M.Sc. Bioinformatics

C-493

14P/212/2 Question Booklet No.....

(To be filled up by the candidate by blue/black ball-point pen)

Roll No. | | | | | | | | | |

Roll No.
(Write the digits in words) .....

Serial No. of OMR Answer Sheet .....

Day and Date ....
(Signature of Invigilator)

INSTRUCTIONS TO CANDIDATES

(Use only **blue/black ball-point pen** in the space above and on both sides of the Answer Sheet)

1. Within 10 minutes of the issue of the Question Booklet, check the Question Booklet to ensure that it contains all the pages in correct sequence and that no page/question is missing. In case of faulty Question Booklet bring it to the notice of the Superintendent/Invigilators immediately to obtain a fresh Question Booklet.
2. Do not bring any loose paper, written or blank, inside the Examination Hall *except the Admit Card without its envelope.*
3. A separate Answer Sheet is given. *It should not be folded or mutilated. A second Answer Sheet shall not be provided. Only the Answer Sheet will be evaluated.*
4. Write your *Roll Number and Serial Number of the Answer Sheet by pen* in the space provided above.
5. **On the front page of the Answer Sheet, write by pen your Roll Number in the space provided at the top, and by darkening the circles at the bottom. Also, wherever applicable, write the Question Booklet Number and the Set Number in appropriate places.**
6. No overwriting is allowed in the entries of Roll No., Question Booklet No. and Set No. (if any) on OMR sheet and also Roll No. and OMR Sheet No. on the Question Booklet.
7. Any change in the aforesaid entries is to be verified by the invigilator, otherwise it will be taken as unfair means.
8. Each question in this Booklet is followed by four alternative answers. *For each question, you are to record the correct option on the Answer Sheet by darkening the appropriate circle* in the corresponding row of the Answer Sheet, by ball-point pen as mentioned in the guidelines given on the first page of the Answer Sheet.
9. For each question, darken only one circle on the Answer Sheet. If you darken more than one circle or darken a circle partially, the answer will be treated as incorrect.
10. *Note that the answer once filled in ink cannot be changed.* If you *do not wish to attempt* a question, leave all the circles in the corresponding row blank (such question will be awarded zero mark).
11. For rough work, use the inner back page of the title cover and the blank page at the end of this Booklet.
12. Deposit *only the OMR Answer Sheet* at the end of the Test.
13. You are not permitted to leave the Examination Hall until the end of the Test.
14. If a candidate attempts to use any form of unfair means, he/she shall be liable to such punishment as the University may determine and impose on him/her.

[उपर्युक्त निर्देश हिन्दी में अन्तिम आवरण-पृष्ठ पर दिये गए हैं]

[No. of Printed Pages : 28+2

No. of Questions/प्रश्नों की संख्या : 150

Time/समय : 2½ Hours/घण्टे **Full Marks/पूर्णांक :** 450

Note/नोट : (1) This paper comprises of Two Sections, viz., Section—A and Section—B having 30 Multiple Choice Questions in Section—A, and 120 Multiple Choice Questions in Section—B comprising 40 questions of Biology, 40 questions of Chemistry and 40 questions of Physics. A candidate has to attempt all **150** questions.

(2) Attempt as many questions as you can. Each question carries **3** marks. **One** mark will be deducted for each incorrect answer. Zero mark will be awarded for each unattempted question.

(3) If more than one alternative answers seem to be approximate to the correct answer, choose the closest one.

Section—A

1. One of the formula for determining mode is

(1) mode = 2 (median) + 3 (mean)

(2) mode = 2 (median) − (mean)

(3) mode = 3 (median) + 2 (mean)

(4) mode = 3 (median) − 2 (mean)

2. A data has 25 observations arranged in descending order. Which observation represent the median?

(1) 12th (2) 13th (3) 14th (4) 15th

3. Chief component of first generation computer was

(1) transistors (2) vacuum tubes and valves

(3) integrated circuits (4) VLSI

4. Central processing unit is combination of

(1) control and storage (2) control and output unit

(3) arithmetic logic and input unit (4) arithmetic logic and control unit

5. Access time is

(1) seek time + latency time (2) seek time

(3) seek time – latency time (4) latency time

6. Which statement is valid?

(1) 1 KB = 1024 bytes (2) 1 MB = 1000 kilobytes

(3) 1 MB = 2048 bytes (4) 1 KB = 1000 bytes

7. Which of the following is problem oriented language?

(1) Machine language (2) Assembly language

(3) High level language (4) Low level language

8. The octal equivalent of 111010 is

(1) 81 (2) 72 (3) 71 (4) 65

9. The word processing task associated with changing the appearance of a document is

(1) editing (2) writing (3) formatting (4) All of the above

10. The personnel who deals with the computer and its management put together are called

(1) software (2) firmware (3) hardware (4) humanware

11. Which of the following is required to communicate between two computers?

(1) Communication software

(2) Protocol

(3) Communication hardware

(4) All of the above including access to transmission medium

12. A database language concerned with the definition of the whole database structure and schema is

(1) DCL (2) DDL (3) DML (4) All of the above

13. Debugging is

(1) creating program code

(2) finding and correcting errors in the program code

(3) identifying the task to be computerized

(4) creating the algorithm

14. If $A=\begin{bmatrix} a & -b \\ c & d \end{bmatrix}$, then A^{-1} = ?

(1) $ad-bc$ (2) $ad+bc$

(3) $\frac{1}{ad-bc}\begin{bmatrix} a & b \\ -c & d \end{bmatrix}$ (4) $\frac{1}{ad+bc}\begin{bmatrix} d & b \\ -c & a \end{bmatrix}$

15. If $\int_{\pi/2}^{a} \sin x\,dx = \frac{1}{2}$, then a = ?

(1) $-\pi/3$ (2) π (3) $-\pi/2$ (4) 1

16. If $f(x)=\frac{x+2}{3}$, then $f^{-1}(x)$ = ?

(1) $2x-3$ (2) $3x-2$ (3) $\frac{3}{x+2}$ (4) $\frac{2}{3x+4}$

17. $(\log_x xy)(\log_{xy} x^y)$ = ?

(1) x (2) xy (3) y (4) x^y

18. The probability of any event lies from

(1) 0 to 1 (2) -1 to 1 (3) -2 to 2 (4) -1 to 0

19. Two events A and B which do not occur simultaneously are called

(1) independent events (2) dependent events

(3) mutually exclusive events (4) not mutually exclusive events

20. The probability of drawing a diamond card randomly from a pack of 52 cards is

(1) 1 (2) $\frac{1}{52}$ (3) $\frac{1}{13}$ (4) $\frac{13}{52}$

21. The number of members of a family is

(1) discrete variable (2) continuous variable

(3) qualitative variable (4) All of these

22. If f is continuous on $[5, 2]$, and if F is an anti derivative of f on $[5, 2]$, where $F(2) = \frac{3}{2}$ and $F(5) = -\frac{4}{3}$. Then $\int_2^5 f(x)\,dx = ?$

(1) $\frac{2}{3}$ (2) $\frac{5}{7}$ (3) $\frac{-17}{6}$ (4) $\frac{-13}{6}$

23. If $y = \ln \frac{1}{x}$, then $\frac{dy}{dx} = ?$

(1) x (2) $-x$ (3) $\frac{1}{x}$ (4) $-\frac{1}{x}$

24. The straight line $2x + 3y + 4 = 0$ touches the x-axis at

(1) $x = -2$ (2) $x = 2$ (3) $x = 1$ (4) $x = -1$

25. The solution set of inequality $-8 \le 2(x-5) < 9$ is

(1) $\left(1, \frac{17}{2}\right)$ (2) $\left(1, \frac{19}{2}\right)$

(3) $\left(1, \frac{17}{2}\right) \cup \left(2, \frac{5}{2}\right)$ (4) $\left(1, \frac{19}{2}\right) \cup \left(2, \frac{5}{2}\right)$

26. A dice is tossed only once. What is the probability that the number is less than 3?

(1) 0 (2) $\frac{1}{4}$ (3) $\frac{1}{3}$ (4) $\frac{1}{2}$

27. If $\frac{dy}{dx}+2xy=y$, then y is

(1) $2e^{x-x^2}$ (2) e^{-x^2+x} (3) e^{-2x} (4) e^{-x^2}

28. A straight line through the origin 0 meets the parallel lines $4x+2y=9$ and $2x+y+6=0$ at points P and Q respectively. Then the point 0 divides the segment PQ in the ratio

(1) 1 : 2 (2) 3 : 4 (3) 2 : 1 (4) 4 : 3

29. Let $\vec{a}=2\hat{i}+\hat{j}+\hat{k}$, $\vec{b}=\hat{i}+2\hat{j}-\hat{k}$ and a unit vector $\vec{c}$ be coplanar. If $\vec{c}$ is perpendicular to $\vec{a}$, then $\vec{c}=$

(1) $\frac{1}{\sqrt{2}}(-\hat{j}+k)$ (2) $\frac{1}{\sqrt{3}}(-\hat{i}-\hat{j}-\hat{k})$

(3) $\frac{1}{\sqrt{5}}(\hat{i}-2\hat{j})$ (4) $\frac{1}{\sqrt{3}}(\hat{i}-\hat{j}-\hat{k})$

30. A sample of 35 observations has the mean 80 and SD as 4. A second sample of 65 observations from the same population has mean 70 and SD 3. The SD of the combined sample is

(1) 5·48 (2) 34·2 (3) 5·85 (4) 4·87

Section—B

BIOLOGY

31. Which one of the following is not a characteristic of living beings?

(1) A degree of orderliness

(2) The ability to respond to stimuli

(3) The capacity to grow, develop and reproduce

(4) The absence of regulatory processes that control and coordinate life functions

32. The elements which comprise large proportion of the weight of human body and other organisms are

(1) oxygen, hydrogen carbon and nitrogen

(2) oxygen, hydrogen, methane and iodine

(3) nitrogen, iodine, hydrogen and boron

(4) chlorine, oxygen, hydrogen and selenium

33. Choose the incorrect statement with regard to ATP

(1) ATP is a nucleic acid containing adenine

(2) ATP has three carbon sugars

(3) ATP has three phosphate groups

(4) ATP serves to transfer energy rather than store genetic information

34. Which of the following is used in genetic engineering?

(1) Restriction endonucleases

(2) DNA polymerases

(3) RNA polymerases

(4) Nucleases

35. In *Mimosa pudica* the turgor changes take place in

(1) leaflets (2) pulvinus (3) rachis (4) stem apex

36. The sub viral entities devoid of their own DNA/RNA are called

(1) Prions (2) Gemini viruses

(3) Meta viruses (4) Caulimo viruses

37. Which of the following statements is incorrect?

(1) *Batrachospermum* occurs in marine water

(2) Red snow is caused by *Chlamydomonas nivalis*

(3) Synzoospores are produced by *Vaucheria*

(4) *Trichodesmium erythreum* causes red colouration in Red Sea

38. Isomorphic type of life cycle is found in

(1) *Vaucheria* (2) *Oedogonium* (3) *Dictyota* (4) *Polysyiphonia*

39. The nucleotide sub units of RNA and DNA are made up of

(1) three elements (2) four elements

(3) five elements (4) two elements

40. A complete set of chromosomes inherited as a unit from one parent is called

(1) genotype (2) genome (3) euploid (4) aneuplosid

41. Changes in gene frequency in a small breeding population due to chance fluctuations are known as

(1) mutation (2) genetic equilibrium

(3) random genetic drift (4) Hardy-Weinberg law

42. The process of introduction of genetic material into a bacterium by a bacteriophage is termed

(1) transduction
(2) transformation
(3) conjugation
(4) transcription

43. The process of fusion of male gamete with the secondary nucleus of the embryo sac is called

(1) fertilization
(2) double fertilization
(3) parthenocarpy
(4) parthenogenesis

44. Secondary growths in the dicot stem and root takes place after the formation of lateral meristem is known as

(1) cork cambium
(2) vascular cambium
(3) procambium
(4) Casparian band

45. Quinine is obtained from

(1) *Quercus*
(2) *Cassia*
(3) *Cinchona*
(4) *Glycerrhiza*

46. MAB stands for

(1) Man and Biotic Community
(2) Man and Biosphere
(3) Man, Antibiotics and Bacteria
(4) Mayar, Anderson and Bisby

47. In the complete oxidation one molecule of glucose there is net gain of

(1) 12 ATP
(2) 36 ATP
(3) 8 ATP
(4) 2 ATP

48. Which of the following is incorrect?

(1) Diadelphous condition of stamens is found in Fabaceae

(2) Syngenesious anthers are found in Asteraceae

(3) Axile pacentation is found in Solanaceae

(4) Bicarpellary, syncarpous, inferior ovary is present in Malvaceae

49. In photosynthesis how many molecules of ATP and NAD PH2 are used

(1) 18 ATP and 12 NADPH2

(2) 12 ATP and 18 NADPH2

(3) 10 ATP and 12 NADPH2

(4) 38 ATP and 23 NADPH2

50. Some protists can lead animal like or plant like life. Which one of the following does not belong to this category?

(1) Acellular slime moulds

(2) Cellular slime moulds

(3) Euglenoid flagellates

(4) Paramecium

51. Glycogen is the polymer of

(1) fructose (2) galactose (3) glucose (4) sucrose

52. Which one of the following is not a high energy compound?

(1) ATP (2) GTP (3) CTP (4) AMP

53. Cytochrome is a

(1) metaloprotein

(2) glycoprotein

(3) phosphoprotein

(4) chromoprotein

54. Sea surface dwelling animals are known as

(1) lentic (2) lotic (3) pellagic (4) benthic

55. The first hypothalamic hormone discovered is

(1) TRH (2) GnRH (3) CRH (4) somatostatin

56. The principal enzyme for DNA replication in Prokaryotes is

(1) DNA polymerase I (2) DNA polymerase II

(3) DNA polymerase III (4) DNA polymerase IV

57. The initiation codon for protein synthesis is

(1) GUG (2) AUA (3) AGU (4) AUG

58. In eukaryote the messenger RNA is synthesised by

(1) RNA polymerase I (2) RNA polymerase II

(3) RNA polymerase III (4) poly A polymerase

59. Prior to ovulation in mammals the ovarian follicle is called

(1) the atretic follicle (2) the primordial follicle

(3) the secondary follicle (4) the Graafian follicle

60. Progesterone is primarily secreted by

(1) corpus iuteum (2) theca interna

(3) sertoli cells (4) theca externa

61. One of the following forms of DNA is left handed helix

(1) A-DNA (2) B-DNA (3) C-DNA (4) Z-DNA

62. Respiratory pigment in insect is

(1) haemoglobin (2) haemocyanin (3) cytochrome (4) chlorophyll

63. Anticodon is present in

(1) t-RNA (2) m-RNA (3) r-RNS (4) hn-RNA

64. Respiratory organ of whale is

(1) gills (2) skin (3) book lungs (4) lungs

65. How many molecules of oxygen is bound to one molecule of haemoglobin in human?

(1) One (2) Two (3) Three (4) Four

66. Glycogen is stored in

(1) kidney (2) lungs (3) blood (4) liver

67. Unit of muscle contraction is

(1) actin (2) myosin (3) actinin (4) actomyosin

68. Which one of the following pituitary hormones is pure protein?

(1) FSH (2) LH (3) TSH (4) Prolactin

69. How many types of immunoglobulins are found in human?

(1) Two (2) Three (3) Four (4) Five

70. One of the following hormones is called orphan hormone

(1) Oxytocin (2) ADH

(3) Insulin (4) Corisol

CHEMISTRY

71. Calculate the route mean square speed of methane (CH_4) in a sample at 25 °C

(1) $6{\cdot}2\ ms^{-1}$ (2) $10{\cdot}2\ ms^{-1}$ (3) $21{\cdot}5\ ms^{-1}$ (4) $6{\cdot}81\ ms^{-1}$

72. If equilibrium constant for reaction *(i)* and *(ii)*

(i) $CO(g)+H_2O(g) \rightleftharpoons CO_2(g)+H_2(g)$

(ii) $CH_4(g)+H_2O(g) \rightleftharpoons CO(g)+3H_2(g)$

are K_1 and K_2, the equilibrium constant for the reaction $CH_4(g)+2H_2O(g) \rightleftharpoons 4H_2(g)$

(1) K_1+K_2 (2) K_1-K_2 (3) K_1K_2 (4) K_1/K_2

73. The electronic configuration of gadolinium (Gd) is

(1) $[Xe]4f^7 5d^1 6s^2$ (2) $[Xe]4f^6 5d6s^2$

(3) $[Xe]4f^6 6s^2$ (4) $[Xe]4f^7 5d^1$

74. If 2 moles of perfect gas *A* are mixed with 3 moles of perfect gas *B*, the change of entropy will be

(1) $+185\ JK^{-1}$ (2) $+28\ JK^{-1}$ (3) $-12\ JK^{-1}$ (4) $-8{\cdot}34\ kJK^{-1}$

75. If *A* is absorbance, ϵ is molar absorptivity at λ_{max} of 1% solution of an organic compound the molecular weight of the compound will be

(1) $M = \epsilon / 10\ A$ (2) $M = 10 / A.\epsilon$

(3) $M = 100\ \epsilon / 10\ A$ (4) $M = 10\ \epsilon / A$

76. Which of the following has the highest bond order?

(1) N_2 (2) O_2 (3) He_2 (4) H_2

77. A complex compound in which the oxidation number of a metal is zero is

(1) $K_4[Fe(CN)_6]$ (2) $K_3[Fe(CN)_6]$

(3) $[Ni(CO)_4]$ (4) $[PI(NH_3)_4]Cl_2$

78. A buffer solution contains 0·1 mole of sodium acetate dissolved in 1000 cm^3 of 0·1 M acetic acid. To the above buffer solution, 0·1 mole of sodium acetate is further added and dissolved. The pH of the resulting buffer is equal to

(1) pK_a (2) $pK_a - \log 2$ (3) $pK_a + \log 2$ (4) $pK_a + 2$

79. Radius of $Fe^{2+} = 0{\cdot}077$ mm and radius of $O^{2-} = 0{\cdot}140$ nm. What will be the coordination number of Fe in FeO?

(1) 2 (2) 4 (3) 6 (4) 8

80. Schottky defect in ceramic materials is due to

(1) interstitial impurity

(2) vacancy-interstitial pair of cation

(3) pair of nearby cation-anion vacancy

(4) substitutional impurity

81. Which of the following compound would not evolve CO_2 when treated with $NaHCO_3$ solution?

(1) Salicylic acid (2) Phenol

(3) Benzoic acid (4) 4-nitro benzoic acid

82. A ligand can also be regarded as

(1) Lewis acid (2) Bronsted base

(3) Lewis base (4) Bronsted acid

83. Which of the following remains un-affected by temperature?

(1) Normality (2) Formality (3) Molarity (4) Molality

84. 'vant-Hoff factor' for an electrolyte is always

(1) less than one (2) greater than one

(3) equal to one (4) zero

85. Which of the following reagent confirms double bond in acetoacetic ester?

(1) Shiff's reagent (2) Bromine water

(3) Tollen's reagent (4) Fehling solution

86. When arsenic is added as an impurity to silicon, the resulting material is

(1) *n*-type semiconductor (2) *p*-type semiconductor

(3) *n*-type conductor (4) insulator

87. The number of atoms per unit cell in simple cubic f.c.c. and b.c.c. are

(1) 4, 2, 1 (2) 1, 2, 4 (3) 1, 4, 2 (4) 2, 4, 1

88. If a material has AB_2X_4 type structure and FCC anion packing it belongs to structure type

(1) Rock salt (2) Perovskite (3) Zinc blend (4) Spinel

89. $E^\circ(Cu^{2+}/Cu) = +0{\cdot}34$ V. What is the value of E (at 298 K) for an aqueous solution in which $[Cu^{2+}] = 0{\cdot}02$ mol dm^{-3} ?

(1) 0·29 V (2) 0·32 V (3) 0·39 V (4) 0·36 V

90. In SF_6 molecule, which of the following hybridization is involved?

(1) sp^3 (2) sp^3d (3) sp^3d^2 (4) sp^3d^3

91. The activation energy for a reaction may be obtained from a graph of

(1) logarithm of specific rate constant versus the reciprocal of absolute temperature

(2) specific rate constant versus absolute temperature

(3) specific rate constant versus concentration of reactant

(4) rate of reaction versus concentration of reactant

92. Which hybridization is found in acetylene?

(1) sp (2) sp^2 (3) sp^3 (4) dsp^2

93. On exposure to air and sunlight chloroform is slowly oxidized to

(1) CCl_4 (2) $COCl_2$ (3) CH_3Cl (4) CH_2CHCl

94. Isocynides are obtained from

(1) Sandmeyer reaction (2) Wurez's reaction

(3) Friedal-Crafts reaction (4) Carbyl amine reaction

95. Critical temperature *Tc*, critical pressure *Pc* and critical volume *Vc* are related by the expression

(1) $\frac{Pc\,Vc}{Tc} = \frac{3}{8}R$ (2) $Pc\,Vc\,Tc = \frac{8}{3}R$

(3) $\frac{Pc}{Tc} = \frac{8}{3}R\,Vc$ (4) $Pc = \frac{8}{3}R\,Vc\,Tc$

96. On increasing the temperature, the rate of reaction is doubled per 10 °C. If the temperatures is increased by 50 °C, then rate of reaction will increase

(1) 12 times (2) 16 times (3) 32 times (4) 50 times

97. Wurtz-Fitting reaction involves interaction of metals between

(1) two molecules of an alkyl halide

(2) one molecule of an alkyl halide and one molecule of an aryl halide

(3) two molecules of an aryl halide

(4) two molecules of chloroform

98. Which of the following reaction is not given by benzaldehyde?

(1) Perkin reaction (2) Cannizzaro reaction

(3) Aldol condensation (4) Knoevenagel reaction

99. Which of the following conditions is necessary for a reaction to be spontaneous?

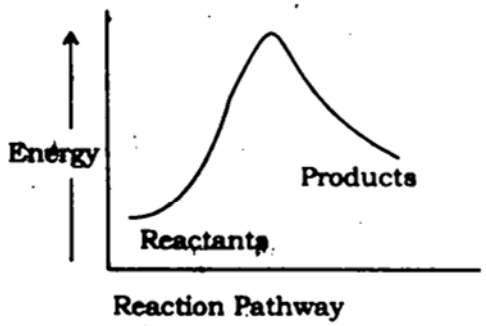
(1) ΔS sur > 0 (2) ΔS sys > 0

(3) ΔS sur $+ \Delta S$ sys > 0 (4) ΔS sur $+ \Delta S$ sys < 0

100. The 'conjugate acid' in the reaction of H_2SO_4 with NaOH is

(1) H_2SO_4 (2) NaOH (3) Na_2SO_4 (4) H_2O

101. The following reaction coordinate diagram represents



(1) an endothermic reaction

(2) an exothermic reaction

(3) a reaction that is neither endothermic nor exothermic

(4) a reaction in which a catalyst is used

102. If mass of the particle $= m$ and length of a one-dimensional box $= L$, the energy of a particle is by

(1) $\frac{nh}{8mL^2}$ (2) $\frac{n^2h^2}{8mL^2}$ (3) $\frac{nh}{8\pi mL^2}$ (4) $\frac{n^2h^2}{8mL}$

103. The resultant magnetic moment from number of unpaired electron can be calculated by the following formula

(1) $\sqrt{2n\,(n+2)}$ BM (2) $\sqrt{n\,(n+2)}$ BM

(3) $\sqrt{2n\,(2n+2)}$ BM (4) $\sqrt{n\,(n\mu 2)}$ BM

104. Ground term symbol of Mn^{2+} (25) is

(1) $^3F_2$ (2) $^2D_{3/2}$ (3) $^6S_{5/2}$ (4) $^5D_4$

105. Which of the following is true for an orthorhombic lattice?

(1) $a = b = c,\ \alpha = \beta = \gamma = 90°$ (2) $a \neq b \neq c,\ \alpha = \beta = \gamma = 90°$

(3) $a \neq b \neq c,\ \alpha = \gamma = 90°,\ \beta \neq 90°$ (4) $a = b \neq c,\ \alpha = \beta = \gamma$

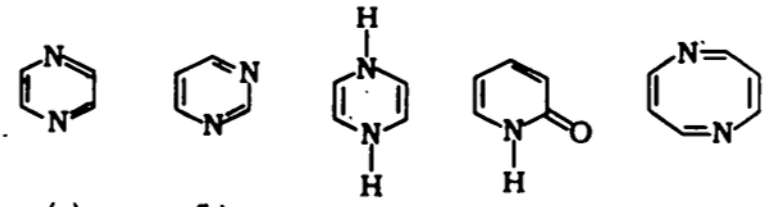
106. The time required for 100% completion of a zero-order reaction is

(1) $\frac{a}{2k}$ (2) ak (3) $\frac{2k}{a}$ (4) $\frac{a}{k}$

107. Consider the ground state of Cr atom ($Z = 24$). The numbers of electrons with the azimuthal quantum numbers, $l = 1$ and 2 are, respectively

(1) 12 and 4 (2) 12 and 5 (3) 16 and 4 (4) 16 and 5

108. Which of the following compounds are aromatic?



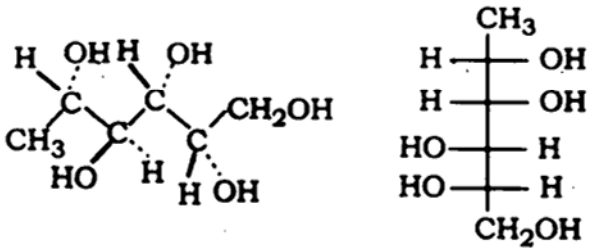
(a) (b) (c) (d) (e)

(1) (a), (b), (c) and (d)
(2) (a), (c) and (d)
(3) (a), (b), (d) and (e)
(4) (a), (b) and (d)

109. Which of the following compounds would have the highest boiling point?

(1) $CH_3CH_2CH_2CH_3$
(2) CH_3NH_2
(3) CH_3OH
(4) CH_2F_2

110. The following stereoisomers are related as



(1) enantiomers
(2) diastereomers
(3) epimers
(4) identical compounds

PHYSICS

111. Two vectors are given as $A = 2\hat{i} + 3\hat{j}$ and $B = \hat{i} + \hat{j}$. The component of the vector A perpendicular to vector B and the same plane as B is

(1) $\frac{1}{\sqrt{2}}(\hat{j} - \hat{i})$ (2) $\frac{3}{\sqrt{2}}(\hat{j} - \hat{i})$ (3) $\frac{5}{\sqrt{2}}(\hat{j} - \hat{i})$ (4) $\frac{1}{\sqrt{2}}(\hat{j} + \hat{i})$

112. A car accelerates from the rest at a constant rate α for some time after which decelerates at a constant rate β to come to the rest. If the total time elapsed is t, the maximum velocity acquired by the car is

(1) $\frac{\alpha\beta}{\alpha + \beta}t$ (2) $\frac{\alpha + \beta}{\alpha\beta}t$ (3) $\frac{\alpha^2 + \beta^2}{\alpha\beta}t$ (4) $\frac{\alpha^2 - \beta^2}{\alpha\beta}t$

113. Which of the following remains constant during the motion of a projectile fired from a planet?

(1) Kinetic energy (2) Momentum

(3) Vertical component of velocity (4) horizontal component of velocity

114. A is a vector which when added to the resultant of vectors $(2\hat{i} - 3\hat{j} + 4\hat{k})$ and $(\hat{i} + 5\hat{j} + 2\hat{k})$ yields a unit vector along y-axis. Then the vector A is

(1) $3\hat{i} + \hat{j} - 6\hat{k}$ (2) $-3\hat{i} - \hat{j} - 6\hat{k}$ (3) $3\hat{i} - \hat{j} + 6\hat{k}$ (4) $3\hat{i} + \hat{j} + 6\hat{k}$

115. The refractive index of a medium in terms of permeability and permittivity is

(1) $\sqrt{\frac{\mu\varepsilon}{\mu_0\varepsilon_0}}$ (2) $\sqrt{\frac{\mu_0\varepsilon_0}{\mu\varepsilon}}$ (3) $\sqrt{\frac{\mu\mu_0}{\varepsilon\varepsilon_0}}$ (4) $\sqrt{\frac{\varepsilon\varepsilon_0}{\mu\mu_0}}$

116. Find the velocity attained by an electron accelerated through a potential difference of 10 MeV. (Velocity of light is $c = 3 \times 10^8$ m/s)

(1) $0{\cdot}94\,c$ (2) $0{\cdot}99\,c$ (3) $6{\cdot}27\,c$ (4) $0{\cdot}89\,c$

117. A moving particle of mass m makes a head-on collision with a particle of mass $2m$ initially at rest. If the collision is perfectly elastic, the percentage loss of energy of colliding particle is

(1) 50 (2) 66·7 (3) 88·9 (4) 100

118. A carpet of mass M, made of an extensive material, is rolled along its length in the form of cylinder of radius R and kept on a rough floor. It the carpet is unrolled, without sliding, to a radius $\frac{R}{2}$, the decrease in potential energy is

(1) $\frac{1}{2}MgR$ (2) $\frac{5}{8}MgR$ (3) $\frac{3}{4}MgR$ (4) $\frac{7}{8}MgR$

119. If a million of tiny droplets of water coalesce into one larger droplet, the ratio of surface energy of the larger drop to the total surface energy of all droplets will be

(1) 1:10 (2) $1:10^2$ (3) $1:10^4$ (4) $1:10^6$

120. A small drop of water of surface tension σ is squeezed between two clean glass plates so that a thin layer of thickness d and area A is formed between them. If the angle of contact is zero, the force required to pull the plates apart is

(1) $\frac{\sigma A}{d}$ (2) $\frac{2\sigma A}{d}$ (3) $\frac{4\sigma A}{d}$ (4) $\frac{8\sigma A}{d}$

121. Two water droplets coalesce to form a large droplet. In this process

(1) energy is liberated

(2) energy is absorbed

(3) energy is neither liberated nor absorbed

(4) a small of amount of mass is converted into energy in accordance with mass-energy relation $E = mc^2$

122. A sphere of volume V falling in a viscous fluid acquires a terminal velocity v_t. The terminal velocity of a sphere of volume $8V$ of the same material and falling in the same fluid will be

(1) $\frac{v_t}{2}$ (2) v_t (3) $2v_t$ (4) $4v_t$

123. The length L of a metallic wire of Young's modulus Y increased by l on loading it by some weight. The potential energy stored in the wire per unit volume is

(1) $\frac{1}{2}Y\frac{l}{L}$ (2) $\frac{1}{2}Y\frac{l^2}{L^2}$ (3) $\frac{1}{2}Y\frac{l^2}{L}$ (4) $\frac{1}{2}Y\frac{l}{L^2}$

124. A real gas behaves like an ideal gas if its

(1) pressure and temperature are both high

(2) pressure and temperature are both low

(3) pressure is low and temperature is high

(4) pressure is high and temperature is low

125. 5 moles of an ideal diatomic gas ($\gamma = 1{\cdot}4$) are heated at constant pressure. If 280 J of heat energy is supplied to the gas, then the change in its internal energy is

(1) 50 J (2) 100 J (3) 150 J (4) 200 J

126. A Carnot's engine working between 0 °C and 100 °C takes up 746 J of heat from the high temperature reservoir in one cycle. The work done by the engine is

(1) 300 J (2) 400 J (3) 200 J (4) 100 J

127. A cylinder is kept in a uniform electric field E, the total electric charge enclosed in inside it is

(1) Q (2) $-Q$ (3) $\frac{Q}{2}$ (4) 0

128. Two equal point charges of $1\,\mu C$ each are located at points $(\hat{i}+\hat{j}+\hat{k})$ m and $(2\hat{i}+3\hat{j}+\hat{k})$ m. The magnitude of electric force between them is

(1) 10^{-3} N (2) 10^{-6} N (3) 10^{-9} N (4) 10^{-12} N

129. Which of the following vectors represents an electrostatic field vector?

(1) $2x\hat{i}+3y\hat{k}$ (2) $-2x\hat{i}+3y\hat{k}$ (3) $5y\hat{j}+7z\hat{k}$ (4) $5x\hat{j}+7z\hat{k}$

130. Which of the following laws was modified by Maxwell?

(1) Faraday's law (2) Ampere's law

(3) Gauss's law (4) Biot-Savart law

131. Three capacitors connected in series have an effective capacitance of $2\,\mu F$. If one of the capacitors is removed, the effective capacitance becomes $3\,\mu F$. The capacitance of the capacitor that is removed is

(1) $1\,\mu F$ (2) $\frac{3}{2}\mu F$ (3) $\frac{2}{3}\mu F$ (4) $6\,\mu F$

132. The direction of the force experienced by a charged particle moving with a uniform velocity v in a uniform magnetic field B is

(1) parallel to v and perpendicular to B

(2) parallel to B and perpendicular to v

(3) parallel to both v and B

(4) perpendicular to both v and B

133. A magnetic needle is kept in a non-uniform magnetic field. It experiences

(1) a force as well as a torque
(2) a force but no torque
(3) a torque but no force
(4) Neither force nor a torque

134. In an LCR circuit, if V is the effective value of the applied voltage, V_R is the voltage across R, V_L is the effective voltage across L, V_C is the effective voltage across C, then

(1) $V = V_R + V_L + V_C$
(2) $V^2 = V_R^2 + V_L^2 + V_C^2$
(3) $V^2 = V_R^2 + (V_L - V_C)^2$
(4) $V^2 = V_L^2 + (V_R - V_C)^2$

135. In silicon crystal, the valence and conduction bands are separated by a forbidden band of energy

(1) 110 eV
(2) 11 eV
(3) 1·1 eV
(4) 0·11 eV

136. The output from a full-wave rectifier is

(1) an a.c. voltage
(2) a d.c. voltage
(3) zero
(4) a pulsating unidirection voltage

137. Which of the following thermodynamic quantities is an intensive variable?

(1) Number density
(2) Volume
(3) Entropy
(4) Mass

138. In electrodynamics we have the relation $R + T = 1$, where R and T are reflection and transmission coefficients respectively. This relation reflects

(1) conservation of momentum
(2) conservation of charge
(3) conservation of probability
(4) conservation of energy

139. Two waves of intensities I and $4I$ superpose, then the maximum and minimum intensities are

(1) $5I, 3I$ (2) $9I, I$ (3) $9I, 5I$ (4) $5I, I$

140. Which one of the following waves cannot be polarized?

(1) Radio waves (2) X-rays

(3) Transverse waves in a string (4) Longitudinal waves in a gas

141. In a single-slit diffraction experiment, the width of the slit is made double its original width. Then the central maximum of the diffraction pattern will become

(1) narrower and fainter (2) narrower and brighter

(3) broader and fainter (4) broader and brighter

142. For a system kept at constant temperature and constant pressure, the state of equilibrium is the state of minimum

(1) enthalpy (2) Gibbs' potential

(3) Helmholtz potential (4) Grand potential

143. A velocity of light in a non-dispersive medium is $0{\cdot}9\,c$. The refractive index of that medium is

(1) 0·9 (2) 1·5 (3) 0 (4) 1·11

144. If magnetic monopole exists, which pair of the Maxwell's equations will get then modified?

(1) $\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$, $\vec{\nabla} \cdot \vec{E} = \frac{\rho}{\varepsilon_0}$ (2) $\vec{\nabla} \times \vec{B} = \mu_0 \vec{J} + \mu_0 \varepsilon_0 \frac{\partial \vec{E}}{\partial t}$; $\vec{\nabla} \cdot \vec{B} = 0$

(3) $\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$, $\vec{\nabla} \cdot \vec{B} = 0$ (4) $\vec{\nabla} \times \vec{B} = \mu_0 \vec{J} + \mu_0 \varepsilon_0 \frac{\partial \vec{E}}{\partial t}$; $\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$

145. In Young's double-slit experiment, the separation between the slits is 1·2 mm and the fringe spacing is 0·5 mm on a screen kept at a distance 1 m from the slits. Find the wavelength of the light

(1) 416 nm (2) 240 nm (3) 60 nm (4) 600 nm

146. A rocket ship is 100 m long on the ground. When it is in flight its length is 99 m to an observer on the ground. What is its speed? (Velocity of light is $c = 3 \times 10^8$ m/s.)

(1) $0{\cdot}242\,c$ (2) $0{\cdot}019\,c$ (3) $0{\cdot}141\,c$ (4) $0{\cdot}95\,c$

147. The phase difference between the electric field and the magnetic field of an electromagnetic wave propagating in an isotropic dielectric medium is

(1) 0 (2) π (3) $\frac{\pi}{2}$ (4) $\frac{2\pi}{3}$

148. The electric field at a radial distance r inside a uniformly charged sphere is proportional to

(1) r^2 (2) r (3) $\frac{1}{r}$ (4) $\frac{1}{r^2}$

149. Which optical phenomenon is responsible for the following fact—"A water drop on the floor looks dark"?

(1) Diffraction (2) Aberration (3) Polarization (4) Interference

150. A particle is created with some momentum at a point r with an angle θ relative to the radial direction inside a spherical zone of radius R. The particle would travel a distance to reach the surface of the spherical zone after its creation is

(1) $\sqrt{R^2 - r^2 \sin^2\theta} - r\cos\theta$ (2) $\sqrt{R^2 - r^2 \cos^2\theta} - r\sin\theta$

(3) $\sqrt{R^2 - r^2 \sin^2\theta} + r\cos\theta$ (4) $\sqrt{R^2 - r^2 \cos^2\theta} + r\sin\theta$

* * *

अभ्यर्थियों के लिए निर्देश

(इस पुस्तिका के प्रथम आवरण-पृष्ठ पर तथा उत्तर-पत्र के दोनों पृष्ठों पर केवल नीली या काली बाल-प्वाइंट पेन से ही लिखें)

1. प्रश्न पुस्तिका मिलने के 10 मिनट के अन्दर ही देख लें कि प्रश्नपत्र में सभी पृष्ठ मौजूद हैं और कोई प्रश्न छूटा नहीं है। पुस्तिका दोषयुक्त पाये जाने पर इसकी सूचना तत्काल कक्ष-निरीक्षक को देकर सम्पूर्ण प्रश्नपत्र की दूसरी पुस्तिका प्राप्त कर लें।

2. परीक्षा भवन में *लिफाफा रहित प्रवेश-पत्र के अतिरिक्त,* लिखा या सादा कोई भी खुला कागज साथ में न लायें।

3. उत्तर-पत्र अलग से दिया गया है। ***इसे न तो मोड़ें और न ही विकृत करें। दूसरा उत्तर-पत्र नहीं दिया जायेगा, केवल उत्तर-पत्र का ही मूल्यांकन किया जायेगा।***

4. अपना *अनुक्रमांक तथा उत्तर-पत्र का क्रमांक प्रथम आवरण-पृष्ठ पर पेन* से निर्धारित स्थान पर लिखें।

5. **उत्तर-पत्र के प्रथम पृष्ठ पर पेन से अपना अनुक्रमांक निर्धारित स्थान पर लिखें तथा नीचे दिये वृत्तों को गाढ़ा कर दें। जहाँ-जहाँ आवश्यक हो वहाँ प्रश्न-पुस्तिका का क्रमांक तथा सेट का नम्बर उचित स्थानों पर लिखें।**

6. ओ० एम० आर० पत्र पर अनुक्रमांक संख्या, प्रश्न-पुस्तिका संख्या व सेट संख्या (यदि कोई हो) तथा प्रश्न-पुस्तिका पर अनुक्रमांक सं० और ओ० एम० आर० पत्र सं० की प्रविष्टियों में उपरिलेखन की अनुमति नहीं है।

7. उपर्युक्त प्रविष्टियों में कोई भी परिवर्तन कक्ष निरीक्षक द्वारा प्रमाणित होना चाहिये अन्यथा यह एक अनुचित साधन का प्रयोग माना जायेगा।

8. प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार वैकल्पिक उत्तर दिये गये हैं। ***प्रत्येक प्रश्न के वैकल्पिक उत्तर के लिये आपको उत्तर-पत्र की सम्बन्धित पंक्ति के सामने दिये गये वृत्त को उत्तर-पत्र के प्रथम पृष्ठ पर दिये गये निर्देशों के अनुसार पेन से गाढ़ा करना है।***

9. प्रत्येक प्रश्न के उत्तर के लिये केवल एक ही वृत्त को गाढ़ा करें। एक से अधिक वृत्तों को गाढ़ा करने पर अथवा एक वृत्त को अपूर्ण भरने पर वह उत्तर गलत माना जायेगा।

10. ध्यान दें कि एक बार स्याही द्वारा अंकित उत्तर बदला नहीं जा सकता है। यदि आप किसी प्रश्न का *उत्तर नहीं देना चाहते हैं,* तो सम्बन्धित पंक्ति के सामने दिये गये सभी वृत्तों को खाली छोड़ दें। ऐसे प्रश्नों पर शून्य अंक दिये जायेंगे।

11. रफ़ कार्य के लिये प्रश्न-पुस्तिका के मुखपृष्ठ के अन्दर वाले पृष्ठ तथा अंतिम पृष्ठ का प्रयोग करें।

12. परीक्षा के उपरान्त केवल ***ओ०एम०आर० उत्तर-पत्र*** परीक्षा भवन में जमा कर दें।

13. परीक्षा समाप्त होने से पहले परीक्षा भवन से बाहर जाने की अनुमति नहीं होगी।

14. यदि कोई अभ्यर्थी परीक्षा में अनुचित साधनों का प्रयोग करता है, तो वह विश्वविद्यालय द्वारा निर्धारित दंड का/की, भागी होगा/होगी।