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Total Pages : 94

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.**

1/66

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

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

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

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) $9a_0$

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 $X_L = \frac{1}{\omega L}$

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

(d) $X_C = \frac{1}{\omega C}$ 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) 40·50 kJ K^{-1} mol^{-1}

(d) 75·48 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) 22·8

(b) 9·2

(c) 7·5

(d) 12·6

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

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

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 $\frac{dy}{dx}$ 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 $\frac{1}{4}$ ft/sec. How fast is the top moving after 12 sec?

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

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

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

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

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

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

(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) (4, 1)

(d) (0, 9)

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

(a) (0, 1)

(b) (0, e)

(c) (e, ∞)

(d) (0, ∞)

PART—B

Answer *any* **sixty** questions

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

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

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	B	C	D
(a)	ii	iii	i	iv
(b)	iv	i	iii	ii
(c)	iii	i	ii	iv
(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

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

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

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

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

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

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

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) $\frac{Q}{4\pi\varepsilon_0 R}$ (b) $\frac{Q}{2\pi\varepsilon_0 R}$

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

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) 0·889 (b) 0·458

(c) 0·210 (d) 0·542

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

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_4OH

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

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

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

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

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

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

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 $f(x) = \frac{\log x}{x}$, $x > 0$ 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

$$y \leq 1$$
$$2x + y \leq 2$$
$$x \geq 0, \quad y \geq 0$$

is

(a) 0

(b) 12

(c) 14

(d) 6