SRMJEEE

Practice Paper-1

EXAM DATE 15th to 25th April

Time : 2:30 Hours *Max. Marks : 315*

PART 1 : PHYSICS

1. The dimension of $\frac{1}{2}\varepsilon_0 E^2$, where ε_0 is permittivity of free space and E is electric field, is
(a) $[ML^2T^{-2}]$ (b) $[ML^{-1}T^{-2}]$
(c) $[ML^2T^{-1}]$ (d) $[MLT^{-1}]$

2. A vernier callipers (with least count = 0.1 mm) has 20 divisions of the vernier scale. The main scale divisions are of
(a) 0.2 mm (b) 0.5 mm
(c) 1.0 mm (d) 2.0 mm

3. Which two of the following quantities are dimensionally equivalent?
(i) Force (ii) Pressure
(iii) Young's Modulus (iv) Energy
(a) (i) and (ii) (b) (i) and (iii)
(c) (ii) and (iii) (d) (ii) and (iv)

4. If units of force and length become 3 times then what will be the value of energy E = 81 J, in new units?
(a) 81 J (b) 9 J (c) 729 J (d) 700 J

5. The speed of a projectile at its maximum height is $\frac{\sqrt{3}}{2}$ times its initial speed. If the range of the projectile is P times the maximum height attained by it, then P is equal to
(a) $\frac{4}{3}$ (b) $2\sqrt{3}$ (c) $4\sqrt{3}$ (d) $\frac{3}{4}$

6. A chain consisting of 5 links, each of mass 0.1 kg is lifted vertically with a constant acceleration of 2.5 m s^{-2}. The force of interaction between the top link and link immediately below it will be
(a) 6.15 N (b) 4.92 N
(c) 9.84 N (d) 2.46 N

7. If the force on a rocket, moving with a velocity of 300 m s^{-1} is 210 N, then the rate of combustion of the fuel is
(a) 0.07 kg s^{-1} (b) 1.4 kg s^{-1}
(c) 0.7 kg s^{-1} (d) 10.7 kg s^{-1}

8. What is the shape of the graph between the speed and kinetic energy of a body?
(a) Straight line (b) Hyperbola
(c) Parabola (d) Exponential

9. The position of a particle is given by $\vec{r} = (\hat{i} + 2\hat{j} - \hat{k})$ and its linear momentum is given by $\vec{p} = (3\hat{i} + 4\hat{j} - 2\hat{k})$. Then its angular momentum, about the origin is perpendicular to
(a) yz-plane (b) z-axis
(c) y-axis (d) x-axis

10. The escape velocity of a body from the earth is v_e. If the radius of earth contracts to $(1/4)^{th}$ of its value, keeping the mass of earth constant, the escape velocity will be
(a) doubled (b) halved
(c) tripled (d) unaltered

11. A uniform rod of mass m, length L, area of cross-section A and Young's modulus Y hangs from a rigid support. Its elongation due to its own weight will be
(a) $\frac{mgL}{AY}$ (b) $\frac{mgL}{2AY}$
(c) $\frac{2mgL}{AY}$ (d) zero

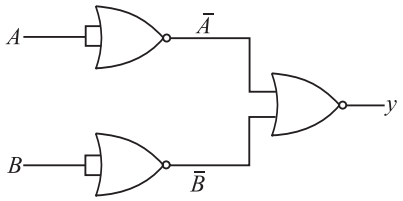
12. Small liquid drops assume spherical shape because
(a) of the action of atmospheric pressure from the sides on the liquid
(b) of the action of the gravitational force
(c) the liquid tends to have minimum surface area due to surface tension
(d) of the friction of air.

13. A particle of mass m oscillates along x-axis according to equation $x = a\sin\omega t$. The nature of the graph between momentum and displacement of the particle is
(a) circle
(b) hyperbola
(c) ellipse
(d) straight line passing through the origin.

14. A sound absorber attenuates the sound level by 20 dB. The intensity decreases by a factor of

(a) 1000 (b) 10000
(c) 10 (d) 100

15. The output y of the circuit shown is



(a) $y = A \cdot B$ (b) $y = \bar{A} \cdot \bar{B}$
(c) $y = \overline{A + B}$ (d) $y = A + B$

16. 1 gram of ice is mixed with 1 gram of steam. At thermal equilibrium, the temperature of the mixture is

(a) 100°C (b) 55°C
(c) 0°C (d) 50°C

17. For cyclic process which of the following quantity is zero?

(a) ΔV (b) ΔU (c) ΔW (d) ΔQ

18. The efficiency of a Carnot engine which operates between the two temperatures $T_1 = 500$ K and $T_2 = 300$ K is

(a) 25% (b) 40% (c) 50% (d) 75%

19. If the temperature of an ideal gas increases three times, then its rms velocity will become

(a) $\sqrt{3}$ times (b) 3 times
(c) one third (d) remains same

20. 1 mole of monatomic and 1 mole of diatomic gas are mixed together. The value of C_V for the mixture is

(a) $2R$ (b) $(3/2)R$
(c) R (d) $R/2$

21. If the focal length of the eye piece of a telescope is doubled, its magnifying power (m) will be

(a) $2m$ (b) $3m$ (c) $\frac{m}{2}$ (d) $4m$

22. If the shift in a star light is towards red end, then

(a) the star is approaching the earth
(b) the star is receding from the earth
(c) the apparent frequency is lesser than actual
(d) both (b) and (c)

23. The magnifying power of a compound microscope increases with

(a) the focal length of objective lens is increased and that of eye lens is decreased
(b) the focal length of eye lens is increased and that of objective lens is decreased
(c) focal lengths of both objects and eye-piece are increased
(d) focal lengths of both objects and eye-piece are decreased.

24. In AC circuits Ohm's law is applicable for

(a) instantaneous values of current and voltage only
(b) rms values of current and voltage only
(c) peak values of current and voltage only
(d) all values of current and voltage.

25. An AC generator of 220 V having internal resistance r = 10 Ω and external resistance R = 100 Ω. What is the power developed in the external circuit?

(a) 484 W (b) 400 W
(c) 441 W (d) 369 W

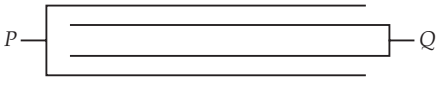
26. At two different places the angles of dip are respectively 30° and 45°. At these two places the ratio of horizontal component of earth's magnetic field is

(a) $\sqrt{3} : \sqrt{2}$ (b) $1 : \sqrt{2}$
(c) $1 : 2$ (d) $1 : \sqrt{3}$

27. In a moving coil galvanometer, to make the field radial

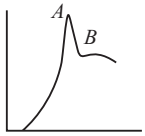
(a) coil is wound on wooden frame
(b) magnetic poles are cylindrically cut
(c) a horse shoe magnet is used
(d) the number of windings in the coil is decreased

28. Four identical plates each of area a are separated by a distance d. The connection is shown below. What is the capacitance between P and Q?



(a) $2a\varepsilon_0/d$ (b) $a\varepsilon_0/(2d)$
(c) $a\varepsilon_0/d$ (d) $4a\varepsilon_0/d$

29. Sharp peak point *A* represents



(a) characteristic X-ray
(b) continuous X-ray
(c) Bremsstrahlung
(d) discontinuous spectrum.

30. What would be maximum wavelength for Brackett series of hydrogen spectrum?
(a) 74583 Å (b) 22790 Å
(c) 40519 Å (d) 18753 Å

31. The photoelectric threshold wavelength for silver is λ_0. The energy of the electron ejected from the surface of silver by an incident wavelength $\lambda(\lambda < \lambda_0)$ will be
(a) $hc(\lambda_0 - \lambda)$ (b) $\dfrac{hc}{\lambda_0 - \lambda}$
(c) $\dfrac{h}{c}\left(\dfrac{\lambda_0 - \lambda}{\lambda\lambda_0}\right)$ (d) $hc\left(\dfrac{\lambda_0 - \lambda}{\lambda\lambda_0}\right)$

32. The element with maximum value of binding energy per nucleon is
(a) iron (b) aluminium
(c) uranium (d) hydrogen

33. Conductivity of semiconductors
(a) is maximum at 0 K
(b) decreases with increase in temperature
(c) increases with increase in temperature
(d) is maximum at 300 K.

34. For sky wave propagation of 10 MHz signal, what should be the minimum electron density in inosphere?
(a) ~ 1.2×10^{12} m^{-3} (b) ~10^6 m^{-3}
(c) ~ 2.3×10^{14} m^{-3} (d) ~ 10^{22} m^{-3}

35. The length of antenna (L) required to propagate a signal of wavelength λ is given as
(a) $L = \lambda/2$ (b) $L = 2\lambda$
(c) $L = \lambda/3$ (d) $L = \lambda/4$

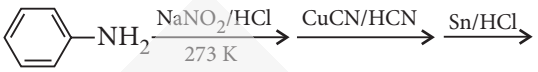
PART 2 : CHEMISTRY

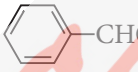
36. The degree of dissociation (α) of a weak electrolyte A_xB_y is related to van't Hoff factor (i) by the expression
(a) $\alpha = \dfrac{i-1}{(x+y-1)}$ (b) $\alpha = \dfrac{i-1}{x+y+1}$
(c) $\alpha = \dfrac{x+y-1}{i-1}$ (d) $\alpha = \dfrac{x+y+1}{i-1}$

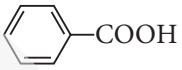
37. Primary and secondary valency of platinum in the complex $[Pt(en)_2Cl_2]$ are
(a) 4, 6 (b) 2, 6 (c) 4, 4 (d) 6, 4

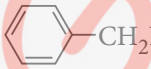
38. The pH of 0.1 M solution of following increases in the order
(a) NaCl < NH_4Cl < NaCN < HCl
(b) HCl < NH_4Cl < NaCl < NaCN
(c) NaCN < NH_4Cl < NaCl < HCl
(d) HCl < NaCl < NaCN < NH_4Cl.

39. What is the end-product of the following reaction?



(a) 

(b) 

(c) 

(d) 

40. The formal charge on the central oxygen atom in O_3 molecule is
(a) 0 (b) +1 (c) –1 (d) –2

41. The stability of complexes of Cu^{2+}, Ni^{2+}, Co^{2+} and Fe^{2+} varies in the order
(a) $Cu^{2+} > Ni^{2+} > Co^{2+} > Fe^{2+}$
(b) $Cu^{2+} > Fe^{2+} > Ni^{2+} > Co^{2+}$
(c) $Ni^{2+} > Co^{2+} > Fe^{2+} > Cu^{2+}$
(d) $Cu^{2+} < Ni^{2+} < Co^{2+} < Fe^{2+}$

42. The compound which reacts fastest with Lucas reagent at room temperature is
(a) butan-1-ol
(b) butan-2-ol
(c) 2-methylpropan-1-ol
(d) 2-methylpropan-2-ol.

43. At low pressure, the van der Waals equation is reduced to
(a) $Z = \dfrac{PV_m}{RT} = 1 - \dfrac{a}{RTV_m}$
(b) $Z = \dfrac{PV_m}{RT} = 1 + \dfrac{bP}{RT}$
(c) $PV_m = RT$
(d) $Z = \dfrac{PV_m}{RT} = 1 - \dfrac{a}{RT}$

44. Which one of the following statements is not true?
(a) Buna-S is a copolymer of butadiene and styrene.

(b) Natural rubber is a polymer of isoprene.
(c) In vulcanization, the formation of sulphur bridges between different chains make rubber harder and stronger.
(d) Natural rubber has the *trans*-configuration at every double bond.

45. $A + Na_2CO_3 \longrightarrow B + C$
$\downarrow CO_2$
Milky cloud, C

The chemical formulae of A, B and C are

	A	*B*	*C*
(a)	$Ca(OH)_2$	NaOH	$CaCO_3$
(b)	NaOH	$Ca(OH)_2$	$CaCO_3$
(c)	NaOH	CaO	$CaCO_3$
(d)	CaO	$Ca(OH)_2$	NaOH

46. The alkane C_6H_{10} producing $OHC(CH_2)_4CHO$ on ozonolysis is
(a) 1-hexene
(b) 3-hexene
(c) cyclohexene
(d) 1-methylcyclohex-1-ene

47. The empirical formula of an organic compound containing carbon and hydrogen is CH_2. The mass of one litre of this organic gas is exactly equal to that of one litre of N_2. Therefore, the molecular formula of the organic gas is
(a) C_2H_4 (b) C_3H_6 (c) C_6H_{12} (d) C_4H_8

48. For the separation of two immiscible liquids which method is used?
(a) Chromatography
(b) Fractionating column
(c) Fractional distillation
(d) Separating funnel

49. Which statement is incorrect for osmotic pressure (π), volume (V) and temperature (T)?
(a) $\pi \propto \frac{1}{V}$ if T is constant.
(b) $\pi \propto V$ if T is constant.
(c) $\pi \propto T$ if V is constant.
(d) πV is constant if T is constant.

50. Aluminium oxide crystallises with aluminium ions in $\frac{2}{3}$ of the octahedral holes and $\frac{1}{3}$ octahedral holes remaining vacant in a closest packed array of oxide ions. The formula of aluminium oxide is
(a) Al_3O_2 (b) Al_2O_3
(c) AlO_2 (d) Al_2O

51. A colloidal solution is subjected to an electric field. The colloidal particles move towards the anode, coagulation of the same colloidal solution is studied using NaCl, $BaCl_2$ and $AlCl_3$ solution. The coagulating power is
(a) $NaCl > AlCl_3 > BaCl_2$
(b) $AlCl_3 > BaCl_2 > NaCl$
(c) $NaCl > BaCl_2 > AlCl_3$
(d) $BaCl_2 > NaCl > AlCl_3$

52. Which of the following is arranged in order of increasing density?
(a) Al < Mg < C (graphite) < B
(b) B < Al < Mg < C (graphite)
(c) C (graphite) < Al < B < Mg
(d) Mg < C (graphite) < B < Al

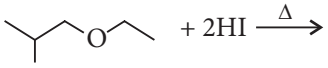
53. In the following sequence of reactions, the alkene affords the compound B.

$$CH_3CH{=}CHCH_3 \xrightarrow{O_3} A \xrightarrow[Zn]{H_2O} B.$$

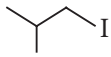
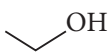
The compound B is
(a) CH_3CHO (b) CH_3CH_2CHO
(c) CH_3COCH_3 (d) $CH_3CH_2COCH_3$

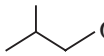
54. For the reaction $A \longrightarrow B$ when concentration of A is made 1.5 times the rate of reaction becomes 1.837 times. The order of reaction is
(a) 1 (b) 1.5 (c) 2 (d) 2.5

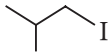
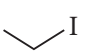
55. In the reaction,

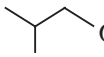


which of the following compound will be formed?

(a)  and 

(b)  and 

(c)  and 

(d)  and 

56. Which of the following series contains atoms/groups having only –*M* (mesomeric) effect ?
(a) COR, OR, COOR (b) Cl, CHO, NH_2
(c) NO_2, CN, SO_3H (d) OH, NR_2, SR

57. Aldol condensation will not take place in
(a) CH_3COCH_3 (b) CH_3CHO
(c) HCHO (d) CH_3CH_2CHO

58. Match the column I with column II and select the correct options.

Column I	Column II
1. Fat soluble vitamin present in vegetable oil	(A) Vitamin A
2. Water soluble vitamin present in citrus fruit	(B) Vitamin E
3. Vitamin present in carrot	(C) Vitamin C
4. Convulsion is caused by deficiency of	(D) Vitamin B_6

(a) 1-(C), 2-(A), 3-(B), 4-(D)
(b) 1-(A), 2-(C), 3-(D), 4-(B)
(c) 1-(B), 2-(C), 3-(A), 4-(D)
(d) 1-(A), 2-(B), 3-(C), 4-(D)

59. Which of the following pair of compounds is expected to exhibit same colour in aqueous solution?
(a) $FeCl_2$, $CuCl_2$ (b) $VOCl_2$, $CuCl_2$
(c) $VOCl_2$, $FeCl_2$ (d) $FeCl_2$, $MnCl_2$

60. The electron identified by quantum numbers n and l, (i) n =4, l = 1 (ii) n = 4, l = 0 (iii) n = 3, l = 2 (iv) n = 3, l = 1 can be placed in order of increasing energy from the lowest to highest as
(a) (iv) < (ii) < (iii) < (i)
(b) (ii) < (iv) < (i) < (iii)
(c) (i) < (iii) < (ii) < (iv)
(d) (iii) < (i) < (iv) < (ii)

61. An electric current of 'I' amperes was passed through a solution of an electrolyte for 't' seconds depositing 'W' grams of the metal 'M' on the cathode. The equivalent mass 'E', of the metal will be

(a) $E = \dfrac{I \times t}{W \times 96,500}$ (b) $E = \dfrac{I \times W}{t \times 96,500}$

(c) $E = \dfrac{96,500 \times W}{I \times t}$ (d) $E = \dfrac{I \times t \times 96,500}{W}$

62. Mn^{2+} forms a complex with Br^- ion. The magnetic moment of the complex is 5.92 BM. The probable formula and geometry of the complex, is
(a) $[MnBr_4]^{2-}$; tetrahedral
(b) $[MnBr_4]^{2-}$; square planar
(c) $[MnBr_6]^{4-}$; octahedral
(d) $[MnBr_5]^{3-}$; trigonal planar.

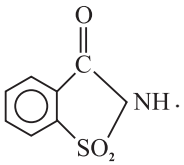
63. How many aldols are formed when acetaldehyde and propanaldehyde undergo aldol condensation?
(a) 2 (b) 4 (c) 3 (d) 8

64. Which of the following orders is true regarding the basic nature of NH_2 group?
(a) *o*-Toluidine > Aniline > *o*-Nitroaniline
(b) *o*-Toluidine < Aniline > *o*-Nitroaniline
(c) *o*-Toluidine < Aniline < *o*-Nitroaniline
(d) *o*-Toluidine > Aniline < *o*-Nitroaniline

65. Nucleotides and nucleosides mainly differ from each other in
(a) presence of phosphate units
(b) presence of base units
(c) presence of nucleic acids
(d) none of the above.

66. Emission of an alpha particle leads to a
(a) decrease of 2 units in the charge of the atom
(b) increase of 2 units in the mass of the atom
(c) decrease of 2 units in the mass of the atom
(d) increase of 4 units in the mass of the atom.

67. Which of the following compounds will be optically active?
(a) $(CH_3)_2CHOH$
(b) $CH_3CH_2CH_2CH_3$
(c) $CH_3 - CHCl - COOH$
(d) $(CH_3)_3CCl$

68. Which is correct about saccharin?
(a) It is 
(b) It is 550 times sweeter than sugar.
(c) It is used as sweetening agent.
(d) All of the above.

69. For a chemical reaction, ΔS = – 0.035 kJ/K and ΔH = –20 kJ. At what temperature does the reaction turn non-spontaneous?

(a) 5.14 K (b) 571.4 K
(c) 57.14 K (d) 5714.0 K

70. The major product of the reaction between *tert*-butyl chloride and sodium ethoxide is
(a) 2-methylprop-1-ene
(b) 1-butene
(c) 2-butene
(d) ethene.

PART 3 : MATHEMATICS

71. If 1, ω, ω^2 are cube roots of unity, then the value of $\frac{a\omega + b\omega^2 + c\omega^3 + d\omega}{c\omega + d\omega^2 + a\omega^2 + b}$ equals
(a) ω (b) ω^2
(c) 0 (d) None of these

72. A relation R in the set of non zero complex numbers is defined by $z_1 R z_2 \Leftrightarrow \frac{z_1 - z_2}{z_1 + z_2}$ is real, then R is
(a) Reflexive only (b) Symmetric only
(c) Transitive only (d) Equivalence

73. If x^m occurs in the expansion of $\left(x + \frac{1}{x^2}\right)^{4n}$, then the coefficient of x^m is
(a) $\frac{(4n)!}{\left(\frac{4n-m}{3}\right)! \cdot \left(\frac{8n+m}{3}\right)!}$
(b) $\frac{(4n)!}{n!(4n-m)!}$
(c) $\frac{(4n)!3!3!}{(4n-3)!}$ (d) None of these

74. The function $f(x) = \frac{x}{1+|x|}$ $\forall\ x \in R$, then which of the following is true ?
(a) $f(x)$ is differentiable everywhere and $0 < f'(x) \le 1$
(b) At $x = 0$, $f'(x)$ is minimum
(c) $x = 0$, gives points of inflexion so $f(x)$ is twice differentiable at $x = 0$
(d) $f(x)$ is not differentiable at $x = \pm 1$

75. The common roots of the equations $x^3 + 2x^2 + 2x + 1 = 0$ and $1 + x^{200} + x^{2023}$ are (ω is non real cube root of unity)
(a) $-\omega, 1$ (b) ω^2, ω
(c) $\omega - \omega^2, 1$ (d) $-\omega^2, 1$

76. The value of λ, if the equation $2x^2 + 2\lambda xy + 3y^2 + 4x + 2y + 2 = 0$ represent a pair of straight lines, is
(a) -1 (b) 2 (c) -2 (d) 1

77. Let $a, b, c \in R^+$ (*i.e.* a, b, c are positive real numbers) then the following system of equations in x, y, z
$\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{z^2}{c^2} = 1$, $\frac{x^2}{a^2} - \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ and $\frac{-x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ has
(a) No solution
(b) Unique solution
(c) Infinitely many solution
(d) Finitely many solution

78. $\int \frac{x^2 - 1}{\left(x^4 + 3x^2 + 1\right)\tan^{-1}\left(x + 1/x\right)}\,dx$ equals
(a) $\tan^{-1}(x + 1/x) + c$
(b) $\cot^{-1}(x + 1/x) + c$
(c) $\log(x + 1/x) + c$
(d) $\log[\tan^{-1}(x + 1/x)] + c$

79. In any triangle ABC, $\frac{\cot\frac{A}{2} + \cot\frac{B}{2} + \cot\frac{C}{2}}{\cot A + \cot B + \cot C} =$
(a) $\frac{a+b+c}{a^2+b^2+c^2}$ (b) $\frac{(a+b+c)^2}{a^2+b^2+c^2}$
(c) $\frac{a^2+b^2+c^2}{(a+b+c)^2}$ (d) none of these

80. The point of contact of the circles $x^2 + y^2 - 4x + 6y - 3 = 0$ and $x^2 + y^2 + 16x + 6y + 37 = 0$ is
(a) (–8, –3) (b) (2, –3)
(c) (–2, –3) (d) None of these

81. The value of the expression
$${}^{23}C_6 + \sum_{j=1}^{5} {}^{28-j}C_5 + \sum_{k=1}^{5} {}^{33-k}C_{28-k} \text{ is}$$
(a) ${}^{33}C_6$ (b) ${}^{23}C_{16}$
(c) ${}^{33}C_7$ (d) None of these

82. The length of perpendicular from $O(0, 0, 0)$ to the plane passing through three non collinear points $\vec{a}, \vec{b}, \vec{c}$ is

(a) $\frac{2\left[\vec{a}\ \vec{b}\ \vec{c}\right]}{\vec{a}\times\vec{b}+\vec{b}\times\vec{c}+\vec{c}\times\vec{a}}$ (b) $[\vec{a}\ \vec{b}\ \vec{c}]$

(c) $\frac{\left[\vec{a}\ \vec{b}\ \vec{c}\right]}{\left|\vec{a}\times\vec{b}-\vec{b}\times\vec{c}-\vec{c}\times\vec{a}\right|}$ (d) None of these

83. The inverse of the function $f(x) = \log_2(x+\sqrt{x^2+1})$ is

(a) $2^x + 2^{-x}$ (b) $\frac{2^x+2^{-x}}{2}$

(c) $\frac{2^{-x}-2^x}{2}$ (d) $\frac{2^x-2^{-x}}{2}$

84. The solution of the differential equation $\frac{x+y\frac{dy}{dx}}{y-x\frac{dy}{dx}} = x^2+2y^2+\frac{y^4}{x^2}$ is

(a) $\frac{y}{4}+\frac{1}{x^2+y^2}=c$ (b) $\frac{2y}{x}-\frac{1}{x^2+y^2}=c$

(c) $\frac{x}{y}-\frac{1}{x^2+y^2}=c$ (d) None of these

85. If a, b, c are in H.P., then $\frac{a}{b+c}, \frac{b}{c+a}, \frac{c}{a+b}$ are in

(a) A.P. (b) H.P.

(c) G.P. (d) None of these

86. Let t be a positive integer and $\Delta_t = \begin{vmatrix} 2t-1 & m^2-1 & \cos^2(m^2) \\ {}^mC_t & 2^m & \cos^2(m) \\ 1 & m+1 & \cos(m^2) \end{vmatrix}$, then the value of $\sum_{t=0}^{m}\Delta_t$ is equal to

(a) 2^m (b) 0

(c) $2^m\cos^2(2^m)$ (d) m^2

87. Let $f(x,y): y^2 = 4\left[\sqrt{y}\right]x$ and $g(x,y): 4\left[\sqrt{x}\right]y = x^2$, where $[\cdot]$ denote greatest integer function, then the area enclosed by $f(x, y)$ and $g(x, y)$ within the square formed by the lines $x = 1 = y$ & $x = 4 = y$ equals

(a) $\frac{121}{3}$ (b) $\frac{11}{3}$

(c) $\frac{3}{11}$ (d) None of these

88. The line of intersection of the planes $\vec{r}\cdot(3\hat{i}-\hat{j}+\hat{k})=1$ and $\vec{r}\cdot(\hat{i}+4\hat{j}-2\hat{k})=2$ is parallel to the vector

(a) $-2\hat{i}+7\hat{j}+13\hat{k}$ (b) $2\hat{i}-7\hat{j}-13\hat{k}$

(c) $2\hat{i}+7\hat{j}+13\hat{k}$ (d) $2\hat{i}+2\hat{j}+13\hat{k}$

89. If $A = \{7, 8, 9\}$, then the relation $R = \{(8, 9)\}$ in A is

(a) Symmetric only (b) Non symmetric

(c) Transitive only (d) Equivalence

90. The mid point of the chord $16x + 9y = 25$ to the ellipse $\frac{x^2}{9}+\frac{y^2}{16}=1$ is

(a) (1, –1) (b) (–1, –1)

(c) (–1, 1) (d) (1, 1)

91. If x, y, z are in A.P., then the value of determinant $\begin{vmatrix} p+2 & p+3 & p+4 \\ p+3 & p+4 & p+5 \\ p+2x & p+2y & p+2z \end{vmatrix}$ equals

(a) 4a (b) 0 (c) – 4a (d) 1

92. The minimum & maximum value of $f(x) = \sin(\cos x) + \cos(\sin x)\ \forall -\frac{\pi}{2} \le x \le \frac{\pi}{2}$ are respectively

(a) cos 1° and 1 + sin 1°

(b) sin 1° and 1 + cos 1°

(c) cos 1° & $\cos\left(\frac{1}{\sqrt{2}}\right)^\circ + \sin\left(\frac{1}{\sqrt{2}}\right)^\circ$

(d) None of these

93. $\log_{2x+3}(6x^2+23x+21) = 4 - \log_{3x+7}(4x^2+12x+9)$, then x equals

(a) – 4 (b) – 2

(c) $-\frac{1}{4}$ (d) None of these

94. Let $P(n): 2^n > n\ \forall\ n \in N$ and $2^k > k, \forall\ n = k$, then which of the following is true $\forall\ k \ge 2$?

(a) $2^k > 5k > 1$ (b) $2^{k+1} > 2k > k+1$

(c) $2^k > 2(k+1) > k$ (d) None of these

95. The number of signals can be given using any number of flags by 5 different colours, is

(a) 225 (b) 325 (c) 215 (d) 315

96. On its annual sports day, School awarded 35 medals in athletics, 15 in Judo and 18 in swimming. If these medals goes to a total of 58 students and only three of them got medals in all the three sports. The number of students who received medals in exactly two of the three sports are

(a) 9 (b) 4 (c) 5 (d) 7

97. For a Binomial distribution whose mean is 9 and S.D. is $\frac{3}{2}$, then the value of n equals

(a) 12 (b) 36
(c) 9 (d) None of these

98. $\int \sqrt{x+\sqrt{x^2+2}}\,dx$
$= k\,(x+\sqrt{x^2+2})^{p/2} - \frac{2}{(x+\sqrt{x^2+2})^{\frac{q}{2}}} + C$
then k, p, q are respectively

(a) $\frac{4}{3}, \frac{3}{2}, 1$ (b) $\frac{1}{3}, 3, 1$
(c) $-2, \frac{1}{3}, 1$ (d) None of these

99. If $\sqrt{b^2+c^2}, \sqrt{c^2+a^2}, \sqrt{a^2+b^2}$ are the three sides of a triangle, then the area of the triangle is

(a) $\sqrt{a^2+b^2+c^2}$
(b) $\sqrt{b^2c^2+c^2a^2+a^2b^2}$
(c) $\sqrt{a+b+c}$ (d) none of these

100. If the curve $y = f(x)$ passing through the point (1, 2) and satisfies the differential equation $xdy + (y + x^3y^2)\,dx = 0$ then

(a) $xy = \frac{1}{2}$ (b) $x^3y = 2$
(c) $\frac{1}{xy} = 2$ (d) None of these

101. The value of θ for which the system of linear equations in x, y, z given as

$(\sin 3\theta)\,x - y + z = 0$, $(\cos 2\theta)\,x + 4y + 3z = 0$ and $2x + 7y + 7z = 0$ has a non-trivial solution, is/are

(a) $\frac{m\pi}{2}$ (b) $\frac{m\pi}{5}$
(c) $n\pi + (-1)^n \frac{\pi}{6}$ (d) None of these

102. The two consecutive terms in the expansion of $(3 + 2x)^{74}$, whose coefficients are equal, is/are

(a) 30^{th} and 31^{st} terms
(b) 29^{th} and 30^{th} terms
(c) 31^{st} and 32^{nd} terms
(d) 28^{th} and 29^{th} terms

103. If a, b, c are in G.P. and $\log\left(\frac{5c}{a}\right)$, $\log\left(\frac{3b}{5c}\right)$ & $\log\left(\frac{a}{3b}\right)$ are in A.P., then the numbers a, b, c form an

(a) Equilateral triangle
(b) Isosceles triangle
(c) Right angle triangle
(d) None of these

104. If the trace of the matrix

$A = \begin{pmatrix} x-5 & 0 & 2 & 4 \\ 3 & x^2-10 & 6 & 1 \\ -2 & 3 & x-7 & 1 \\ 1 & 2 & 0 & -2 \end{pmatrix}$ assumes

the value zero, then the value of x equals to,

(a) $-6, -4$ (b) $-6, 4$
(c) $6, 4$ (d) $6, -4$

105. $\lim_{x \to 1} \frac{x^8 - 2x + 1}{x^4 - 2x + 1}$ equals

(a) 3 (b) 0 (c) –3 (d) 1

PART 4 : BIOLOGY

71. Binomial nomenclature was given by

(a) Darwin (b) Linnaeus
(c) Lamarck (d) Theophrastus.

72. Epidermal layer is beneficial for

(a) jute fibres (b) hemp fibres
(c) cotton fibres (d) sun hemp.

73. Which of the following statements is correct with reference to the flowers of Family Solanaceae?

(a) Pentamerous, actinomorphic, unisexual, hypogynous
(b) Pentamerous, zygomorphic, bisexual, epigynous
(c) Pentamerous, bisexual, actinomorphic, hypogynous

(d) Trimerous, actinomorphic, bisexual, hypogynous

74. Identify the plant parts whose transverse sections show a clear and prominent pith.
(a) Dicot stem and monocot stem
(b) Dicot stem and monocot root
(c) Dicot root and monocot root
(d) Dicot stem and dicot root

75. Tetradynamous condition is found in
(a) *Hibiscus rosa-sinesis*
(b) *Petunia hybrida*
(c) *Helianthus annuus*
(d) *Brassica compestris*.

76. The lateral roots originate from
(a) pericycle (b) exodermis
(c) vascular bundles (d) endodermis.

77. Which of the following is a complex tissue?
(a) Parenchyma (b) Collenchyma
(c) Xylem (d) Sclerenchyma

78. The term genome denotes
(a) haploid set of chromosome
(b) bivalent
(c) monovalent
(d) diploid chromosomal set.

79. Karyotype is
(a) chromosomes which is specific for each species of living organism
(b) all organism have some type of chromosome
(c) division of nucleus
(d) none of the above.

80. Sickle-cell anaemia is
(a) caused by substitution of valine by glutamic acid in the beta globin chain of haemoglobin
(b) caused by a change in a single base pair of DNA
(c) characterised by elongated sickle like RBCs with a nucleus
(d) an autosomal linked dominant trait.

81. Ribose sugar is present in
(a) RNA polymerase and ATP
(b) RNA and ATP
(c) RNA polymerase, RNA and ATP
(d) RNA only.

82. The prokaryotic enzymes with 5′ → 3′ exonuclease property is/are
(a) DNA polymerase I
(b) DNA polymerase II
(c) DNA polymerase III
(d) both (a) and (c).

83. Insect tolerant gene from *Bacillus thuringiensis* is introduced using Ti plasmid of
(a) *Escherichia coli*
(b) *Haemophilus influenzae*
(c) *Agrobacterium tumefaciens*
(d) *Arabidopsis thaliana.*

84. In plant tissue culture, the callus tissues can be regenerated into complete plantlets primarily by altering the concentration of
(a) sugars (b) vitamins
(c) amino acids (d) hormones.

85. Totipotency technique was first initiated by
(a) White (b) Gautheret
(c) Haberlandt (d) F.C. Steward.

86. The Bowman's capsule is found in
(a) renal pyramid (b) cortex
(c) medulla (d) renal pelvis.

87. Which pair is wrong?
(a) C_3-maize
(b) C_4-kranz anatomy
(c) Calvin cycle-PGA
(d) Hatch and Slack cycle - OAA

88. C_4-plants have an advantage over C_3-plants when the weather is
(a) only hot (b) hot and dry
(c) hot and wet (d) cold and dry.

89. Respiratory quotient (R.Q) is less than one for
(a) banana (b) potato
(c) citrus fruits (d) castor seeds.

90. Respiratory quotient (RQ) is defined as
(a) ratio between CO_2 liberated and O_2 taken in
(b) percentage of CO_2 liberated
(c) ratio between O_2 taken in and food material consumed
(d) percentage of oxygen liberated.

91. Auxin enhances
(a) cell enlargement (b) cell division
(c) axillary growth (d) stomatal closure.

92. Excessive elongation of plant stem is due to
(a) cytokinin (b) IAA
(c) gibberellin (d) auxin.

93. In plants, the induction of flowering, by low temperature treatment, is called
(a) vernalisation (b) photoperiodism
(c) pruning (d) cryobiology.

94. When fungi feed on dead organic matter, they are known as
(a) parasites (b) saprophytes
(c) dimorphic (d) none of these.

95. Which of the following is the pair of biofertilisers?
(a) *Azolla* and BGA
(b) *Nostoc* and legume
(c) *Rhizobium* and grasses
(d) *Salmonella* and *E. coli*

96. Blindness is prevented by use of which crop in poor countries?
(a) Golden rice (b) Wheat
(c) Gram (d) Pea

97. Which of the following is used as a bioweapon?
(a) *Clostridium botulinum*
(b) *Escherichia coli*
(c) *Vibrio cholerae*
(d) Both (a) and (c)

98. Which of the following statements is correct?
(a) During inspiration external intercostal muscles and diaphragm contract.
(b) Cyanosis means collapse of alveoli.
(c) Eupnea is slow breathing.
(d) Coryza is caused by human corona virus.

99. Which valve is present at the opening of coronary sinus?
(a) Mitral valve
(b) Eustachian valve
(c) Thebesian valve
(d) Tricuspid valve

100. The frequency of heart beat in our body is maintained by
(a) AV Node
(b) SA Node
(c) Node of Ranvier
(d) Chordae tendineae.

101. A vector for cloning genes in plants is
(a) *Rhizobium* (b) *Agrobacterium*
(c) *Pseudomonas* (d) *Azotobacter*.

102. The protein whose removal enables myosin to bind actin in smooth muscle is
(a) tropomyosin (b) caldesmon
(c) myosin light chain kinase
(d) calmodulin.

103. _____ accelerates heart beat due to stimulation of adrenal medulla by sympathetic nerves.
(a) Adrenaline (b) Thyroxine
(c) Vasopressin (d) Collip's hormone

104. Which of the following match is correct ?

	Hormone	**Effect**
(a)	Oxytocin	Milk ejection hormone
(b)	Glucagon	Decreases blood sugar level
(c)	Adrenaline	Decreases heart rate
(d)	Thyroxine	Decreases BMR

105. Genetic engineering is
(a) making artificial genes
(b) hybridisation of DNA of one organism to that of others
(c) production of alcohol by using microorganisms
(d) making artificial limbs, diagnostic instruments such as ECG, EEG, etc.

106. Population growth-curve is sigmoid, if the growth pattern is
(a) logistic (b) geometric
(c) exponential (d) accretionary.

107. The theory of natural selection was given by
(a) Darwin (b) Lamarck
(c) Augustus (d) Weismann.

108. Connecting link between annelida and mollusca is
(a) *Peripatus* (b) *Neopilina*
(c) *Proterospongia* (d) *Archaeopteryx*.

109. Column I lists the components of body defense and column II lists the corresponding descriptions. Match the two columns. Choose the correct option from those given.

Column I	Column II
A. Active natural immunity	p. Injection of gamma globulins
B. First line of defense	q. Complement proteins and interferons
C. Passive natural immunity	r. Direct contact with the pathogens that have entered inside
D. Second line of defense	s. Surface barriers
	t. Antibodies transferred through the placenta

(a) A = s, B = r, C = t, D = q
(b) A = r, B = s, C = q, D = t
(c) A = r, B = s, C = t, D = q
(d) A = t, B = r, C = q, D = p

110. Tissue transplant between identical twins is called
(a) autograft
(b) allograft
(c) xenograft
(d) isograft.

111. One of the inflammatory reactions induced by histamines is
(a) vasoconstriction of blood vessels
(b) vasodilation of peripheral blood vessels
(c) increased vascular permeability
(d) accelerated blood clotting.

112. Which of these is not a cell of the macrophage system ?
(a) Kupffer cell
(b) osteoclasts
(c) Langerhans cells
(d) astrocyte.

113. Match the following:

List-I		List-II	
(i)	Statins	A.	*Propionibacterium shermanni*
(ii)	Swiss cheese	B.	*Streptococcus*
(iii)	Cyclosporin A	C.	*Aspergillus niger*
(iv)	Citric acid	D.	*Trichoderma polysporum*
(v)	Clot buster	E.	*Monascus purpureus*

(a) (i)-E, (ii)-A, (iii)-D, (iv)-C, (v)-B
(b) (i)-B, (ii)-A, (iii)-D, (iv)-E, (v)-C
(c) (i)-E, (ii)-A, (iii)-B, (iv)-C, (v)-D
(d) (i)-C, (ii)-E, (iii)-A, (iv)-D, (v)-B

114. In *Entamoeba histolytica*, the presence of chromatoid bodies is characteristic of
(a) cystic stage
(b) mature quadrinucleate stage
(c) trophozoite stages
(d) mature binucleate stage.

115. Bacterial endotoxin is
(a) lipopolysaccharide located on the surface of the bacteria
(b) a toxic protein that stays inside the bacterial cell
(c) a toxic protein that is excreted into the medium
(d) none of these.

116. Acquired immuno deficiency syndrome (AIDS) is
(a) reduction in the number of killer T-cells
(b) an autoimmune disease
(c) reduction in the number of helper T-cells
(d) result of the inability of the body to produce interferons.

117. An artificial pacemaker is implanted subcutaneously and connected to the heart in patients
(a) having 90% blockage of the three main coronary arteries
(b) having a very high blood pressure
(c) with irregularity in the heart rhythm
(d) suffering from arteriosclerosis.

118. Which of the following is an example of hybrid vigour?
(a) Mule (b) Donkey
(c) Horse (d) Neopilina

119. In India, which state occupies first position in poultry farming?
(a) Kerala
(b) Uttar Pradesh
(c) Madhya Pradesh
(d) Andhra Pradesh

120. Aquaculture doesn't include
(a) prawns (b) pisces
(c) silkworm (d) shell fishery.

ANSWER KEY

PART 1 : PHYSICS

1.	(b)	**2.**	(d)	**3.**	(c)	**4.**	(b)	**5.**	(c)	**6.**	(b)	**7.**	(c)	**8.**	(c)
9.	(d)	**10.**	(a)	**11.**	(b)	**12.**	(c)	**13.**	(c)	**14.**	(d)	**15.**	(a)	**16.**	(a)
17.	(b)	**18.**	(b)	**19.**	(a)	**20.**	(a)	**21.**	(c)	**22.**	(d)	**23.**	(d)	**24.**	(d)
25.	(b)	**26.**	(a)	**27.**	(b)	**28.**	(a)	**29.**	(a)	**30.**	(c)	**31.**	(d)	**32.**	(a)
33.	(c)	**34.**	(a)	**35.**	(d)										

PART 2 : CHEMISTRY

36.	(a)	**37.**	(b)	**38.**	(b)	**39.**	(c)	**40.**	(b)	**41.**	(a)	**42.**	(d)	**43.**	(a)
44.	(d)	**45.**	(a)	**46.**	(c)	**47.**	(a)	**48.**	(d)	**49.**	(b)	**50.**	(b)	**51.**	(b)
52.	(d)	**53.**	(a)	**54.**	(b)	**55.**	(c)	**56.**	(c)	**57.**	(c)	**58.**	(c)	**59.**	(b)
60.	(a)	**61.**	(c)	**62.**	(a)	**63.**	(b)	**64.**	(b)	**65.**	(a)	**66.**	(a)	**67.**	(c)
68.	(d)	**69.**	(d)	**70.**	(a)										

PART 3 : MATHEMATICS

71.	(b)	**72.**	(d)	**73.**	(a)	**74.**	(a)	**75.**	(b)	**76.**	(d)	**77.**	(b)	**78.**	(d)
79.	(b)	**80.**	(c)	**81.**	(a)	**82.**	(d)	**83.**	(d)	**84.**	(b)	**85.**	(b)	**86.**	(b)
87.	(b)	**88.**	(a)	**89.**	(b)	**90.**	(d)	**91.**	(b)	**92.**	(a)	**93.**	(c)	**94.**	(b)
95.	(b)	**96.**	(b)	**97.**	(a)	**98.**	(b)	**99.**	(d)	**100.**	(b)	**101.**	(c)	**102.**	(a)
103.	(d)	**104.**	(b)	**105.**	(a)										

PART 4 : BIOLOGY

71.	(b)	**72.**	(c)	**73.**	(c)	**74.**	(b)	**75.**	(d)	**76.**	(a)	**77.**	(c)	**78.**	(a)
79.	(a)	**80.**	(b)	**81.**	(b)	**82.**	(a)	**83.**	(c)	**84.**	(d)	**85.**	(c)	**86.**	(b)
87.	(a)	**88.**	(b)	**89.**	(d)	**90.**	(a)	**91.**	(a)	**92.**	(c)	**93.**	(a)	**94.**	(b)
95.	(a)	**96.**	(a)	**97.**	(d)	**98.**	(a)	**99.**	(c)	**100.**	(b)	**101.**	(b)	**102.**	(a)
103.	(a)	**104.**	(a)	**105.**	(b)	**106.**	(a)	**107.**	(a)	**108.**	(b)	**109.**	(c)	**110.**	(d)
111.	(b)	**112.**	(c)	**113.**	(a)	**114.**	(a)	**115.**	(a)	**116.**	(c)	**117.**	(c)	**118.**	(a)
119.	(d)	**120.**	(c)												

eXplanations

PART 1 : PHYSICS

1. **(b) :** Energy density of an electric field E is $u_E = \frac{1}{2}\varepsilon_0 E^2$ where ε_0 is permittivity of free space.

$$u_E = \frac{\text{Energy}}{\text{Volume}} = \frac{[ML^2T^{-2}]}{[L^3]} = [ML^{-1}T^{-2}]$$

Hence, the dimension of $\frac{1}{2}\varepsilon_0 E^2$ is $[ML^{-1}T^{-2}]$.

2. **(d) :** N VSD = $(N-1)$ MSD

20 VSD = 19 MSD $\quad\therefore$ 1 MSD = $\frac{20}{19}$ VSD

$$\text{LC} = 1\text{ MSD} - 1\text{ VSD} = 1\text{ MSD} - \frac{19}{20}\text{ MSD}$$

$$\text{LC} = \left(1 - \frac{19}{20}\right)\text{MSD} = \frac{1}{20} \times \text{MSD}$$

$$0.1\text{ mm} = \frac{1}{20} \times \text{MSD}$$

$\therefore$ MSD = 0.1 mm × 20 = 2.0 mm

3. **(c) :** $\text{Pressure} = \frac{\text{Force}}{\text{Area}}$

$$= \frac{[MLT^{-2}]}{[L^2]} = [ML^{-1}T^{-2}]$$

$$\text{Young's Modulus} = \frac{\text{Longitudinal stress}}{\text{Longitudinal strain}}$$

$$= \frac{[ML^{-1}T^{-2}]}{[M^0L^0T^0]} = [ML^{-1}T^{-2}]$$

4. **(b) :** E = Work done = $F \times l$.

If the new unit of l = 3 m = 1 m′, and F = 3 N = 1 N′.

where m′ is new meter and N′ is new newton.

$\therefore$ In the new units 81 J is only 9 (new joule)

i.e. Energy = 81 J = 9 new units, J′.

5. **(c) :** Let u be the initial speed and θ be the angle of the projection.

As per question,

Speed at the maximum height,

$$v_H = u\cos\theta = \frac{\sqrt{3}}{2}u$$

$$\therefore \quad \cos\theta = \frac{\sqrt{3}}{2} \quad \text{or} \quad \theta = \cos^{-1}\left(\frac{\sqrt{3}}{2}\right) = 30°$$

Range, $R = \frac{u^2\sin 2\theta}{g}$

Maximum height, $H = \frac{u^2\sin^2\theta}{2g}$

As $R = PH$ (Given)

$$\therefore \quad \frac{u^2\sin 2\theta}{g} = P\frac{u^2\sin^2\theta}{2g}$$

$$\text{or} \quad 2\sin\theta\cos\theta = \frac{P}{2}\sin^2\theta \quad \text{or} \quad \tan\theta = \frac{4}{P}$$

$$\text{or} \quad P = \frac{4}{\tan\theta} = \frac{4}{\tan 30°} = 4\sqrt{3}$$

6. **(b) :** Let F be the upward force and m be the mass of the each link. Then

$F - 5mg = 5ma$ or $F = 5m(a+g)$

Let the force of interaction between the top (first) link and the link (second) immediately below it be F_{12}.

The forces on the top link are

(i) Upward force F

(ii) Weight mg

(iii) Force of interaction F_{12}

The equation of motion of the top link is

$F - mg - F_{12} = ma$

or $F_{12} = F - mg - ma$

$= 5m(a+g) - m(a+g) = 4m(a+g)$

$= 4 \times 0.1(2.5 + 9.8) = 4.92$ N

7. **(c) :** $\text{Force} = \frac{d}{dt}(\text{momentum})$

$$= \frac{d}{dt}(mv) = v\left(\frac{dm}{dt}\right)$$

$\therefore$ Rate of combustion, $\frac{dm}{dt} = \frac{F}{v} = \frac{210}{300} = 0.7$ kg s^{-1}

8. **(c) :** As kinetic energy $\propto v^2$, therefore graph between speed and kinetic energy must be parabolic.

9. **(d) :** $\vec{L} = \vec{r} \times \vec{p} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 2 & -1 \\ 3 & 4 & -2 \end{vmatrix}$

$= \hat{i}(-4+4) - \hat{j}(-2+3) + \hat{k}(4-6) = 0\hat{i} - 1\hat{j} - 2\hat{k}$

$\vec{L}$ has components along $-y$ axis and $-z$ axis but it has no component along the x-axis. The angular momentum is in yz plane, *i.e.*, perpendicular to x-axis.

10. **(a) :** Escape velocity, $v_e = \sqrt{\frac{2GM}{R}}$

If radius is reduced to $\left(\frac{1}{4}\right)^{\text{th}}$ of its value keeping mass constant, its escape velocity becomes

$$v_e' = \sqrt{\frac{2GM}{R/4}} = 2\sqrt{\frac{2GM}{R}} = 2v_e$$

11. **(b) :** When a wire of length L and cross section area A is stretched by a force F, then

Young's modulus, $Y = \frac{FL}{A\Delta L}$ or $\Delta L = \frac{FL}{AY}$

In case of elongation by its own weight, $F(=mg)$ will act at centre of gravity of the wire so that length of the wire which is stretched will be $\left(\frac{L}{2}\right)$.

$$\therefore \quad \Delta L = \frac{(mg)(L/2)}{AY} = \frac{mgL}{2AY}$$

12. **(c)**

13. **(c) :** $x = a\sin\omega t$ or $\frac{x}{a} = \sin\omega t$ ...(i)

Velocity, $v = \frac{dx}{dt} = a\omega\cos\omega t$

$$\frac{v}{a\omega} = \cos\omega t \qquad \text{...(ii)}$$

Squaring and adding eqn. (i) and (ii), we get

$$\frac{x^2}{a^2} + \frac{v^2}{a^2\omega^2} = \sin^2\omega t + \cos^2\omega t$$

$$\frac{x^2}{a^2} + \frac{v^2}{a^2\omega^2} = 1$$

It is an equation of ellipse.

Hence, the graph between velocity and displacement is an ellipse.

Momentum of the particle = mv

$\therefore$ The nature of graph of the momentum and displacement is same as that of velocity and displacement.

14. **(d) :** Let the intensity of sound be I_1 and I_2.

Loudness of sound initially

$$L_1 = 10\log_{10}\left(\frac{I_1}{I_0}\right)$$

where I_0 is threshold of hearing

Later, $L_2 = 10\log_{10}\left(\frac{I_2}{I_0}\right)$

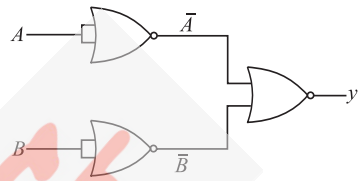
Given : $L_1 - L_2 = 20$ dB

$$\therefore \quad L_1 - L_2 = 10\log_{10}\left(\frac{I_1}{I_0}\right) - 10\log_{10}\left(\frac{I_2}{I_0}\right)$$

$$20 = 10\log_{10}\left(\frac{I_1}{I_2}\right) \quad \text{or} \quad 10^2 = \left(\frac{I_1}{I_2}\right)$$

$$\text{or} \quad I_2 = \frac{I_1}{100}$$

15. **(a) :**



The output y of the given circuit is

$y = \overline{\bar{A} + \bar{B}} = \bar{\bar{A}} \cdot \bar{\bar{B}}$ (by de Morgan's theorem)

$= A \cdot B$ $(\because \ \bar{\bar{A}} = A, \bar{\bar{B}} = B)$

16. **(a) :** Here,

Mass of ice, $m_{ice} = 1$ g

Mass of steam, $m_{steam} = 1$ g

Latent heat of fusion of ice, $L_{ice} = 80$ cal g^{-1}

Latent heat of steam, $L_{steam} = 540$ cal g^{-1}

Specific heat of water, $s_{water} = 1$ cal g^{-1} °C^{-1}

Heat required to convert ice at 0°C to water at 100°C is

$Q_1 = m_{ice}\, L_{ice} + m_{ice}\, s_{water}\, \Delta T$

= (1 g)(80 cal g^{-1}) + (1 g)(1 cal g^{-1} °C^{-1}) (100°C – 0°C)

= 80 cal + 100 cal = 180 cal

Heat released by steam at 100°C to condense into water at 100°C is

$Q_2 = m_{steam}\, L_{steam}$

= (1 g)(540 cal g^{-1}) = 540 cal

As $Q_1 < Q_2$, whole of the steam will not condense, so the temperature of the mixture is 100°C.

17. **(b) :** As internal energy is a state variable and in cyclic process, final state coincides with the initial state.

$\therefore \quad \Delta U = 0$

18. **(b) :** The efficiency of a Carnot engine is

$$\eta = 1 - \frac{T_2}{T_1}$$

Here, $T_1 = 500$ K, $T_2 = 300$ K

$$\therefore \quad \eta = 1 - \frac{300\text{ K}}{500\text{ K}} = \frac{500\text{ K} - 300\text{ K}}{500\text{ K}}$$

$$= \frac{200\text{ K}}{500\text{ K}} = \frac{2}{5} = \frac{2}{5} \times 100\% = 40\%$$

19. (a) : The rms velocity of an ideal gas is

$$v_{rms} = \sqrt{\frac{3RT}{M}}$$

where T is the absolute temperature and M is the molar mass of an ideal gas.

Since M remains the same, so $v_{rms} \propto \sqrt{T}$

$$\therefore \quad \frac{v'_{rms}}{v_{rms}} = \sqrt{\frac{T'}{T}} = \sqrt{\frac{3T}{T}} = \sqrt{3}$$

or $\quad v'_{rms} = \sqrt{3}\, v_{rms}$

20. (a) : For mixture of gases, $C_V = \dfrac{n_1 C_{V_1} + n_2 C_{V_2}}{n_1 + n_2}$

Here, $C_{V_1} = \dfrac{3}{2}R,\ n_1 = 1,\ C_{V_2} = \dfrac{5}{2}R,\ n_2 = 1$

$$\therefore \quad C_V = \frac{\left(1 \times \frac{3}{2}R\right) + \left(1 \times \frac{5}{2}R\right)}{1+1} = \frac{4}{2}R = 2R$$

21. (c) : Magnifying power of a telescope,

$$m = \frac{f_o}{f_e} \qquad \text{...(i)}$$

where f_o is the focal length of the objective and f_e is the focal length of the eyepiece.

When the focal length of eyepiece is doubled, its magnifying power becomes

$$m' = \frac{f_o}{2f_e} = \frac{m}{2} \qquad \text{(Using (i))}$$

22. (d) : When the shift in star light is towards red end wavelength increases and the apparent frequency is less than the actual. The star must be receding away from the earth.

23. (d) : Magnifying power of compound microscope

$$M = -\frac{v_o}{u_o}\left(1 + \frac{D}{f_e}\right) = -\frac{L}{f_o}\left(1 + \frac{D}{f_e}\right)$$

24. (d)

25. (b) : Power in internal and external resistance

$$= \frac{V^2}{R+r}$$

$$\therefore \quad \text{Total power} = \frac{(220)^2}{100+10} = \frac{220 \times 220}{110}$$

or Total power = 440 W

This power is shared between two resistances.

Ratio of powers = Ratio of resistances

$$\frac{P_{100}}{P_{10}} = \frac{100}{10} = 10 \quad \therefore \quad P_{10} = \frac{P_{100}}{10}$$

$P_{100} + P_{10} = 440$

$$\therefore \quad P_{100} + \frac{P_{100}}{10} = 440 \quad \text{or} \quad \frac{11}{10}(P_{100}) = 440$$

$$\text{or} \quad P_{100} = \frac{440 \times 10}{11} = 400\text{ W}$$

26. (a) : Horizontal component, $B_H = B_e\cos\theta$

$\therefore \quad B_{H_1} = B_e\cos 30°$ and $B_{H_2} = B_e\cos 45°$

Thus,

$$\frac{B_{H_1}}{B_{H_2}} = \frac{\cos 30°}{\cos 45°} = \frac{\frac{\sqrt{3}}{2}}{\frac{1}{\sqrt{2}}} = \frac{\sqrt{3}}{\sqrt{2}}$$

27. (b)

28. (a) : The arrangement is equivalent to two capacitors joined in parallel.

$$\therefore \quad C_P = \frac{2\varepsilon_0 a}{d}$$

29. (a) : The peak is characteristic of the target material and forms the characteristic X-ray spectrum of the target element.

30. (c) : For Brackett series, $n_1 = 4$, $n_2 = 5, 6, 7$ .....

$$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

where $R = 1.09687 \times 10^7\ \text{m}^{-1}$, called Rydberg's constant.

$$\frac{1}{\lambda} = R\left(\frac{1}{4^2} - \frac{1}{n_2^2}\right)$$

For maximum wavelength, $n_2 = 5$

$$\frac{1}{\lambda_{max}} = 1.09687 \times 10^7\left(\frac{1}{4^2} - \frac{1}{5^2}\right)$$

$\lambda_{max} = 40519$ Å

31. (d) : According to Einstein's photoelectric equation,

$$K = \frac{hc}{\lambda} - \frac{hc}{\lambda_0} = hc\left(\frac{1}{\lambda} - \frac{1}{\lambda_0}\right) = hc\left(\frac{\lambda_0 - \lambda}{\lambda\lambda_0}\right)$$

32. **(a) :** The binding energy per nucleon is maximum for iron.

33. **(c) :** Conductivity of semiconductors increases with increase in temperature and vice versa.
Semiconductors behave as insulators at 0 K.

34. **(a) :** Here, $\upsilon = 10\ \text{MHz} = 10^7\ \text{Hz}$
As $\upsilon = 9(N_{max})^{1/2}$

$$\therefore \quad N_{max} = \frac{\upsilon^2}{81} = \frac{(10^7)^2}{81} \sim 1.2 \times 10^{12}\ \text{m}^{-3}$$

35. **(d) :** The length of antenna is generally taken by $\lambda/4$.

PART 2 : CHEMISTRY

36. **(a) :** $\underset{1-\alpha}{A_xB_y} \rightleftharpoons \underset{x\alpha}{xA^+} + \underset{y\alpha}{yB^-}$

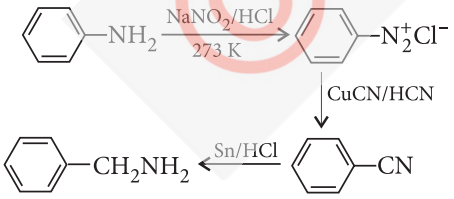
Total $= 1 + \alpha(x + y - 1)$ or $i = 1 + \alpha(x + y - 1)$

or $\alpha = \dfrac{i-1}{x+y-1}$

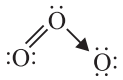
37. **(b) :** Primary valency corresponds to oxidation number while secondary valency corresponds to coordination number.

38. **(b) :** HCl is strong acid and NaCl is neutral salt. NaCN undergoes anionic hydrolysis and gives basic solution. Hence its pH > 7. Whereas NH_4Cl undergoes cationic hydrolysis and gives acidic solution, thus its pH < 7.
Therefore the increasing order of pH is
$HCl < NH_4Cl < NaCl < NaCN$.

39. **(c) :**



40. **(b) :** The Lewis dot structure of O_3 is



Formal charge on central oxygen atom
= valence electrons $-\ \dfrac{1}{2}$ bonding electrons
$-$ non-bonding electrons
$= 6 - \dfrac{1}{2} \times 6 - 2 = +1$

41. **(a) :** Smaller cations form more stable complexes.
Ionic radii : $Fe^{2+} > Co^{2+} > Ni^{2+} > Cu^{2+}$
$\therefore$ Stability : $Fe^{2+} < Co^{2+} < Ni^{2+} < Cu^{2+}$

42. **(d) :** 3° alcohols react fastest with Lucas reagent.

$CH_3CH_2CH_2CH_2OH$ 1°

$CH_3 - CH_2 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_3$ 2°

$CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_2 - OH$ 1°

$CH_3 - \underset{\displaystyle OH}{\underset{|}{\overset{\displaystyle CH_3}{\overset{|}{C}}}} - CH_3$ 3°

43. **(a) :** Real gas equation is

$$\left(P + \frac{a}{V_m^2}\right)(V_m - b) = RT$$

$$PV_m + \frac{a}{V_m} - Pb - \frac{ab}{V_m^2} = RT$$

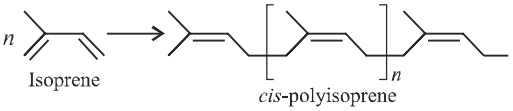
As P is small, thus V_m will be large and the terms Pb and ab/V_m^2 can be neglected.

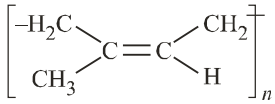
$$PV_m + \frac{a}{V_m} = RT$$

or $PV_m = RT - a/V_m$

Thus $Z = \dfrac{PV_m}{RT} = 1 - \dfrac{a}{RTV_m}$

44. **(d) :** Natural rubber is *cis*-1, 4 polyisoprene and has only *cis*-configuration about the double bond.





cis-polyisoprene
(Natural rubber)

whereas in gutta-percha, only *trans*-configuration exists about the double bond.

45. **(a) :** $\underset{(A)}{Ca(OH)_2} + Na_2CO_3 \longrightarrow 2NaOH + \underset{(C)}{CaCO_3}$
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad \underset{(B)}{}$
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad |\ CO_2$
$\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad \longrightarrow CaCO_3$

46. **(c) :** Since the alkene (C_6H_{10}) on ozonolysis gives a single dialdehyde containing six C-atoms, therefore, the alkene must be cyclohexene.

47. **(a) :** Empirical formula weight = 12 + 2 × 1 = 14

Equal number of moles occupy equal volume in identical conditions.

$\therefore$ Molecular weight = 14 × 2 = 28

$(\text{Empirical weight})_n$ = Molecular weight

$$n = \frac{28}{14} = 2$$

Molecular formula = $(\text{Empirical formula})_n$

$= C_2H_4$

48. **(d) :** Separating funnel since the two liquids are immiscible.

49. **(b)**

50. **(b) :** There is one octahedral hole per oxide ion. Two third of the total octahedral holes in a closest packed array of oxide ions are occupied by aluminium ions. Hence, the ratio of aluminium ions to oxygen ions must be $\frac{2}{3}:1$ *i.e.*, 2 : 3. Hence, formula of aluminium oxide is Al_2O_3.

51. **(b) :** The colloidal particle are moving towards positive electrode (anode) *i.e.* the particles are anions. For anions coagulation increases with increase in positive charge of particles used for coagulation.

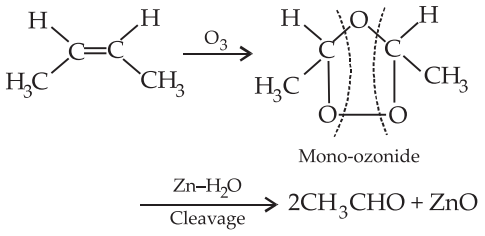
$Al^{3+} > Ba^{2+} > Na^+$

$AlCl_3 > BaCl_2 > NaCl$

52. **(d) :** Density increases from left to right upto middle in a periods and increases down the group in periodic table. Graphite form of carbon is less dense thus order of density is

Mg < C (graphite) < B < Al.

53. **(a) :** The complete reaction sequence is as follows :



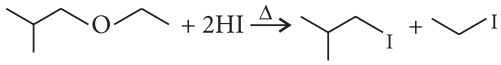
Mono-ozonide

$$\xrightarrow[\text{Cleavage}]{Zn-H_2O} 2CH_3CHO + ZnO$$

54. **(b) :** $r_1 = k[A]^x$, $r_2 = k[1.5A]^x$

$$\frac{r_1}{r_2} = \frac{k[A]^x}{k[1.5A]^x} \Rightarrow 1.837 = [1.5]^x \Rightarrow x = 1.5$$

55. **(c) :** When mixed ethers are heated, it gives two different alkyl halides with HI.



$+H_2O$

56. **(c) :** $-COR, COOR \Rightarrow -M$ $\quad OR \Rightarrow +M$

$-Cl, -NH_2 \Rightarrow +M$ $\quad -CHO \Rightarrow -M$

$-NO_2, -CN, -SO_3H \Rightarrow -M$

$-OH, -NH_2, -SR \Rightarrow +M$

57. **(c) :** The carbonyl compounds having atleast one α-hydrogen atom undergo condensation reaction in presence of dilute NaOH solution. This reaction is called as aldol condensation reaction. As formaldehyde (HCHO) has no α-hydrogen atom attached to carbonyl group, it does not respond to this test.

58. **(c)**

59. **(b) :** Both V^{4+} and Cu^{2+} have one unpaired electron in the *d*-orbital. $V^{4+} = [Ar]3d^1$, $Cu^{2+} = [Ar]3d^9$.

60. **(a) :** (i) $n + l = 5$; $n = 4$

(ii) $n + l = 4$; n = 4

(iii) $n + l = 5$; $n = 3$

(iv) $n + l = 4$; $n = 3$

Lower $n + l$ means less energy and if for two subshells $n + l$ is same than lower n, lower will be the energy. Thus correct order is (iv) < (ii) < (iii) < (i).

61. **(c) :** $Z = \frac{E}{96500} \Rightarrow E = Z \times 96{,}500$

But, $Z = \frac{W}{I \times t} \Rightarrow E = \frac{W \times 96500}{I \times t}$

62. **(a) :** $\sqrt{n(n+2)} = 5.92$

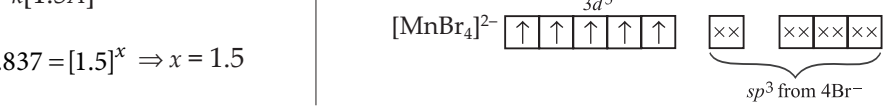
$n(n + 2) = 35.05$

$n = 5$

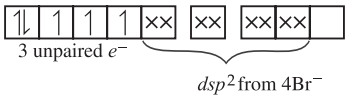
Thus unpaired electrons should be 5 in the complex.

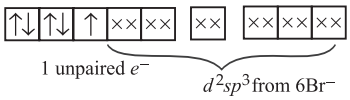
$[MnBr_4]^{2-}$: Tetrahedral *i.e.* sp^3

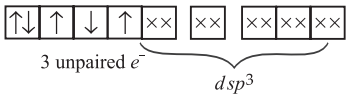
For sp^3 no required of *d*-orbitals thus the electronic configuration will be



While in others the configuration will be

$[MnBr_4]^{2-}$ 

$[MnBr_6]^{4-}$ 

$[MnBr_5]^{3-}$ 

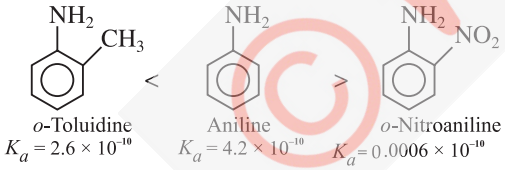
63. **(b) :** $CH_3CHO + CH_3CH_2CHO \longrightarrow$

$CH_3 - CH_2 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_2CHO +$

$CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_2CH_2CHO + CH_3 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_2CHO$

$+ CH_3CH_2 - \underset{\displaystyle OH}{\underset{|}{CH}} - CH_2CH_2CHO$

64. **(b) :** *Ortho* substituted anilines are weaker bases than anilines regardles of the nature of the substituent whether electron releasing or electron withdrawing. This is called *ortho* effect and is probably due to a combination of steric and electronic factors.



o-Toluidine $K_a = 2.6 \times 10^{-10}$ Aniline $K_a = 4.2 \times 10^{-10}$ *o*-Nitroaniline $K_a = 0.0006 \times 10^{-10}$

65. **(a) :** Nucleotides have phosphate units.

66. **(a) :** Emission of α-particle leads to decrease of 2 units of charge.

eg. : $^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He$

67. **(c) :** $CH_3 - \underset{\displaystyle COOH}{\overset{\displaystyle Cl}{\overset{|}{\underset{|}{C^*}}}} - H$ has a chiral carbon atom hence it is optically active.

68. **(d) :** All are characteristics of saccharin.

69. **(d) :** $\Delta G = \Delta H - T\Delta S$

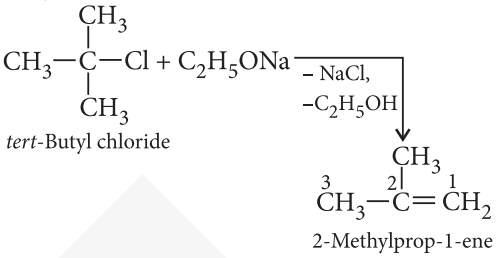
For a process to be non-spontaneous, ΔG must be +ve.

i.*e.*, $\Delta G = \Delta H - T\Delta S > 0$

$\Rightarrow T > \dfrac{\Delta H}{\Delta S} = \dfrac{-20}{-0.035} = 571.42$ K

Hence, $T > 571.4$ K

70. **(a) :** Sodium ethoxide is a strong base, so it causes dehydrohalogenation of 3° alkyl halide and gives alkene.



tert-Butyl chloride

2-Methylprop-1-ene

PART 3 : MATHEMATICS

71. **(b) :** $\dfrac{a\omega + b\omega^2 + c\omega^3 + d\omega}{c\omega + d\omega^2 + a\omega^2 + b}$

$= \dfrac{\omega(a\omega + b\omega^2 + c\omega^3 + d\omega)}{\omega(c\omega + d\omega^2 + a\omega^2 + b)}$

$= \dfrac{1}{\omega}\left(\dfrac{a\omega^2 + b + c\omega + d\omega^2}{a\omega^2 + b + c\omega + d\omega^2}\right) = \dfrac{1}{\omega} = \omega^2$

72. **(d) :** (i) Let $z_1 \in C - \{0\}$

$\therefore \dfrac{z_1 - z_1}{z_1 + z_1} = 0 = 0 + i0$ which is real

so $z_1 R z_1 \Rightarrow R$ is reflexive

(ii) Let $z_1 R z_2 \Rightarrow \dfrac{z_1 - z_2}{z_2 + z_1}$ is real

$\Rightarrow -\dfrac{z_1 - z_2}{z_1 + z_2}$ is real $\Rightarrow \dfrac{z_2 - z_1}{z_2 + z_1}$ is real

$\therefore z_2 R z_1 \Rightarrow R$ is symmetric.

(iii) Let $z_1 R z_2$ and $z_2 R z_3$

$\therefore \dfrac{z_1 - z_2}{z_1 + z_2}$ and $\dfrac{z_2 - z_3}{z_2 + z_3}$ are real.

Let $z_1 = x_1 + iy_1$, $z_2 = x_2 + iy_2$, $z_3 = x_3 + iy_3$

$\therefore \dfrac{z_1 - z_2}{z_1 + z_2}$ is real $\Rightarrow \text{Im}\left(\dfrac{z_1 - z_2}{z_1 + z_2}\right) = 0$

$\Rightarrow \dfrac{x_1}{y_1} = \dfrac{x_2}{y_2}$ ...(1)

Similarly, we have, $\dfrac{x_2}{y_2} = \dfrac{x_3}{y_3}$ ...(2)

$\therefore$ From (1) and (2), we have

$\dfrac{x_1}{y_1} = \dfrac{x_3}{y_3} \Rightarrow x_1 y_3 = x_3 y_1 \quad \therefore \dfrac{z_1 - z_3}{z_1 + z_3}$ is real

$\therefore z_1 R z_3 \Rightarrow R$ is transitive.

Hence R is an equivalence relation.

73. **(a)** : General term in the expansion is

$T_{r+1} = {}^{4n}C_r\, x^{4n-r}\, \dfrac{1}{x^{2r}} = {}^{4n}C_r\, x^{4n-3r}$

For x^m, putting $4n - 3r = m \Rightarrow r = \dfrac{4n-m}{3}$

$\therefore$ Required coefficient of x^m is ${}^{4n}C_{\frac{4n-m}{3}}$

74. **(a)** : Given, $f(x) = \dfrac{x}{1+|x|}\ \forall\ x \in R$

$$= \begin{cases} \dfrac{x}{1+x} & , \quad x > 0 \\ 0 & , \quad x = 0 \\ \dfrac{x}{1-x} & , \quad x < 0 \end{cases}$$

$$\therefore f'(x) = \begin{cases} \dfrac{1}{(1+x)^2}, & \forall \quad x \geq 0 \\ \dfrac{1}{(1-x)^2}, & \forall \quad x \leq 0 \end{cases}$$

$$\text{Again, } f''(x) = \begin{cases} \dfrac{-2}{(1+x)^3} & \forall \quad x \geq 0 \\ \dfrac{2}{(1-x)^3} & \forall \quad x \leq 0 \end{cases}$$

Here $f''(x)$ changes its sign from +ve to –ve in the immediate neighbourhood of $x = 0$.

$\therefore$ $f'(0)$ is maximum at $x = 0$

$\therefore$ $0 < f'(x) \leq 1$

75. **(b)** : $x^3 + 2x^2 + 2x + 1 = 0$

$\Rightarrow$ $(x^3 + 1) + 2x\,(x + 1) = 0$

$\Rightarrow$ $(x + 1)\,[x^2 - x + 1] + 2x(x + 1) = 0$

$\Rightarrow$ $(x + 1)(x^2 + x + 1) = 0$

$\therefore$ $x = -1, \omega, \omega^2$

Now, say $f(x) = 1 + x^{200} + x^{2023}$

$\therefore$ $f(-1) = 1 + 1 - 1 \neq 0$, not a common root

$f(\omega) = 1 + (\omega^{66})^3\omega^2 + (\omega^3)^{674}\,\omega = 1 + \omega^2 + \omega = 0$

$\therefore$ ω is common root.

And $f(\omega^2) = 1 + \omega + \omega^2 = 0$

$\therefore$ ω^2 is also common root.

76. **(d)** : $2x^2 + 2\lambda xy + 3y^2 + 4x + 2y + 2 = 0$ and $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ will represent a pair of straight lines if $\Delta = \begin{vmatrix} a & h & g \\ h & b & f \\ g & f & c \end{vmatrix} = 0$

$$\therefore \quad \begin{vmatrix} 2 & \lambda & 2 \\ \lambda & 3 & 1 \\ 2 & 1 & 2 \end{vmatrix} = 0$$

$\Rightarrow$ $2(6 - 1) - \lambda(2\lambda - 2) + 2(\lambda - 6) = 0$

$\Rightarrow$ $10 - 2\lambda^2 + 2\lambda + 2\lambda - 12 = 0$

$\Rightarrow$ $-2\lambda^2 + 4\lambda - 2 = 0$

$\Rightarrow$ $\lambda^2 - 2\lambda + 1 = 0 \quad \Rightarrow \quad \lambda = 1$

77. **(b)** : Let $\dfrac{x^2}{a^2} = X$, $\dfrac{y^2}{b^2} = Y$, $\dfrac{z^2}{c^2} = Z$

So, the given equations become

$X + Y - Z = 1$

$X - Y + Z = 1$

$-X + Y + Z = 1$

So, coefficient matrix $A = \begin{pmatrix} 1 & 1 & -1 \\ 1 & -1 & 1 \\ -1 & 1 & 1 \end{pmatrix}$

as $|A| \neq 0$, so system of equations has unique solution.

78. **(d)** : $\displaystyle\int \frac{x^2\left(1 - 1/x^2\right)}{x^2\left(x^2 + 1/x^2 + 3\right)\tan^{-1}(x + 1/x)}\,dx$

$= \displaystyle\int \frac{dt}{(1 + t^2)(\tan^{-1} t)}$ $\left[\text{Putting } t = x + \dfrac{1}{x}\right]$

$= \log\,(\tan^{-1}\,(x + 1/x)) + c.$

79. **(b)**

80. **(c)** : As $r_1 + r_2 = AB$

$\Rightarrow$ circles touches externally, so common chord is common tangent, whose equation is given by

$S_1 - S_2 = 0 \quad \Rightarrow \quad 20x + 40 = 0 \quad \Rightarrow x = -2$

Putting $x = -2$ in one of the given circles, we get $y = -3$

$\therefore$ Required point, which is the point of contact is $(-2, -3)$.

81. **(a)** : ${}^{23}C_6 + ({}^{23}C_5 + \ldots + {}^{27}C_5) + ({}^{28}C_{23} + \ldots + {}^{32}C_{27})$

$= {}^{23}C_6 + {}^{23}C_5 + {}^{24}C_5 + \ldots + {}^{32}C_5$

$= {}^{23+10}C_6 = {}^{33}C_6 \qquad ({}^{\because}\ {}^nC_r + {}^nC_{r+1} = {}^{n+1}C_{r+1})$

82. **(d)** : Vector equation of plane through $\vec{a}, \vec{b}, \vec{c}$ is

$\vec{r} \cdot \left(\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}\right) = \left[\vec{a}\,\vec{b}\,\vec{c}\right]$

$\therefore$ Distance from $O(0,0,0)$ to the plane is

$$\frac{\vec{O} \cdot \left|\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}\right| - \left[\vec{a}\vec{b}\vec{c}\right]}{\left|\vec{a} \times \vec{b} + \vec{b} \times \vec{c} + \vec{c} \times \vec{a}\right|}$$

83. **(d)** : We have to find the inverse of $f(x)$ which means f is one one and onto function.

Let $f(x) = y = \log_2\,(x + \sqrt{x^2 + 1})$

$\Rightarrow$ $2^y = x + \sqrt{x^2 + 1}$ ...(i)

$$\Rightarrow 2^{-y} = \frac{1}{x+\sqrt{x^2+1}} = \frac{\sqrt{x^2+1}-x}{1} \quad \text{...(ii)}$$

By subtracting (i) and (ii), we have

$$2^y - 2^{-y} = 2x \Rightarrow x = \frac{1}{2}(2^y - 2^{-y})$$

$$\therefore f^{-1}(y) = \frac{1}{2}(2^y - 2^{-y})$$

$$\therefore f^{-1}(x) = \frac{1}{2}(2^x - 2^{-x})$$

84. (b) : Given, $\dfrac{x + y\dfrac{dy}{dx}}{y - x\dfrac{dy}{dx}} = x^2 + 2y^2 + \dfrac{y^4}{x^2}$

$$\Rightarrow \frac{d(x^2+y^2)}{(x^2+y^2)^2} = 2\frac{d\left(\frac{x}{y}\right)}{\left(\frac{x}{y}\right)^2}$$

Integrating, we get

$$-\frac{1}{x^2+y^2} = \frac{-2}{x/y} + c \Rightarrow c = \frac{2y}{x} - \frac{1}{x^2+y^2}$$

85. (b) : Given a, b, c are in H.P.

So, $\frac{1}{a}, \frac{1}{b}, \frac{1}{c}$ are in A.P.

$\Rightarrow \frac{a+b+c}{a}, \frac{b+c+a}{b}, \frac{c+a+b}{c}$ are in A.P.

$\Rightarrow \frac{b+c}{a}, \frac{c+a}{b}, \frac{a+b}{c}$ are in A.P.

$\Rightarrow \frac{a}{b+c}, \frac{b}{c+a}, \frac{c}{a+b}$ are in H.P.

86. (b) : Applying the property of summation of determinant to column C_1 and the L.H.S., we have

$$\sum_{t=0}^{m} \Delta_t = \begin{vmatrix} \sum_{t=0}^{m}(2t-1) & m^2-1 & \cos^2(m^2) \\ \sum_{t=0}^{m} {}^mC_t & 2^m & \cos^2(m) \\ \sum_{t=0}^{m} 1 & m+1 & \cos(m^2) \end{vmatrix}$$

So, $\sum_{t=0}^{m} \Delta_t = 0 \quad (\because C_1 \sim C_2)$

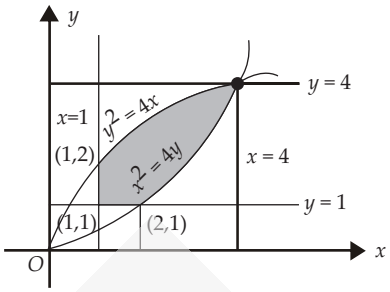
87. (b) : Given, $x = 1, x = 4$

Consider $1 < x < 4$

$\Rightarrow 1 < \sqrt{x} < 2 \Rightarrow \left[\sqrt{x}\right] = 1 = \left[\sqrt{y}\right]$

Similarly, we consider $y^2 = 4x$ & $x^2 = 4y$ by using

$\left[\sqrt{x}\right] = 1 = \left[\sqrt{y}\right]$



Now, required area $= \int_1^4 2\sqrt{x}\,dx - \int_2^4 \frac{x^2}{4}dx - 1\times 1$

$$= \frac{2\times 2}{3}[x^{3/2}]_1^4 - \left[\frac{x^3}{12}\right]_2^4 - 1$$

$$= \frac{4}{3}(8-1) - \frac{(64-8)}{12} - 1 = \frac{28}{3} - \frac{56}{12} - 1$$

$$= \frac{44}{12} = \frac{11}{3} \text{ sq. units}$$

88. (a) : Line of intersection of the given planes will be $\perp$ to each of the normal vector $\hat{n}_1 = 3\hat{i} - \hat{j} + \hat{k}$ and $\hat{n}_2 = \hat{i} + 4\hat{j} - 2\hat{k}$ so it will be parallel to $\hat{n}_1 \times \hat{n}_2$ vector.

$$\hat{n}_1 \times \hat{n}_2 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & -1 & 1 \\ 1 & 4 & -2 \end{vmatrix} = -2\hat{i} + 7\hat{j} + 13\hat{k}$$

89. (b) : Given, $R = \{(8, 9)\}$

As $(8, 9) \in R$ but $(9, 8) \notin R$

So R is non-symmetric.

90. (d) : Given equation of line is

$16x + 9y = 25$ ...(i)

and ellipse is $16x^2 + 9y^2 = 144$ ...(ii)

Let (h, k) be middle point of the chord to the ellipse. So, the equation of chord is given by

$T = S'$

$\Rightarrow 16xh + 9yk - 144 = 16h^2 + 9k^2 - 144$

$\Rightarrow 16hx + 9ky = 16h^2 + 9k^2$ ...(iii)

Now (i) & (iii) represent the same line.

$$\therefore \frac{16h}{16} = \frac{9k}{9} = \frac{16h^2+9k^2}{25} = \lambda \text{ (say)}$$

$\Rightarrow h = k = \dfrac{16h^2 + 9k^2}{25} = \lambda$

$\Rightarrow h = \lambda = k$ and $16h^2 + 9k^2 = 25\lambda$

$\Rightarrow 25\lambda^2 = 25\lambda \Rightarrow \lambda = 1 \quad (\because \lambda \neq 0)$

$\Rightarrow h = 1 = k$ is the required middle point on the given chord.

91. **(b) :** As x, y, z are in A.P. $\therefore x + z = 2y$ ....(*)

Now using $C_1 \to C_1 + C_3 - 2C_2$, we get

$$\begin{vmatrix} 0 & p+3 & p+4 \\ 0 & p+4 & p+5 \\ 2(x-2y+z) & p+2y & p+2z \end{vmatrix} = 0$$

$[\because x + z - 2y = 0$ by using (*)]

92. **(a) :** Given, $f(x) = \sin(\cos x) + \cos(\sin x)$

When a function is even & defined in negative as well as positive interval, for maxima & minima, we check the maxima/minima in the positive interval only to find the maximum & minimum values of f in $0 \le x \le \pi/2$.

Now, $x \in [0, \pi/2]$, $\sin(\cos x)$ & $\cos(\sin x)$ are decreasing functions so maximum of $f(x)$ is $f(0)$ & minimum of $f(x)$ is $f(\pi/2)$

$\therefore f(\pi/2) = \sin(\cos \pi/2) + \cos(\sin \pi/2) = \cos 1°$

and $f(0) = \sin(\cos 0°) + \cos(\sin 0°)$

$= \sin 1° + \cos 0° = 1 + \sin 1°$

93. **(c) :** If $\log_a x = t$ then $x = a^t$ such that $a > 0$ and $a \neq 1$

Now, $\log_{2x+3}(2x + 3)(3x + 7)$

$= 4 - \log_{3x+7}(2x + 3)^2$ ...(i)

Now, $2x + 3 > 0$ and $2x + 3 \neq 1$

$3x + 7 > 0$ and $3x + 7 \neq 1$

$\therefore 1 + \log_{2x+3}(3x + 7) = 4 - \log_{3x+7}(2x + 3)^2$

$[\because \log_a(ab) = 1 + \log_a b]$

$\Rightarrow \log_{2x+3}(3x + 7) + 2\log_{3x+7}(2x + 3) - 3 = 0$

Substituting $t = \log_{2x+3}(3x + 7)$, we get

$t + \dfrac{2}{t} - 3 = 0 \Rightarrow t^2 - 3t + 2 = 0 \Rightarrow t = 1, t = 2$

$\Rightarrow$ Either $2x + 3 = 3x + 7$ or $(2x + 3)^2 = 3x + 7$

$\Rightarrow x = -4$ or $x = -2, -\dfrac{1}{4}$

$\Rightarrow x = -4, -2, -\dfrac{1}{4}$

From these three values, only $x = -1/4$ satisfies the equation (i).

94. **(b) :** $P(n) = 2^n > n \Rightarrow P(k) = 2^k > k$

$\Rightarrow 2 \cdot 2^k > 2k \Rightarrow 2 \cdot 2^k > 2k > k + 1$ as $k \ge 2$

95. **(b) :** Total number of signals can be made by using at a time one or more but not larger than five flags.

Now, number of signals, when r flags are used at a time from 5 flags is equal to the number of arrangement of 5 taking r at a time *i.e.* ${}^5P_r$ $(r = 1, 2, \ldots 5)$

$\therefore$ Required ways

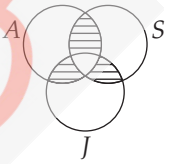
$= {}^5P_1 + {}^5P_2 + \ldots + {}^5P_5$

$= 5 + 20 + 60 + 120 + 120 = 325$

96. **(b) :** Let A denotes the set of students who received medal in athletics, J be the set of students who got medal in Judo and S be the set of students who got medal in swimming.

$\therefore n(A) = 35, n(J) = 15, n(S) = 18$

$n(A \cup J \cup S) = 58$ and $n(A \cap J \cap S) = 3$



Now $n(A \cup J \cup S) = n(A) + n(J) + n(S) - n(A \cap J) - n(A \cap S) - n(J \cap S) + n(A \cap J \cap S)$

$\Rightarrow 58 = 35 + 15 + 18 + 3 - n(A \cap J) - n(A \cap S) - n(J \cap S)$

$\Rightarrow n(A \cap S) + n(A \cap J) + n(J \cap S) = 71 - 58 = 13$

$\therefore$ Number of students who received medals in exactly two of the three sports

$= n(A \cap J) + n(J \cap S) + n(S \cap A) - 3n(A \cap S \cap J)$

$= 13 - 3 \times 3 = 13 - 9 = 4.$

97. **(a) :** For Binomial Distribution,

mean $= np = 9$ and S.D. $= \dfrac{3}{2}$

$\Rightarrow np = 9$ and $npq = \dfrac{9}{4}$

$\therefore q = \dfrac{1}{4}, p = \dfrac{3}{4}$

$\therefore np = 9 \Rightarrow n = \dfrac{9 \times 4}{3} = 12$

98. **(b) :** Let $I = \int \sqrt{x + \sqrt{x^2 + 2}}\, dx$

Put $x + \sqrt{x^2 + 2} = t \Rightarrow dx = \dfrac{1}{2}\left(1 + \dfrac{2}{t^2}\right) dt$

$\therefore I = \dfrac{1}{2}\int t^{1/2}\left(1 + \dfrac{2}{t^2}\right) dt$

$= \dfrac{1}{3}t^{3/2} - \dfrac{2}{t^{1/2}} + l$

$$= \frac{1}{3}\left(x+\sqrt{x^2+2}\right)^{3/2} - \frac{2}{\left(x+\sqrt{x^2+2}\right)^{1/2}} + l$$

$\therefore k = \frac{1}{3}, p = 3, q = 1$

99. (d) : The three sides of the triangle are

$\sqrt{b^2+c^2}, \sqrt{c^2+a^2}, \sqrt{a^2+b^2}$

Let the angle opposite to the first side be θ, then

$$\cos\theta = \frac{(\sqrt{c^2+a^2})^2 + (\sqrt{a^2+b^2})^2 - (\sqrt{b^2+c^2})^2}{2\sqrt{c^2+a^2}\sqrt{a^2+b^2}}$$

$$= \frac{2a^2}{2\sqrt{c^2+a^2}\sqrt{a^2+b^2}} = \frac{a^2}{\sqrt{a^2+b^2}\sqrt{a^2+c^2}}$$

Now, $\sin^2\theta = 1 - \cos^2\theta$

$$= 1 - \frac{a^4}{(a^2+b^2)(a^2+c^2)} = \frac{a^2b^2+b^2c^2+a^2c^2}{(a^2+b^2)(a^2+c^2)}$$

$$\Rightarrow \sin\theta = \sqrt{\frac{a^2b^2+b^2c^2+c^2a^2}{(a^2+b^2)(a^2+c^2)}}$$

$$\therefore \Delta = \frac{1}{2}\sqrt{c^2+a^2} \times \sqrt{a^2+b^2} \times \sin\theta$$

$$= \frac{1}{2}\sqrt{c^2+a^2}\sqrt{a^2+b^2} \times \frac{\sqrt{a^2b^2+b^2c^2+c^2a^2}}{\sqrt{a^2+b^2}\sqrt{c^2+a^2}}$$

$$= \frac{1}{2}\sqrt{a^2b^2+b^2c^2+c^2a^2}$$

100. (b) : $xdy + (y + x^3y^2)dx = 0$

$\Rightarrow xdy + ydx = -x^3y^2dx$

$$\Rightarrow \frac{x\,dy + ydx}{x^2y^2} = -xdx \Rightarrow \frac{d(xy)}{(xy)^2} = -xdx$$

Integrating, we get

$$-\frac{1}{xy} = -\frac{x^2}{2} + c \qquad \ldots(*)$$

Since, curve passes through (1, 2).

$$\therefore -\frac{1}{2} = -\frac{1}{2} + c \Rightarrow c = 0$$

$$\therefore -\frac{1}{xy} = -\frac{x^2}{2} \Rightarrow \frac{1}{y} = \frac{x^3}{2} \text{ (from (*))}$$

$\Rightarrow y = \frac{2}{x^3} \Rightarrow x^3y = 2$ is required curve.

101. (c) : For non-trivial solution, determinant of coefficient matrix of system of equation vanish

$$\therefore \begin{vmatrix} \sin 3\theta & -1 & 1 \\ \cos 2\theta & 4 & 3 \\ 2 & 7 & 7 \end{vmatrix} = 0$$

Solving the determinant, we get

$\theta = m\pi$ or $\theta = n\pi + (-1)^n \frac{\pi}{6}$

102. (a) : Let the consecutive terms are T_r and T_{r+1} having equal coefficients.

$\therefore$ Coefficient of T_r^{th} term = Coefficient of T_{r+1}^{th} term

$$\therefore {}^{74}C_{r-1}\, 3^{74} \left(\frac{2}{3}\right)^{r-1} = {}^{74}C_r\, 3^{74} \left(\frac{2}{3}\right)^r$$

$\Rightarrow {}^{74}C_{r-1} \times 3 = {}^{74}C_r \times 2$

$$\Rightarrow \frac{3 \times 74!}{(r-1)!\,(75-r)!} = \frac{2 \times 74!}{r!\,(74-r)!}$$

$$\Rightarrow \frac{3}{75-r} = \frac{2}{r} \Rightarrow 150 - 2r = 3r$$

$\Rightarrow r = 30$

$\therefore T_{30}$ and T_{31} are two consecutive terms, whose coefficients are same.

103. (d) : Given, a, b, c are in G.P. $\Rightarrow b^2 = ac$

and $\log\left(\frac{5c}{a}\right), \log\left(\frac{3b}{5c}\right), \log\left(\frac{a}{3b}\right)$ are in A.P.

$$\Rightarrow 2\log\left(\frac{3b}{5c}\right) = \log\left(\frac{5c}{a}\right) + \log\left(\frac{a}{3b}\right)$$

$$= \log\left(\frac{5c}{a} \cdot \frac{a}{3b}\right)$$

$$\Rightarrow \left(\frac{3b}{5c}\right)^2 = \frac{5c}{3b}$$

$$\Rightarrow (3b)^3 = (5c)^3$$

$$\Rightarrow \frac{b}{c} = \frac{5}{3} \Rightarrow c = \frac{3b}{5}$$

Now, $\frac{b^2}{c^2} = \frac{25}{9} \Rightarrow \frac{ac}{c^2} = \frac{25}{9}$ ($\because a, b, c$ are in G.P.)

$$\Rightarrow \frac{a}{c} = \frac{25}{9} \Rightarrow a = \frac{25}{9}c = \frac{25}{9} \times \frac{3b}{5} = \frac{5}{3}b.$$

$\therefore$ Numbers are $\frac{5}{3}b,\ b,\ \frac{3}{5}b$ or 25, 15, 9

which do not form any triangle as sum of two numbers is less than the third.

104. (b) : Given $\sum_{i=1}^{m} a_{ii} = 0$

$\Rightarrow (x-5) + (x^2-10) + (x-7) + (-2) = 0$

$\Rightarrow x^2 + 2x - 24 = 0 \quad \Rightarrow \quad (x-4)(x+6) = 0$

$\Rightarrow x = -6, 4$

105. (a) : $\lim_{x \to 1} \frac{x^8 - 2x + 1}{x^4 - 2x + 1}$ [(0/0) form]

Using L' Hospital Rule, we have

$\lim_{x \to 1} \frac{8x^7 - 2}{4x^3 - 2} = \frac{8-2}{4-2} = 3$

PART 4 : BIOLOGY

71. (b) : Linnaeus is to be remembered as having given a precise system of plant nomenclature. *Species Plantarum*, published in May 1753, in two volumes, was the first book in which binomial nomenclature was used for describing all the plants. Each plant was given a generic name, followed by a trivial name and then a specific phrase-name.

72. (c)

73. (c) : Solanaceae is having floral formula $\text{Br} \oplus \, ♀^{♂} \, K_{(5)} \overset{\frown}{C_{(5)}} A_5 \, G_{(\underline{2})}$ and is characterised by pentamerous, bisexual, actinomorphic and hypogynous features.

74. (b)

75. (d) : In tetradynamous condition there are six stamens, 4 are long and 2 are short *i.e.*, 4 + 2 arrangement of stamens. It is characterstic feature of cruciferae members. In liliaceae 6 stamens are arranged in whorls of 3 each (3 + 3). In solanaceae there are 5 stamens they are epipetallous and polyandrous. In malvaceae there are numerous stamens that are monoadelphous.

76. (a)

77. (c) : Depending upon the constitution of cells, plant tissues are of two types simple and complex. A simple tissue is made up of similar cells which carry out the same function. A complex tissue is made up of two or more than two types of cells which are aggregated from the beginning and perform a similar function. Complex tissues are conducting tissues, they are of two types : phloem and xylem. Phloem transports organic food and xylem transports water or sap inside the body of the plant.

78. (a)

79. (a) : Karyotype represent total number of chromosomes in a cell which is specific to each species of living organism.

80. (b) : Sickle cell anaemia is due to inheritance of a defective allele coding for β-globin. It results in the transformation of Hb^A into Hb^S in which glutamic acid is replaced by valine at sixth position in each of two β-chains of haemoglobin. The substitution of amino acid in the globin protein results due to the single base substitution at the sixth codon of the beta globin gene from GAG to GUG. Sickle cell anaemia is a disease where the red blood cells become sickle shaped instead of biconcave disc.

81. (b)

82. (a) : Prokaryotes have these major types of DNA synthesising enzymes called DNA polymerases I, II and III. All of them add nucleotides in 5′ → 3′ direction on 3′ → 5′ strand. They also possess 3′→5′ exonuclease activity while only DNA polymerase I has 5′ → 3′ exonuclease activity too.

83. (c) : Bt toxin genes were isolated from *Bacillus thuringiensis* and incorporated into the several crop plants such as cotton. The vector used to introduce new genes into plant cells is most often a plasmid from the soil bacterium *Agrobacterium tumefaciens*.

84. (d) **85. (c)** **86. (b)**

87. (a) : In maize, C_4 cycle takes place so it is called C_4 plant. Kranz anatomy is present in C_4 plants. PGA is related to Calvin cycle and OAA to Hatch and Slack cycle as both are the first stable products in their corresponding cycles.

88. (b) : C_4-plants have an advantage over C_3 plants when the weather is hot and dry. In such a weather, photorespiration does not occur in these plants.

89. (d) : Respiratory quotient is the ratio of the volume of CO_2 formed to the volume of O_2 utilised during respiration. It is less than one in case of proteins and fats. In case of carbohydrate it is equal to one. In the early stages of germination of castor seeds the RQ is less than one because castor seeds consists of fat. For fats RQ is always less than one.

90. (a)

91. (a) : The primary physiological effect of auxin on growth of a plant is by its effect on the elongation of cells or cell enlargement. The cell elongation is believed to be prompted by auxin in three ways – by increase in osmotic solutes, by decrease in wall pressure and by increase in permeability of cytoplasm to water.

92. (c) : Gibberellins help in cell growth of stem, leaves and other aerial parts. Therefore, they increase the size of stem, leaves, flowers and fruits.Besides, general increase in stem length, gibberellins specifically induce internodal growth in some genetically dwarf varieties of plants like pea and maize.

93. (a)

94. (b) : Saprophytes refer to saprotroph, a term used for organisms which obtain nutrients from dead organic matter.

95. (a) : Biofertilisers are organisms which bring about nutrient enrichment of the soil. Biofertilizers are of three types - nitrogen fixing bacteria, nitrogen fixing cyanobacteria and mycorrhiza. Among symbiotic nitrogen fixing cyanobacteria *Anabaena azollae* and *Nostoc punctaeformae* are present symbiotically in leaves of *Azolla* and *Anthoceros*. *Azolla-Anabaena* symbiotic system is the main biofertilizer which is inoculated in rice fields in South-Eastern Asia, which is found to increase yield upto 50%.

96. (a) : Golden rice is a type of transgenic crop. It is also known as miracle rice. It is rich in vitamin A or carotene and iron. Vitmanin A prevents blindness.

97. (d) : Pathogenic microbes which are used as weapons are called bioweapons. Mostly bacteria are used as bioweapon as they can be cultured easily on artificial medium in laboratories. *Clostridium botulinum* is food posion causing bacteria. The canned food which is not sufficiently heated acts as a source of infection. *Vibrio cholerae* causes chlorea and is a potential organisms which can be used as bioweapon.

98. (a) : Inspiration is a process by which fresh air enters the lungs. The diaphragm, intercostal muscles and abdominal muscles play an important role. The diaphragm becomes flat and gets lowered by the contraction of its muscle fibres thereby increases the volume of the thoracic cavity in length. External intercostal muscles occur between ribs. These muscles contract and pull the ribs and sternum upward and outward thus increasing the volume of the thoracic cavity. The abdominal muscles play a passive role in inspiration. These muscles relax and allow compression of abdominal organs by the diaphragm.

99. (c) : The right atrium receives the openings of superior vena cava, inferior vena cava and coronary sinus. The opening of the coronary sinus has coronary or Thebesian valve. Thebesian valve is a semicircular fold of the inner membrane lining of the right atrium, at the orifice of the coronary sinus.

100. (b)

101. (b) : *Agrobacterium tumefaciens*, a pathogen of several dicot plants is able to transfer a piece of DNA known as T-DNA to convert normal plant cells into tumour inducing cells. The tumour inducing plasmid of *Agrobacterium tumefaciens* have been modified into cloning vector which is not pathogenic to plant and it is used as a vector.

102. (a)

103. (a) : Adrenaline accelerates the heart beat due to stimulation of adrenal medulla by sympathetic nerve.

104. (a)

105. (b) : Genetic engineering is hybridisation of DNA of one organism to that of others. It is the alteration of DNA to encode the synthesis of new protein that perform new functions.

106. (a) : Unlimited resources result in exponential growth. In nature, a given habitat has limited resources to support only a certain number of individuals of a population, beyond which no further growth is possible. This limit is called as nature's carrying capacity (*K*) for that species in that habitat. Thus, a population growing in a natural habitat with limited resources shows initially a lag phase, followed by phases of increase and decrease and finally the population density reaches the carrying

capacity. This type of growth results in sigmoid growth curve and is called logistic growth. Since resources for growth for most animal populations become limiting sooner or later, the logistic growth model is more realistic. It is also called S or sigmoid growth form.

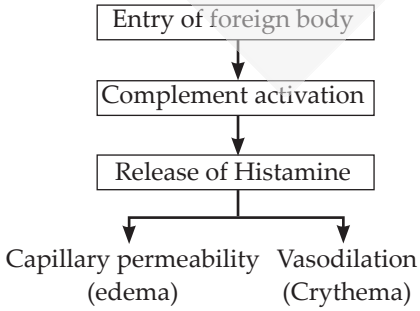
107. (a) : Theory of Natural Selection was given by Darwin. It states that as a result of struggle for existence, variability and inheritance, the successive generations tend to become better adapted to their environment. These adaptations, preserved in the individuals of the species and ultimately lead to the origin of new species from the old ones.

108. (b) : *Neopilina* belongs to class monoplacophora of phylum mollusca. It is considered as connecting link between annelida and mollusca.

109. (c)

110. (d) : In isograft the donor and recipient are genetically identical *e.g.,* transplantation of tissue or organ between a twin brother/sister.

111. (b) : Inflammatory response, in allergy is caused by histamine and IgE. Whenever, the allergen enters the body of a sensitised person, it causes antigen-antibody reaction and lysis of mast cells. This releases histamine which acts as allergy mediator. It dilates arteries and causes fluid accumulation. The blood pressure decreases drastically often resulting in the death of the individual within a short time.



112. (c) : Langerhans cells are present in pancreas. Pancreas is not included in macrophage system. Langerhans cells contain alpha cells, beta cells, delta cells, pancreatic polypeptide cells that produce glucagon, insulin, somatostatin, pancreatic polypeptide hormones respectively.

113. (a)

114. (a) : Presense of chromatoid bodies during life cycle of *Entamoeba histolytica* is characteristic of cystic stage (mature binucleate stage). During cystic stage, cytoplasm of *E. histolytica* contains one or two glycogen masses (reserve food) and one or more characteristic refractile bar-like chromatoid bodies or chromidial bars with rounded end. Both glycogen masses and chromadial bars gradually disappear.

115. (a) : Lipopolysaccharide present on cell wall of bacteria acts as endotoxin.

116. (c)

117. (c) : A pacemaker (or "artificial pacemaker"), is a medical device designed to regulate the beating of the heart. The purpose of an artificial pacemaker is to stimulate the heart when either the heart's native pacemaker is not fast enough or if there are blocks in the heart's electrical conduction system preventing the propagation of electrical impulses from the native pacemaker to the lower chambers of the heart, known as the ventricles. Generally, pacemakers do not treat fast rhythms of the heart.

118. (a) : Hybrid vigour (heterosis) results from heterozygous advantage. Mule is a hybrid of a cross between male donkey and female horse and shows hybrid vigour.

119. (d) : Poultry is today one of the fastest growing segments of the agricultural sector in India. While the production of agricultural crops in India has been growing at a rate of 1.5 to 2 percent per annum. India produced 37 billion poultry eggs in the year 2000-2001 and ranked fifth in the world in egg production. The development of poultry is not uniform across regions. Andhra Pradesh have recorded the highest production level of 77 eggs per capita per annum.

120. (c) : Aquaculture means culture of aquatic organisms in water. Silkworm is cultured on land in mulberry trees.

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