CEEB: Question Papers (2010-2012) Rs.50/-

COMBINED ENTRANCE EXAMINATION, 2012
M.Sc. BIOTECHNOLOGY
[Field of Study Code : BIT]

Time Allowed : 3 hours   *Maximum Marks* : 240

INSTRUCTIONS FOR CANDIDATES

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

(i) Write your Name and Registration Number in the space provided for the purpose on the top of this Question Paper and in the Answer Sheet.

(ii) **Please darken the appropriate Circle of Question Paper Series Code on the Answer Sheet.**

(iii) The Question Paper is divided into two parts : Part—A and Part—B. Both parts have multiple-choice questions. All answers are to be entered in the Answer Sheet provided with the Question Paper for the purpose by darkening the correct choice, i.e., (a) or (b) or (c) or (d) with BALLPOINT PEN only against each question in the corresponding circle.

(iv) Part—A consists of 60 questions and all are compulsory. Answer all the questions in the Answer Sheet provided for the purpose. Each correct answer carries *1* mark. **There will be negative marking and ½ mark will be deducted for each wrong answer.**

(v) Part—B consists of 100 questions consisting Biological and Physical Sciences. **Answer any 60 questions.** Each correct answer carries *3* marks. **There will be negative marking and 1 mark will be deducted for each wrong answer.**
In case any candidate answers more than the required 60 questions, the first 60 questions attempted will be evaluated.

(vi) Answer written by the candidates inside the Question Paper will not be evaluated.

(vii) Calculators and Log Tables may be used.

(viii) Pages at the end have been provided for Rough Work.

(ix) Return the Question Paper and Answer Sheet to the Invigilator at the end of the Entrance Examination. **DO NOT FOLD THE ANSWER SHEET.**

INSTRUCTIONS FOR MARKING ANSWERS

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

Wrong	Wrong	Wrong	Wrong	Correct
● ⓑ ⓒ ●	Ⓐ̸ ⓑ ⓒ ⓓ	Ⓐ̸ ⓑ ⓒ ⓓ̸	◉ ⓑ ⓒ ●	ⓐ ⓑ ⓒ ●

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. Of the following, which component of the cell membrane is likely to function as a receptor in cell-to-cell signaling?

   (a) Lipid

   (b) Channel-forming protein

   (c) Glycoprotein

   (d) Cholesterol

2. Which one of the following is *not* a water-soluble vitamin?

   (a) Cyanocobalamin

   (b) Ascorbic acid

   (c) Retinol

   (d) Niacin

3. At which stage of mitosis do you find chromosomes being first visible under the microscope?

   (a) Metaphase

   (b) Telophase

   (c) Anaphase

   (d) Prophase

4. Which one of the following hormones is a modified amino acid?

   (a) Prostaglandin

   (b) Progesterone

   (c) Epinephrine

   (d) Estrogen

5. The best stage to observe shape, size and number of chromosomes is

   (a) interphase

   (b) prophase

   (c) metaphase

   (d) telophase

6. The small subunit of the ribosome in prokaryotes harbours which one of the following rRNAs?

    (a)   23S

    (b)   16S

    (c)   18S

    (d)   5S

7. DNA molecules absorb maximum light at the wavelength of

    (a)   280 nm

    (b)   360 nm

    (c)   260 nm

    (d)   220 nm

8. Middle lamella of plant cell wall is formed by

    (a)   cellulose

    (b)   sodium pectate

    (c)   calcium pectate

    (d)   calcium carbonate

9. A cybrid is a hybrid carrying

    (a)   cytoplasms of two different plants

    (b)   genomes of two different plants

    (c)   genome of one plant and cytoplasms of both plants

    (d)   genomes and cytoplasms of two different plants

10. The botanical name of green gram is

    (a)   *Phaseolus aconitifolius*

    (b)   *Phaseolus aureus*

    (c)   *Phaseolus lunatus*

    (d)   *Phaseolus trilobus*

11. The phytohormone which is responsible for regulating the opening and closing of stomata is

    (a)   GA

    (b)   ABA

    (c)   IBA

    (d)   kinetin

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12. A method of breaking dormancy is

    (a) stratification

    (b) scarification

    (c) vernalisation

    (d) desiccation

13. Which of the following is a common feature found at the 3′ terminal region of prokaryotic mRNAs?

    (a) Poly T stretch

    (b) Poly A stretch

    (c) Shine-Dalgarno sequence

    (d) Stem-loop structure

14. A quantitative amino acid analysis reveals that bovine serum albumin (BSA) contains 0·58% tryptophan ($M_r = 204$) by weight. The minimum estimated molecular weight of BSA (i.e., assuming there is only one tryptophan residue per protein molecule) will be

    (a) 35000

    (b) 45000

    (c) 25000

    (d) 32000

15. In Archaebacteria, the membrane phospholipids are linked by

    (a) ester linkages

    (b) ether linkages

    (c) phosphodiester linkages

    (d) glycosidic bonds

16. The soil bacterium *Agrobacterium tumefaciens* can infect a monocot crop in the presence of

    (a) chloramphenicol

    (b) acetosyringone

    (c) puromycin

    (d) EDTA

17. Hybridomas are formed by fusing antibody-producing splenocytes with

    (a) viruses

    (b) bacteria

    (c) myeloma cells

    (d) red blood cells

18. Doctors prescribe synergistic drug combinations to treat bacterial infections. The purpose of such treatment is to

    (a) change the bacteria with cell wall to L-forms lacking cell walls

    (b) reduce the treatment time of the disease

    (c) prevent microorganisms from acquiring drug resistance

    (d) reduce the toxic side effects of the antibiotics

19. *E. coli* cells are rod-shaped, about 2 μm long and 0·8 μm in diameter. The volume of a cylinder is $\pi r^2 h$, where h is the height of the cylinder. If the average density of *E. coli* (mostly) is $1 \cdot 1 \times 10^3$ g/L, the mass of a single cell will be

    (a) 1×10^{-16} g

    (b) 1×10^{-12} g

    (c) 1×10^{-8} g

    (d) 1×10^{-18} g

20. Water has a high dielectric constant of 80 in contrast with many nonpolar solvents having a very low dielectric constant. Due to this property, the electrostatic interactions between various charged side chains of amino acids in proteins after their transfer from a nonpolar solvent to water would

    (a) decrease

    (b) increase

    (c) remain unaffected

    (d) attain a value of zero

5/66

21. A car travels at the rate of 30 km/hr for 2 hours and then at the rate of 60 km/hr for 4 hours. Its average speed during the entire trip will be

    (a) 90 km/hr

    (b) 45 km/hr

    (c) 50 km/hr

    (d) 15 km/hr

22. In an Atwood machine, the two masses are 400 gm and 600 gm. If $g = 10$ m/s^2, the tension in the string is approximately

    (a) 4 N

    (b) 2·4 N

    (c) 0·6 N

    (d) 0·4 N

23. Rays of different colors fail to converge at a point after going through a double-convex lens. This defect is due to

    (a) spherical aberration only

    (b) chromatic aberration only

    (c) neither spherical aberration nor chromatic aberration

    (d) both spherical aberration and chromatic aberration

24. Kepler's third law for circular orbits (R = orbit radius and T = time period) states that

    (a) $T^2 \propto R^3$

    (b) $T^3 \propto R^2$

    (c) $T \propto R^2$

    (d) $T \propto R^3$

25. An isothermal process is one in which

    (a) no heat is given out

    (b) no work is done

    (c) the temperature remains constant

    (d) the entropy must increase

6/66

26. Two sounds A and B have intensity levels (loudness) of 80 db and 40 db respectively. The ratio I_A / I_B of their intensities (in watts/m^2) is

(a) 2

(b) 10^2

(c) 10^4

(d) 10^6

27. Two waves are represented by the equations $y_1 = a\sin(\omega t + 0 \cdot 57)$ and $y_2 = a\cos\omega t$, where a is in meter and t in second. The phase difference (in radian) between them is approximately

(a) 0·57

(b) 1

(c) 1·25

(d) 1·57

28. A plane parallel-plate capacitor consists of conducting plates separated by vacuum and distance d. The distance between the plates is now doubled and a dielectric slab of width $2d$ is inserted between the plates so that capacitance is unchanged. The dielectric constant of the material of the slab should be

(a) 1/2

(b) 1

(c) 2

(d) 4

29. An infinitely long straight wire along the positive x-axis carries a current $+I$ directed to the right. The magnetic field B due to the wire at a point $P(0, +y)$ (on the positive y-axis) points along

(a) the positive z-axis

(b) the positive x-axis

(c) the positive y-axis

(d) the negative z-axis

30. In the Bohr model of the atom, if the radius of electron's orbit in the ground state is a_0, the radius of the orbit of the $n = 3$ level is

(a) $2a_0$

(b) $3a_0$

(c) $4a_0$

(d) $9a_0$

7/66

31. *n*-type germanium is obtained by doping pure germanium with an impurity which is

(a) pentavalent

(b) tetravalent

(c) trivalent

(d) of any valency which does not matter

32. The triple-point temperature of water is

(a) 273 K

(b) 273·15 K

(c) 273·16 K

(d) 0 °C

33. The Newton's law of cooling states that the rate of cooling of a body depends upon

(a) the temperature of the body and not upon that of its surroundings

(b) the temperature of the surroundings and not upon that of the body

(c) the difference in the temperatures of the body and the surroundings

(d) the sum of the temperatures of the body and the surroundings

34. The capacitive reactance X_C and inductive reactance X_L in an a.c. circuit of frequency ω are (C = capacitance, L = inductance)

(a) $X_C = \omega C$ and $X_L = \omega L$

(b) $X_C = \omega C$ and $X_L = \dfrac{1}{\omega L}$

(c) $X_C = \dfrac{1}{\omega C}$ and $X_L = \dfrac{1}{\omega L}$

(d) $X_C = \dfrac{1}{\omega C}$ and $X_L = \omega L$

35. The de Broglie wavelength of a particle of mass m and velocity v is

(a) h/mv

(b) hmv

(c) mh/v

(d) m/hv

8/66

36. Azeotropes arise due to a large deviation from

   (a) Raoult's law

   (b) Henry's law

   (c) Boyle's law

   (d) Dalton's law

37. To the aqueous solutions containing Fe(III) and Zn(II) ions, an addition of ammonium hydroxide will lead to

   (a) precipitation of ferric hydroxide

   (b) precipitation of zinc hydroxide

   (c) precipitation of both zinc hydroxide and ferric hydroxide

   (d) no precipitation

38. Colloidal sols are purified by

   (a) peptization

   (b) coagulation

   (c) flocculation

   (d) dialysis

39. Molar heat capacity of water at equilibrium with ice at constant pressure will be

   (a) zero

   (b) infinity

   (c) $40 \cdot 50$ kJ K^{-1} mol^{-1}

   (d) $75 \cdot 48$ J K^{-1} mol^{-1}

40. If 16 gm of $O_2(g)$ reacts with excess of $C_2H_6(g)$ as per the equation

   $$2C_2H_6(g) + 7O_2(g) \rightarrow 4CO_2(g) + 6H_2O(g)$$

   the amount (in gm) of CO_2 formed is approximately

   (a) $22 \cdot 8$

   (b) $9 \cdot 2$

   (c) $7 \cdot 5$

   (d) $12 \cdot 6$

9/66

41. An isotope of the element uranium is represented as $^{235}U_{92}$. The no. of electrons, protons and neutrons respectively present in the neutral atom of this isotope are

(a) 92, 92 and 143

(b) 92, 92 and 235

(c) 92, 93 and 142

(d) 92, 143 and 92

42. A catalyst is a substance that

(a) increases the equilibrium concentration of the products

(b) changes the equilibrium constant of the reaction

(c) shortens the time to reach equilibrium

(d) supplies energy to the reaction

43. The presence of three unpaired electrons in $2p$ orbital of nitrogen follows

(a) Heisenberg uncertainty principle

(b) Aufbau principle

(c) Hund rule

(d) Pauli exclusion principle

44. The major product obtained in the nitration of toluene is

(a) o-nitrotoluene

(b) p-nitrotoluene

(c) 2,4-dinitrotoluene

(d) 2,4,6-trinitrotoluene

45. Coordinate covalent compounds are formed by

(a) transfer of electrons only

(b) sharing of electrons only

(c) donation of electrons

(d) transfer and sharing of electrons

46. The number of sigma bonds present in the compound

$$CH_3 - CH = C = CH - C \equiv C - H$$

is

(a) 8

(b) 10

(c) 11

(d) 15

10/66

47. Supercritical CO_2 is used as

(a) dry ice

(b) firefighter

(c) solvent for extraction of organic compounds from natural resources

(d) highly inert medium for carrying out reactions

48. Esters on reaction with hydroxylamine give

(a) oximes

(b) alcohols

(c) hydroxamic acid

(d) no products

49. The number of electrons required to deposit 1 g atom of Al (at. wt. = 27) from a solution of $AlCl_3$ is

(a) $1\ N_A$

(b) $2\ N_A$

(c) $3\ N_A$

(d) $4\ N_A$

50. The amount of water to be added to 10 ml of 10 N HCl solution to make it decinormal solution is

(a) 1000 ml

(b) 990 ml

(c) 100 ml

(d) 10 ml

51. The equation of the plane parallel to the plane $2x - 3y + z + 8 = 0$ and passing through the point $(-1, 1, 2)$ is

(a) $2x - 3y + z - 3 = 0$

(b) $2x - 3y + z + 3 = 0$

(c) $2x + 3y + z - 3 = 0$

(d) $2x + 3y + z + 3 = 0$

11/66

52. The number of dice that must be rolled to have at least 95% chance of rolling at least a six is

(a) ≥ 10

(b) ≥ 13

(c) ≥ 15

(d) ≥ 17

53. If A is an $n \times n$ matrix, then AA^T is

(a) a symmetric matrix

(b) a skew-symmetric matrix

(c) an identity matrix

(d) a triangular matrix

54. If $y = x^x$, then $\dfrac{dy}{dx}$ is equal to

(a) $x^x(x - \ln x)$

(b) $x^x(1 - \ln x)$

(c) $x^x(1 + \ln x)$

(d) $x^x(x + \ln x)$

55. A 15-feet ladder is resting against a wall. The bottom is initially 10 ft away and is being pushed towards the wall at $\dfrac{1}{4}$ ft/sec. How fast is the top moving after 12 sec?

(a) $\dfrac{1}{4\sqrt{176}}$ ft/sec

(b) $\dfrac{5}{4\sqrt{176}}$ ft/sec

(c) $\dfrac{7}{4\sqrt{176}}$ ft/sec

(d) $\dfrac{9}{4\sqrt{176}}$ ft/sec

12/66

56. The point on the curve $y = x^2 + 1$, in the first quadrant and which is closest to the point $(0, 2)$, is

(a) $(1, 0)$

(b) $\left(\dfrac{1}{\sqrt{2}}, \dfrac{3}{2}\right)$

(c) $\left(\sqrt{\dfrac{3}{2}}, \dfrac{5}{2}\right)$

(d) $(0, 0)$

57. The smallest non-negative integer n for which $n! > 2^n$ is

(a) 1

(b) 2

(c) 3

(d) 4

58. The function $f(x) = \begin{cases} x + a, & x < 1 \\ ax^2 + 1, & x \geq 1 \end{cases}$, $a \in \mathbf{R}$, is continuous for

(a) every value of a

(b) $a \geq 1$ only

(c) $a \leq 1$ only

(d) $a = 1$ only

59. The point on the curve $y = (x - 3)^2$, where the tangent is parallel to the chord joining $(3, 0)$ and $(5, 4)$, is

(a) $(2, 1)$

(b) $(1, 4)$

(c) $\cdot (4, 1)$

(d) $(0, 9)$

60. The function $f(x) = \dfrac{x}{\ln x}$ is increasing in the interval

(a) $(0, 1)$

(b) $(0, e)$

(c) (e, ∞)

(d) $(0, \infty)$

13/66

61. Which of the following was the first enzyme to be crystallized?

(a) Pepsin

(b) Trypsin

(c) Urease

(d) DNA polymerase I

62. Out of 38 ATP molecules produced per glucose molecule in the respiratory chain cycle, how many are produced from NADH and $FADH_2$?

(a) 20

(b) 22

(c) 16

(d) 36

63. In a chemical reaction if ΔG is negative, it means that

(a) the products contain more free energy than the reactants

(b) an input of energy is required to break the bonds

(c) the reaction will proceed spontaneously

(d) the reaction is endergonic

64. What is the pH of a solution that has an H^+ concentration of $1 \cdot 75 \times 10^{-5}$ mol/L?

(a) 4·76

(b) 5·20

(c) 9·19

(d) 7·86

65. Feedback inhibition differs from repression, because feedback inhibition

(a) is less precise

(b) is slower acting

(c) slows down the action of preexisting enzymes

(d) stops the synthesis of new enzymes

14/66

66. In Lineweaver-Burk plot, the y intercept represents

(a) K_m/V_{max}

(b) $1/K_m$

(c) $1/V_{max}$

(d) V_{max}/K_m

67. Which one of the following methods is **not** used to remove small molecules from macromolecules in protein purification?

(a) Dialysis

(b) Ultrafiltration

(c) Gel-filtration chromatography

(d) Ammonium sulphate precipitation

68. Which one of the following is **not** an anabolic product of nitrogen assimilation?

(a) Urea

(b) Glutamine

(c) Asparagine

(d) Aspartate

69. Allosteric inhibition of an enzyme involves which of the following?

(a) Binding of an inhibitor to a site other than the substrate-binding site

(b) Binding of an inhibitor competitively to the substrate-binding site

(c) Binding of an inhibitor non-competitively to the substrate-binding site

(d) Cooperative binding of substrate to an enzyme with four or more subunits

70. The zymogen chymotrypsinogen is converted to active chymotrypsin by

(a) binding of a necessary metal ion

(b) reduction of a disulphide bond

(c) selective proteolytic cleavage

(d) phosphorylation of an amino acid side chain

71. A 1 M acetic acid solution was diluted 10-fold with water and the pH of the diluted solution was measured by a pH meter after calibration with standard solutions. If the activity coefficient for diluted acid solution was 0·1, the pH of the solution would be

(a) 0

(b) 1

(c) 2

(d) 3

15/66

72. Urea is a strong denaturant of proteins, because 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 non-polar side chains

73. Which one of the following is an extracellularly produced bacterial homo-polysaccharide?

    (a) Xanthan

    (b) Dextran

    (c) Heparin

    (d) Sialic acid

74. Enzymes of β-oxidation of fatty acids to acetyl coenzyme A are located in which cellular organelle?

    (a) Ribosome

    (b) Glyoxysome

    (c) Golgi body

    (d) Nucleolus

75. The possible reason attributed to the occurrence of L amino acids over D amino acids is

    (a) Darwinian selection

    (b) unknown forces

    (c) steric interactions

    (d) asymmetry in the physical force of interaction

76. Which one of the following antibiotics blocks the active site of an enzyme that many bacteria use to make cell walls?

    (a) Amphotericin

    (b) Gentamycin

    (c) Penicillin

    (d) Cephalosporin

77. Immunodiagnostic tests for detection of influenza infection are based on the phenomenon of

    (a)   haemagglutination

    (b)   agglutination

    (c)   haemagglutination inhibition

    (d)   precipitation

78. Which regions of the antibody molecule actually contact the antigen?

    (a)   Hypervariable regions of the light and heavy chains

    (b)   Hypervariable regions of the light chain

    (c)   Hypervariable regions of the heavy chain

    (d)   Framework regions of both heavy and light chains

79. Match the following :

(A) Photoautotrophs	(i) use inorganic chemical reactions for energy production
(B) Chemoautotrophs	(ii) use sunlight as a source of energy and organic compounds as a carbon source
(C) Photoheterotrophs	(iii) use sunlight and carbon dioxide
(D) Chemoheterotrophs	(iv) use organic compounds for energy production

    (a)

A	B	C	D
ii	iii	i	iv

    (b)

A	B	C	D
iv	i	iii	ii

    (c)

A	B	C	D
iii	i	ii	iv

    (d)

A	B	C	D
i	ii	iv	iii

80. A set of microfuge tubes containing DNA, RNA and protein samples have lost their labels. Which of the following strategies will you adopt to distinguish and relabel them?

    (a)   Measuring their absorptions at 260 nm and 280 nm

    (b)   Measuring their absorptions at 240 nm, 260 nm and 280 nm

    (c)   Measuring their absorptions at 260 nm and 280 nm at 30 °C and 80 °C

    (d)   Measuring their absorptions at 240 nm, 260 nm and 280 nm at 30 °C and 80 °C

17/66

81. Assume that you inoculated 100 facultatively anaerobic cells onto nutrient agar and incubated the plate aerobically. You then inoculated 100 cells of the same species onto nutrient agar and incubated the second plate anaerobically. After incubation for 24 hours, you should have

    (a) more colonies on the aerobic plate

    (b) more colonies on the anaerobic plate

    (c) the same number of colonies on both plates

    (d) less colonies on the anaerobic plate

82. Arrange the following in the correct sequence to elicit an antibody response :

    1. T_H cell recognizes B cell.

    2. APC contacts antigen.

    3. Antigen fragment goes to surface of APC.

    4. T_H recognizes antigen digest and MHC.

    5. B cell proliferates.

    (a) 1, 2, 3, 4, 5

    (b) 5, 4, 3, 2, 1

    (c) 3, 4, 5, 1, 2

    (d) 2, 3, 4, 1, 5

83. The water used to prepare intravenous solutions in a hospital contained endotoxins. Infection control personnel performed plate counts to find the source of the bacteria. Their results were as follows :

	Bacteria/100 ml
Municipal water pipes	0
Boiler	0
Hot water line	300

    All of the following conclusions about the bacteria can be drawn *except* which one?

    (a) They were present as a biofilm in the pipes

    (b) They were Gram-negative

    (c) They came from fecal contamination

    (d) They came from the city water supply

84. If the following are placed in the order of occurrence, which would be the third step?

(a) Activation of C5 through C9

(b) Cell lysis

(c) Antigen-antibody reaction

(d) Activation of C3

85. Which one of the following enzymes is required to release the tension imposed by uncoiling of DNA strands?

(a) Endonuclease

(b) DNA ligase

(c) DNA helicase

(d) DNA gyrase

86. Which one of the following is *not* a component required for prokaryotic replication?

(a) DNA gyrase

(b) Single-strand DNA-binding protein

(c) DNA polymerase III

(d) DNA polymerase β

87. You have a small gene that you want to amplify by PCR. You add radioactively labelled nucleotides to the PCR reaction mix. After three replication cycles, what percentage of the DNA single-strands would be radioactively labelled?

(a) 0

(b) 12·5

(c) 50·0

(d) 87·5

88. The molecular weight of an *E. coli* DNA molecule is about $3 \cdot 1 \times 10^9$ g/mol. The average molecular weight of a nucleotide pair is 660 g/mol and each nucleotide pair contributes 0·34 nm to the length of DNA. Assume that the average protein in *E. coli* consists of a chain of 400 amino acids. What is the maximum number of proteins that can be coded by the *E. coli* DNA molecule?

(a) 4000

(b) 8000

(c) 6000

(d) 2000

19/66

89. Carotenes protect plants against

    (a) photooxidation

    (b) desiccation

    (c) photorespiration

    (d) photosynthesis

90. Diethyl pyrocarbonate (DEPC) is a potent inhibitor of

    (a) DNases

    (b) DNA polymerases

    (c) RNases

    (d) restriction endonucleases

91. In *E. coli*, the inability of the *lac* repressor to bind an inducer would result in

    (a) no substantial synthesis of β galactosidase

    (b) constitutive synthesis of β galactosidase

    (c) inducible synthesis of β galactosidase

    (d) synthesis of inactive β galactosidase

92. When bacteria produce mammalian proteins, cDNA is used rather than genomic DNA. Which of the following is the best explanation?

    (a) It is easier to clone cDNA than genomic DNA of comparable size

    (b) It is easier to clone RNA than DNA

    (c) It is not possible to clone the entire coding region of the gene

    (d) Most eukaryotic genes have introns that cannot be removed by bacteria

93. A set of genes from *Bacillus subtilis* that encode the proteins required for sporulation have conserved DNA sequences –35 and –10 nucleotides before the site of transcription initiation, although the sequence at –35 is different from that seen in most other genes from that species. Which of the following best explains this difference?

    (a) A novel sigma factor is required for transcription initiation at these genes

    (b) The –35 sequence is the binding site for a repressor of transcription

    (c) The replication of these genes requires a specifically modified DNA polymerase

    (d) Translation of the mRNAs transcribed from these genes requires specific ribosomes that recognize a modified Shine-Dalgarno sequence

94. The enzyme reverse transcriptase is useful in the generation of cDNA libraries for which of the following reasons?

(a) It is sensitive to high temperatures and so can be readily 'killed' by heat treatment when the reaction is completed

(b) It does not require a primer to initiate polymerization as do most DNA polymerases

(c) It is insensitive to high temperatures and so can survive the many cycles of heating required to perform the polymerase chain reaction

(d) It is an RNA-dependent DNA polymerase

95. Genes located on the Y-chromosome are known as

(a) mutant genes

(b) sex-linked genes

(c) autosomal genes

(d) holandric genes

96. Which of the following is an exception to the law of purity of gametes?

(a) Linkage

(b) Synteny

(c) Paramutation

(d) Interaction

97. Under of which of the following conditions a chromosomal segment may **not** undergo recombination?

(a) An inversion

(b) Balanced lethal

(c) Translocation

(d) Duplication

98. Xenia refers to

(a) somatic mutation

(b) inbreeding depression

(c) chimera in plant

(d) effect of pollen on endosperm

21/66

99. Gene silencing through RNA interference was first discovered in

(a) animals

(b) plants

(c) humans

(d) amphibians

100. DNA proofreading by RNA polymerase is linked to

(a) backtracking

(b) chewing

(c) degradation

(d) synchronization

101. Protooncogenes

(a) are only found in malignant tissues

(b) are from retroviruses capable of causing tumours

(c) inactivate oncogenes

(d) regulate cell growth and differentiation

102. Steroid hormones bind to

(a) cytoplasmic receptors

(b) G-protein-linked membrane receptors

(c) enzyme-linked membrane receptors

(d) membrane ion channels

103. What locks all transmembrane proteins in the bilayer?

(a) Chemical bonds that form between the phospholipids and the proteins

(b) Hydrophobic interactions between non-polar amino acids of the proteins and the nonpolar chains of phospholipids

(c) The addition of sugar molecules to the protein surface facing the external environment

(d) Non-covalent interactions between Serine and Threonine of the proteins with the phospholipids

104. In the human ABO blood grouping, the four basic blood types are type A, type B, type AB and type O. The blood proteins A and B are

  (a) simple dominant and recessive traits

  (b) incomplete dominant traits

  (c) codominant traits

  (d) sex-linked traits

105. Which animal group has radial symmetry, a water-vascular system, moves with tube feet and has an endoskeleton?

  (a) Arachnids

  (b) Crustaceans

  (c) Echinoderms

  (d) Cnidarians

106. How is the digestion of fats different from that of proteins and carbohydrates?

  (a) Fat digestion occurs in the small intestine, and the digestion of proteins and carbohydrates occurs in the stomach

  (b) Fats are absorbed into the cells as fatty acids and monoglycerides but are then modified for absorption into the blood; amino acids and glucose are not modified further

  (c) Fats enter the hepatic portal circulation, but digested proteins and carbohydrates enter the lymphatic system

  (d) Digested fats are absorbed in the large intestine, and digested proteins and carbohydrates are absorbed in the small intestine

107. If the trophoblast layer fails to form in a mammalian embryo, which of the following structures would not develop?

  (a) The blastopore

  (b) The inner cell mass

  (c) The archenteron

  (d) The fetal placenta

108. What type of insects goes through a series of larval instars before molting into a pupa, and finally an adult?

  (a) Heterometabolous

  (b) Holometabolous

  (c) Homometabolous

  (d) Hemimetabolous

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109. Two unlinked loci affect mouse hair color. CC or Cc mice are agouti. Mice with genotype cc are albino because all pigment production and deposition of pigment in hair are blocked. At the second locus, the B allele (black agouti coat) is dominant to the b allele (brown agouti coat). A mouse with a black agouti coat is mated with an albino mouse of genotype bbcc. Half of the offsprings are albino, one quarter are black agouti and one quarter are brown agouti. What is the genotype of the black agouti parent?

   (a) BBCC

   (b) BbCc

   (c) bbCC

   (d) BbCC

110. Which of the following are *not* analogous organs?

   (a) Flippers of whale

   (b) Wings of pterosaur

   (c) Fins of fish

   (d) Flippers of turtle

111. Which of the following silkworms produces tusser silk?

   (a) *Bombyx mori*

   (b) *Bombyx mandarina*

   (c) *Antheraea assamensis*

   (d) *Samia cynthia*

112. If you were to accidentally plant a mutant strain of barley that could not synthesize the plant hormone abscisic acid (ABA), what would you expect to happen?

   (a) The shoots would elongate too much and fall over because they could not support themselves

   (b) The shoots would not elongate normally, and you would get short plants

   (c) The seeds would germinate prematurely

   (d) The leaves would fall off the plant

113. When sunlight is on the chloroplast, pH is lowest in the

   (a) stroma

   (b) space enclosed by the inner and outer membranes

   (c) space enclosed by the thylakoid membrane

   (d) cytosol

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114. The phenomenon leading to heterozygosity in plants is known as

(a) autogamy

(b) geitonogamy

(c) cleistogamy

(d) xenogamy

115. Bryophytes can be distinguished from algae, because they

(a) are thalloid forms

(b) have no conducting tissue

(c) possess archegonia

(d) contain chloroplast

116. Which of the following diseases is caused by *Alternaria solani*?

(a) Late blight of potato

(b) Wart of potato

(c) Early blight of potato

(d) Leaf curl of potato

117. The vectorless gene transfer involves all of the following, *except*

(a) biolistic gun

(b) microinjection

(c) electroporation

(d) lipofection

118. Embryo culture is used for

(a) establishing suspension culture

(b) recovery of interspecific hybrids

(c) somatic hybridization

(d) haploid production

119. Transition zone between vegetational types is

(a) ecotone

(b) ecotype

(c) ecocline

(d) ecological succession

120. Essential element for photolysis of water is

(a) carbon

(b) chlorine

(c) nitrogen

(d) oxygen

121. A flywheel of moment of inertia 1000 kg m^2 is brought to rest from an angular speed of 20 rad/sec in 100 sec. The magnitude of the torque applied for the purpose is

(a) 200 N m

(b) 100 N m

(c) 50 N m

(d) 20 N m

122. A particle executes simple harmonic motion with amplitude A. Its speed when its displacement is $A/2$ is (v_{max} being the maximum speed)

(a) v_{max}

(b) $\left(\dfrac{\sqrt{3}}{2}\right)v_{max}$

(c) $\left(\dfrac{1}{\sqrt{2}}\right)v_{max}$

(d) $v_{max}/2$

123. If K is the kinetic energy of the earth and P is the gravitational potential energy of the earth as it revolves around the sun, then which of the following statements is true?

(a) $K = 2P$

(b) $P = -K$

(c) $P = -2K$

(d) $P = -K/2$

124. Two substances have bulk moduli B_1 and B_2, and have the same volume. If the same pressure is applied to the two substances, the ratio of their changes in volume, $\Delta V_1 : \Delta V_2$, will equal

(a) B_1/B_2

(b) B_2/B_1

(c) $\sqrt{B_1/B_2}$

(d) $\sqrt{B_2/B_1}$

125. A plane sound wave of frequency f_0 and wavelength λ_0 is travelling to the right. At the instant $t = 0$ sec, an observer travelling left with a small speed v, finds that he has just crossed a crest in the wave. The number of crests that he would have passed during the time interval $[0, t]$ is equal to the integer closest to but less than or equal to

(a) $f_0 t$

(b) $(f_0 + v/\lambda_0)t$

(c) $(f_0 - v/\lambda_0)t$

(d) vt/λ_0

26/66

126. A two-slit interference experiment is carried out with light of wavelength λ. The slit separation d for the interference to produce only one maximum on either side of the central maxima is

(a) $6\lambda > d > 5\lambda$

(b) $4\lambda > d > 3\lambda$

(c) $2\lambda > d > \lambda$

(d) $\lambda > d > 0 \cdot 5\lambda$

127. A uniformly charged spherical shell of radius R carries a total charge Q. The electric potential at a point distant $R/2$ from the center of the shell is

(a) $\dfrac{Q}{4\pi\varepsilon_0 R}$

(b) $\dfrac{Q}{2\pi\varepsilon_0 R}$

(c) $\dfrac{Q}{8\pi\varepsilon_0 R}$

(d) zero

128. The work done on a point dipole (dipole moment p) in rotating it from the positive x-axis to the positive y-axis while it is placed in a uniform electrostatic field E along the positive x-axis is

(a) zero

(b) $+pE$

(c) $-pE$

(d) $2pE$

129. A parallel-plate capacitor with air as dielectric has the capacitance C. A slab of dielectric constant K of same thickness as the separation between the plates is introduced so as to fill half the capacitor. The new capacitance is

(a) $(K + 1)C/2$

(b) $KC/2$

(c) $(K + 1)C$

(d) $(K + C)/2$

130. In a radioactive decay process, the β particles are

(a) decay products of neutrons inside the nucleus

(b) electrons produced as a result of collisions between atoms

(c) electrons orbiting around the nucleus

(d) electrons present inside the nucleus

131. The number of units (kilowatt-hr) consumed by a 60-watt incandescent bulb lit for 6 hours is

(a) 0·36

(b) 3·6

(c) 36

(d) 360

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132. The power of radiation emitted by a perfect blackbody depends upon its absolute temperature T as

(a) T

(b) T^2

(c) T^3

(d) T^4

133. For $PbO_2 \rightarrow PbO$, $\Delta G_{298} < 0$ and for $SnO_2 \rightarrow SnO$, $\Delta G_{298} > 0$. The most probable state of Pb and Sn will be

(a) Pb^{+4}, Sn^{+4}

(b) Pb^{+4}, Sn^{+2}

(c) Pb^{+2}, Sn^{+2}

(d) Pb^{+2}, Sn^{+4}

134. The Joule-Thomson coefficient for an ideal gas is

(a) positive

(b) zero

(c) negative

(d) infinity

135. The inversion temperature for a gas is given by

(a) a/Rb

(b) $2a/Rb$

(c) Rb/a

(d) $2Rb/a$

136. The internal energy of an ideal gas depends on

(a) pressure and volume

(b) pressure and temperature

(c) temperature only

(d) temperature and volume

137. A normalized valence bond wave function turned out to have the form $\psi = 0 \cdot 889 \, \psi_{cov} + 0 \cdot 458 \, \psi_{ion}$. What is the chance that in 1000 inspections of the molecule, both electrons of the bond will be found on one atom?

(a) $0 \cdot 889$

(b) $0 \cdot 458$

(c) $0 \cdot 210$

(d) $0 \cdot 542$

138. Which of the following molecules will not exhibit a pure rotation spectrum?

(a) HCl

(b) N_2O

(c) SF_4

(d) XeF_4

139. Consider two pure gases A and B each at 1 atm pressure and 298 K. Calculate the enthalpy change relative to the unmixed gases for a mixture of 5 moles of A and 5 moles of B.

(a) -17.2 kJ

(b) -34.4 kJ

(c) Zero

(d) 115.3 J

140. In the preparation of acetophenone from benzene using acetyl chloride, excess of $AlCl_3$ is used, because it

(a) is a poor Friedel-Crafts reaction catalyst

(b) deactivates benzene

(c) deactivates acetyl chloride due to common-ion effect

(d) complexes with acetophenone

141. Saturated solution of KNO_3 is used to make salt bridge, because

(a) velocity of K^+ is greater than that of NO_3^-

(b) velocity of NO_3^- is greater than that of K^+

(c) velocities of K^+ and NO_3^- are nearly the same

(d) KNO_3 is highly soluble in water

142. The density of a gas is found to be 0.00125 g/cc at 25 °C. What will be the vapor density of the gas?

(a) 28   (b) 12.5

(c) 25   (d) 14

143. The ratio of energy of photon with $\lambda = 1000$ Å to that of $\lambda = 4000$ Å is

(a) 2 : 1

(b) 4 : 1

(c) 1 : 2

(d) 1 : 4

144. For a given solution, pH $= 6.8$ at 70 °C, where $K_w = 10^{-13}$. The nature of the solution is

(a) acidic

(b) alkaline

(c) neutral

(d) unpredictable

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145. AgBr will have the highest solubility in which of the following solvents?

   (a) Pure water

   (b) 10^{-2} M NaBr

   (c) 10^{-2} M HBr

   (d) 10^{-2} M NH$_4$OH

146. Choose from the following the appropriate alternative in which the compounds are arranged in the increasing order of their basicity (least to most basic).

   (a) Aniline < Acetamide < Ethylamine < Dimethylamine

   (b) Acetamide < Aniline < Ethylamine < Dimethylamine

   (c) Dimethylamine < Ethylamine < Acetamide < Aniline

   (d) Ethylamine < Dimethylamine < Aniline < Acetamide

147. Which of the following compounds has most acidic hydrogens?

   (a) Methyl acetate

   (b) 2-Pentanone

   (c) 2,4-Pentane dione

   (d) 2,3-Pentane dione

148. The reaction of ketones with peroxybenzoic acid will give what type of product according to Baeyer-Villiger oxidation reaction?

   (a) Carboxylic acid

   (b) Anhydride

   (c) Ester

   (d) Mixture of alcohols

149. How many peaks will be shown by N,N-dimethylaniline in the region between 3300 cm^{-1} to 3600 cm^{-1} of IR spectroscopy?

   (a) Two peaks

   (b) No peak

   (c) Three peaks

   (d) One peak

150. Vehicles emit a major air pollutant in the form of

   (a) lead

   (b) iron

   (c) ammonia

   (d) sulphur

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151. When amino group is introduced into benzene ring, it results into

(a) redshift

(b) blueshift

(c) hyperchromic shift

(d) hypochromic shift

152. Which of the following is *not* a major greenhouse gas in stratosphere?

(a) CO_2

(b) Water vapor

(c) Methane

(d) Ozone

153. The determinant of a skew-symmetric matrix of order 7 is equal to

(a) 0

(b) 1

(c) −1

(d) 7

154. $\int 2^{2^x} 2^x \, dx$ is equal to

(a) $\dfrac{1}{(\ln 3)^2} 2^{2^x} + C$

(b) $\dfrac{1}{(\ln 3)^2} 2^{2^{2^x}} + C$

(c) $\dfrac{1}{(\ln 2)^2} 2^{2^x} + C$

(d) $\dfrac{1}{(\ln 2)^3} 2^{2^{2^x}} + C$

155. The complex number $(\sqrt{3} + i)^{50}$ is equal to

(a) $2^{50} + 2^{50}\sqrt{3} i$

(b) $2^{49} + 2^{49}\sqrt{3} i$

(c) $2^{47} + 2^{47}\sqrt{3} i$

(d) $2^{46} + 2^{46}\sqrt{3} i$

156. The number w, different from 1, is a solution of $z^3 = 1$. The determinant of the matrix $A = \begin{bmatrix} 1 & w & w^2 \\ w & w^2 & 1 \\ w^2 & w & 1 \end{bmatrix}$ is

(a) 0

(b) 1

(c) −1

(d) 2

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157. A can solve 90% of the problems given in a book and B can solve 70%. The probability that at least one of them will solve a problem selected at random from the book is

(a)   0·99

(b)   0·97

(c)   0·95

(d)   0·93

158. The maximum value of the function $f(x) = \dfrac{\log x}{x}$, $x > 0$ is equal to

(a)   0

(b) e

(c) $1/e$

(d) $2/e$

159. The linear system of equations
$$x + 2y + z = 1$$
$$2x + y + z = 2$$
$$3x + z = 3$$

has

(a)   unique solution

(b)   infinitely many solutions

(c)   no solution

(d)   zero solution

160. The maximum value of
$$z = 2x + 5y$$
subject to the constraints
$$y \le 1$$
$$2x + y \le 2$$
$$x \ge 0, \ y \ge 0$$

is

(a)   0

(b)   12

(c)   14

(d)   6

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COMBINED ENTRANCE EXAMINATION, 2011

M.Sc. BIOTECHNOLOGY

[Field of Study Code : BIT]

Time Allowed : 3 hours

Maximum Marks : 240

INSTRUCTIONS FOR CANDIDATES

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

(i) Write your Name and Registration Number in the space provided for the purpose on the top of this Question Paper and in the Answer Sheet.

(ii) **Please darken the appropriate Circle of Question Paper Series Code on the Answer Sheet.**

(iii) The Question Paper is divided into two parts : Part—A and Part—B. Both parts have multiple-choice questions. All answers are to be entered in the Answer Sheet provided with the Question Paper for the purpose by darkening the correct choice, i.e., (a) or (b) or (c) or (d) with BALLPOINT PEN only against each question in the corresponding circle.

(iv) Part—A consists of 60 questions and all are compulsory. Answer all the questions in the Answer Sheet provided for the purpose. Each correct answer carries *1* mark. **There will be negative marking and ½ mark will be deducted for each wrong answer.**

(v) Part—B consists of 100 questions consisting Biological and Physical Sciences. **Answer any 60 questions.** Each correct answer carries *3* marks. **There will be negative marking and 1 mark will be deducted for each wrong answer.**
In case any candidate answers more than the required 60 questions, the first 60 questions attempted will be evaluated.

(vi) Answer written by the candidates inside the Question Paper will not be evaluated.

(vii) Simple 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
● ⓑ ⓒ ●	⬥ ⓑ ⓒ ⓓ	⬥ ⓑ ⓒ ⬥	ⓐ ⓑ ⓒ ●	ⓐ ⓑ ⓒ ●

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.**

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1. Which of the following **does not** increase as a consequence of sewage effluent discharge into water bodies?

    (a)   Microbial load

    (b)   Phosphate level

    (c)   Dissolved oxygen

    (d)   Cyanobacterial density

2. Which of the following sequences correctly describes the cell cycle?

    (a) G_1 Phase : G_2 Phase : Mitosis : Cytokinesis

    (b)   S Phase : G_2 Phase : Mitosis : Cytokinesis : G_1 Phase

    (c) G_1 Phase : S Phase : G_2 Phase : Cytokinesis : Mitosis

    (d)   Cytokinesis : Mitosis : G_1 Phase : S Phase : G_2 Phase

3. Which of the following states of chromatin is normally associated with active genes?

    (a)   Euchromatin

    (b)   Facultative heterochromatin

    (c)   Constitutive heterochromatin

    (d)   Centromeric heterochromatin

4. Coenzyme A

    (a)   is derived from thiamine

    (b)   has a functional group containing cobalt

    (c)   forms thioester bonds with substrates

    (d)   has a sulfhydryl functional group that reacts only with amino groups

5. The polymerase chain reaction

    (a)   is a method for sequencing DNA

    (b)   is used to transcribe specific genes

    (c)   amplifies specific DNA sequences

    (d)   uses a DNA polymerase that denatures at 55 °C

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6. All photosynthetic bacteria

    (a) use chlorophyll a as their photosynthetic pigment

    (b) use bacteriorhodopsin as their photosynthetic pigment

    (c) release oxygen gas

    (d) are photoautotrophs

7. Which of the following is a likely cause of goiter?

    (a) The diet contains too much iodine

    (b) There is an inadequate supply of functional thyroxine

    (c) Circulating levels of thyrotropin are too low

    (d) There is an excess level of functional thyroxine

8. Which of the following antibiotics acts by inhibiting bacterial cell wall synthesis?

    (a) Gentamycin

    (b) Erythromycin

    (c) Ampicillin

    (d) Amphotericin

9. Amnion and allantois are found in

    (a) fish, frog, fowl and fox

    (b) frog and fish

    (c) fowl and fox

    (d) fox, frog and fowl

10. After the discharge of oocyte, the Graafian follicle forms a yellow body known as

    (a) corpus allatum

    (b) corpus callosum

    (c) corpus cardiacum

    (d) corpus luteum

11. The specific characteristic of a C_4 plant is

    (a) bulliform cell

    (b) Kranz anatomy

    (c) parallel venation

    (d) isobilateral leaf

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12. The isoelectric point of an amino acid is defined as

    (a)   the pH where the molecule carries no net electric charge

    (b)   the pH where the carboxyl group is uncharged

    (c)   the pH where the amino group is uncharged

    (d)   the pH of maximum electrolytic mobility

13. The peptide hormone involved in controlling blood pressure is

    (a)   testosterone

    (b)   oxytocin

    (c)   vasopressin

    (d)   interferon B

14. Microtubules are made up of one of the following proteins

    (a)   Globulin

    (b)   Albumin

    (c)   Gelsolin

    (d)   Tubulin

15. The exoskeleton of shrimp is made up of

    (a)   cellulose

    (b)   chitin

    (c)   lipopolysaccharide

    (d)   glycopolysaccharide

16. With an increase in the root-shoot ratio

    (a)   the rate of transpiration increases

    (b)   the rate of absorption of water increases

    (c)   the rate of evaporation increases

    (d)   the rate of transcription and absorption increases

17. 90% of photosynthesis in the world is carried out by

   (a) angiosperms

   (b) monocots

   (c) gymnosperms

   (d) algae

18. Which is a typical example of insect pollination?

   (a) *Pisum sativum*

   (b) *Cicer arietinum*

   (c) *Brassica campestris*

   (d) *Salvia splenderis*

19. Spawn is

   (a) a type of mushroom

   (b) a type of SCP

   (c) a type of yeast powder

   (d) inoculum in mushroom culture

20. Read the following statements regarding sympathetic nerve fiber :

   1. They stimulate an organ.

   2. They secrete noradrenalin.

   3. They inhibit an organ.

   4. They secrete acetyl choline.

   Which of the above are correct?

   (a) 1 and 2

   (b) 1 and 3

   (c) 2 and 3

   (d) 1 and 4

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21. Which of the following are isoelectronic with F^-?

    (a) S^{2-} and Na^+ or Mg^{2+}

    (b) O^{2-} and Ca^{2+} or Na^+

    (c) O^{2-} and Mg^{2+} or Li^+

    (d) O^{2-} and Mg^{2+} or Na^+

22. As the s character of hybridized orbital decreases, the bond angle

    (a) remains the same

    (b) increases

    (c) decreases

    (d) will increase up to $180°$

23. One litre of an unknown gas weighs 1·25 g at NTP. The possible formula of the gas is

    (a) CO_2

    (b) N_2

    (c) NO_2

    (d) O_2

24. The better process of getting freshwater from seawater is known as

    (a) osmosis

    (b) filtration

    (c) pressure desaltation

    (d) reverse osmosis

25. In a gaseous reaction $N_2 + O_2 \leftrightarrow 2NO + $ heat, if the pressure is increased, the equilibrium constant would

    (a) decrease

    (b) increase

    (c) remain unchanged

    (d) sometimes increase, sometimes decrease

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26. Which of the following will be favouring the formation of more product(s) by lowering the pressure?

(a) $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$

(b) $2SO_2 + O_2 \rightarrow 2SO_3$

(c) $H_2(g) + I_2(g) \rightarrow 2HI(g)$

(d) $4HCl + O_2 \rightarrow 2H_2O + 2Cl_2$

27. The pH of an aqueous solution of sodium carbonate is

(a) less than 7

(b) more than 7

(c) 7

(d) 0

28. Frenkel defect generally appears in

(a) AgBr

(b) ZnS

(c) AgI

(d) All of the above

29. Which of the following metals is protected by a layer of its own oxide?

(a) Al

(b) Ag

(c) Au

(d) Fe

30. The shape of SO_4^{2-} is

(a) square planar

(b) tetrahedral

(c) trigonal bipyramidal

(d) hexagonal

31. The process of separation of racemic modification into d and l enantiomers is called

(a) resolution

(b) racemization

(c) enantiomerization

(d) deracemization

32. The triple bond of acetylene is made up of

    (a) three σ bonds

    (b) one σ bond and two π bonds

    (c) three π bonds

    (d) two s bonds and one p bond

33. If chloroform is left open in air in the presence of sunlight

    (a) explosion takes place

    (b) phosgene is formed

    (c) polymerization takes place

    (d) no reaction takes place

34. Which of the following enzymes hydrolyzes triglyceride to fatty acids and glycerol? ⌄

    (a) Zymase

    (b) Dialase

    (c) Lipase

    (d) Invertase

35. The correct structure of benzene was proposed by

    (a) Faraday

    (b) Davy

    (c) Kekulé

    (d) Wöhler

36. Which of the following is *not* a dimensionless quantity?

    (a) Strain

    (b) Sound angle

    (c) Dielectric constant

    (d) Planck's constant

37. When a semiconductor is continuously heated, the value of its resistance

   (a) increases

   (b) decreases

   (c) decreases and then increases

   (d) remains unchanged

38. In an atom for the electron to revolve around the nucleus, the necessary centripetal force is obtained from the following force exerted by the nucleus on the electron

   (a) Nuclear force

   (b) Gravitational force

   (c) Magnetic force

   (d) Electrostatic force

39. When a neutral metal sphere is charged by contact with a positively charged glass rod, the sphere

   (a) loses electrons

   (b) gains electrons

   (c) loses protons

   (d) gains protons

40. If a bomb at rest explodes into two equal parts, then the constituent parts will

   (a) have same speed and travel in random directions

   (b) have same speed but travel in opposite directions

   (c) have different speeds and travel in random directions

   (d) have different speeds but travel in the same direction

41. Dispersion of a white light into its constituent colours while passing through a prism is caused because

   (a) different wavelengths travel at different velocities

   (b) of total internal reflection

   (c) refractive index of the material is different for different wavelengths

   (d) All of the above

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42. An oscillator is

    (a)   an amplifier with positive feedback

    (b)   an amplifier with negative feedback

    (c)   an amplifier without feedback

    (d)   a converter of a.c. to d.c. energy

43. The logic gate NAND is a universal gate because

    (a)   it complements all other gates

    (b)   it can inhibit the function of any other gate

    (c)   it allows any signal to pass through it

    (d)   all basic Boolean functions can be derived

44. The order of radius of the nucleus of an atom is

    (a) 10^{-10} m

    (b) 10^{-12} m

    (c) 10^{-15} m

    (d) 10^{-17} m

45. For the explanation of the atomic structure, Bohr used

    (a)   quantization of linear momentum

    (b)   quantization of angular momentum

    (c)   quantization of frequency

    (d)   quantization of energy

46. Two projectiles are fired at different angles with the same magnitude of velocity such that they have the same range. The angles at which they are projected are

    (a) $10°$ and $50°$

    (b) $25°$ and $65°$

    (c) $35°$ and $75°$

    (d) $30°$ and $90°$

47. The density of gold is 19·3 g cm^{-3} at 20 °C. If the coefficient of linear expansion of gold is $1·42 \times 10^{-5}$ °C^{-1}, the density of gold at 90 °C would be

(a)   19·35 g cm^{-3}

(b)   19·24 g cm^{-3}

(c)   19·26 g cm^{-3}

(d)   19·28 g cm^{-3}

48. If one mole of an ideal gas doubles its volume as it undergoes an isothermal expansion, its pressure is

(a)   quadrupled

(b)   doubled

(c)   unchanged

(d)   halved

49. According to the theory of relativity, the length of a rod in motion

(a)   is same as its rest length

(b)   is less than its rest length

(c)   is more than its rest length

(d)   may be more or less depending on the speed of the rod

50. In β-decay

(a)   atomic number decreases by one

(b)   mass number decreases by one

(c)   atomic number increases by one

(d)   None of the above

51. Given $\lim\limits_{x \to 0}\left(\dfrac{x^n - 2^n}{x - 2}\right) = 80$, then the value of n is

(a)   2

(b)   4

(c)   5

(d)   6

52. The point on the curve $x^2 - 2y^2 = 18$ at which the tangent is perpendicular to $x - y = 18$ is

(a) (3, 6)

(b) (6, 3)

(c) (- 3, 6)

(d) (6, - 3)

53. The differential equation corresponding to $y = ce^{-x}$ is

(a) $\dfrac{dy}{dx} - y = 0$

(b) $\dfrac{dy}{dx} + y = 0$

(c) $y\dfrac{dy}{dx} = 0$

(d) $x - \dfrac{dy}{dx} = 0$

54. A bag contains 3 red, 4 white and 5 blue balls. All balls are different. Two balls are drawn at random. The probability that they are different in colours is

(a) $\dfrac{1}{33}$

(b) $\dfrac{5}{22}$

(c) $\dfrac{47}{66}$

(d) $\dfrac{37}{33}$

55. The equation $4x^2 + 21y^2 + 24x + 84y + 36 = 0$ represents

(a) a parabola

(b) a hyperbola

(c) a circle

(d) an ellipse

56. Which of the following are collinear points?

  (a) (2, −1), (2, 1), (4, 5)

  (b) (3, 8), (−4, 2), (5, −1)

  (c) (0, 0), (1, 0), (1, 1)

  (d) (2, 7), (3, −1), (−5, 6)

57. In a group of 50 persons, 14 drink tea but not coffee and 30 drink tea. How many persons drink tea and coffee both?

  (a) 30

  (b) 36

  (c) 16

  (d) 20

58. If $\bar{a} = 2i + j + 2k$ and $\bar{b} = 5i - 3j + k$ are two vectors, then the projection of $\bar{b}$ on $\bar{a}$ is

  (a) 3

  (b) −4

  (c) $\dfrac{9}{\sqrt{35}}$

  (d) $-\dfrac{9}{\sqrt{35}}$

59. If $A = \begin{bmatrix} 3 & 5 \\ -4 & 2 \end{bmatrix}$, then A^2 is

  (a) $\begin{bmatrix} 9 & 25 \\ 16 & 4 \end{bmatrix}$

  (b) $\begin{bmatrix} 9 & 25 \\ -16 & 4 \end{bmatrix}$

  (c) $\begin{bmatrix} -11 & -25 \\ -20 & 0 \end{bmatrix}$

  (d) $\begin{bmatrix} -11 & 25 \\ -20 & -16 \end{bmatrix}$

60. If $_9P_5 + 5\,_9P_4 = _{10}P_r$, then the value of r is

  (a) 3

  (b) 5

  (c) 4

  (d) 6

PART—B

Answer *any* *sixty* questions

61. Structure of which of the following antibiotics is similar to aminoacyl tRNA?

(a) Chloramphenicol

(b) Cycloheximide

(c) Puromycin

(d) Streptomycin

62. Which one of the following enzymes *does not* catalyze a physiologically irreversible step in glycolysis?

(a) Hexokinase

(b) Phosphofructokinase

(c) Phosphoglycerate kinase

(d) Pyruvate kinase

63. Which of the following processes *does not* occur in mitochondria of mammalian cells?

(a) Fatty acid biosynthesis

(b) Protein synthesis

(c) DNA synthesis

(d) β-oxidation of fatty acids

64. A protein is poorly expressed in a diseased tissue. To determine whether the defect is at the level of transcription or translation, which of the following blotting techniques would you use?

(a) Southern and Western

(b) Southern and Northern

(c) Northern and Western

(d) Western and South-Western

65. The primary transcript of the chicken ovalbumin gene is 7700 nucleotides long, but the mature mRNA that is translated on the ribosome is 1872 nucleotides long. This size difference occurs primarily as a result of

(a) capping

(b) cleavage of polycistronic mRNA

(c) removal of poly-A tails

(d) removal of introns

66. Two 10-kDa and 30-kDa proteins with similar properties in a solution can be separated by

   (a) hydrophobic interaction chromatography

   (b) gel filtration chromatography

   (c) ion-exchange chromatography

   (d) affinity chromatography

67. How many turns of a DNA double helix must be unwound during replication of *E. coli* chromosome?

   (a) $4 \cdot 6 \times 10^6$

   (b) $4 \cdot 6 \times 10^5$

   (c) $4 \cdot 6 \times 10^7$

   (d) $4 \cdot 6 \times 10^4$

68. The type of silencing involved in miRNA is

   (a) replicational

   (b) transcriptional

   (c) post-transcriptional

   (d) post-translational

69. The Ames test is used to determine if a chemical

   (a) increases the rate at which a bacterial cell divides

   (b) decreases the number of cells in a culture

   (c) is a potential mutagen

   (d) decreases the ability of a cell to photosynthesize

70. Which of the following is a connecting link between glycolysis and Krebs cycle?

   (a) Citric acid

   (b) Pyruvic acid

   (c) Acetyl CoA

   (d) Glucose

71. Cyanide poisoning affects which of the following processes?

   (a) Electron transport chain reaction

   (b) Fatty acid biosynthesis

   (c) Fatty acid oxidation

   (d) Nucleic acid biosynthesis

47/66

72. For an enzyme assay, it was observed based on the change of the product thus formed that $100\,\mu$ moles of the substrate is converted to product per minute per milligram of the enzyme used. The specific activity of the enzyme would be

(a) 100 units

(b) 10 units

(c) 1 unit

(d) 1000 units

·73. At what phase of bacterial growth, antibiotics are usually most effective?

(a) Lag phase

(b) Log phase

(c) Stationary phase

(d) Late lag phase

74. The molecular formula for glycine is $C_2H_5O_2N$. What would be the molecular formula for a linear oligomer made by linking ten glycine molecules together by condensation synthesis?

(a) $C_{20}H_5O_{20}N_{10}$

(b) $C_{20}H_{32}O_{11}N_{10}$

(c) $C_{20}H_{40}O_{10}N_{10}$

(d) $C_{20}H_{68}O_{29}N_{10}$

75. The isoelectric point of an enzyme is 6. It was observed that at this point there are 5 positively and 5 negatively charged side chains of amino acids. When the enzyme solution was titrated with HCl to pH 3, it was observed that two ionized aspartate chains got protonated. The net charge on the enzyme at pH 3 would therefore be

(a) +3

(b) +2

(c) −3

(d) −2

76. End labeling of DNA fragment is a prerequisite for Maxam-Gilbert method of DNA sequencing. Which of the following enzymes is used in accomplishing this?

(a) Taq polymerase

(b) Restriction enzyme

(c) Polynucleotide kinase

(d) Ligase

77. The expansion of one cell sheet over other cells during early embryonic development is called

   (a) involution

   (b) ingression

   (c) delamination

   (d) epiboly

78. Spemann's organizer is responsible for

   (a) embryonic differentiation

   (b) embryoattachment

   (c) primary embryonic induction

   (d) cell-cell communication

79. In the α-helix, the hydrogen bonds

   (a) are perpendicular to the helix axis

   (b) occur between the side chains

   (c) are roughly parallel to the helix axis

   (d) occur between only some of the amino acids

80. Identify the prochiral molecule in the citric acid cycle.

   (a) Oxaloacetate

   (b) Isocitrate

   (c) Citrate

   (d) Succinate

81. λ phage can transduce bacterial genes only at or near the gene involved in

   (a) repressor synthesis

   (b) immunity repressor

   (c) CAP

   (d) galactose utilization

82. An RNA-DNA hybrid of gene sequence with its transcript contains some loops. This indicates that

   (a) the gene has undergone a frameshift mutation

   (b) the mRNA is polycistronic

   (c) the mRNA is edited

   (d) the gene contains introns

83. The enzymes which do not conform to Michaelis-Menten kinetics such as aspartate transcarbamoylase are called

(a) allosteric enzymes

(b) trypsins

(c) rennins

(d) amylases

84. If lysosomes in a cell are ruptured, what would be the most likely effect?

(a) The mitochondria and the chloroplasts would divide

(b) The DNA within the mitochondria would break down

(c) The macromolecules in the cytoplasm would begin to break down

(d) More proteins would be made

85. The role of DNA ligase in DNA replication is to

(a) add more nucleotides to the growing strand one at a time

(b) ligate base to sugar to phosphate in a nucleotide

(c) join Okazaki fragments to one another

(d) remove incorrectly paired bases

86. In the lysogenic cycle of bacteriophage λ

(a) the *cI* gene product represses the transcription of λ specific genes

(b) a bacteriophage carries DNA between bacterial cells

(c) both early and late phage genes are transcribed

(d) the viral genome is made into RNA which stays in the host cell

87. When tryptophan accumulates in a bacterial cell

(a) it binds to the operator, preventing transcription of adjacent genes

(b) it binds to the promoter, allowing transcription of adjacent genes

(c) it binds to the repressor, causing it to bind to the operon

(d) it binds to RNA and initiates a negative feedback loop to reduce transcription

88. Control of gene expression in eukaryotes includes all of the following, *except*

(a) binding of proteins to DNA

(b) activation of transcription factors

(c) feedback inhibition of enzyme activity

(d) DNA methylation

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89. RNA interference (RNAi) inhibits

    (a) RNA synthesis of specific genes

    (b) recognition of the promoter by RNA polymerase

    (c) transcription of all genes

    (d) translation of specific mRNAs

90. An expression vector requires all of the following, *except*

    (a) genes for ribosomal RNA

    (b) a promoter of transcription

    (c) an origin of DNA replication

    (d) restriction enzyme recognition sites

91. Phenylketonuria is an example of a genetic disease in which

    (a) a single enzyme is not functional

    (b) inheritance is sex-linked

    (c) two parents without the disease cannot have a child with the disease

    (d) a transport protein does not work properly

92. According to the clonal selection theory

    (a) an antibody changes its shape after binding to the antigen

    (b) there is no clonal selection in B cells

    (c) the animal contains many types of B cells, each producing one kind of antibody

    (d) each B cell produces many types of antibodies

93. Sympatric species are often similar in appearance because

    (a) appearances are often of little evolutionary significance

    (b) the genetic changes accompanying speciation are often small

    (c) the genetic changes accompanying speciation are often large

    (d) the traits that differ among species are not the same as the traits that differ among individuals within the species

94. A neuron that has just fired an action potential cannot be immediately restimulated to fire a second action potential. The short interval of time during which restimulation is not possible is called

(a) hyperpolarization

(b) refractory period

(c) repolarization

(d) resting potential

95. Which of the following statements about the structure of skeletal muscle is true?

(a) The light bands of the sarcomere are the regions where actin and myosin filaments overlap

(b) When the muscle contracts, the A bands of the sarcomere lengthen

(c) When the muscle contracts the H zone of the sarcomere shortens

(d) The sarcoplasm of the muscle cell is contained within the sarcoplasmic reticulum

96. Archaeopteryx is known as the missing/connecting link because it is a fossil and has characters between

(a) fishes and amphibians

(b) birds and reptiles

(c) reptiles and mammals

(d) chordates and non-chordates

97. Phagocytic cells lining blood sinuses of liver are known as

(a) enterochromaffin cells

(b) Kupffer cells

(c) oxyntic cells

(d) zymogenic cells

98. Sertoli cells are found

(a) in the germinal epithelium of ovary

(b) between seminiferous tubules

(c) in the germinal epithelium of seminiferous tubules

(d) in the upper part of fallopian tube

52/cc

99. The sequence, Blue-green algae → Hydrilla → Wolffia → Typha → Shrubs → Trees, represents

   (a) a food chain

   (b) a food pyramid

   (c) an ecological succession

   (d) a phylogeny

100. Identify the incorrect statement.

   (a) γδ T cells are not MHC restricted while α'β T cells are

   (b) γδ T cells do not go through the selection in the thymus while α'β T cells go through the thymic selection

   (c) γδ T cells are part of the innate immune system while α'β T cells are the most important component of the adaptive immune system

   (d) γδ T cells and α'β T cells get activated differently when presented with antigens on MHC molecules

101. Macrophages phagocytose mycobacteria and confine them to phagosomal compartments. This process does not allow the mycobacterial antigens to be presented by MHC-I molecules. Therefore under such conditions

   (a) there will be activation of only CD4+ T cells

   (b) there will be activation of only CD8+ T cells

   (c) there will be activation of both CD4+ and CD8+ T cells

   (d) there will be no T cell activation

102. If you purify IgG antibody from one animal and inject back into the same animal, what will you expect to happen?

   (a) There will not be any immune response against the injected IgG as it is from the same animal

   (b) There will no antibody response but T cells will be activated

   (c) There will be antibody response against the Fc portion of the antibody injected

   (d) There will be antibody response against the variable portion of the antibody injected

103. Mark the group which represents pro-inflammatory cytokines.

   (a) IL2, IL4, IL5, IL15

   (b) IL10, TGF β, IL13

   (c) IL1 β, IL6, IL12

   (d) IL8, IP10, IL17

104. An allosteric inhibitor of an enzyme usually

    (a) binds to the active site

    (b) participates in feedback regulation

    (c) denatures the enzyme

    (d) causes the enzyme to work faster

105. Histamine is released by

    (a) macrophage

    (b) lymphocytes

    (c) mast cells

    (d) basophils

106. Which of the following is true about tumour suppressor genes?

    (a) They encode proteins that positively regulate cell growth

    (b) P53 is a tumour suppressor gene found on chromosome 21

    (c) P53 triggers necrosis

    (d) RB1 is a tumour suppressor gene located on chromosome 13

107. Which one of the following is a mobile electron carrier in linear photosynthetic electron transport?

    (a) Plastoquinone

    (b) Plastocyanin

    (c) Cytochrome f

    (d) D1 protein

108. In which one of the following, oxygenic photosynthesis *does not* occur in the specialized organelles?

    (a) Auto-heterotrophic bacteria

    (b) Cyanobacteria

    (c) Algae

    (d) Higher plants

109. Genome-wise gene expression analysis is performed using

    (a) DNA microarrays

    (b) Northern analysis

    (c) real-time PCR

    (d) RT-PCR

110 One of the following organic chemicals is called a compatible solute and is accumulated in the cells when plants are subjected to hyper-osmotic stress

(a) Glucose

(b) Proline

(c) Urea

(d) Glycerin

111. On doping silicon with P, we get

(a) insulator

(b) metallic conductor

(c) n-type semiconductor

(d) p-type semiconductor

112. A solution containing 15 g of a solute in 100 g of water makes the solution freeze at -1.0 °C. If 30 g of the same solute is dissolved in 100 g of water, the solution will freeze at

(a) -0.5 °C

(b) -2.0 °C

(c) 2.0 °C

(d) -1.5 °C

113. The order of splitting of d orbitals in a transition metal complex is $d_{x^2-y^2} \gg d_{xy} > d_{z^2} > d_{xz} = d_{yz}$. The structure of the complex is

(a) linear

(b) tetrahedral

(c) octahedral

(d) square planar

114. A frequency of 1000 cm^{-1} is in the region of

(a) far UV

(b) visible

(c) near IR

(d) IR

115. Chloroform belongs to the point group

(a) C_3

(b) C_{2v}

(c) C_{3v}

(d) D_2

116. $_{15}P^{30} \rightarrow {}_{14}Si^{30} + X$, where X is

(a) neutron

(b) proton

(c) neutrino

(d) positron

117. Which of the following can be used for the separation of strontium and barium?

(a) $Na_2CO_3 + HCl$

(b) H_2SO_4

(c) Ammonia and ammonium oxalate

(d) Chromate and acetic acid

118. Malachite is a/an

(a) compound of manganese

(b) compound of copper

(c) compound of magnesium

(d) organic compound

119. A 200 mL sample of seawater is found to contain 7·3 g NaCl (mol. mass = 58·45). The molarity of seawater with respect to NaCl is

(a) 0·012 M

(b) 0·625 M

(c) 0·025 M

(d) 0·213 M

120. Consider the following reaction at equilibrium :

$$C(s) + H_2O(g) \leftrightarrow CO(g) + H_2(g)$$

Predict the effect of adding C to the reaction mixture.

(a) Equilibrium shifts to left

(b) Equilibrium shifts to right

(c) No effect

(d) Equilibrium oscillates

121. How much heat does a body lose when 0.36 g of sweat evaporates from the skin at $25\,°C$? (Assume that sweat contains only water). Heat of vapourization of water at $25\,°C = 44.0$ kJ mol^{-1}

(a) 44.0 kJ

(b) 17.99 kJ

(c) 0.88 kJ

(d) 0.167 kJ

122. What is/are the type(s) of intermolecular forces present in CH_3OH?

(a)   Dispersion

(b)   Dispersion, dipole-dipole

(c)   Dispersion, dipole-dipole, hydrogen bonding

(d)   Hydrogen bonding

123. Which one of the following has the shortest wavelength?

(a)   Radiowave

(b)   Microwave

(c)   Infrared

(d)   Ultraviolet

124. Half-life period of a radioactive isotope is 36 days. How much time would it take for 75% of its decomposition?

(a)   18 days

(b)   72 days

(c)   54 days

(d)   108 days

125. How many significant figures are there in a measured quantity 0.03090 g?

(a)   6

(b)   5

(c)   4

(d)   2

126. Which one of the following is a weak electrolyte?

(a)   NaOH

(b) $Ca(NO_3)_2$

(c)   HI

(d)   HCOOH

127. The ammonium salt of the compound x on heating gives phthalimide. What is x?

(a)   Benzoic acid

(b)   Phthalic acid

(c)   Salicylic acid

(d)   Terephthalic acid

128. Enthalpy of chemisorption lies in the range

    (a)   80 to 240 kJ mol^{-1}

    (b)   0 to 20 kJ mol^{-1}

    (c)   0 to 40 kJ mol^{-1}

    (d)   40 to 60 kJ mol^{-1}

129. In the case of a compound, the molar magnetic susceptibility value first increases with increase of temperature and after a particular temperature, the value decreases with increase of temperature. The compound is

    (a)   diamagnetic

    (b)   paramagnetic

    (c)   ferromagnetic

    (d)   antiferromagnetic

130. A phenol and a carboxylic acid may be distinguished by treatment with

    (a) $NaHCO_3$

    (b)   NaOH

    (c)   metallic sodium

    (d)   barium hydroxide

131. The following quantity has the dimension of action

    (a)   Energy

    (b)   Planck's constant

    (c)   Angular momentum

    (d)   Torque

132. Which of the following represents correct Hamilton's canonical equation of motion?

    (a) $\dfrac{\partial q_i}{\partial t} = \dfrac{\partial H}{\partial p_i}$
                  (b) $\dfrac{\partial p_i}{\partial t} = \dfrac{\partial H}{\partial q_i}$

    (c) $\dfrac{\partial p_i}{\partial t} = \dfrac{\partial q_i}{\partial H}$
                   (d) $\dfrac{\partial q_i}{\partial t} = -\dfrac{\partial H}{\partial p_i}$

133. At low temperatures, specific heat C_v is proportional to

    (a) T^2
                  (b) T^3

    (c) $3R$
                  (d) $1/T$

134. Which is Meissner effect?

   (a) Superconductor becomes insulator

   (b) Superconductor becomes diamagnetic

   (c) Superconductor becomes a normal conductor

   (d) None of the above

135. Normal Zeeman effect is due to

   (a) strong electric field

   (b) strong magnetic field

   (c) weak electric field

   (d) weak magnetic field

136. The number of normal modes of vibrations in a linear molecule with n atoms is

   (a) $3n$ (b) $3n-2$

   (c) $3n-6$ (d) $3n-5$

137. Nuclear magnetic resonance occurs when frequency of electromagnetic radiation is given by

   (a) $gB/2\pi$ (b) $g^2 B/2\pi$

   (c) $gB^2/2\pi$ (d) $gB_0/\hbar$

138. Which one of the following is a man-made series?

   (a) $4n+1$ (b) $4n$

   (c) $4n+2$ (d) $4n+3$

139. Transformers are laminated to

   (a) increase coupling

   (b) decrease hysteresis loss

   (c) decrease eddy current

   (d) increase permeability

140. In Fraunhofer diffraction, the nature of wavefront is

(a) spherical

(b) plane

(c) cylindrical

(d) parabolic

141. Rayleigh criterion for an angular separation of two point sources is

(a) $\lambda^2 / 2D$

(b) $1 \cdot 22\lambda / D$

(c) $\pi\lambda / D$

(d) λ / D

142. Which one of the following is a ferrimagnetic material?

(a) Sodium chloride

(b) Barium titanate

(c) Magnetite

(d) Calcium sulphate

143. Negative feedback in an amplifier

(a) increases stability and reduces gain

(b) enhances noise and enhances gain

(c) enhances noise and reduces gain

(d) reduces noise and enhances gain

144. The net charge of a *p*-type semiconductor is

(a) positive

(b) negative

(c) neutral

(d) not predictable

145. A semiconductor RAM can be built from

    (a) AND gate

    (b) NAND gate

    (c) R-S flip-flop

    (d) half-adder

146. Geiger-Nuttal law is related to

    (a) alpha decay

    (b) beta decay

    (c) gamma decay

    (d) electron capture

147. Reciprocal lattice of a simple cubic is

    (a) f.c.c.   (b) b.c.c.

    (c) simple cubic   (d) hexagonal

148. In a Hall effect experiment, which of the following is measured?

    (a) Nature of charge carriers

    (b) Number of charge carriers

    (c) Nature as well as number of charge carriers

    (d) None of the above

149. An ideal amplifier has the following characteristics

    (a) Infinite gain, infinite bandwidth, zero output impedance and infinite input impedance

    (b) Infinite gain, infinite bandwidth, finite input impedance and finite output impedance

    (c) Finite gain, infinite bandwidth, infinite input impedance and finite output impedance

    (d) Infinite gain, infinite bandwidth, infinite output impedance and zero input impedance

150. The electronic spectrum lies in

    (a) infrared   (b) microwave

    (c) radio frequencies   (d) UV-vis

151. A triangle of maximum area that can be inscribed in a circle is

    (a)   a right-angled triangle

    (b)   an equilateral triangle

    (c)   an isosceles triangle

    (d)   Depends on the radius of the circle

152. The equation of the asymptote of $x^3 + y^3 = 3xy$ is

    (a) $x = 0$ and $y = 0$

    (b) $x + y = 0$

    (c) $x + y + 1 = 0$

    (d) $x + y = 1$

153. The value of $-\int_{-a}^{a} |x|dx$ is

    (a) $-a$

    (b) $-a^2$

    (c)   0

    (d) $-2a$

154. The differential equation $\dfrac{d^2x}{dt^2} + 4x = 0$

    (a)   represents a periodic motion with period $\pi/2$

    (b)   represents a periodic motion with period π

    (c)   represents a periodic motion with period 2π

    (d)   represents a motion which is not periodic

155. The equation $\dfrac{d^2y}{dx^2} - 2\dfrac{dy}{dx} + y = 0$, satisfying the conditions $y(0) = 0$, $y'(0) = 1$, has

    (a)   two linearly independent solutions

    (b)   exactly one solution

    (c)   no solutions

    (d)   infinite number of solutions

156. The curves $r = a(1+\cos\theta)$ and $r = b(1-\sin\theta)$

    (a)   need not intersect

    (b)   intersect orthogonally

    (c)   have the angle of intersection which may depend on the values of a and b

    (d)   have the angle of intersection equal to $\pi/4$

157. An eigenvalue of the matrix $\begin{bmatrix} 3 & 1 \\ 0 & 2 \end{bmatrix}$ is

    (a)   6

    (b)   5

    (c)   3

    (d)   0

158. The vector normal to the surface $xy^3z^2 = 4$ at $(1, 1, 1)$ is

    (a) $i + j + k$

    (b) $i + 3j + 2k$

    (c) $3i + 3j + k$

    (d) $i + j + 2k$

159. Which of the following is a group under multiplication?

    (a)   Set of positive integers

    (b)   Set of integers

    (c)   Set of non-zero rational numbers

    (d)   Set of irrational numbers

160. $\int_C (z-a)^2 dz$, where C is the circle $|z-a| = r$, is

    (a)   0   (b) $2\pi r$

    (c) $2\pi r^2$ (d) $4\pi^2 r^2$

$$\star\,\star\,\star$$

66

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(i) Write your Name and Registration Number in the space provided for the purpose on the top of this Question Paper and in the Answer Sheet.

(ii) **Please darken the appropriate Circle of Question Paper Series Code on the Answer Sheet.**

(iii) The Question Paper is divided into two parts : Part—A and Part—B. Both parts have multiple-choice questions. All answers are to be entered in the Answer Sheet provided with the Question Paper for the purpose by darkening the correct choice, i.e., (a) or (b) or (c) or (d) with BALLPOINT PEN only against each question in the corresponding circle.

(iv) Part—A consists of 60 questions and all are compulsory. Answer all the questions in the Answer Sheet provided for the purpose. Each correct answer carries 1 mark. **There will be negative marking and ½ mark will be deducted for each wrong answer.**

(v) Part—B consists of 100 questions consisting Biological and Physical Sciences. **Answer any 60 questions.** Each correct answer carries 3 marks. **There will be negative marking and 1 mark will be deducted for each wrong answer.**

In case any candidate answers more than the required 60 questions, the first 60 questions attempted will be evaluated.

(vi) Answer written by the candidates inside the Question Paper will not be evaluated.

(vii) Simple 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 <u>ONLY ONE CIRCLE</u> for each question as shown in example below :

Wrong	Wrong	Wrong	Wrong	Correct
● ⓑ ©　●	Ⓐ ⓑ © ⓓ	Ⓐ ⓑ © ⓓ	◉ ⓑ © ●	ⓐ ⓑ © ●

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.**

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PART—A

All questions are to be answered

1. The cotyledon is called scutellum in the family

    (a)   Malvaceae

    (b)   Cruciferae

    (c)   Solanaceae

    (d)   Gramineae

2. The correct sequence of increasing order of organizational complexity is

    (a)   populations → species → ecosystems → communities

    (b)   species → populations → ecosystems → communities

    (c)   ecosystems → species → populations → communities

    (d)   species → populations → communities → ecosystems

3. Female sex organs do not have a sterile jacket around them in

    (a)   algae

    (b)   bryophytes

    (c)   pteridophytes

    (d)   gymnosperms

4. The maximum frequency of recombination of genes at two loci can be

    (a)   25%

    (b)   50%

    (c)   75%

    (d)   100%

5. The resolution of a compound microscope can be enhanced by using

    (a)   light of shorter wavelength

    (b)   light of long wavelength

    (c)   light of variable wavelength

    (d)   smaller numerical aperture

6. A child had difficulty in breathing and was suspected of having severe asthma. An elevated number of which cells in a routine blood panel might support this diagnosis?

(a) Eosinophils

(b) Basophils

(c) Neutrophils

(d) Monocytes

7. N-acetylmuramic acid is a component of

(a) bacterial cell wall

(b) fungal cell wall

(c) mitochondrial membrane

(d) chloroplast membrane

8. Enzyme alcohol dehydrogenase belongs to the class

(a) oxidoreductase

(b) transferase

(c) hydrolase

(d) lyase

9. In a eukaryotic chromosome, DNA replication is initiated at

(a) centromere and continues towards the telomere

(b) telomere and continues towards the centromere

(c) centromere and telomere

(d) multiple points all along the DNA

10. Which is true of bacteria?

(a) Bacteria lack DNA

(b) Mitochondria and nuclear membrane are present

(c) Nucleoid is the region which contains DNA

(d) RNA acts as genetic material

11. Which one of the following is *not* a water-soluble vitamin?

    (a) Thiamine (B_1)

    (b) Riboflavin (B_2)

    (c) Pyridoxine (B_6)

    (d) α-Tocopherol (E)

12. The number of neck vertebrae in giraffe is

    (a) 7

    (b) 70

    (c) 27

    (d) variable and depends on the length of the giraffe's neck

13. Match the items in *List—I* with *List—II* and choose the correct answer from the alternatives given below :

	List—I		*List—II*
(1)	PS II	(i)	Light-generated energy
(2)	$NADPH_2$	(ii)	More chlorophyll
(3)	PS I	(iii)	More accessory pigments
(4)	ATP	(iv)	Reducing power

    (a)
(1)	(2)	(3)	(4)
(iv)	(ii)	(i)	(iii)

    (b)
(1)	(2)	(3)	(4)
(iii)	(iv)	(i)	(ii)

    (c)
(1)	(2)	(3)	(4)
(iii)	(iv)	(ii)	(i)

    (d)
(1)	(2)	(3)	(4)
(ii)	(iv)	(iii)	(i)

14. *Staphylococcus aureus* is a skin pathogen and produces coagulase enzyme that clots fibrinogen in plasma. This results in

    (a) protection of the pathogen from phagocytosis

    (b) rapid spread of the pathogen

    (c) lysis of the pathogen

    (d) lysis of phagocytes

67/66

25/66 68/66

15. The linkage found between sugar and base in RNA and DNA is

    (a) O-glycosidic

    (b) N-glycosidic

    (c) phosphodiester

    (d) ester

16. Which of the following does **not** participate in the formation of antigen-antibody complex?

    (a) Hydrophobic bond

    (b) Covalent bond

    (c) Electrostatic interaction

    (d) Hydrogen bond

17. Which of the following characteristics distinguishes most RNA molecules from DNA?

    (a) A purine or pyrimidine base linked to a pentose sugar

    (b) A 3'-phosphate group linked to a pentose sugar

    (c) A 5'-phosphate group linked t a pentose sugar

    (d) Susceptibility to alkaline hydrolysis

18. Which of the following may **not** be found in protozoan cell?

    (a) Mitochondria

    (b) Golgi complex

    (c) Lysosome

    (d) Cell wall

19. High concentrations of keratinoid pigment are found in the

    (a) green algae

    (b) blue algae

    (c) red algae

    (d) golden-brown algae

20. Euglenoids are unique among the algae because of their ability

    (a) to synthesize proteins

    (b) to practice photosynthesis

    (c) to produce lipids

    (d) to produce carbon dioxide

21. A nucleus has less mass than the sum of masses of its constituent protons and neutrons because

    (a) of its binding energy

    (b) of emission of beta particles during its formation

    (c) the volume of nucleus is large

    (d) the volume of nucleus is small

22. A man enters a well 200 metres deep. His weight will be

    (a) the same as on the surface

    (b) more than that on the surface

    (c) less than that on the surface

    (d) zero

23. Two very light balls made of plastic are suspended with a very narrow spacing between them. If air is blown through this space, the balls will

    (a) remain stationary

    (b) move apart

    (c) be blown very far apart

    (d) come closer

24. A blotting paper absorbs ink which is due to the phenomenon of

    (a) surface tension

    (b) viscosity

    (c) osmosis

    (d) diffusion

25. An iron ball is embedded inside an ice cube floating on water in a measuring flask. What would happen when the ice cube melts completely?

(a) The water level will first fall and then rise

(b) There will be no change in water level

(c) The water level will fall

(d) The water level will rise

26. According to Kepler, the path traced by each planet of the solar system is an ellipse with the sun at one focus. If T is the time of one revolution of the planet in its orbit with semi-major axis a and semi-minor axis b, then

(a) $T^2/a^2 = $ constant

(b) $T^2/a^3 = $ constant

(c) $T^2/b^2 = $ constant

(d) $T^2/b^3 = $ constant

27. If there are n molecules of a gas per unit volume in a room at temperature T, the gas pressure will be

(a) $\frac{3}{2}nRT$

(b) $\frac{3}{2}nkT$

(c) nkT

(d) nRT

28. If G is the gravitational constant and g the acceleration due to gravity on the Moon, the escape velocity on the surface of the Moon assuming it to be a sphere of radius R is given by

(a) $\sqrt{2gR}$

(b) $\sqrt{gR/2}$

(c) $\sqrt{2gGR}$

(d) $\sqrt{2gR/G}$

29. The spectrum resulting from blackbody radiation is

(a) line spectrum

(b) continuous spectrum

(c) band spectrum

(d) line as well as band spectrum

30. When the slit is illuminated with white light in a Fresnel biprism experiment

(a) no fringes are formed

(b) bright red and dark fringes are formed

(c) bright blue and dark fringes are formed ·

(d) the central fringe is white

31. The ratio of speed of sound in nitrogen gas and in helium gas at 300 K is

(a) $\sqrt{3/5}$

(b) $\sqrt{3}/5$

(c) $\sqrt{2/7}$

(d) $\sqrt{2}/7$

32. When pressure is exerted on a fluid by an external force, it is transmitted equally in all directions. This fact is known as

(a) Bernoulli principle

(b) Pascal's principle

(c) Archimedes principle

(d) Euler principle

33. The internal energy of a gas increases when it

(a) expands isothermally

(b) is compressed isothermally

(c) is compressed adiabatically

(d) expands adiabatically

34. The snow on the mountains melts very slowly by the sunlight because

(a) its conductivity is very low

(b) the air pressure on the mountains is low

(c) it reflects most of the sunlight

(d) its latent heat of fusion is high

35. No charge flows between two electrically charged bodies connected by a metallic wire when they have the same

    (a)   potential

    (b)   charge

    (c)   capacity

    (d)   resistance

36. The de Broglie relationship is expressed as

    (a) $\lambda = \dfrac{h}{\upsilon}$

    (b) $\lambda = \dfrac{m}{\upsilon}$

    (c) $\lambda = \dfrac{h}{m\upsilon}$

    (d) $\lambda = \dfrac{h}{m}$

37. Mohr's salt is a/an

    (a)   simple salt

    (b)   coordination compound

    (c)   organometallic compound

    (d)   double salt

38. Ice floats on water because of the

    (a)   stronger hydrogen bonding in ice than water

    (b)   weaker hydrogen bonding in ice than water

    (c)   stronger ionic bonding in water than ice

    (d)   stronger ionic bonding in ice than in water

39. Which of the following has the lowest bond angle?

   (a) OF_2

   (b) Cl_2O

   (c) NH_3

   (d) OH_2

40. The blue colour of $CuSO_4 \cdot 5H_2O$ is due to

   (a) SO_4^{2-} ion

   (b) water of hydration

   (c) d^9 configuration of copper ion

   (d) metallic character of copper

41. 2-Butanol on treatment with HCl mainly gives

   (a) 1-butene

   (b) 2-butene

   (c) 2-methyl propene

   (d) 1-chlorobutane

42. Boiling point of water is

   (a) 100 °C

   (b) 89 °C

   (c) 62 °C

   (d) dependent on pressure

43. Aniline is an

   (a) aromatic carboxylic acid

   (b) aromatic amine

   (c) aliphatic amine

   (d) aliphatic carboxylic acid

73/66

44. N, S, halogens in organic compound analysis are detected by

(a) Lassaigne's test

(b) Carius method

(c) Kjeldahl's method

(d) Dumas method

45. Baeyer's reagent is

(a) cold dilute alkaline $KMnO_4$

(b) aqueous $KMnO_4$

(c) acidic $KMnO_4$

(d) concentrated $KMnO_4$ solution

46. Major constituent of natural gas is

(a) methane

(b) propane

(c) LPG

(d) butane

47. For exothermic reaction

(a) reaction enthalpy is (+)

(b) reaction enthalpy is (−)

(c) reaction entropy is (+)

(d) reaction entropy is (−)

48. Radioactive decay follows —— kinetics.

(a) zero-order

(b) first-order

(c) second-order

(d) third-order

49. The vapour pressure (p) of an ideal solution of a non-volatile solute (mole fraction x) is given by

(a) $p = x / p^0$

(b) $p = p^0 / x$

(c) $p = 1 / xp^0$

(d) $p = xp^0$

50. Splitting of spectral lines in an electric field is known as

(a) Zeeman effect

(b) Compton effect

(c) Stark effect

(d) Bohr effect

51. The general solution of the differential equation $\sin x \, dy/dx + y \cos x = 1$ is

(a) $y \sin x = x + A$

(b) $y \cos x = x + A$

(c) $y = x \sin x + A \cos x$

(d) $y = x \cos x + A \sin x$

52. The equation of the tangent to the curve $x^2 + 3y^2 + x + 6y + 4 = 0$ at the origin is

(a) $2x + 3y + 2 = 0$

(b) $3x + 2y + 2 = 0$

(c) $2x + 3y + 4 = 0$

(d) Tangent cannot be drawn

53. The equation of the plane perpendicular to the straight line $(x - 1)/-1 = (y - 2)/1 = z/2$ and through $(1, 1, 1)$ is

(a) $x - y + 2z = 2$

(b) $-x + y + 2z = 2$

(c) $x + 2y - z = 2$

(d) $2x - y + z = 2$

54. Let A, B be two subsets of a set X such that $A \cap B = \phi$. Then

(a) $A \subseteq (X - B)$

(b) $(X - A) \cap (X - B) = \phi$

(c) $(X - A) \cup (X - B) = \phi$

(d) $(X - B) \subseteq A$

55. The sum of the squares of the first 100 natural numbers is

   (a) 383350

   (b) 833350

   (c) 583330

   (d) 338350

56. The area of the region formed by the curve $xy = 1$ and the straight lines $x = 1$, $x = e$ and $y = 0$ is

   (a) 5 square units

   (b) e square units

   (c) $2e$ square units

   (d) 1 square unit

57. The function $f(x) = \sin x$ is

   (a) one-to-one and onto from $[0, \pi/2]$ to $[0, 1]$

   (b) one-to-one and onto from $[0, \pi]$ to $[0, 1]$

   (c) one-to-one and onto from $[0, \pi/2]$ to $[0, \pi/2]$

   (d) one-to-one and onto from $[0, \pi]$ to $[0, \pi]$

58. If $\log_y x = 5$, then $\log_x y$ is equal to

   (a) 2

   (b) 4

   (c) $\frac{1}{2}$

   (d) $\frac{1}{5}$

59. If ω is a complex cube root of unity, $\omega^{100} + \omega^{17} + 1$ is equal to

   (a) 0

   (b) -3

   (c) 3

   (d) -1

60. A fair coin is tossed 10 times. The probability that head appears exactly three times is

   (a) $3/10$

   (b) $3/20$

   (c) $15/2^6$

   (d) $15/2^7$

61. The role of sigma factor in prokaryotic transcription is

    (a) in proper assembly of RNA polymerase

    (b) to prolong the RNA synthesis activity of RNA polymerase

    (c) to keep RNA polymerase subunits intact during transcription

    (d) to help in specific binding of RNA polymerase to promoter region for initiating transcription

62. The mature B cells before encountering antigens, express

    (a) only IgM isotype antibodies on their surface

    (b) both IgM and IgD isotype antibodies with same antigen specificity on their surface

    (c) transient pre-B cell receptor on their surface

    (d) only IgG isotype antibodies on their surface

63. Which of the following answers completes the sentence correctly?

    The phosphofructokinase and the pyruvate kinase reactions are similar in that

    (a) both generate ATP

    (b) both involve a 'high-energy' sugar derivative

    (c) both involve three-carbon compounds

    (d) both are essentially irreversible

64. Triton X-100 is a surfactant that forms micellar structure in aqueous solutions. One can form reverse micelles of the surfactants easily by

    (a) addition of salts

    (b) making the pH acidic from alkaline

    (c) addition of heavy metal ions

    (d) addition of non-polar solvents

65. The elevation of intracellular level of inositol triphosphate (IP_3) results in the release of Ca^{2+} from which of the following organelles?

    (a) Mitochondria

    (b) Endoplasmic reticulum

    (c) Peroxisomes

    (d) Lysosomes

77/66

66. In a population that is in Hardy-Weinberg equilibrium, 16% of the individuals show the recessive trait. What is the frequency of the dominant allele in the population?

(a) 0·84

(b) 0·6

(c) 0·49

(d) 0·09

67. Klenow fragment is obtained from DNA polymerase I. It retains which of the following activities of the holoenzyme?

(a) $3' \rightarrow 5'$ exonuclease activity and $5' \rightarrow 3'$ polymerase activity

(b) $3' \rightarrow 5'$ exonuclease activity and $5' \rightarrow 3'$ exonuclease activity

(c) $5' \rightarrow 3'$ exonuclease activity and $5' \rightarrow 3'$ polymerase activity

(d) Only $5' \rightarrow 3'$ exonuclease activity

68. Formation of acetaldehyde from pyruvate is achieved by

(a) lactate dehydrogenase

(b) pyruvate decarboxylase

(c) pyruvate dehydrogenase

(d) pyruvate kinase

69. How large would you expect the gene for a 40000-dalton protein in a eukaryote to be if each amino acid weighs about 100 daltons; there is five times as much intron as exon sequence in the gene? (Ignore the contribution of the promoter and the 5' and 3' untranslated regions.)

(a) ~ 1200 bp

(b) > 1200 bp

(c) ~ 2400 bp

(d) ~ 7200 bp

70. SDS is used in polyacrylamide gel electrophoresis of a mixture of proteins for their efficient separation on the gel. SDS, in this experiment, is used to

(a) solubilize the protein

(b) stabilize the protein

(c) decrease the surface tension of buffer

(d) have uniform charge density on the proteins

71. Cleavage of an IgG molecule by the protease, papain, produces

    (a) an antigen-binding site and two constant regions

    (b) two heavy chain-light chain dimers

    (c) $F(ab)_2$ fragment and Fc fragment

    (d) two Fab fragments and one Fc fragment

72. Which of the following is the best method to determine bacteriophage concentration in a sample?

    (a) Spectrophotometry

    (b) Plaque assay

    (c) Light microscopy

    (d) Copy number assay

73. An enveloped virus has gene 'A' which codes for transcriptional activator, gene 'B' for capsid protein, gene 'C' for matrix protein, and gene 'D' codes for envelope protein. Upon normal course of infection, which one would most likely generate a neutralizing antibody?

    (a) Gene A

    (b) Gene B

    (c) Gene C

    (d) Gene D

74. A mammalian cell has an outstretched double-stranded DNA of 1·2 metres which duplicates in 4 hr. If it duplicates at the rate of 20 micrometres/min, how many origins of replication are there in the DNA?

    (a) 2500

    (b) 250

    (c) 25

    (d) 1

75. State which of the following statements is correct for a reaction of the type : $A + B \Leftrightarrow AB$

    (a) Larger the value of the equilibrium constant, weaker the binding between A and B

    (b) Lower the value of the equilibrium constant, stronger the binding between A and B

    (c) Larger the value of the equilibrium constant, stronger the binding between A and B

    (d) This is a third-order reaction

76. The wall-less mycoplasmas are considered to be related to gram-positive bacteria. Which of the following would provide the most compelling evidence for this?

(a) They share common rRNA sequence

(b) Both groups are prokaryotic and human pathogens

(c) Some gram-positive bacteria and some mycoplasmas produce catalase

(d) Some gram-positive bacteria and some mycoplasmas have coccus-shaped cells

77. A bacterial strain can grow on agar supplemented with arginine (Arg), tryptophan (Trp) and histidine (His). It fails to grow on agar containing (I) only Arg and Trp or (II) only His and Trp. It will grow if (III) only Arg and His are present. What is the genotype of the bacterium with respect to these three amino acids?

(a) $Arg^+His^+Trp^-$

(b) $Arg^-His^-Trp^+$

(c) $Arg^+His^-Trp^+$

(d) $Arg^-His^+Trp^+$

78. A bacterial population increases from 1×10^2 cells/ml to 1×10^9 cells/ml in 10 hr. What is the growth rate?

(a) $2\cdot3$ generations/hr

(b) $1\cdot5$ generations/hr

(c) $1\cdot8$ generations/hr

(d) 2 generations/hr

79. When one uses a native glycoprotein antigen for immunization, it will mostly produce antibodies against

(a) hydrophobic domains of the antigen

(b) sugar part of the antigen

(c) conformation of the antigen

(d) sequential epitopes present in the antigen

80. 'Ramachandran plot' is well-known for the elegant contributions towards understanding the conformations of polypeptides by the Indian scientist Prof. G. N. Ramachandran. In this plot, the values of the dihedral angle ψ (psi) are based on rotation around

(a) $N—C^\alpha$ bond

(b) $C^\alpha—C'$ bond

(c) $C'—N$ bond

(d) $N—H$ bond

81. For hydrophobic interactions to occur between two non-polar (—CH_2) groups of leucine and valine side chains, the change in entropy ΔS at a given temperature would be

   (a) +ve

   (b) −ve

   (c) zero

   (d) dependent on ΔH

82. A protein solution in water having a concentration of 1 mg/ml and an extinction coefficient value of 0.738 ml/mg-cm is placed in a quartz cuvette of 1 cm path length in a UV spectrometer. The absorbance of the solution at its λ_{max} would be

   (a) 0.738

   (b) 1.355

   (c) 0.0738

   (d) 0.262

83. A globular protein that is water-soluble, would have which of the following amino acids buried in its core?

   (a) Arginine

   (b) Phenylalanine

   (c) Serine

   (d) Aspartate

84. Vitamin K is required for which of the following amino acid modifications?

   (a) Proline to hydroxyproline

   (b) Lysine to β-methyllysine

   (c) Lysine to hydroxylysine

   (d) Glutamate to γ-carboxyglutamate

85. In the clover butterfly, all males are yellow, but females may be yellow if they are homozygous (cc) or white if they possess the dominant allele (C-). Mating between heterozygous is expected to produce a progeny containing

   (a) $\frac{1}{2}$ yellow : $\frac{1}{2}$ white

   (b) $\frac{3}{4}$ white : $\frac{1}{4}$ yellow

   (c) $\frac{3}{8}$ white : $\frac{5}{8}$ yellow

   (d) $\frac{9}{16}$ yellow : $\frac{7}{16}$ white

86. Differentiation of most somatic cells does not appear to involve the loss of genes or recombination of DNA segments. The most striking exception to this rule is found in

(a) histone genes

(b) immunoglobulin genes

(c) mitochondrial genes

(d) hemoglobin genes

87. The discoidal pattern of cleavage occurs in

(a) telolecithal eggs

(b) centrolecithal eggs

(c) isolecithal eggs

(d) alecithal eggs

88. Which of the following has all the generally accepted characteristic features of G-band?

(a) Giemsa dark, quinacrine bright, A—T rich, late replicating band

(b) Giemsa light, quinacrine bright, A—T rich, early replicating band

(c) Giemsa dark, quinacrine dull, G—C rich, late replicating band

(d) Giemsa light, quinacrine dull, G—C rich, early replicating band

89. Homeotic genes code for

(a) transcription factors having a 60-amino acid-long conserved domain and they give positional information

(b) tyrosine kinases with conserved SH2 domain and they give molecular address to body parts

(c) transmembrane proteins having characteristic transmembrane domains involved in signal transduction

(d) G-protein with GTPase activity that participates in signalling process during early development

90. In transmembrane proteins, the distribution of hydrophilic and hydrophobic amino acids would be the following

(a) Residues on the surface of protein are hydrophilic and buried residues are hydrophobic

(b) Residues on the surface of protein are hydrophobic and buried residues are hydrophilic

(c) Hydrophobic and hydrophilic residues are randomly distributed

(d) Transmembrane proteins contain mostly hydrophilic residues

91. The nature of DNA melting curve is

   (a) hyperbolic

   (b) parabolic

   (c) straight line

   (d) sigmoidal

92. During the replication of a lysogenic phage in its specific host cell, the late proteins are involved in

   (a) integration of prophage DNA into host DNA

   (b) excision of prophage DNA from host DNA

   (c) replication of the phage nucleic acid

   (d) phage assembly and escape from its host cell

93. When chromatin is completely digested with micrococcal nuclease, what is the length of the resulting pieces of DNA?

   (a) Random number of base pairs

   (b) About 200 base pairs

   (c) About 60 base pairs

   (d) About 80 base pairs

94. Cell culture initiated by excised and disrupted tissues is called as

   (a) cell line

   (b) primary cell culture

   (c) cell strain

   (d) secondary cell culture

95. Systemic lupus erythematosus is an example of a/an

   (a) genetic disease

   (b) autoimmune disease

   (c) congenital disease

   (d) cancer

96. The causative agent of visceral leishmaniasis is

   (a) *Leishmania donovani*

   (b) *Leishmania major*

   (c) *Leishmania braziliensis*

   (d) *Leishmania amazonensis*

83/66

97. The organism that represents both unicellular and multicellular organizations during its life cycle is

(a) *Caenorhabditis elegans*

(b) *Dictyostelium discoideum*

(c) *Euglena viridis*

(d) *Leishmania donovani*

98. Taxol is an inhibitor of

(a) DNA synthesis

(b) protein transport

(c) signal transduction

(d) microtubule polymerization

99. Reverse transcription polymerase chain reaction is related to

(a) Southern blot analysis

(b) Northern blot analysis

(c) Western blot analysis

(d) DNA synthesis

100. The distance traveled per turn of α-helix in nm is

(a) 0·34

(b) 0·44

(c) 0·54

(d) 0·64

101. Sanger's method of DNA sequencing involves

(a) chemical reactions to cleave DNA at specific bases

(b) introduction of radiolabel at 5′ or 3′ end

(c) large number of identical DNA molecules to be sequenced

(d) use of dideoxynucleoside triphosphate analogs

2. In order to use enzymes as digestive aids, in which order will you screen organisms?

(a) Fungi, bacteria, yeasts, actinomycetes

(b) Bacteria, yeasts, actinomycetes, fungi

(c) Actinomycetes, yeasts, fungi, bacteria

(d) Yeasts, fungi, bacteria, actinomycetes

103. An elevated level of creatine kinase in the blood serum will lead to the diagnosis of
    (a) hepatitis
    (b) early myocardial infarction
    (c) late myocardial infarction
    (d) prostate carcinoma

104. In order to decrease the level of hemicellulose in plant products, which of the following enzymes will you use?
    (a) Cellulase, amylase, pectinase
    (b) Arabinase, mannase, cellulase
    (c) Pectinase, mannase, xylanase
    (d) Mannase, xylanase, arabinase

105. Which of the following is *not* found in electron transport chain of mammalian mitochondria but found in plant and fungi mitochondria?
    (a) Alternative oxidase
    (b) ATP synthase
    (c) Cytochrome oxidase
    (d) Cytochrome c

106. Which particular feature is *not* shared by pteridophytes and gymnosperms?
    (a) Plant body is differentiated into stem, leaves and roots
    (b) Presence of vascular tissues
    (c) Alternation of generation
    (d) Secondary growth in stem and root

107. Which one of the following is the main carbon reserve in bacteria?
    (a) Poly-β-hydroxybutyrate
    (b) Starch
    (c) Sucrose
    (d) Lignin

108. Where would all atmospheric nitrogen eventually accumulate in the absence of denitrification?
    (a) Sea
    (b) Soil
    (c) Plants
    (d) Animals

109. An extracellular ligand will

(a) elicit the same response in various cells that have a receptor for the ligand

(b) elicit the same response but to varying degrees in various cells that have a receptor for the ligand

(c) elicit different responses in various cells that have a receptor for the ligand

(d) elicit the same response in all types of cells because receptors have to be identical to bind to the same ligand

110. In a couple, husband has an X-linked deadly disease and wife is homozygous normal. Which of the following is true?

(a) They will have 50% chance of male child having the disease

(b) They can safely go for only female child

(c) They can safely go for only male child

(d) They should not plan for any child

111. The law of conservation of momentum can be derived from the use of

(a) Newton's second law alone

(b) Newton's second and third laws

(c) Newton's third law alone

(d) Newton's first and third laws

112. Which of the following is true for the second law of thermodynamics?

(a) It can be expressed by a mathematical equation

(b) It gives magnitude of change

(c) It specifies a direction of change

(d) It cannot be applied to the behaviour of organisms

113. Which of the following is true for the formation of spectra by a grating and a prism using a white light source?

(a) Red light is more deviated in a prism than the violet

(b) Green light is more deviated in a grating than the red

(c) Red light is more deviated in a grating than the violet

(d) Violet light is similarly deviated both in the prism and in the grating

114. Maxwell's theoretical concept of displacement current is an example of

(a) changing electric field creating a magnetic field

(b) changing magnetic field creating an electric field

(c) chemical energy converted into electrical energy

(d) perpetual motion of electric charges

86|66 53/65 60|66

115. A laser beam violates the following while propagating through air

    (a) Rectilinear propagation of light

    (b) Inverse square law of variation of light intensity with distance from the source

    (c) Scattering of light by dust particles

    (d) Total internal reflection

116. The precession of the Mercury's orbit around the Sun is explained by

    (a) gravitational force of outer planets of solar system

    (b) gravitational force of stars of the central galaxy

    (c) special theory of relativity

    (d) general theory of relativity

117. The flash spectrum recorded during total solar eclipse consists of

    (a) continuous colours from red to violet

    (b) dark lines in continuous spectrum

    (c) bright spectral lines

    (d) dark as well as bright spectral lines

118. In the beta decay of the free neutron, the hypothesis of neutrino is used for conservation of

    (a) charge and angular momentum

    (b) linear and angular momenta

    (c) energy and linear momentum

    (d) energy, charge, linear and angular momenta

119. The existence of zero-point energy of harmonic oscillator in quantum mechanics is a consequence of

    (a) conservation of linear momentum

    (b) conservation of angular momentum

    (c) conservation of energy

    (d) uncertainty principle

120. The role of grid in a triode valve is to create a

    (a) weak repelling force on electrons

    (b) weak attracting force on electrons

    (c) weak magnetic field

    (d) strong magnetic field

121. The result of the Michelson-Morley experiment is consistent with

    (a)   the presence of ether in empty space

    (b)   different speeds of light for moving observers

    (c)   same speed of light for moving observers

    (d)   a fixed speed of light in ether

122. A rocket is propelled forward by a stream of gas from a hot chamber through a nozzle. This is an example of conversion of

    (a)   chemical energy to mechanical energy

    (b)   internal energy to bulk kinetic energy

    (c)   order into disorder

    (d)   mechanical energy to internal energy

123. The reflection of ultrasonic waves at the boundary of two media occurs according to

    (a)   Weber-Fechner law

    (b)   Helmholtz's theorem

    (c)   Bernoulli's principle

    (d)   the laws of geometric optics

124. The viscosity of a fluid results from the transport of the following quantity from one layer to the other

    (a)   Mass

    (b)   Momentum

    (c)   Kinetic energy

    (d)   Potential energy

125. In a moving fluid if u is the fluid velocity at a point and v is the velocity of sound at that point, the ratio u/v is called

    (a)   Reynolds' number

    (b)   Froude number

    (c)   Strouhal number

    (d)   Mach number

126. On a flying airplane, in addition to the downward force of gravity F_g, there is a net upward component of force F_l called lift, a net backward force F_d called drag and a net forward force F_t called thrust. If the airplane moves with constant velocity, then

    (a) $F_l = F_g$

    (b) $F_t > F_d$

    (c) $F_t = F_d$

    (d)   vector sum of F_t, F_d, F_l, F_g is zero

127. If an object moves under the influence of a central force which varies inversely with square of the distance, its trajectory will be
    (a) a circle or an ellipse
    (b) a parabola
    (c) a hyperbola
    (d) a circle or an ellipse or a parabola or a hyperbola

128. Diamond and graphite both contain carbon atoms but diamond is an insulator and graphite is a good conductor of electricity. This is due to difference in their
    (a) crystal structure
    (b) transparency
    (c) density
    (d) hardness

129. By applying a magnetic field to a superconductor, its critical temperature
    (a) is increased
    (b) is reduced
    (c) remains unchanged
    (d) first increases then decreases

130. By increasing the dopant density on both sides of a p-n junction
    (a) built-in voltage increases and depletion width decreases
    (b) both built-in voltage and depletion width increase
    (c) built-in voltage decreases and depletion width increases
    (d) both built-in voltage and depletion width decrease

131. NH_3 and BF_3 combine readily because of formation of
    (a) an ionic bond
    (b) a coordinate bond
    (c) a hydrogen bond
    (d) a covalent bond

132. In the brown ring test of NO_3^- ion, the formula of the complex formed is
    (a) $[Fe(NO)SO_4]H_2O$
    (b) $[Fe(NO)SO_4]2H_2O$
    (c) $[FeSO_4]NO$
    (d) $[Fe(NO)(H_2O)_5]SO_4$

133. Replacement of one hydrogen atom in ammonia molecule with —OH group

(a) increases the basicity

(b) decreases the basicity

(c) neither increases nor decreases the basicity

(d) increases both acidity and basicity

134. The formula of inorganic benzene is

(a) $B_3N_3F_6$

(b) $B_3N_3H_6$

(c) C_6H_6

(d) C_6H_5OH

135. The oxidation state of Xe in $XeOF_4$ is

(a) +VI

(b) +IV

(c) +VIII

(d) +II

136. $[Ti(H_2O)_6]^{3+}$ is purple coloured due to

(a) charge-transfer transition

(b) f-f transition

(c) d-d transition

(d) crystal defect

137. Which of the following is *not* formed?

(a) OF_6

(b) SF_6

(c) SeF_6

(d) TeF_6

138. Claisen condensation of ethyl acetate with sodium ethoxide gives a/an

(a) α-ketoester

(b) β-ketoester

(c) γ-ketoester

(d) α-ketocarboxylic acid

139. IUPAC name of stearic acid is

(a) hexadecanoic acid

(b) octadecanoic acid

(c) cis-9,12-octadecadienoic acid

(d) cis-9-octadecanoic acid

140. Bromination of trans-2-butene gives

(a) meso-2,3-dibromobutane

(b) racemic 2,3-dibromobutane

(c) (R, R)-2,3-dibromobutane

(d) (S, S)-2,3-dibromobutane

141. Hardness of water can be estimated in laboratory by

(a) complexometric titration

(b) argentometric titration

(c) iodimetric titration

(d) iodometric titration

142. Which of the following is aromatic?

(a) Cyclohexadienyl anion

(b) Cyclopentadienyl anion

(c) Cyclopentadienyl cation

(d) Cyclohexadienyl cation

143. Bromobenzene on treatment with sodamide in ammonia gives aniline. The reaction involves a

(a) ketene

(b) carbene

(c) carbanion

(d) benzyne intermediate

144. Rate of hydrolysis of RCOL is maximum when L is

(a) NH_2

(b) $OCOCH_3$

(c) OCH_2CH_3

(d) Cl

145. Which of the following acids has the lowest pK_a value?

(a) Phenyl acetic acid

(b) Acetic acid

(c) Formic acid

(d) Benzoic acid

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146. What is the pH of a buffer solution made by using 10 ml of $0.2\,M$ sodium acetate and 30 ml of $0.1\,M$ acetic acid? (pK_a of acetic acid ~ 4.75)

   (a) 4.45

   (b) 4.58

   (c) 4.92

   (d) 5.05

147. The enthalpy change of an adiabatic expansion of two moles of an ideal gas, when its temperature decreases from 300 K to 200 K during the expansion (consider $C_p = 20\,J\,K^{-1}\,mol^{-1}$), would be

   (a) 2 kJ

   (b) 4 kJ

   (c) – 2 kJ

   (d) – 4 kJ

148. In the following nuclear fusion reaction, what would be the appropriate combination of X and Y particles?

$$_{92}U^{236} \rightarrow\ _{40}Zr^{94} +\ _{58}Ce^{140} + X + Y$$
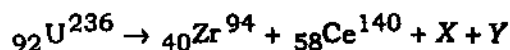
   (a) X = two beta and Y = three alpha

   (b) X = three beta and Y = two alpha

   (c) X = two beta and Y = six neutron

   (d) X = six beta and Y = two neutron

149. What would be the e.m.f. of the following cell?

$$Cu | Cu^{2+}\ (a = 0.01) \parallel Ag^+\ (a = 0.01) | Ag$$
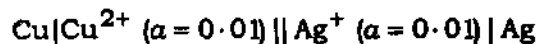
   (Given : $E^\circ_{Cu^{2+}/Cu} = 0.34\ V,\ E^\circ_{Ag^+/Ag} = 0.79\ V$)

   (a) 0.420 V

   (b) 0.390 V

   (c) – 0.390 V

   (d) – 0.420 V

150. For a van der Waals gas subjected to Joule-Thomson experiment, there will be cooling only if

   (a) $2a\,/\,RT = b$

   (b) $2a\,/\,RT < b$

   (c) $2a\,/\,RT > b$

   (d) $2b\,/\,RT > a$

151. The function $f(x) = x|x|$ is

(a) differentiable at $x = 0$ and $\dfrac{df}{dx}$ at $x = 0$ is 0

(b) not differentiable though continuous at $x = 0$

(c) not continuous at $x = 0$

(d) differentiable at $x = 0$ and $\dfrac{df}{dx}$ at $x = 0$ is 1

152. The area and perimeter of a triangle formed by the straight lines $x = 0$, $y = 0$ and $y = mx + c$ are 6 square units and 12 units. The number of such possible straight lines $y = mx + c$

(a) is one only

(b) is exactly two

(c) is exactly four

(d) is exactly eight

153. The foot of the perpendicular from the origin to the straight line $(x - 1)/1 = (y - 1)/2 = (z - 1)/3$ is

(a) $(4/7, 1/7, -2/7)$

(b) $(1/7, -2/7, 4/7)$

(c) $(4/7, -2/7, 1/7)$

(d) $(-2/7, 1/7, 4/7)$

154. The sum of the nth roots of i is

(a) i

(b) -1

(c) 1

(d) 0

155. The eigenvalues of the matrix
$$\begin{pmatrix} 1 & 2+i & 0 \\ 2-i & 1 & 5-i \\ 0 & 5+i & 0 \end{pmatrix}$$

(a) are all real

(b) are one real and two non-real complex numbers

(c) are all non-real complex numbers

(d) are two real and one non-real complex number

156. $^nC_0 + {}^nC_1 + {}^nC_2 + \cdots + {}^nC_{n-1}$ equals to

(a) 2^n

(b) $2^n - 1$

(c) $2^n - 2$

(d) $2^n + 1$

157. If $P(A) = 2P(B)$, $P(A \cup B) = \dfrac{1}{2}$ and $P(A \cap B) = \dfrac{1}{3}$, then

(a) $P(B) = 5/18$

(b) $P(B) = 5/9$

(c) $P(B) = 5/36$

(d) $P(B) = 5/27$

158. The base and perpendicular of a right-angled triangle are the roots of the equation $x^2 - 8\alpha x + 2\alpha^2 = 0$, where α is a positive number. The area of the triangle is

(a) α^2 square units

(b) α square units

(c) 2α square units

(d) $2\alpha^2$ square units

159. The sum $\displaystyle\sum_{n=1}^{\infty} \dfrac{(-1)^{n+1}}{n2^n}$ equals to

(a) $\ln(3/2)$

(b) $\ln(1/2)$

(c) $3/2$

(d) $1/2$

160. Let X and Y be two sets such that X and Y have 10 elements in common. Then the number of elements common to $X \times Y$ and $Y \times X$ is

(a) 20

(b) 50

(c) 100

(d) 200

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