net charge at pH 7?
- (a) Aspartate
  - (b) Valine
  - (c) Leucine
  - (d) Proline
48. Which of the following is a correct statement of the Beer-Lambert law?
- (a) The absorbance of a compound in solution is directly proportional to both, its concentration and the path length of the cuvette.
  - (b) The absorbance of a compound in solution is directly proportional to its concentration and inversely proportional to the path length of the cuvette.
  - (c) The absorbance of a compound in solution is inversely proportional to its concentration and directly proportional to the path length of the cuvette.
  - (d) The absorbance of a compound in solution is inversely proportional to both, its concentration and the path length of the cuvette.
49. Which of the following substances cannot form hydrogen bond between them?
- (a) Water and glucose
  - (b) Water and octanol
  - (c) Water and octane
  - (d) Water and octylglucoside

50. The lustre of a metal is related to which of the following properties?
- (a) Density
  - (b) Electrical conductivity
  - (c) Chemical hardness
  - (d) Chemical inertness
51. Which of the following amino acids actually has a secondary amino group?
- (a) Lysine
  - (b) Proline
  - (c) Alanine
  - (d) Valine
52. The absorption peaks observed in an NMR spectroscopy experiment, are observed by subjecting the magnetized nucleus to which one of the following types of electromagnetic radiation?
- (a) X-rays
  - (b) Gamma rays
  - (c) Radio waves
  - (d) Infrared radiation
53. A 10 N HCl solution as diluted 100 fold with water and the pH of the diluted solution was measured by a pH meter after calibration with standard solutions. Given that the activity coefficient for diluted HCl solution was 0.01. What would be the pH of the solution?
- (a) 1
  - (b) 2
  - (c) 3
  - (d) 4
54. The UV spectrum of a peptide solution with the sequence Gly-Ser-Ala-Gly-Ser-Ala-Gly-Ser-Leu at pH 7.0 is likely to have a maximum near which of the following wavelengths?
- (a) 220 nm
  - (b) 260 nm
  - (c) 280 nm
  - (d) 560 nm

55. Water has a high dielectric constant of 80 in contrast with many non-polar solvents have very low dielectric constants. Due to this property, how would the strength of electrostatic interactions between various charged side chains of amino acids in proteins change after their transfer from a non-polar solvent to water?
- (a) Become stronger
  - (b) Become weaker
  - (c) Will not change
  - (d) May become stronger or weaker depending upon the particular interacting side chains
56. Which among the following statements about living systems is **not** correct?
- (a) They can grow and divide.
  - (b) They can evolve.
  - (c) They constitute a thermodynamically closed system.
  - (d) They can convert one form energy into another.
57. A sample of seawater (200 ml) from the Arabian Sea contains 8.2 g of NaCl. What is the molar concentration of NaCl in seawater?
- (a) 0.107 M
  - (b) 0.701 M
  - (c) 0.82 M
  - (d) 8.2 M
58. The paramagnetic nature of oxygen is best explained by which of the following?
- (a) Valence-bond theory
  - (b) Valance shell electron pair repulsion theory
  - (c) Molecular-orbital theory
  - (d) Crystal-field theory
59. Which of the following is obtained for the reaction of 1 mole calcium phosphide with excess water?
- (a) One mole of phosphine
  - (b) Two moles of phosphoric acid
  - (c) Two moles of phosphine
  - (d) One mole of phosphoric acid
60. If  $\cos(\theta) = \sin(\theta)$ , then the value of  $\theta$  is
- (a)  $\pi$
  - (b)  $\pi/2$
  - (c)  $\pi/3$
  - (d)  $\pi/4$

**PART—B**

Answer *any sixty* questions

61. Holocentric chromosomes are
- (a) chromosomes with multiple centromeres
  - (b) supernumerary chromosomes
  - (c) short chromosome with many genes
  - (d) chromosomes with centromere at the centre
62. Polytene chromosomes are formed due to
- (a) repeated S-phase, but no M-phase
  - (b) repeated karyokinesis, but no cytokinesis
  - (c) repeated S-phase, but M-phase without anaphase
  - (d) non-disjunction of chromosomes
63. C-value paradox tells us about
- (a) linearity of the relationship between genome size and complexity of organism
  - (b) non-linearity of the relationship between genome size and complexity of organism
  - (c) dosage compensation
  - (d) number of chromosomes
64. Dosage compensation in humans is brought about by
- (a) inactivity of one X-chromosome in females
  - (b) hyperactivity of single X-chromosome in males
  - (c) hypoactivity of both X-chromosomes in females
  - (d) hyperactivity of autosomes in females
65. Which of the following is the **incorrect** statement about mature human red blood cells?
- (a) They lack nuclei and membrane bound organelles.
  - (b) Cytoplasm is rich in hemoglobin.
  - (c) They have a biconcave shape.
  - (d) The membrane is lipid monolayer.

66. In response to DNA damage, p53 can mediate
- (a) cell cycle arrest only
  - (b) apoptosis only
  - (c) either cell cycle arrest or apoptosis
  - (d) cell division
67. Which of the following methods is **true** regarding the extraction of membrane protein?
- (a) Integral membrane protein is removed by change in pH
  - (b) Peripheral membrane protein is removed by urea
  - (c) Integral membrane protein is extracted by salt
  - (d) Amphitropic protein is removed by chelating agents
68. What function might you postulate for a polypeptide having a Zn-finger motif?
- (a) Signal transduction
  - (b) Transcription factor
  - (c) Growth hormone receptor
  - (d) Cytoskeletal component
69. Which of the following is the most likely outcome of a cross between two heterozygous tall plants?
- (a) 63 tall : 59 short
  - (b) 76 tall : 23 short
  - (c) 24 tall : 49 medium : 25 short
  - (d) 53 tall : 147 short
70. In a cross between two black Labrador retrievers, the phenotypic ratio of the offspring is 9 black puppies to 3 chocolate puppies to 4 yellow puppies. This is an example of
- (a) partial recessiveness
  - (b) incomplete penetrance
  - (c) incomplete dominance
  - (d) epistasis



71. In a sample from a population, there were 65 individuals with the 'BB' genotype, 30 individuals with the 'Bb' genotype, and 15 individuals with the 'bb' genotype. The frequency of the 'b' allele was
- (a) 0.27
  - (b) 0.59
  - (c) 0.41
  - (d) 0.73
72. Which of the following statements is **true** for trypsin, chymotrypsin and elastase?
- (a) They have similar reaction kinetics.
  - (b) They use ATP for catalysis.
  - (c) They are serine proteases.
  - (d) They have similar thermostability.
73. In the fluid mosaic model for membrane structure
- (a) carbohydrate is on the outer membrane surface
  - (b) lipids but not proteins can diffuse in the plane of the membrane
  - (c) proteins occur only in the inner leaflet of the membrane
  - (d) the polar ends of phospholipids face the interior of the membrane
74. Substrate combines more firmly with enzyme, when
- (a)  $K_m$  is high
  - (b)  $K_i$  is high
  - (c)  $K_i$  is low
  - (d)  $K_m$  is low
75. What will be the probability of obtaining a plant with AaBBCc genotypes from trihybrid (AaBbCc) parents?
- (a) 4 out of 64
  - (b) 1 out of 64
  - (c) 8 out of 64
  - (d) 0 out of 64

76. Which of the following is not a general feature of a nucleotide?
- (a) A phosphate is attached to the 2' hydroxyl of ribose.
  - (b) A base ring nitrogen atom is attached to the 1' carbon atom of ribose.
  - (c) A hydroxyl group is attached to the 3' carbon atom of ribose.
  - (d) A hydrogen atom or hydroxyl group is attached to the 2' carbon atom of ribose.
77. Which of the following would yield only one type of monomer after complete hydrolysis?
- (a) Glycogen
  - (b) DNA
  - (c) Lipoprotein
  - (d) Triacylglycerol
78. Transition type of gene mutation is caused, when
- (a) GC is replaced by TA
  - (b) CG is replaced by GC
  - (c) AT is replaced by CG
  - (d) AT is replaced by GC
79. Color blindness in human being is an X-linked trait. A color-blind man has a 45-X daughter who is also color-blind. The nondisjunction that led to the 45,X child occur in which parents and in which meiotic division?
- (a) Father; First meiotic division
  - (b) Both father and mother; First meiotic division
  - (c) Mother; First meiotic division
  - (d) XYY
80. A child with Edward's syndrome (18 trisomy) having his mother where nondisjunction of chromosome 18 occurred in the division of the secondary oocytes. What is the chance that a mature egg arising from this cell division will receive two numbers of chromosome 18?
- (a)  $1/4$
  - (b)  $1/2$
  - (c)  $1/8$
  - (d)  $3/4$

- 81.** Maturation of B cells occurs in the following order
- (a) progenitor B cells, affinity maturation, Ig gene rearrangement, class switching
  - (b) Ig gene rearrangement, progenitor B cells, class switching, affinity maturation
  - (c) progenitor B cells, Ig gene rearrangement, affinity maturation, class switching
  - (d) class switching, progenitor B cells, Ig gene rearrangement, affinity maturation
- 82.** Which class of B cell receptors is expressed in naive B cells?
- (a) IgG, IgA
  - (b) IgE, IgG
  - (c) IgM
  - (d) IgM, IgD
- 83.** Superantigens can bind to
- (a) MHC I
  - (b) MHC II
  - (c) TCR and MHC II together
  - (d) BCR and MHC I together
- 84.** When the substrate concentration is much lower than  $K_m$  in an enzyme assay, the rate
- (a) approaches  $V_{max}$
  - (b) shows zero-order kinetics
  - (c) is proportional to substrate concentration
  - (d) is constant
- 85.** In enzyme assays, initial rates are used to
- (a) increase the sensitivity of the assay
  - (b) prevent the substrate inhibition
  - (c) promote substrate inhibition
  - (d) minimize the contribution of reverse reaction

86. In an electromagnetic spectrum, if the wavelength decreases, then
- (a) energy increases, frequency increases and wave number increases
  - (b) energy increases, frequency increases and wave number decreases
  - (c) energy decreases, frequency increases and wave number decreases
  - (d) energy decreases, frequency decreases and wave number increases
87. Which of the following statements is **true** for circularly polarized light?
- (a) The magnitude of the electric vector is constant, but its direction varies
  - (b) The magnitude of the electric vector varies, but its direction is constant
  - (c) Both the magnitude and direction vary
  - (d) All the above conditions are possible depending upon the medium of propagation
88. Transmission electron microscopy is best for high magnification viewing of
- (a) internal structure of fixed cells
  - (b) internal structure of live and motile cells
  - (c) surface structure of fixed cells
  - (d) surface structure of live and motile cells
89. Refractive index is best described as the
- (a) extent by which a medium slows the velocity of light
  - (b) specific point at which the rays focus
  - (c) focusing of a cone of light on a slide
  - (d) coefficient of angle of refraction
90. Diffusibility of ions and molecules through a biological membrane increases in the order
- (a) indole > water > glycerol > glucose > Na<sup>+</sup>
  - (b) water > indole > glycerol > glucose > Na<sup>+</sup>
  - (c) indole > water > glucose > glycerol > Na<sup>+</sup>
  - (d) Na<sup>+</sup> > glycerol > glucose > indole > water

91. Which of the following statements is **not** true for facilitated diffusion?
- (a) Takes place along a concentration gradient
  - (b) Takes place against a concentration gradient
  - (c) Can be bidirectional
  - (d) Follows Michaelis-Menten kinetics
92. Which of the following bacteria is not a plant pathogen?
- (a) *Pseudomonas*
  - (b) *Xanthomonas*
  - (c) *Shigella*
  - (d) *Erwinia*
93. Which of the following is a ketose sugar?
- (a) Glucose
  - (b) Ribulose
  - (c) Galactose
  - (d) Xylose
94. A double-stranded DNA will be more stable in
- (a) pure water
  - (b) 0.05 M NaCl
  - (c) 1 M urea
  - (d) 20% formamide
95. A protein oligomerizes to form a dimer in acidic pH and a tetramer at neutral pH. Which of the following techniques can be used to separate the two species?
- (a) SDS-PAGE
  - (b) Ion-exchange chromatography
  - (c) Hydrophobic interaction chromatography
  - (d) Gel permeation chromatography

96. In crosses involving different pairs of genes A & B, C & D and E & F, the following proportions of recombinants were obtained

A & B = 52%, C & D = 13.8% and E & F = 26.4%

The pair of genes which are not linked is

- (a) A & B
  - (b) C & D
  - (c) E & F
  - (d) All of the above
97. DNA fingerprinting has proved in forensic science. It involves the use of
- (a) mini-satellites
  - (b) r-RNA
  - (c) c-DNA
  - (d) bacterial DNA
98. The main product of glycolysis in skeletal muscles under heavy exercise conditions is
- (a) lactate
  - (b) pyruvate
  - (c)  $\alpha$ -ketoglutarate
  - (d) succinate
99. Enzymes alcohol dehydrogenase belongs to class
- (a) oxidoreductase
  - (b) transferase
  - (c) hydrolases
  - (d) lyases
100. Lysozyme breaks down
- (a)  $\alpha$  (1-4) linkage between NAM and NAG
  - (b)  $\beta$  (1-4) linkage between NAM and NAG
  - (c) covalent crosslinks in the peptidoglycan
  - (d)  $\beta$  (1-4) linkage between two glucose molecules
101. In sickle-cell anemia, which of the following hemoglobin subunits is affected?
- (a) Alpha subunit
  - (b) Beta subunit
  - (c) Zeta subunit
  - (d) Gamma subunit

- 102.** Which of the following groups of antibodies can cross placenta?
- (a) IgM
  - (b) IgG
  - (c) IgD
  - (d) IgA
- 103.** Which of the following hereditary blood disease?
- (a) Thalassemia
  - (b) Pernicious anemia
  - (c) Megaloblastic anemia
  - (d) Galactosemia
- 104.** Sarcoma is cancer of
- (a) skin
  - (b) bones
  - (c) connective tissue/organ
  - (d) lung
- 105.** Which of the following staining techniques is used to check viability of cells?
- (a) Gram's staining
  - (b) Giemsa staining
  - (c) Trypan blue staining
  - (d) Coomassie staining
- 106.** Which of the following methods is used for estimation of sugars?
- (a) Lowry
  - (b) Orcinol
  - (c) DNSA
  - (d) Diphenylamine

107. The concentration of a bovine serum albumin solution determined using a UV spectrophotometer and the knowledge of its extinction coefficient was found to be 1.4 mg/ml. Given that the molecular weight of the protein is 70 kDa, its concentration in molar units will be
- (a) 20  $\mu$ M
  - (b) 50  $\mu$ M
  - (c) 20 mM
  - (d) 50 mM
108. Urea acts as a strong denaturant of proteins as it
- (a) perturbs electrostatic interactions only
  - (b) perturbs hydrophobic interactions only
  - (c) perturbs hydrophobic interactions as well as binds to peptide groups
  - (d) perturbs hydrophobic interactions as well as binds to nonpolar side chains
109. A right-handed  $\alpha$  helix has
- (a) 3.0 residues of amino acids per turn
  - (b) 3.3 residues of amino acids per turn
  - (c) 3.6 residues of amino acids per turn
  - (d) 4.0 residues of amino acids per turn
110. Triple-helical protein collagen is rich in the amino acid
- (a) glycine
  - (b) alanine
  - (c) proline
  - (d) valine
111. Which one of the following techniques cannot be used to determine the molecular weight of a protein?
- (a) UV absorption
  - (b) Viscosity
  - (c) Light scattering
  - (d) Osmotic pressure measurement



112. Two plasmids are of the same compatibility group, if
- (a) they can coexist in the same bacterial cell
  - (b) they cannot coexist in the same bacterial cell
  - (c) they carry the same antibiotic gene
  - (d) they carry the same toxin gene
113. The smooth endoplasmic reticulum is especially abundant in cells that synthesize extensive amounts of
- (a) nucleic acid
  - (b) lipids
  - (c) oligosaccharides
  - (d) enzymes
114. Retrotransposons transpose by
- (a) cut-paste mechanism
  - (b) copy-paste mechanism
  - (c) gene amplification mechanism
  - (d) gene deletion mechanism
115. The value of  $e^{i\pi}$  is given by
- (a) 0
  - (b) 1
  - (c)  $-i\pi$
  - (d)  $e$
116. Resistance to methotrexate, a drug commonly used in cancer therapy, arises due to the process of
- (a) amplification in dihydrofolatereductase gene
  - (b) deletion in the dihydrofolatereductase gene
  - (c) mutation in the dihydrofolatereductase gene
  - (d) transposition in the dihydrofolatereductase gene

117. Short sequence of DNA used for identification of complementary sequence is called as
- (a) probe
  - (b) marker
  - (c) aptamer
  - (d) expressed sequence tag
118. Given four different factors (1) size, (2) color, (3) internal organization and (4) strength; the prokaryotic and eukaryotic cells can be distinguished by
- (a) 1 only
  - (b) 3 and 4
  - (c) 1 and 3
  - (d) 1 and 4
119. Cyanobacteria carry out photosynthesis but some of them can also convert nitrogen gas into reduced forms of nitrogen in a process called
- (a) denitrification
  - (b) nitrification
  - (c) nitrogen fixation
  - (d) ammonia assimilation
120. Other than cytoplasm, intermediate filaments can be found inside which of the following organelles?
- (a) Endoplasmic reticulum
  - (b) Nucleus
  - (c) Golgi apparatus
  - (d) Lysosomes
121. Many proteins are found completely outside bilayer on either extracellular side or cytoplasmic side but are covalently linked to the membrane bilayer. This is achieved by
- (a) carbohydrate anchor
  - (b) peptide anchor
  - (c) lipid anchor
  - (d) oligonucleotide anchor
122. A mutation that can confer ampicillin resistance is likely to be in the gene coding for
- (a) transpeptidase
  - (b) amylase
  - (c) racemase
  - (d) viability staining of  $\beta$ -lactamase

123. Bacteria depends on permeability barrier of
- (a) cell wall
  - (b) exopolysaccharide
  - (c) peptidoglycan
  - (d) cell membrane
124. Phase-contrast microscopy is preferred over bright-field microscopy to study
- (a) stained samples
  - (b) colourless samples
  - (c) viruses
  - (d) plant cells
125. *Agrobacterium tumefaciens* can bring about horizontal transfer of genes into plant via
- (a) transposons
  - (b) chromosomes
  - (c) plasmids
  - (d) cosmids
126. In phenol-chloroform method for DNA extraction, the DNA is separated in the
- (a) precipitate
  - (b) aqueous layer
  - (c) organic layer
  - (d) interphase
127. A growing culture of bacterial cells was inhibited by the addition of 100 micrograms per mL streptomycin. This action of the antibiotic can be attributed to
- (a) protein synthesis inhibition
  - (b) oxidative phosphorylation inhibition
  - (c) cell wall synthesis inhibition
  - (d) DNA synthesis inhibition
128. Formaldehyde is used in RNA gel electrophoresis as a
- (a) denaturant
  - (b) preservative
  - (c) buffer
  - (d) chelator

129. Starch content of potatoes can be increased by using a bacterial gene, known as
- (a) sucrose phosphate synthase gene
  - (b) ADP-glucose pyrophosphorylase gene
  - (c) amylose synthase
  - (d) starch dehydrogenase
130. Which of the following genes is responsible for resistance against chilling?
- (a) Glycerol-1-phosphate acyl transferase
  - (b) Polygalactouranase
  - (c) ACC deaminase
  - (d) Cellulose
131. All are plant-derived alkaloids, *except*
- (a) menthol
  - (b) nicotine
  - (c) quinine
  - (d) codeine
132. Which of the following is best suited method for production of virus free plants?
- (a) Embryo culture
  - (b) Meristem culture
  - (c) Anther culture
  - (d) Ovule culture
133. Which of the following reactions involves dehydration?
- I. Peptide bond formation
  - II. Phosphodiester formation
  - III. Glycosidic bond formation
  - IV. Hydrogen bond formation between nitrogen bases
- (a) I, IV
  - (b) II, III
  - (c) II, IV
  - (d) I, III

- 134.** During the cell interactions involved in generating a cytotoxic T cell response, the T helper cell receives the necessary signal 2 from an antigen-presenting cell through which of the following?
- (a) IL-2 with IL-2R                      (b) B7 with CD-28  
(c) TCR with MHC Class I              (d) IgD with antigen
- 135.** CD8 is a marker of
- (a) B cells                                      (b) helper T cells  
(c) cytotoxic T cells                      (d) an activated macrophage
- 136.** Which of the following is characteristic of B but not T cells?
- (a) Class I MHC                              (b) CD3  
(c) Measles virus receptor              (d) Surface immunoglobulin
- 137.** Cell with specific killing effects is
- (a) NK cell  
(b) Neutrophils  
(c) CTL  
(d) Macrophage
- 138.** The Class I MHC processing pathway primarily
- (a) processes antigens that are present in the cytosol  
(b) generates peptides, complexes them with Class I MHC molecules for presentation to helper T cells  
(c) generates peptides, complexes them with Class I MHC molecules for presentation to NK cells  
(d) generates peptides, complexes them with Class I MHC molecules for presentation to Kupfer cells
- 139.** Interactions between \_\_\_\_ are not restricted by MHC molecules.
- (a) Th cell and dendritic cell  
(b) Tc cell and target cell  
(c) NK cell and target cell  
(d) Th cell and B cell

140. \_\_\_\_ express CD3 and CD4 molecules.
- (a) Ts and Tc cells (b) Th1 and Th2 cells  
(c) Th1 and Tc cells (d) All T cells
141. Viral replication within cells is inhibited directly by
- (a) IFN- $\alpha$  (b) TNF- $\alpha$   
(c) IL-1 (d) IL-4
142. If you measure the ability of cytotoxic T cells from an HLA-B27 person to kill virus X-infected target cells, which one of the following statements is **correct**?
- (a) Any virus X-infected target cell will be killed  
(b) Only virus X-infected cells of HLA-B27 type will be killed  
(c) Any HLA-B27 cell will be killed  
(d) No HLA-B27 cell will be killed
143. Bone marrow transplantation in immune compromised patients can potentially cause
- (a) GVHD  
(b) T cell leukemia  
(c) delayed hypersensitivity  
(d) inability to use live donor
144. Beer's law states that
- (a) absorbance is proportional to both the path length and concentration of the absorbing species  
(b) absorbance is proportional to the log of the concentration of the absorbing species  
(c) absorbance is equal to  $P_0 / P$   
(d) absorbance is inversely proportional to both the path length and concentration of the absorbing species
145. In the following reaction, the molecules labelled with numbers from 1 to 6 are
- $$\alpha\text{-Ketoglutarate} \xrightarrow[3 \downarrow \quad 4 \downarrow]{1} \text{Glutamate} \xrightarrow[5 \downarrow \quad 6 \downarrow]{2} \text{Glutamine}$$
- (a) Glutamate dehydrogenase, Glutamine Synthetase, NAD(P)H + H<sup>+</sup>, NAD(P)<sup>+</sup>, ATP and ADP respectively  
(b) Glutamine Synthetase, Glutamate dehydrogenase, NAD(P)H + H<sup>+</sup>, NAD(P)<sup>+</sup>, ATP and ADP respectively  
(c) Glutamine Synthetase, Glutamate dehydrogenase, ATP, ADP, NAD(P)H + H<sup>+</sup> and NAD(P)<sup>+</sup> respectively  
(d) Glutamate dehydrogenase, Glutamine Synthetase, ATP, ADP, NAD(P)H + H<sup>+</sup> and NAD(P)<sup>+</sup> respectively

- 146.** Which of the following metal constituents of membrane associated proteins is involved in respiratory electron transport?
- (a) Magnesium
  - (b) Manganese
  - (c) Iron
  - (d) Potassium
- 147.** In eukaryotes, euchromatin replicates predominantly during
- (a) early S-phase
  - (b) mid S-phase
  - (c) G<sub>2</sub>-phase
  - (d) late S-phase
- 148.** For radioactive decay, which of the following statements is false?
- (a) Alpha decay is seen in heavier elements.
  - (b) Beta particles are less massive than alpha particle.
  - (c) Gamma rays are more energetic than alpha or beta particles.
  - (d) A nucleus can emit an electron.
- 149.** Which of the following cell types is unlikely to be infected by viruses?
- (a) Nerve cell
  - (b) Red blood cell
  - (c) Liver cell
  - (d) White blood cell
- 150.** In prokaryotes, the lagging strand primers are removed by
- (a) DNA polymerase I
  - (b) DNA polymerase III
  - (c) 3' to 5' exonuclease
  - (d) DNA ligase

151. A particle at rest is decaying to two particles and their momentums are  $P_1$  and  $P_2$ . The relation between  $P_1$  and  $P_2$  is
- (a) equal magnitudes of  $P_1$  and  $P_2$
  - (b)  $P_1 = P_2$
  - (c)  $P_1 = P_2 / 2$
  - (d)  $P_2 = P_1 / 2$
152. A stone is initially at rest and then it is released from height  $h$  as measured from earth surface, where gravitational potential energy is  $mgh$ , ( $m$  = mass of stone ). While falling
- (a) kinetic energy of the stone will remain same
  - (b) potential energy of the stone will remain same
  - (c) total energy will remain same
  - (d) None of the above
153. The main function of centrosomes is
- (a) osmoregulation
  - (b) secretion
  - (c) protein synthesis
  - (d) formation of spindle fibre
154. What special types of cells are produced during the gametophyte stage of a plant's life cycle?
- (a) Haploid gametes
  - (b) Zygotes
  - (c) Spores
  - (d) Seed cells
155. One map unit of one centimorgan corresponds to recombination frequency of
- (a) 1%
  - (b) 10%
  - (c) 100%
  - (d) 0.1%



156. Infectious proteins are present in
- (a) satellite viruses
  - (b) Gemini viruses
  - (c) viroids
  - (d) prions
157. An enzyme that relieves torsional strain while double-stranded DNA is being unwound is
- (a) DNA ligase
  - (b) DNA gyrase
  - (c) DNA relaxase
  - (d) DNA helicase
158. Which of the following **incorrectly** matches the organelle with its function?
- (a) Glyoxysome—seed growth
  - (b) Mitochondrion—photophosphorylation
  - (c) Peroxisome—ROS quenching
  - (d) ER—glycosylation
159. The single most abundant protein in animal tissues is
- (a) collagen
  - (b) actin
  - (c) fibronectin
  - (d) RuBisCO
160. Which of the following modifications leads to protein degradation?
- (a) Methylation
  - (b) Acetylation
  - (c) Acylation
  - (d) Ubiquitination

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