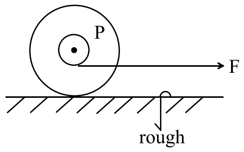
1. A ball suspended by a thread swings in a vertical plane so that its acceleration values at the extreme and lowest positions are equal. Find the thread deflection angle in extreme position
a) 53° b) 37° c) 45° d) 47°
2. An electron revolves around the nucleus. The radius of the circular orbit is r. To double the kinetic energy of electron its orbit radius is
a) $\frac{r}{\sqrt{2}}$ b) $\sqrt{2}\,r$ c) $2\,r$ d) $\frac{r}{2}$
3. Two particles of mass M and m are moving in a circle of radii R and r. If their time periods are same, what will be the ratio of their linear velocities?
a) MR : mr b) M : m c) R : r d) 1 : 1
4. The time period of a satellite in a circular orbit of radius R is T. The radius of the orbit in which time period is 8 T is
a) 2 R b) 3 R c) 4 R d) 5 R
5. The universal gravitational constant has a dimension
a) $[M^1L^{-3}T^2]$ b) $[M^{-1}L^3T^{-2}]$
c) $[M^{-1}L^{-3}T^2]$ d) $[M^1L^3T^2]$
6. Energy required to move a body of mass m from an orbit of radius 2R to 3R is
a) $\frac{GMm}{12R^2}$ b) $\frac{GMm}{3R^2}$ c) $\frac{GMm}{8R}$ d) $\frac{GMm}{6R}$
7. Consider a yo-yo kept vertically on the floor. Its inner and outer radii are r and R respectively. A thread is wound over its inner surface and placed over a rough horizontal surface. Thread is pulled over by a force F. In case of pure rolling



a) Thread unwinds, yo-yo rotates anticlockwise and friction acts leftwards
b) Thread winds, yo-yo rotates clockwise and friction acts left
c) Thread unwinds, yo-yo moves right and friction acts rightwards
d) Thread winds, yo-yo moves right and friction is zero
8. A ring and a disc have same mass and same radius. Ratio of moments of inertia of the ring about a tangent in its plane to that of the disc about its diameter is
a) 2 : 1 b) 4 : 1 c) 6 : 1 d) 8 : 1
9. A rigid body can be hinged about any point on the axis. When it is hinged such that the hinge is at x, the moment of inertia is given by
$I = 3x^2 - 24x + 17$
Then the X-coordinate of centre of mass is,
a) 2 b) 4 c) 6 d) 3
10. The maximum velocity of a particle in S.H.M. is 0.16 m/s and maximum acceleration is 0.64 m/s^2. The amplitude is
a) 4×10^{-2}m b) 4×10^{-1}m
c) 4×10 m d) 4×10^0m
11. The displacement of a particle moving in S.H.M. at any instant is given by $y = A \sin \omega t$. The acceleration after time $t = \frac{T}{4}$ is (where T is the time period)
a) $A\omega$ b) $-A\omega$ c) $A\omega^2$ d) $-A\omega^2$
12. In S.H.M., graph of which of the following is a straight line?
a) T.E. against displacement
b) P.E. against displacement
c) Acceleration against time
d) Velocity against displacement
13. After effects of elasticity are maximum for
a) Glass b) Quartz c) Rubber d) Metal
14. Hooke's law states that
a) Stress is directly proportional to the strain
b) Stress is inversely proportional to the strain
c) Stress is proportional to Young's modulus
d) Stress and strain are independent of each other
15. The angle of contact between a solid and a liquid is characteristic property of
a) Solid only
b) Liquid only
c) Both the solid and liquid
d) Shape of the solid
16. In gravity free space, the liquid in a capillary tube will rise to
a) Same height as on earth
b) Less height as on earth
c) Slightly more height that as the earth
d) Infinite height
17. Soap helps in cleaning clothes, because
a) Chemicals of soap change

b) It increases the surface tension of the solution
c) It absorbs the dirt
d) It lowers the surface tension of the solution

18. In Quincke's tube experiment, the difference in amplitudes is due to
a) Refraction b) Reflection
c) Superposition d) Polarization

19. Doppler effect is not applicable
a) When the source and observer both are at rest
b) When there is relative motion between source and observer
c) When source is at rest and observer is moving
d) When source is moving and observer is at rest

20. A standing wave having 3 nodes and 2 antinodes is formed between two atoms having a distance 1.21 Å between them. The wavelength of the standing wave is
a) 1.21 Å b) 2.42 Å c) 6.05 Å d) 3.63 Å

21. In a stationary wave,
a) In each time period all particles come to rest twice simultaneously
b) In each time period, all particles come to rest once simultaneously
c) All the particles never remain at rest simultaneously
d) All the particles never remain at rest

22. Two closed organ pipes of length 100 cm and 101 cm produce 16 beats in 20 s. When each pipe is sounded in its fundamental mode, calculate the velocity of sound
a) 303 ms^{-1} b) 332 ms^{-1}
c) 323.2 ms^{-1} d) 300 ms^{-1}

23. Degrees of freedom of a monoatomic gas due to its rotational motion will be
a) 3 b) 5 c) 0 d) 6

24. Athermanous bodies are those
a) Which do not allow heat radiation to pass through
b) Which allow heat radiation to pass through
c) Which are special type of black bodies
d) Which are insulators

25. During melting process, the heat given to a body is utilised in
a) Increasing the temperature
b) Increasing the density of the material
c) Increasing the potential energy of the molecules
d) Increasing the kinetic energy of the molecules

26. Phase difference between incident and reflected rays is 180° in
a) Air and glass b) Water and glass
c) Air and water d) Glass and water

27. In an isotropic medium,
a) Speed of light changes
b) Speed of light remains constant
c) Direction of propagation of light changes
d) Wavelength of light changes

28. The path difference at a point on the screen in Young's experiment is 5λ. If the distance of that point from the central bright band is 0.5 mm, then the bandwidth is
a) 2.5 mm b) 1 mm c) 0.1 mm d) 10 mm

29. What is the effect on Fresnel's biprism experiment when white light is used?
a) Fringes are affected
b) Diffraction pattern is spread more
c) Central fringe is white and all others are coloured
d) Fringes are not affected

30. In Young's double-slit experiment, an interference pattern is obtained on a screen by a light of wavelength 6000 Å, coming from the coherent sources S_1 and S_2. At certain point P on the screen, third dark fringe is formed. Then the path difference $S_1P - S_2P$ in microns is
a) 0.75 b) 1.5 c) 3.0 d) 4.5

31. A cube of side l is placed in a uniform field E, where $E = E\hat{i}$. The net electric flux through the cube is
a) Zero b) l^2E c) $4l^2E$ d) $6l^2E$

32. The energy density of air medium is 44.25×10^{-8} J/m^3. The intensity of the electric field in the medium is
a) 300 N/C b) 3 N/C
c) 305 N/C d) 316.2 N/C

33. When a balance point is obtained in a potentiometer for finding the internal resistance of a cell, the current through the potentiometer wire is due to
a) The cell whose internal resistance is to be found
b) The auxiliary battery
c) Both cell and auxiliary battery
d) Neither cell nor the battery

34. Resistances in the two gaps of a metrebridge are 10 ohm and 30 ohm respectively. If the resistances are interchanged, the balance point shifts by

a) 33.3 cm b) 66.67 cm c) 25 cm d) 50 cm

35. In a metrebridge, the balancing length from the left end (standard resistance of one ohm is in the right gap) is found to be 20 cm. The value of the unknown resistance is

a) 0.8 Ω b) 0.5 Ω c) 0.4 Ω d) 0.25 Ω

36. A galvanometer has a resistance of 3663 ohm. A shunt S is connected across it such that (1/34) of the total current passes through the galvanometer. Then the value of the shunt is

a) 3663 ohm b) 111 ohm
c) 107.7 ohm d) 3555.3 ohm

37. To make the field radial in a moving coil galvanometer,

a) The number of turns in the coil is increased
b) Magnet is taken in the form of horse shoe type
c) Poles are cylindrically cut
d) Coil is wound on an aluminium frame

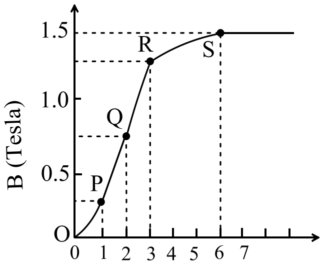
38. Two concentric circular coils of ten turns each are situated in the same plane. Their radii are 20 cm and 40 cm and they carry respectively 0.2 A and 0.3 A current in opposite direction. The magnetic field in weber/m^2 at the centre is

a) $\frac{35}{4}\mu_0$ b) $\frac{\mu_0}{80}$ c) $\frac{7}{80}\mu_0$ d) $\frac{5}{4}\mu_0$

39. Relative permeability of iron is 5500, then its magnetic susceptibility will be

a) 5500×10^7 b) 5500×10^{-7}
c) 5501 d) 5499

40. The basic magnetization curve for a ferromagnetic material is shown in figure. Then, the value of relative permeability is highest for the point



H($\times 10^3$A/m)

a) P b) Q c) R d) S

41. A very small circular loop of radius a is initially (at t = 0) coplanar and concentric with a much larger fixed circular loop of radius b. A constant current I flows in the larger loop. The smaller loop is rotated with a constant angular speed ω about the common diameter. The e. m. f. induced in the smaller loop as a function of time t is

a) $\frac{\pi a^2 \mu_0 I}{2b}\omega\cos(\omega t)$ b) $\frac{\pi a^2 \mu_0 I}{2b}\omega\sin(\omega^2 t^2)$
c) $\frac{\pi a^2 \mu_0 I}{2b}\omega\sin(\omega t)$ d) $\frac{\pi a^2 \mu_0 I}{2b}\omega\sin^2(\omega t)$

42. With an increase in the frequency of an A.C. supply, the inductive reactance

a) Increases b) Remains constant
c) Decreases d) Decreases sharply

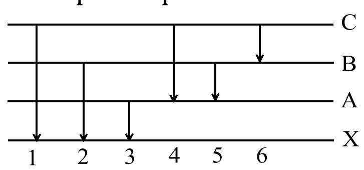
43. The pressure of gas in cathode ray tube is

a) 10^{-2} mm b) 10^{-3} mm of mercury
c) 10^5 N/m^2 d) 1 mm of mercury

44. The stopping potential for photoelectrons ejected from a photosensitive material of work function 1.6 eV, when photons of energy 2.4 eV are incident on it, is

a) 0.8 V b) 2.0 V c) 4.0 V d) 8.0 V

45. The figure indicates the energy level diagram of an atom and the origin of six spectral lines in emission (for example, line no. 5 arises from the transition from level B to A). Which of the following spectral lines will also occur in the absorption spectrum?



a) 1, 4, 6 b) 4, 5, 6
c) 1, 2, 3 d) 1, 2, 3, 4, 5, 6

46. Ratio of longest wavelengths corresponding to Lyman and Balmer series in hydrogen spectrum is

a) $\frac{5}{27}$ b) $\frac{3}{23}$ c) $\frac{7}{29}$ d) $\frac{9}{31}$

47. The electrical conductivity of a p-type semiconductor is determined by the number of

a) Holes b) Valence electrons
c) Electrons d) Conduction electrons

48. Which of the following diode emits red and yellow light?

a) Ga-As b) Ga-As-P c) Ga-P d) As-P

49. The ratio of magnetic induction along the axis to magnetic induction along the equator of a magnet is

a) 1 : 1
b) 1 : 2
c) 2 : 1
d) 4 : 1

50. 50.000 contains _____ significant figures.
a) 5 b) 3
c) 2 d) 1

51. An ionic crystal lattice has r^+/r^- radius ratio of 0.524. its coordination number is
a) 2 b) 4 c) 6 d) 8

52. The force that holds kernels together in the crystal is called _______.
a) Ionic bond b) Hydrogen bond
c) Covalent bond d) Metallic bond

53. The fraction of the total volume occupied by the atoms present in a simple cube is
a) $\frac{\pi}{4}$ b) $\frac{\pi}{6}$ c) $\frac{\pi}{3\sqrt{2}}$ d) $\frac{\pi}{4\sqrt{2}}$

54. Sodium metal crystallizes in body centred cubic lattice with cell edge 4.29 Å. The radius of the sodium atom is,
a) 18.6 Å b) 1.86 Å c) 1.86 pm d) 18.6 pm

55. Which statement is wrong regarding osmotic pressure (P), volume (V) and temperature (T)?
a) $P \propto \frac{1}{V}$ if T is constant
b) $P \propto T$ if V is constant
c) $P \propto V$ if T is constant
d) PV is constant if T is constant

56. Volume of water needed to mix with 10 ml of 10 N HNO_3 to get 0.1 N HNO_3
a) 1000 ml b) 990 ml c) 1010 ml d) 10 ml

57. $\frac{M}{20}$ NaCl and $\frac{M}{20}$ CH_3COOH are kept in separate containers. If their osmotic pressure are P_1 and P_2 respectively. What is the correct statement ?
a) $P_1 = P_2$ b) $P_1 > P_2$
c) $P_2 > P_1$ d) $P_1 = P_2 = 1$ atm.

58. The phenomenon of osmosis was reported by
a) Traube b) Graham
c) Abbe Nollet d) Raoult

59. Amongst the following the homogeneous system is :
a) Water and kerosene kept together
b) Air enclosed in a container
c) Emulsion
d) A solution of HCI in water to which few drops of AgNO3 solution is added

60. If for a reaction ΔH is negative and ΔS is positive then the reaction is
a) Spontaneous at all temperatures
b) Non spontaneous at all temperatures
c) Spontaneous only at high temperatures
d) Spontaneous only at low temperatures

61. If the heat of neutralization of a strong acid with strong base is -57 kJ, the same for 0.1 N, H_2SO_4 with 0.3 N, NaOH is
a) -5.7 kJ b) -11.4 kJ c) 5.7 kJ d) 11.4 kJ

62. According to the second law of thermodynamics, a process, reaction is spontaneous, if during the process
a) ΔS universe > 0
b) ΔS universe = 0
c) ΔS universe < 0
d) ΔS universe = ΔS system

63. A current when passed liberates 0.504 gm of H; Cu can be liberated by the same current flowing
a) 12.7 gm b) 16.0 gm c) 31.8 gm d) 63.5 gm

64. The atomic weight of Al is 27. When 5 Faraday current is passed through Al^{3+} solution, the weight of Al deposited is
a) 27 gm b) 36 gm c) 45 gm d) 49 gm

65. The value of constant in Nernst equation $E=E^0-\frac{\text{constant}}{n}1n\ Q$ at 25°C is
a) 0.0592mV b) 0.0592V
c) 25.7mV d) 0.0296V

66. Specific conductance for one molar aqueous solution is more for
a) LiCl b) CsCl
c) NaCl d) None of these

67. The influence of temperature on reaction rate is predicted by
a) Kirchoff's equation
b) Aeehenious equation
c) Van der waal's equation
d) Kinetic equation

68. The formation of SO_3 from SO_2 and O_2 takes place in the following steps:
1. $2SO_2 + 2NO_2 \longrightarrow 2SO_3 + 2NO$
2. $2NO + O_2 \longrightarrow 2NO_2$
a) NO_2 is intermediate b) NO is catalyst
c) NO_2 is catalyst and NO is intermediate d) NO is catalyst and NO_2 is intermediate

69. Rate of a reactions
a) Increase with increase in temperature
b) decrease with increase in temperature
c) Does not depend on temperature
d) Does not depend on concentration

70. Froth flotation method may be used to increase the concentration of mineral in
a) Chalcopyrites b) Bauxite

c) Haematite d) Calamine

71. Iron is mainly extracted by ____________.
a) Self reduction method
b) Carbon reduction method
c) Electrolysis method
d) Leaching with aqueous solution of NaOH followed by reduction

72. In metallurgical process, the flux used for removing acidic impurities is
a) Limestone b) Sodium carbonate
c) Silica d) Common salt

73. Hydrogen sulphide reacts with lead acetate forming a black compound which reacts with H_2O_2 to form another compound. The color of the compound is
a) Black b) Yellow c) White d) Pink

74. Which of the following hydrohalic acid has the highest value of dipole movement?
a) HF b) HCl c) HBr d) HI

75. Welding of magnesium can be done in an atmosphere of
a) O_2 b) N_2 c) He d) All

76. The trace metal present in insulin is
a) Fe b) Co c) Zn d) Au

77. Which of the following is not regarded as a transition element?
a) Co b) Zn c) Sc d) Mn

78. In Lanthanides, last electrons enters into (n-2) f sub shell. What is the value of n?
a) 4 b) 6 c) 7 d) 8

79. The number of groups acting only as secondary valencies in the complex $[CoCl_2(NH_3)_4]Cl$ are
a) 4 b) 2
c) 6 d) None of these

80. Which of the following has metal-metal bond?
a) $Ni(CO)_4$ b) $Fe(CO)_5$
c) $Cr(CO)_6$ d) $Mn_2(CO)_{10}$

81. Chelating Ligand among the following is
a) EDTA b) Phen
c) Dipy d) All the above

82. A complex with the composition $[MA_2B_2]_2$ is found to have no geometrical isomers. Both A and B are monodentate Ligands. The structure of the complex is
a) Linear b) Tetrahedral
c) Square planer d) Octahedral

83. $K_4[Fe(CN)_6]$ is a
a) Complex compound b) Double salt
c) Neutral molecule d) None of these

84. The total number of electrons present in the central carbon atom of a free radical is
a) 7 b) 8 c) 9 d) 6

85. In which of the following reaction, the product is an ether?
a) $C_6H_6 + CH_3COCl$/anhydrous $AlCl_3$
b) C_2H_5Cl + aq. KOH
c) $C_6H_6 + C_6H_5COCl$/anhydrous $AlCl_3$
d) $C_2H_5Cl + C_2H_5ONa$

86. Ethylene glycol is used
a) As an antifreeze in automobile radiations
b) For preventing the deposition of ice on the wings of aeroplane
c) As a solvent and preservative
d) All of these

87. Ethyl alcohol reacts with sodium with evolution of H_2 gas. Ethyl alcohol is
a) Strongly acidic b) Strongly basic
c) Weakly basic d) Very weakly acidic

88. Diethyl ketone and dimethyl ketone can be distinguished with
a) Tollen's reagent b) Fehling's solution
c) Schiff's reagent d) Haloform test

89. Which of the following substance when boiled with NaOH will evolve NH_3?
a) Ethylamine b) Aniline
c) Acetamide d) acetoxime

90. A compound 'A' has a molecular formula C_2Cl_3OH. It reduces Fehlings solution and on oxidation, it gives a monocarboxylic acid 'B'. 'A' is obtained by the action of chlorine on ethyl alcohol. The compound 'A' is :
a) Chloral
b) Chloroform
c) Methyl chloride
d) Monochloro acetic acid

91. Which of the following amines will not react with nitrous acid to give nitrogen?
a) CH_3NH_2
b) $CH_3-CH_2-NH_2$
c) $CH_3-CH(CH_3)-NH_2$
d) $(CH_3)_3N$

92. The numberof electrons in the valence shell of nitrogen in an amine is
a) 5 b) 6 c) 7 d) 8

93. Which of the following reaction is given by only primary amines?
a) Reaction with HONO
b) Reaction with chloroform and alcoholic KOH
c) Reaction with acetyl chloride

d) Reaction with Grignard reagent

94. Deficiency of niacin causes ____________ disease.

a) Pellagra b) Xerophthalmia
c) Osteomalacia d) Rickets

95. The monosaccharides are

a) Sweet in taste b) Sour in taste
c) Soluble in water d) Both (a) and (c)

96. Which of the following contain ester linkage?

a) Nylon – 6 b) Terylene
c) Nylon – 66 d) Glycerol

97. Pepticle bond is a key feature in

a) Poly saccharide b) Proteins
c) Nucleotide d) Vitamins

98. The main constituent of most of the natural fibres is

a) glycogen b) Starch
c) Cellulose d) Polythene

99. Which gas has the highest partial pressure atmosphere?

a) CO_2
b) H_2O
c) O_2
d) N_2

100. Which of the following acts as an oxidizing agent?

a) HNO_3 b) Cl_2
c) $FeCl_3$ d) All of the above

101. The false statement in the following is

a) $p \wedge (\sim p)$ is a contradiction
b) $p \vee (\sim p)$ is a tautology
c) $\sim (\sim p) p$ is tautology
d) $(p \rightarrow q) \leftrightarrow (\sim q \rightarrow \sim p)$ is a contradiction

102. Duals of the following statements are given. Which one is not correct?

a) $(p \vee q) \wedge (r \vee s), (p \wedge q)(r \wedge s)$
b) $[p \vee (\sim q)] \wedge (\sim p), [p \wedge (\sim q)] \vee (\sim p)$
c) $(p \wedge q) \vee r, (p \vee q) \wedge r$
d) $(p \vee q) \vee s, (p \wedge q) \vee s$

103. The symbolic form of the statement 'Since it is raining the atmosphere is very cold' is

a) $p \rightarrow q$ b) $p \leftrightarrow q$ c) $p \wedge q$ d) $p \vee q$

104. Let $A = \begin{bmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{bmatrix}$ and $(10)B = \begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & \alpha \\ 1 & -2 & 3 \end{bmatrix}$. If B is the inverse of matrix A, then α is

a) 5 b) −1 c) 2 d) −2

105. Let $F(\alpha) = \begin{bmatrix} \cos\alpha & -\sin\alpha & 0 \\ \sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}$, where $\alpha \in R$. Then $[F(\alpha)]^{-1}$ is equal to

a) $F(-\alpha)$ b) $F(\alpha^{-1})$
c) $F(2\alpha)$ d) None of these

106. If $A = \begin{bmatrix} 1 & 1 & 1 \\ 2 & 1 & -3 \\ -1 & 2 & 3 \end{bmatrix}$, then $M_{31} =$

a) −4 b) 4 c) 5 d) −1

107. In triangle ABC, if $\sin A \sin B = \frac{ab}{c^2}$, then the triangle is

a) Equilateral b) Isosceles
c) Right angled d) Obtuse angled

108. $\cot^{-1}\left(\frac{ab+1}{a-b}\right) + \cot^{-1}\left(\frac{bc+1}{b-c}\right) + \cot^{-1}\left(\frac{ca+1}{c-a}\right)$ is equal to

a) 0 b) 1
c) $\frac{\pi}{4}$ d) None of these

109. The set of values of x, for which the expression $\frac{\tan 3x - \tan 2x}{1 + \tan 3x \tan 2x} = 1$, is

a) ϕ
b) $\frac{\pi}{4}$
c) $\left\{n\pi + \frac{\pi}{4} : n = 1,2,3 \dots\right\}$
d) $\left\{2n\pi + \frac{\pi}{4} : n = 1,2,3 \dots\right\}$

110. If $ax^2 + 2xy - 3y^2 + 4x + c = 0$ represents a pair of perpendicular lines, then

a) $a = 3, c = 2$ b) $a = 3, c = \frac{6}{3}$
c) $a = 3, c = \frac{4}{5}$ d) $a = 3, c = 6$

111. If $\frac{x^2}{a} + \frac{y^2}{b} + \frac{2xy}{h} = 0$ represent pair of straight lines and slope of one line is twice the other. Then $ab : h^2$ is

a) 9 : 8 b) 8 : 9 c) 1 : 2 d) 2 : 1

112. If the acute angles between the pair of lines $3x^2 - 7xy + 4y^2 = 0$ and $6x^2 - 5xy + y^2 = 0$ be θ_1 and θ_2 respectively, then

a) $\theta_1 = \theta_2$ b) $\theta_1 = 2\theta_2$ c) $2\theta_1 = \theta_2$ d) $\theta_1 = \frac{1}{2}\theta_2^2$

113. If $\overline{AB} = 3\hat{i} - 2\hat{j} + 2\hat{k}$ and $\overline{BC} = -\hat{j} - 2\hat{k}$ are adjacent sides of a parallelogram, then angle between its diagonals can be

a) $\cos^{-1}\left(\frac{2}{\sqrt{13}}\right)$ b) $\frac{\pi}{3}$
c) $\frac{4\pi}{3}$ d) $\frac{2\pi}{3}$

114. If $\bar{a} = \frac{11}{2}\hat{\imath}, \bar{b} = 12\hat{\jmath}$ and $\bar{c} = \frac{13}{3}\hat{k}$ represents the three co-terminus edges of a parallelopiped, then its volume is given by

a) 510 b) 145 c) 286 d) 268

115. The volume of the parallelopiped whose edges are represented by $-12\hat{\imath} + \alpha\hat{k}, 3\hat{\jmath} - \hat{k}$ and $2\hat{\imath} + \hat{\jmath} - 15\hat{k}$ is 546. Then $\alpha =$

a) 3 b) 2 c) -3 d) -2

116. If θ is the acute angle between two intersecting straight lines, one having direction cosines l_1, m_1, n_1 and the other having direction cosines l_2, m_2, n_2 then $\sin^2\theta =$

a) $(l_1 + l_2 + l_3)^2 + (m_1 + m_2 + m_3)^2$

b) $(l_1m_2 + l_2m_1)^2 + (m_1n_2 + m_2n_1)^2 + (n_1l_2 + n_2l_1)^2$

c) $(l_1m_2 - l_2m_1)^2 + (m_1n_2 - m_2n_1)^2 + (n_1l_2 - n_2l_1)^2$

d) None of these

117. If the line joining the points $(-2,1,-8)$ and (a,b,c) is parallel to the line whose direction ratios are 6, 2, 3, then a, b, c are

a) $4,3,-5$ b) $1,2,-4$ c) $0,3,-2$ d) $6,2,3$

118. If O is the origin, OP = 3 and d.r.s of OP are $-1,2,-2$, then co-ordinates of p will be

a) $(1,2,2)$ b) $(-1,2,-2)$

c) $(-3,6,-9)$ d) $\left(-\frac{1}{3},\frac{2}{3},\frac{2}{3}\right)$

119. The vector equation of the line through (2, 3, 4) and parallel to Z-axis is

a) $\bar{r} = (2\hat{\imath} + 3\hat{\jmath} + 4\hat{k}) + \lambda\hat{k}$

b) $\bar{r} = 2\hat{\imath} + \lambda(\hat{\imath} + \hat{\jmath})$

c) $\bar{r} = (2\hat{\imath} + 3\hat{\jmath} + 4\hat{k}) + 4\lambda(\hat{\imath} - \hat{\jmath})$

d) $\bar{r} = (3\hat{\jmath} + 4\hat{k}) + \lambda\hat{\imath}$

120. Foot of the perpendicular from the point (α, β, γ) on Y-axis is

a) $(0,0,0)$ b) $(0,0,\gamma)$ c) $(0,\beta,0)$ d) $(\alpha,0,0)$

121. The point of intersection of the lines $\frac{x-5}{3} = \frac{y-7}{-1} = \frac{z+2}{1}, \frac{x+3}{-36} = \frac{y-3}{2} = \frac{z-6}{4}$ is

a) $\left(21,\frac{5}{3},\frac{10}{3}\right)$ b) $(2,10,4)$

c) $(-3,3,6)$ d) $(5,7,-2)$

122. If product of distances of point $(1,2,-1)$ from planes $2x - 3y + z + k = 0$ and $x + 2y + 3z = 0$ is 1, then k is equal to

a) 12 b) 14 c) 10 d) 8

123. A plane which passes through the point (3, 2, 0) and the line $\frac{x-3}{1} = \frac{y-6}{5} = \frac{z-4}{4}$ is

a) $x - y + z = 1$ b) $x + y + z = 5$

c) $x + 2y - z = 0$ d) $2x - y + z = 5$

124. The maximum value of $z = 4x + 2y$ subject to the constraints $2x + 3y \le 18, x + y \ge 10, x, y \ge 0$ is

a) 36 b) 40

c) 20 d) None of these

125. For the function $z = 4x + 9y$ to be maximum under the constraints $x + 5y \le 200, 2x + 3y \le 134, x \ge 0, y \ge 0$; the values of x and y are

a) 10, 38 b) 28, 10 c) 13, 36 d) 30, 34

126. If $f(x) = \begin{cases} \frac{x}{e^{\frac{1}{x}}+1}, & \text{when } x \ne 0 \\ 0, & \text{when } x = 0 \end{cases}$, then

a) $\lim_{x\to 0^+} f(x) = 1$

b) $\lim_{x\to 0^-} f(x) = 1$

c) $f(x)$ is continuous at $x = 0$

d) f is not continuous at $x = 0$

127. The value of f at $x = 0$ so that the function $f(x) = \frac{2^x - 2^{-x}}{x}, x \ne 0$ is continuous at $x = 0$, is

a) $\log 2$ b) 4 c) e^4 d) $\log 4$

128. If function $f(x) = \frac{\sqrt{1+x} - \sqrt[3]{1+x}}{x}$ is continuous at $x = 0$, then f(0) is equal to

a) 2 b) $\frac{1}{4}$ c) $\frac{1}{6}$ d) $\frac{1}{3}$

129. If $f(x) = \sqrt{1 + \cos^2(x^2)}$, then $f'\left(\frac{\sqrt{\pi}}{2}\right)$ is

a) $\frac{\sqrt{\pi}}{6}$ b) $-\frac{\sqrt{\pi}}{6}$ c) $\frac{1}{\sqrt{6}}$ d) $\frac{\pi}{\sqrt{6}}$

130. If $y\sec x + \tan x + x^2y = 0$, then $\frac{dy}{dx} =$

a) $\frac{2xy + \sec^2 x + y\sec x\tan x}{x^2 + \sec x}$

b) $-\frac{2xy + \sec^2 x + \sec x\tan x}{x^2 + \sec x}$

c) $-\frac{2xy + \sec^2 x + y\sec x\tan x}{x^2 + \sec x}$

d) None of these

131. n^{th} order derivative of $\frac{1}{x}$ w.r.t. x is

a) $\frac{n!}{x^{n+1}}$ b) $x^{n+1}\,n!$

c) $\frac{(-1)^n n!}{x^{n+1}}$ d) None of these

132. Maximum value of $x(1-x)^2$ when $0 \le x \le 2$, is

a) $\frac{2}{27}$ b) $\frac{4}{27}$ c) 5 d) 0

133. The maximum and minimum values of the function $|\sin 4x + 3|$ are

a) 1, 2 b) 4, 2 c) 2, 4 d) -1, 1

134. The angle between the curves $y = \sin x$ and $y = \cos x$ is

a) $\tan^{-1}(2\sqrt{2})$ b) $\tan^{-1}(3\sqrt{2})$
c) $\tan^{-1}(3\sqrt{3})$ d) $\tan^{-1}(5\sqrt{2})$

135. $\int e^{\sin\theta}[\log(\sin\theta)+\text{cosec}^2\theta]\cos\theta\, d\theta =$
a) $e^{\sin\theta}[\log(\sin\theta)+\text{cosec}^2\theta]+c$
b) $e^{\sin\theta}[\log(\sin\theta)+\text{cosec}\theta]+c$
c) $e^{\sin\theta}[\log(\sin\theta)-\text{cosec}\,\theta]+c$
d) $e^{\sin\theta}[\log(\sin\theta)-\text{cosec}^2\theta]+c$

136. $\int \frac{e^x(1+\sin x)}{1+\cos x}dx$ is equal to
a) $\log|\tan x|+c$ b) $e^x\tan\frac{x}{2}+c$
c) $e^x\cot x+c$ d) $\sin\log x+c$

137. Let $f(x)=\int\frac{x^2dx}{(1+x^2)(1+\sqrt{1+x^2})}$ and $f(0)=0$, then the value of $f(1)$ will be
a) $\log(1+\sqrt{2})$ b) $\log(1+\sqrt{2})-\frac{\pi}{4}$
c) $\log(1+\sqrt{2})+\frac{\pi}{2}$ d) None of these

138. $\int_0^{\pi}\frac{x}{1+\sin x}dx$ is equal to
a) $-\pi$ b) $\frac{\pi}{2}$
c) π d) None of these

139. If for non-zero x, $af(x)+bf\left(\frac{1}{x}\right)=\frac{1}{x}-5$, when $a\neq b$, then $\int_1^2 f(x)\,dx=$
a) $\frac{1}{(a^2+b^2)}\left[a\log 2-5a+\frac{7}{2}b\right]$
b) $\frac{1}{(a^2-b^2)}\left[a\log 2-5a+\frac{7}{2}b\right]$
c) $\frac{1}{(a^2-b^2)}\left[a\log 2-5a-\frac{7}{2}b\right]$
d) $\frac{1}{(a^2+b^2)}\left[a\log 2-5a-\frac{7}{2}b\right]$

140. $\int_0^{\pi/2}\frac{\sin x}{\sin x+\cos x}dx$ equals
a) $\frac{\pi}{2}$ b) $\frac{\pi}{3}$ c) $\frac{\pi}{4}$ d) $\frac{\pi}{6}$

141. The area of the region bounded by $x^2+y^2-6x-4y+12=0$, $y=x$ and $x=\frac{5}{2}$ is
a) $\left(\frac{\pi}{6}-\frac{\sqrt{3}+1}{8}\right)$ sq. unit b) $\left(\frac{\pi}{6}+\frac{\sqrt{3}-1}{8}\right)$ sq. unit
c) $\left(\frac{\pi}{6}-\frac{\sqrt{3}-1}{8}\right)$ sq. unit d) None of these

142. Let $f:[-1,2]\to[0,\infty]$ be a continuous function such that $f(x)=f(1-x)\forall x\in[-1,2]$. Let $R_1=\int_{-1}^{2}x\,f(x)\,dx$ and R_2 be the area of the region bounded by $y=f(x), x=-1, x=2$ and the X-axis. Then,
a) $R_1=2R_2$ b) $R_1=3R_2$
c) $2R_1=R_2$ d) $3R_1=R_2$

143. The area of the region bounded by the curve $y^2=4a^2(x-1)$ and the lines $x=1, y=4a$ is
a) $\frac{21a}{2}$ sq. units b) $\frac{16}{3}$ sq. units
c) $\frac{17a}{3}$ sq. units d) $\frac{16a}{3}$ sq. units

144. The differential equation $\cot y\ dx=x\,dy$ has a solution of the form
a) $y=\cos x$ b) $x=c\sec y$
c) $x=\sin y$ d) $y=\sin x$

145. The solution of the differential equation $\frac{dy}{dx}+y=\cos x$ is
a) $y=\frac{1}{2}(\cos x+\sin x)+ce^{-x}$
b) $y=\frac{1}{2}(\cos x-\sin x)+ce^{-x}$
c) $y=\cos x+\sin x+ce^{-x}$
d) None of these

146. The solution of $\frac{dy}{dx}+1=e^{x+y}$ is
a) $e^{-(x+y)}+x+c=0$ b) $e^{-(x+y)}-x+c=0$
c) $e^{(x+y)}+x+c=0$ d) $e^{(x+y)}-x+c=0$

147. The random variable X has the following probability distribution:
x : -3 -1 0 1 3
$P(X=x)$; 0.05 0.45 0.20 0.25 0.05
Then, its mean is
a) -0.2 b) 0.2 c) -0.4 d) 0.4

148. The random variable X has the following probability distribution

x	0	1	2	3	4
$P(X=x)$	k	3k	5k	2k	k

Then the value of $P(X\geq 2)$ is
a) $\frac{1}{3}$ b) $\frac{2}{3}$ c) $\frac{3}{4}$ d) $\frac{1}{4}$

149. The number of terms in the series 101+99+97+....+47 is
a) 25 b) 28
c) 30 d) 20

150. The four arithmetic means between 2 and 23 are
a) 5,9,11,13 b) 7,11,15,19 c) 5,11,15,22 d) 7,15,19,21

: ANSWER KEY :

1)	a	2)	d	3)	c	4)	c	5)	b	6)	d	7)	b
8)	c	9)	b	10)	a	11)	d	12)	a	13)	a	14)	a
15)	c	16)	d	17)	d	18)	c	19)	a	20)	a	21)	a
22)	c	23)	c	24)	a	25)	c	26)	a	27)	b	28)	c
29)	c	30)	b	31)	a	32)	d	33)	b	34)	d	35)	d
36)	b	37)	c	38)	d	39)	d	40)	b	41)	c	42)	a
43)	b	44)	a	45)	c	46)	a	47)	a	48)	b	49)	c
50)	a	51)	c	52)	d	53)	b	54)	b	55)	c	56)	b
57)	b	58)	a	59)	b	60)	a	61)	a	62)	a	63)	b
64)	c	65)	c	66)	b	67)	b	68)	c	69)	a	70)	a
71)	b	72)	a	73)	c	74)	a	75)	c	76)	c	77)	b
78)	b	79)	a	80)	d	81)	d	82)	b	83)	a	84)	c
85)	d	86)	d	87)	d	88)	d	89)	c	90)	a	91)	d
92)	d	93)	b	94)	a	95)	d	96)	b	97)	b	98)	c
99)	b	100)	d	101)	d	102)	d	103)	a	104)	a	105)	a
106)	a	107)	c	108)	a	109)	a	110)	b	111)	a	112)	a
113)	a	114)	c	115)	c	116)	c	117)	a	118)	b	119)	a
120)	c	121)	a	122)	a	123)	a	124)	d	125)	a	126)	c
127)	d	128)	c	129)	b	130)	c	131)	c	132)	b	133)	b
134)	a	135)	c	136)	b	137)	b	138)	c	139)	b	140)	c
141)	c	142)	c	143)	d	144)	b	145)	a	146)	a	147)	a
148)	b	149)	b	150)	b								

: HINTS AND SOLUTIONS :

3 **(c)**

$T_1 = T_2 \Rightarrow \omega_1 = \omega_2$

$\omega = \frac{v}{r} \Rightarrow \frac{v}{r} = \text{constant}$

$\therefore \frac{v_1}{r_1} = \frac{v_2}{r_2} \Rightarrow \frac{v_1}{v_2} = \frac{r_1}{r_2} = \frac{R}{r}$

4 **(c)**

$T_1 = T, T_2 = 8T$

$\therefore R_2 = R_1 \left(\frac{T_2}{T_1}\right)^{2/3} = R\left(\frac{8T}{T}\right)^{2/3} = 4R$

6 **(d)**

Change in potential energy in displacing a body from r_1 to r_2 is given by

$\Delta U = GMm\left[\frac{1}{r_1} - \frac{1}{r_2}\right] = GMm\left(\frac{1}{2R} - \frac{1}{3R}\right)$

$= \frac{GMm}{6R}$

8 **(c)**

The moment of inertia of ring about a tangent in its plane

$= \frac{MR^2}{2} + MR^2 = \frac{3MR^2}{2}$

The moment of inertia of disc about its diameter

$= \frac{MR^2}{4}$

$\therefore \text{Ratio} = \frac{3MR^2/2}{MR^2/4} = \frac{6}{1}$

10 **(a)**

$v_{max} = A\omega$ and $a_{max} = A\omega^2$

$\therefore \frac{a_{max}}{v_{max}} = \frac{A\omega^2}{A\omega} = \frac{0.64}{0.16} \Rightarrow \omega = 4 \text{ rad/s}$

$\therefore 0.16 = A \times 4 \Rightarrow A = 0.04 \text{ m} = 4 \times 10^{-2}\text{m}$

11 **(d)**

$-A\omega^2$ is the acceleration of the particle when it is at one extreme point

22 **(c)**

Number of beats per second,

$n = \frac{16}{20} = \frac{4}{5} \Rightarrow n = n_1 - n_2 = \frac{v}{4}\left(\frac{1}{l_1} - \frac{1}{l_2}\right)$

$\therefore \frac{4}{5} = \frac{v}{4}\left(\frac{1}{1} - \frac{1}{1.01}\right) = \frac{0.01v}{4 \times 1.01} = \frac{v}{4 \times 101}$

$\therefore v = \frac{16 \times 101}{5} = 323.2 \text{ ms}^{-1}$

28 **(c)**

Path difference $= 5\lambda = 10 \times \frac{\lambda}{2}$

$\Rightarrow$ Point is bright

$\therefore$ Using, $X_n = nX$ we get,

$0.5 = 5X \Rightarrow X = 0.1$ mm

29 **(c)**

With white light, the rays reaching the centre have zero path difference. So we get white fringe at the centre and coloured near the central fringe

30 **(b)**

For dark fringe at P,

$S_1P - S_2P = \Delta = (2n-1)\lambda/2$

Here, n =3 and $\lambda = 6000$

$\therefore \Delta = \frac{5\lambda}{2} = 5 \times \frac{6000}{2} = 15000\text{Å} = 1.5$ micron

31 **(a)**

As there is no charge residing inside the cube, the net flux is zero

32 **(d)**

$u = \frac{1}{2}\varepsilon_0 E^2$

$\therefore E = \sqrt{\frac{2u}{\varepsilon_0}} = \sqrt{\frac{2 \times 44.25 \times 10^{-8}}{8.85 \times 10^{-12}}} = 316.2$ N/C

33 **(b)**

When null point is obtained on potentiometer wire, the cell whose potential difference is to be measured does not supply current to potentiometer wire since galvanometer deflection is zero. Therefore current through the potentiometer wire is due to auxillary battery

34 **(d)**

$S = \left(\frac{100-1}{1}\right)R$

Initially, $30 = \left(\frac{100-l}{l}\right) \times 10$

$\therefore l = 25$ cm

Finally, $10 = \left(\frac{100-l}{l}\right) \times 30$

$\therefore l = 75$ cm

So, shift 75 cm − 25 cm = 50 cm

35 **(d)**

$\frac{X}{1} = \frac{20}{80} \Rightarrow X = \frac{1}{4}\Omega = 0.25\ \Omega$

36 **(b)**

$\frac{I_g}{I} = \frac{1}{34} = \frac{S}{S + 3663}$

$\therefore S = \frac{3663}{33} = 111\ \Omega$

38 **(d)**

Two coils are carrying currents in opposite direction, hence net magnetic field at centre will be difference of the two fields

$\therefore B_{net} = \frac{\mu_0}{4\pi}.2\pi N\left[\frac{i_1}{r_1} - \frac{i_2}{r_2}\right]$

$= \frac{10\mu_0}{2}\left[\frac{0.2}{0.2} - \frac{0.3}{0.4}\right] = \frac{5}{4}\mu_0$

39 **(d)**

$\chi_m = (\mu_r - 1) \Rightarrow \chi_m = (5500 - 1) = 5400$

40 **(b)**

$B = \mu_0\mu_r H \Rightarrow \mu_r \propto \frac{B}{H}$ = slope of B-H curve

According to the given graph, slope of the graph is highest at point Q

41 **(c)**

$e = nBA\omega \sin \omega t$

Given that, $n = 1, B = \frac{\mu_0 I}{2b}, A = \pi a^2$

$\therefore e = \frac{\mu_0 I}{2b}(\pi a^2)\omega \sin(\omega t)$

44 **(a)**

$eV_0 = hv - W_0$

$eV_0 = (2.4 - 1.6)$eV

$\therefore V_0 = 0.8$ V

45 **(c)**

The absorption lines are obtained when the electron jumps from ground state (n = 1) to the higher energy states. Thus only 1, 2 and 3 lines will be obtained

46 **(a)**

For Lyman series,

$\therefore \frac{1}{\lambda_l} = R(1)^2\left[\frac{1}{1^2} - \frac{1}{2^2}\right] = \frac{3R}{4}$

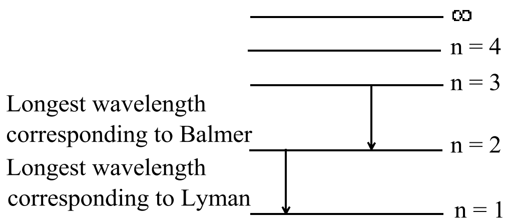
$\therefore \lambda_l = \frac{4}{3R}$

For Balmer series,

$\frac{1}{\lambda_b} = R(1)^2\left[\frac{1}{1^2} - \frac{1}{3^2}\right] = \frac{5R}{36}$

$\therefore \frac{1}{\lambda_b} = \frac{36}{5R}$

$\therefore \frac{\lambda_l}{\lambda_b} = \frac{4}{3R} \times \frac{5R}{36} = \frac{5}{3 \times 9} = \frac{5}{27}$



53 **(b)**

In a simple cubic cell ,number of atoms /unit cell

$= 8 \times \frac{1}{8} = 1$

Volume of the atom $= \frac{4}{3}\pi r^3$

Volume of the cube = $a^3 = (2r)^3 = 8r^3$ ($\because a = 2r$)

Fraction of the total volume occupied

$= \frac{\frac{4}{3}\pi r^3}{8r^3} = \frac{\pi}{6}$

54 **(b)**

In Bcc,

$r = \frac{\sqrt{3}}{4}a \qquad \therefore\ r = \frac{\sqrt{3}}{4} \times 4.29 = 1.86\ \text{Å}$

56 **(b)**

Dilute 10 n HNO_3 solution 100 times to get 0.1 N HNO_3 solution i.e. 10ml. solution is to be diluted to 1000ml.Hence 990 ml H_2O is needed for dilution.

57 **(b)**

NaCl dissociates completely while CH_3CHOOH dissociates to a small extent. Hence $P_1 > P_2$.

69 **(a)**

Increase in temperature favours collision of molecules.

89 **(c)**

```
      O
      ||
CH3 – C – NH2 + NaOH
        O
        ||
→ CH3 – C – ONa + NH3
```

90 **(a)**

```
    O   Cl
    ||   |
H – C – C – Cl : Chloral
         |
         Cl
```

Chloral reduces Fehling's solution because of aldehyde

```
   O
   ||
(– C – H) group.
```

91 **(d)**

Amines are basic in nature and basicity depends upon +I effects of group attached to nitrogen in amine

+I effects of $CH_3 >$ +I effect of H

93 **(b)**

Reaction of primary amine with chloroform and alcohol KOH is carbylamine reaction.

101 **(d)**

$p \rightarrow q$ is logically equivalent to $\sim q \rightarrow \sim p$

$\therefore (p \rightarrow q) \leftrightarrow (\sim q \leftrightarrow \sim p)$ is tautology

But, it is given contradiction

Hence, it is false statement

102 **(d)**

Dual of $(p \vee q) \vee s$ is $(p \wedge q) \wedge s$

103 **(a)**

p : It is raining

q : The atmosphere is very cold

104 **(a)**

Given, $\begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & \alpha \\ 1 & -2 & 3 \end{bmatrix} = 10A^{-1}$

$\Rightarrow \begin{bmatrix} 4 & 2 & 2 \\ -5 & 0 & \alpha \\ 1 & -2 & 3 \end{bmatrix}\begin{bmatrix} 1 & -1 & 1 \\ 2 & 1 & -3 \\ 1 & 1 & 1 \end{bmatrix} = \begin{bmatrix} 10 & 0 & 0 \\ 0 & 10 & 0 \\ 0 & 0 & 10 \end{bmatrix}$

$\Rightarrow -5 + \alpha = 0 \Rightarrow \alpha = 5$

(Equating the element of 2nd row and first column)

105 **(a)**

$F(\alpha).F(-\alpha)$

$= \begin{bmatrix} \cos\alpha & -\sin\alpha & 0 \\ \sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} \cos\alpha & \sin\alpha & 0 \\ -\sin\alpha & \cos\alpha & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} = I$

$\therefore [F(\alpha)]^{-1} = F(-\alpha)$

106 **(a)**

$M_{31} = \begin{vmatrix} 1 & 1 \\ 1 & -3 \end{vmatrix} = -3 - 1 = -4$

107 **(c)**

$\sin A \sin B = \frac{ab}{c^2}$

$\Rightarrow \sin A \sin B = \frac{(k\sin A)(k\sin B)}{k^2 \sin^2 C}$

$\Rightarrow \sin^2 C = 1 \Rightarrow \sin C = 1 \qquad \dots [\because \sin C \neq -1]$

$\Rightarrow \angle = 90°$

108 **(a)**

Since, $\cot^{-1} x - \cot^{-1} y = \cot\left(\frac{xy+1}{y-x}\right)$

$\therefore \cot^{-1}\frac{ab+1}{a-b} + \cot^{-1}\frac{bc+1}{b-c} + \cot^{-1}\frac{ca+1}{c-a}$

$= \cot^{-1} b - \cot^{-1} a + \cot^{-1} c - \cot^{-1} b + \cot^{-1} a - \cot^{-1} c$

$= 0$

109 **(a)**

We have, $\frac{\tan 3x - \tan 2x}{1 + \tan 3x \tan 2x} = 1$

$\Rightarrow \tan(3x - 2x) = 1$

$\Rightarrow \tan x = 1$

$\Rightarrow \tan x = \tan\frac{\pi}{4}$

$\Rightarrow x = n\pi + \frac{\pi}{4}$

But this value does not satisfy the given equation

Hence, option (A) is the correct answer

110 **(b)**

Since the given lines are perpendicular,

$\therefore a + b = 0$

Here $a = a, b = -3$

$\therefore a + b = 0 \Rightarrow a - 3 = 0 \Rightarrow a = 3$

Also we have $h = 1, g = 2, f = 0, c = c$

The condition is

$3(-3)c + 3(2^2) - c(1^2) = 0$

$\therefore -10c + 12 = 0 \Rightarrow c = \frac{6}{5}$

111 **(a)**

Let m_1, m_2 be the slopes

$\therefore m_1 + m_2 = -\frac{2b}{h}$ and $m_1 m_2 = \frac{b}{a}$

Given, $m_2 = 2m_1$

$\therefore 3m_1 = -\frac{2b}{h}$ and $2m_1^2 = \frac{b}{a}$

$\therefore \frac{9m_1^2}{2m_1^2} = \frac{4b^2}{h^2} \times ab : h^2 = 9 : 8$

112 **(a)**

Here, $\theta_1 = \tan^{-1}\left(\frac{2\sqrt{\frac{49}{4}-12}}{3+4}\right) = \tan^{-1}\left(\frac{1}{7}\right)$

and $\theta_2 = \tan^{-1}\left(\frac{2\sqrt{\frac{25}{4}-6}}{6+1}\right) = \tan^{-1}\left(\frac{1}{7}\right)$

Hence, $\theta_1 = \theta_2$

113 **(a)**

From given $\overline{AC} = \overline{AB} + \overline{BC} = 3\hat{i} - 3\hat{j}$

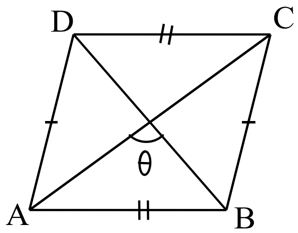
Also $\overline{BC} = \overline{AD}$

and $\overline{AD} + \overline{DB} = \overline{AB}$

$\Rightarrow \overline{DB} = \overline{AB} - \overline{AD}$

$= \overline{AB} - \overline{BC}$

$= 3\hat{i} - \hat{j} + 4\hat{k}$



$\therefore$ Angle between $\overline{AC}$ and $\overline{BD}$

$= \cos^{-1}\left(\frac{\overline{AC}.(\overline{BD})}{|\overline{AC}|.|\overline{BD}|}\right)$

$= \cos^{-1}\left(\frac{12}{\sqrt{9+9}\sqrt{9+1+16}}\right)$

$= \cos^{-1}\left(\frac{12}{3\sqrt{2}\sqrt{2}\sqrt{13}}\right)$

$= \cos^{-1}\left(\frac{2}{\sqrt{13}}\right)$

114 **(c)**

$[\bar{a}\,\bar{b}\,\bar{c}] = \left(\frac{11}{2}\right)(12)\left(\frac{13}{3}\right)[\hat{i}\,\hat{j}\,\hat{k}]$

$= \frac{132 \times 13}{6} = \frac{1716}{6}$

$= 286$

$\therefore$ Required volume $= [\bar{a}\,\bar{b}\,\bar{c}]$

$= 286$

115 **(c)**

Since, $\begin{vmatrix} -12 & 0 & \alpha \\ 0 & 3 & -1 \\ 2 & 1 & -15 \end{vmatrix} = 546$

$\therefore \alpha = -3$

117 **(a)**

Let $A(-2, 1, -8)$ and $B(a, b, c)$ be two points

Then the direction ratios of the line AB are

$(a + 2, b - 1, c + 8)$

Given that AB is parallel to the line whose directions ratios are 6, 2, 3

Hence, $(a + 2, b - 1, c + 8)$ is proportional to 6, 2, 3

$\therefore a + 2 = 6, b - 1 = 2, c + 8 = 3$

$\Rightarrow a = 4, b = 3, c = -5$

118 **(b)**

For a line passing through origin d.r.s are the co-ordinates of the point

119 **(a)**

Line is || to Z – axis

$\therefore$ D.r's are (0, 0, 1)

$\therefore$ Required equation is

$\vec{r} = 2\hat{i} + 3\hat{j} + 4\hat{k} + \lambda(0.\hat{i} + 0.\hat{j} + 1\hat{k})$

$\Rightarrow \vec{r} = 2\hat{i} + 3\hat{j} + 4\hat{k} + \lambda\hat{k}$

120 **(c)**

As on Y-axis $x = 0, z = 0$

$\therefore$ foot of perpendicular from the point (α, β, γ) is $(0, \beta, 0)$

121 **(a)**

Let $\frac{x-5}{3} = \frac{y-7}{-1} = \frac{z+2}{1} = r_1$

and $\frac{x+3}{-36} = \frac{y-3}{2} = \frac{z-6}{4} = r_2$

$\therefore x = 3r_1 + 5, y = -r_1 + 7, z = r_1 - 2$ and

$x = -36r_2 - 3, y = 2r_2 + 3, z = 4r_2 + 6$

On solving, we get $x = 21, y = \frac{5}{3}, z = \frac{10}{3}$

122 **(a)**

Let d_1 be the distance of the point $(1, 2, -1)$ from the plane $2x - 3y + z + k = 0$

$\therefore d_1 = \left|\frac{2(1) - 3(2) + (-1) + k}{\sqrt{2^2 + (-3)^2 + 1^2}}\right| = \left|\frac{-5 + k}{\sqrt{4 + 9 + 1}}\right|$

$= \left|\frac{k - 5}{\sqrt{14}}\right|$

Let d_2 be the distance of the point $(1, 2, -1)$ from the plane

$x + 2y + 3z = 0$

$\therefore d_2 = \left|\frac{(1) + 2(2) + 3(-1)}{\sqrt{1^2 + 2^2 + 3^2}}\right| = \left|\frac{2}{\sqrt{14}}\right|$

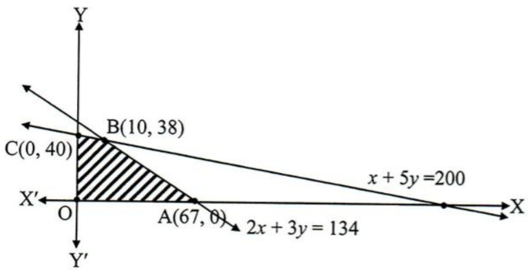
Given that $d_1 d_2 = 1$

$\therefore \left|\frac{k-5}{\sqrt{14}}\right|\left|\frac{2}{\sqrt{14}}\right| = 1$
$\Rightarrow (k-5)2 = 14$
$\Rightarrow k - 5 = 7$
$\Rightarrow k = 12$

123 **(a)**
Plane passing through (3, 2, 0) is
$a(x-3) + b(y-2) + c(z-0) = 0$ ...(i)
Plane (i) is passing through the line
$\frac{x-3}{1} = \frac{y-6}{5} = \frac{z-4}{4}$
$\therefore a(3-3) + b(6-2) + c(4-0) = 0$
$\Rightarrow 0.a + 4b + 4c = 0$ ...(ii)
And also $1.a + 5b + 4c = 0$ ...(iii)
From (ii) and (iii), we get
$a = -4, b = 4, c = -4$
$\therefore$ equation of required plane is $x - y + z = 1$

124 **(d)**
After drawing the graph, we get the points on the region are (9, 0), (0, 6), (10, 0), (0, 10) and (12, −1). But there is no feasible point as no point satisfying all the inequations simultaneously

125 **(a)**
$O \equiv (0,0), A \equiv (67,0), B \equiv (10,38), C \equiv (0,40)$
are the corner points of the feasible region



$z(0,0) = 0$
$z(67,0) = 268$
$z(10,38) = 382$
$z(0,40) = 360$
$\therefore$ Maximum $z = 382$ at (10, 38)

126 **(c)**
$f(0) = 0;$
$$f(0^-) = \lim_{h\to 0} \frac{-h}{e^{\frac{-1}{h}} + 1} = \lim_{h\to 0} \frac{-h}{1 + \frac{1}{e^{\frac{1}{h}}}} = 0$$
$$f(0^+) = \lim_{h\to 0} \frac{h}{e^{\frac{1}{h}} + 1} = 0$$

127 **(d)**
$$f(0) = \lim_{x\to 0} f(x) = \lim_{x\to 0}\left(\frac{2^x - 2^{-x}}{x}\right)\ \left(\frac{0}{0}\text{ form}\right)$$
$$= \lim_{x\to 0}\left[\frac{(2^x + 2^{-x})\log_e 2}{1}\right]$$
$= (2^0 + 2^0)\log_e 2$
$= (1+1)\log_e 2$
$= 2\log_e 2 = \log_e 4$

128 **(c)**
$$f(0) = \lim_{x\to 0}\frac{\sqrt{1+x} - \sqrt[3]{1+x}}{x}$$
By L – Hospital Rule
$$= \lim_{x\to 0}\frac{\frac{1}{2\sqrt{1+x}} - \frac{1}{3}.\frac{1}{(1+x)^{\frac{2}{3}}}}{1} = \frac{1}{2} - \frac{1}{3} = \frac{1}{6}$$

129 **(b)**
$f(x) = \sqrt{1 + \cos^2(x^2)}$
$\therefore f'(x)$
$$= \frac{1}{2\sqrt{1+\cos^2(x^2)}}.(2\cos x^2).(-\sin x^2).(2x)$$
$$\therefore f'(x) = \frac{-x\sin 2x^2}{\sqrt{1+\cos^2(x^2)}}$$
At $x = \frac{\sqrt{\pi}}{2}, f'\left(\frac{\sqrt{\pi}}{2}\right) = \frac{-\frac{\sqrt{\pi}}{2}.\sin\frac{2\pi}{4}}{\sqrt{1+\cos^2\frac{\pi}{4}}} = \frac{-\frac{\sqrt{\pi}}{2}.1}{\sqrt{\frac{3}{2}}}$
$$\therefore f'\left(\frac{\sqrt{\pi}}{2}\right) = -\sqrt{\frac{\pi}{6}}$$

130 **(c)**
$y\sec x + \tan x + x^2 y = 0$
Differentiable w.r.t. x, we get
$$\sec x\frac{dy}{dx} + y\sec x\tan x + \sec^2 x + 2xy + x^2\frac{dy}{dx} = 0$$
$$\Rightarrow \frac{dy}{dx} = -\frac{2xy + \sec^2 x + y\sec x\tan x}{x^2 + \sec x}$$

131 **(c)**
Let $y = \frac{1}{x}$
Then, $\frac{dy}{dx} = \frac{1}{x^2}, \frac{d^2y}{dx^2} = \frac{2}{x^3}, \ldots$
$$\therefore \frac{d^n y}{dx^n} = \frac{(-1)^n n!}{x^{n+1}}$$

132 **(b)**
Given $f(x) = x(1-x)^2, f(x) = x^3 - 2x^2 + x$
$\therefore f'(x) = 3x^2 - 4x + 1$
Put $f'(x) = 0$ i.e., $3x^2 - 4x + 1 = 0$
$\Rightarrow 3x^2 - 3x - x + 1 = 0 \Rightarrow x = 1, 1/3$
$f''(x) = 6x - 4$
$\therefore f''(1) = 2 =$ positive and $f''(1/3) = -2 = -ve$
Hence, maximum value will be $x = \frac{1}{3}$
$\therefore$ Maximum value $f\left(\frac{1}{3}\right) = \frac{4}{27}$

133 **(b)**

Here $f(x) = |\sin 4x + 3|$

We know that minimum value of $\sin x$ is -1 and maximum is 1

Hence minimum $|\sin 4x + 3| = |-1+3| = 2$ and maximum $|\sin 4x + 3| = |1+3| = 4$

134 **(a)**

If $\sin x = \cos x \Rightarrow x = \frac{\pi}{4}$

If $y = \sin x \Rightarrow \left(\frac{dy}{dx}\right)_{x=\pi/4} = \frac{1}{\sqrt{2}}$

If $y = \cos x \Rightarrow \left(\frac{dy}{dx}\right)_{x=\pi/4} = \frac{-1}{\sqrt{2}}$

$$\tan\theta = \frac{m_1 - m_2}{1 + m_1 m_2} = 2\sqrt{2} \Rightarrow \theta = \tan^{-1}(2\sqrt{2})$$

136 **(b)**

$$\int \frac{e^x(1+\sin x)}{1+\cos x} dx$$

$$= \int \frac{e^x\left[1 + 2\sin\left(\frac{x}{2}\right)\cos\left(\frac{x}{2}\right)\right]}{2\cos^2\left(\frac{x}{2}\right)} dx$$

$$= \int e^x\left(\frac{1}{2}\sec^2\frac{x}{2} + \tan\frac{x}{2}\right) dx$$

$$= e^x \tan\frac{x}{2} + c$$

$$\ldots\left[\because \int e^x[f(x) + f'(x)]dx = e^x f(x) + c\right]$$

137 **(b)**

Put $x = \tan\theta \Rightarrow dx = \sec^2\theta\, d\theta$

$$\therefore f(x) = \int \frac{\tan^2\theta \sec^2\theta\, d\theta}{\sec^2\theta(1+\sec\theta)}$$

$$= \int \frac{\tan^2\theta\, d\theta}{1+\sec\theta} = \int \frac{\sin^2\theta\, d\theta}{\cos\theta(1+\cos\theta)}$$

$$= \int \frac{1-\cos^2\theta\, d\theta}{\cos\theta\,(1+\cos\theta)}$$

$$= \int \frac{(1-\cos\theta)d\theta}{\cos\theta} = \int \sec\theta\, d\theta - \int d\theta$$

$$= \log(\sec\theta + \tan\theta) - \theta + c$$

$$= \log\left(x + \sqrt{1+x^2}\right) - \tan^{-1} x + c$$

$$\therefore f(0) = \log\left(0 + \sqrt{1+0}\right) - \tan^{-1}(0) + c$$

$$\Rightarrow 0 = \log 1 - 0 + c \Rightarrow c = 0$$

$$\therefore f(x) = \log\left(x + \sqrt{1+x^2}\right) - \tan^{-1} x$$

$$\therefore f(1) = \log(1 + \sqrt{1+1^2}) - \tan^{-1}(1)$$

$$= \log(1+\sqrt{2}) - \frac{\pi}{4}$$

138 **(c)**

Let $I = \int_0^{\pi} \frac{x}{1+\sin x} dx$ ...(i)

$$\therefore I = \int_0^{\pi} \frac{\pi - x}{1+\sin x} dx \quad \ldots(ii)$$

$$\ldots\left[\because \int_0^a f(x)dx = \int_0^a f(a-x)dx\right]$$

Adding (i) and (ii), we get

$$2I = \int_0^{\pi} \frac{\pi}{1+\sin x} dx$$

$$= \pi \int_0^{\pi} \frac{1-\sin x}{(1+\sin x)(1-\sin x)} dx$$

$$= \pi \int_0^{\pi} \frac{1-\sin x}{\cos^2 x} dx$$

$$= \pi \int_0^{\pi} (\sec^2 x - \sec x \tan x) dx$$

$$= \pi[\tan x - \sec x]_0^{\pi}$$

$$\therefore 2I = \pi[0 - (-1) - (0-1)] = 2\pi$$

$$\therefore I = \pi$$

139 **(b)**

$af(x) + bf\left(\frac{1}{x}\right) = \frac{1}{x} - 5$ (for each $x \neq 0$) ...(i)

Replacing x by $\frac{1}{x}$ in (i), we get

$af\left(\frac{1}{x}\right) + bf(x) = x - 5$ ....(i)

Eliminating $f\left(\frac{1}{x}\right)$ from (i) and (ii), we get

$$(a^2 - b^2)f(x) = \frac{a}{x} - bx - 5a + 5b$$

By taking Integral on both sides, we get

$$(a^2 - b^2)\int_1^2 f(x)dx$$

$$= \left[a\log|x| - \frac{b}{2}x^2 - 5(a-b)x\right]_1^2$$

$$= a\log 2 - 2b - 10\,(a-b)$$

$$- a\log 1 + \frac{b}{2} + 5(a-b)$$

$$= a\log 2 - 5a + \frac{7}{2}b$$

$$\Rightarrow \int_1^2 f(x)dx = \frac{1}{a^2 - b^2}\left[a\log 2 - 5a + \frac{7}{2}b\right]$$

140 **(c)**

Let $I = \int_0^{\pi/2} \frac{\sin x . dx}{\sin x + \cos x}$ ...(i)

$$= \int_0^{\pi/2} \frac{\cos x\,.\,dx}{\cos x + \sin x} \quad \ldots(ii) \quad \ldots\left[\because \int_0^a f(x)dx = \int_0^a f(a-x)dx\right]$$

Adding (i) and (ii), we get

$$2I = \int_0^{\pi/2} dx \Rightarrow I = \frac{\pi}{4}$$

142 **(c)**

$$R_1 = \int_{-1}^{2} x\, f(x)\, dx$$

$$= \int_{-1}^{2} (1-x)\, f(1-x) dx$$

$$\ldots.\left[\because \int_a^b f(x)\, dx = \int_a^b f(a+b-x) dx\right]$$

$$= \int_{-1}^{2} (1-x) f(x) dx$$

$\ldots.[\because f(x) = f(1-x)(\text{given})]$

$$\therefore R_1 = \int_{-1}^{2} f(x)\, dx - R_1$$

$$= 2R_1 = \int_{-1}^{2} f(x)\, dx$$

According to the given condition

$$R_2 = \int_{-1}^{2} f(x)\, dx$$

$\therefore 2R_1 = R_2$

144 **(b)**

$\cot y \;\; dx = x\, dy$

On integrating both sides, we get

$$\int \frac{dx}{x} = \int \tan y\, dy + \log c$$

$\Rightarrow \log x = \log(\sec y) + \log c$

$\Rightarrow \log x = \log(c. \sec y)$

$\Rightarrow x = c \sec y$

145 **(a)**

Here, $P = 1$ and $Q = \cos x$

$\therefore$ I. F. $= e^{\int 1 dx} = e^x$

$\therefore$ the required solution is $ye^x = \int \cos x \,.\, e^x\, dx + c$

$$\Rightarrow y = \frac{1}{2}(\cos x + \sin x) + ce^{-x}$$

146 **(a)**

$\frac{dy}{dx} = e^{x+y} - 1 \quad$ ....(i)

Put $x + y = v \quad$ ....(ii)

$$\Rightarrow 1 + \frac{dy}{dx} = \frac{dv}{dx}$$

$\Rightarrow \frac{dy}{dx} = \frac{dv}{dx} - 1 \quad$ .....(iii)

Substituting (ii) and (iii) in (i), we get

$$\frac{dv}{dx} = e^v$$

On integrating both sides, we get

$$\int e^{-v}\, dv = \int dx + c$$

$\Rightarrow -e^{-v} = x + c$

$\Rightarrow x + e^{-v} + c = 0$

$\Rightarrow x + e^{-(x+y)} + c = 0$

147 **(a)**

Mean $= E(X) = \sum x_i \cdot P(x_i)$

$= (0.05)(-3) + (0.45)(-1) + (0.20)0 + (0.25)1 + (0.05)3$

$= -0.15 - 0.45 + 0 + 0.25 + 0.15 = -0.2$

148 **(b)**

Since, $\sum P_i(X = x) = 1$

$\therefore k + 3k + 5k + 2k + k = 1$

$\therefore 12\, k = 1 \;\; \therefore k = \frac{1}{12}$

Now, $P(X \geq 2) = P(X = 2) + P(X = 3) + P(X = 4)$

$= 5k + 2k + k$

$$= 8k = 8\left(\frac{1}{12}\right) = \frac{2}{3}$$