1. The transverse displacement y (x,t) of a wave on a string is given by y (x,t) = $e^{-\left(ax^2 + bt^2 + 2\sqrt{ab}\ xt\right)}$.

   This represents a

   (a) wave moving in –x direction with speed $\sqrt{\dfrac{b}{a}}$

   (b) standing wave of frequency $\sqrt{b}$

   (c) standing wave of frequency $\dfrac{1}{\sqrt{b}}$

   (d) wave moving in +x direction with speed $\sqrt{\dfrac{a}{b}}$

2. A screw gauge gives the following reading when used to measure the diameter of a wire.
   Main scale reading : 0 mm; Circular scale reading : 52 divisions
   Given that 1 mm on main scale corresponds to 100 divisions of the circular scale.
   The diameter of wire from the above data is
   (a) 0.052 cm   (b) 0.026 cm
   (c) 0.005 cm   (d) 0.52 cm

3. A mass m hangs with the help of a string wrapped around a pulley on a frictionless bearing. The pulley has mass m and radius R. Assuming pulley to be a perfect uniform circular disc, the acceleration of the mass m, if the string does not slip on the pulley, is

   (a) g   (b) $\dfrac{2}{3}g$

   (c) $\dfrac{g}{3}$ (d) $\dfrac{3}{2}g$

4. Work done in increasing the size of a soap bubble from radius of 3 cm to 5 cm is nearly (surface tension of soap solution = 0.3 Nm^{-1})
   (a) 0.2 π mJ   (b) 2π mJ
   (c) 0.4 π mJ   (d) 4 π mJ

5. A thin horizontal circular disc is rotating about a vertical axis passing through its centre. An insect is at rest at a point near the rim of the disc. The insect now moves along a diameter of the disc to reach its other end. During the journey of the insect, the angular speed of the disc
   (a) continuously decreases   (b) continuously and then decreases
   (c) first increases and then decreases   (d) remains unchanged

6. Two particles are executing simple harmonic motion of the same amplitude A and frequency ω along the x-axis. Their mean position is separated by distance X_0 ($X_0 > A$). if the maximum separation between them is ($X_0 + A$), the phase difference between their motion is

   (a) $\dfrac{\pi}{3}$ (b) $\dfrac{\pi}{4}$

   (c) $\dfrac{\pi}{6}$ (d) $\dfrac{\pi}{2}$

7. Two bodies of masses m and 4 m are placed at a distance r. The gravitational potential at a point on the line joining them where the gravitational field is zero, is

(a) $-\frac{4Gm}{4}$

(b) $-\frac{6Gm}{4}$

(c) $-\frac{9Gm}{4}$

(d) zero

8. Two identical charged spheres suspended from a common point by two massless strings of length l are initially a distance d(d << l) apart because of their mutual repulsion. The charge begins to leak from both the spheres at a constant rate. As a result charges approach each other with a velocity v. Then, as a function of distance x between them,

(a) $v \propto x^{-1}$

(b) $v \propto x^{1/2}$

(c) $v \propto x$

(d) $v \propto x^{-1/2}$

9. A boat is moving due east in a region where the earth's magnetic field is 5.0×10^{-5} NA^{-1}m^{-1} due North and horizontal. The boat carries a vertical aerial 2 m long. If the speed of the boat is 1.50 ms^{-1}, the magnitude of the induced emf in the wire of aerial is

(a) 0.75 mV

(b) 0.50 mV

(c) 0.15 mV

(d) 1 mV

10. An object, moving with a speed of 6.25 m/s, is decelerated at a rate given by $\frac{dv}{dt} = -2.5\sqrt{v}$, where v is the instantaneous speed. The time taken by the object, to come to rest, would be

(a) 2 s

(b) 4 s

(c) 8 s

(d) 1 s

11. A fully charged capacitor C with initial charge q_0 is connected to a coil of self inductance L at t = 0. The time at which the energy is stored equally between the electric and the magnetic fields is

(a) $\frac{\pi}{4} \sqrt{LC}$

(b) $2\pi \sqrt{LC}$

(c) $\sqrt{LC}$

(d) $\pi \sqrt{LC}$

12. Let the xz-plane be the boundary between two transparent media. Medium 1 in z ≥ 0 has a refractive index of $\sqrt{3}$. A ray of light in A = $6\sqrt{3}$ I + $8\sqrt{3}$ j – 10 k is incident on the plane of separation. The angle of refraction in medium 2 is

(a) 45˚

(b) 60˚

(c) 75˚

(d) 30˚

13. A current I flows in an infinitely long wire with cross-section in the form of a semi-circular ring of radius R. The magnitude of the magnetic induction along its axis is

(a) $\mu_0 I / 2\pi^2 R$

(b) $\mu_0 I / 2\pi R$

(c) $\mu_0 I / 4\pi R$

(d) $\mu_0 I / \pi^2 R$

14. A thermally insulated vessel contains an ideal gas of molecular mass M and ratio of specific heat γ. It is moving with speed v and it suddenly brought to rest. Assuming no heat is lost to the surroundings, its temperature increases by

(a) $\frac{(\gamma-1)}{2\gamma R}$ Mv^2K

(b) $\gamma Mv^2/2R$ x K

(c) $\frac{(\gamma-1)}{2R}$ Mv^2K

(d) $\frac{(\gamma-1)}{2(\gamma+1)R}$ Mv^2K

15. A mass M, attached to a horizontal spring, executes SHM with amplitude A_1. When the mass M passes through its mean position, then a smaller mass m is placed over it and both of them move together with amplitude A_2. The ratio of (A_1/A_2) is

(a) $\frac{M+m}{M}$

(b) $(M/M + m)^{1/2}$

(c) $(M+m/M)^{1/2}$

(d) $\frac{M}{M+m}$

16. Water is flowing continuously from a tap having an internal diameter 8 x 10^{-3}m. The water velocity as it leaves the tap is 0.4 ms^{-1}. The diameter of the water stream at a distance 2 x 10^{-1} m below the tap is close to

(a) 7.5 x 10^{-3} m

(b) 9.6 x 10^{-3} m

(c) 3.6 x 10^{-3} m

(d) 5.0 x 10^{-3} m

17. This question has Statement I and Statement II. Of the four choices given after the statements, choose the one that best describes the two statements.

Statement I Sky wave signals are used for long distance radio communication. These signals are in general, less stable than ground wave signals.

Statement II The state of ionosphere varies from hour to hour, day to day and season to season.

(a) Statement I is false, Statement II is true

(b) Statement I is true, Statement II is true; Statement II is a correct explanation for Statement I

(c) Statement I is true, Statement II is true; Statement II is not a correct explanation for Statement I

(d) Statement I is true, Statement II is false

18. Three perfect gases at absolute temperatures T_1, T_2 and T_3 are mixed. The masses of molecules are m_1, m_2 and m_3 and the number of molecules are n_1, n_2 and n_3 respectively. Assuming no loss of energy, the final temperature of the mixture is

(a) $n_1T_1 + n_2T_2 + n_3T_3 / n_1 + n_2 + n_3$

(b) $n_1T^2_1 + n_2T^2_2 + n_3T^2_3$

(c) $n^2_1T^2_1 + n^2_2T^2_2 + n^2_3T^2_3 / n_1T_1 + n_2T_2 + n_3T_3$

(d) $(T_1 + T_2 + T_3/3)$

19. A pulley of radius 2 m is rotated about its axis by a force $F = (20t - 5t^2)$ N (where, t is measured in seconds) applied tangentially. If the moment of inertia of the pulley about its axis of rotation is 10 kg-m^2, the number of rotations made by the pulley before its direction of motion if reserved, is
    (a) more than 3 but less than 6
    (b) more than 6 but less than 9
    (c) more than 9
    (d) less than 3

20. A Resistor R and 2 μF capacitor in series is connected through a switch to 200 V direct supply. Across the capacitor is a neon bulb that lights up at 120 V. Calculate the value of R to make the bulb light up 5 s after the switch has been closed. ($\log_{10} 2.5 = 0.4$)
    (a) $1.7 \times 10^5 \Omega$ (b) $2.7 \times 10^6 \Omega$
    (c) $3.3 \times 10^7 \Omega$ (d) $1.3 \times 10^4 \Omega$

21. A Carnot engine operating between temperature T_1 and T_2 has efficiency $\frac{1}{6}$, When T_2 is lowered by 62 K, its efficiency increases to $\frac{1}{3}$. Then, T_1 and T_2 are respectively
    (a) 372 K and 330 K   (b) 330 K and 268 K
    (b) 310 K and 248 K   (d) 372 K and 310 K

22. If a wire is stretched to make it 0.1% longer, its resistance will
    (a) increased by 0.2%   (b) decreased by 0.2%
    (c) decreased by 0.05%   (d) increased by 0.05%

23. This question has a paragraph followed by two statements, Statement I and Statement II. Of the given four alternatives after the statements, choose the one that describes the statements.
    A thin air film is formed by putting the convex surface of a plane-convex lens over a plane glass plate. With monochromatic light, this film gives an interference pattern due to light reflected from the top (convex) surface and the bottom (glass plate) surface of the film.
    Statement I When light reflects from the air-glass plate interface, the reflected wave suffers a phase change of π.
    Statement II The centre of the interference pattern is dark.
    (a) Statement I is true, Statement II is true; Statement II is the correct explanation of Statement I
    (b) Statement I is true, Statement II is true; Statement II is not the correct explanation of Statement I
    (c) Statement I is false, Statement II is true
    (d) Statement I is true, Statement II is false

24. A car is fitted with a convex side-view mirror of focal length 20 cm. A second car 2.8 m behind the first car is overtaking the first car at a relative speed of 15 m/s. The speed of the image of the second car as seen in the mirror of the first one is
    (a) $\frac{1}{15}$ m/s   (b) 10 m/s
    (c) 15 m/s   (d) $\frac{1}{10}$ m/s

25. Energy required for the electron excitation in Li^{2+} from the first to the third Bohr orbit is
    (a) 36.3 eV
    (b) 108.8 eV
    (c) 122.4 eV
    (d) 12.1 eV

26. The electrostatic potential inside a charged spherical ball is given by $\Phi = ar^2 + b$, where r is the distance from the centre, a and b are constants. Then, the charge density inside the ball is
    (a) $-6a\,\varepsilon_0 r$
    (b) $-24\pi a\,\varepsilon_0$
    (c) $-6a\,\varepsilon_0$
    (d) $-24\pi a\varepsilon_0 r$

27. A water fountain on the ground sprinkles water all around it. If the speed of water coming out of the fountain is v, the total area around the fountain that gets wet is
    (a) $\pi v^4/g^2$
    (b) $\frac{\pi}{2}\, v^4/g^2$
    (c) $\pi\, v^2 g^2$
    (d) $\pi v^2/g$

28. 100g of water is heated from 30°C to 50°C. Ignoring the slight expansion of the water, the change in its internal energy is (specific heat of water is 4184 J/kg/K)
    (a) 8.4 kJ
    (b) 84 kJ
    (c) 2.1 kJ
    (d) 4.2 kJ

29. The half life of a radioactive substance is 20 min. The approximate time interval (t_2-t_1) between the time t_2 when $\frac{2}{3}$ of it has decayed and time t_1 when $\frac{1}{3}$ of it had decayed is
    (a) 14 min
    (b) 20 min
    (c) 28 min
    (d) 7 min

30. This question has Statement I and Statement II. Of the four choices given after the statements, choose the one that best describes the two statements.
    Statement I A metallic surface is irradiated by a monochromatic light of frequency $v>v_0$ (the threshold frequency). The maximum kinetic energy and the stopping potential are K_{max} and V_0 respectively. If the frequency incident on the surface is doubled, both the K_{max} and V_0 are also doubled.
    Statement II The maximum kinetic energy and the stopping potential of photoelectrons emitted from a surface are linearly dependent on the frequency of incident light.
    (a) Statement I is true, Statement II is true; Statement II is the correct explanation of Statement I
    (b) Statement I is true, Statement II is true; Statement II is not the correct explanation of Statement I
    (c) Statement I is false, Statement II is true
    (d) Statement I is true, Statement II is false

31. The presence or absence of hydroxyl group on which carbon atom of sugar differentiates RNA and DNA?
    (a) 1st
    (b) 2nd
    (c) 3rd
    (d) 4th

32. Among the following, the maximum covalent character is shown by the compound
    (a) $FaCl_2$
    (b) $SnCl_2$
    (c) $AlCl_3$
    (d) $MgCl_2$

33. Which of the following statements is wrong?
    (a) The stability of hydrides increases from NH_3 to BiH_3 in group of 15 of the periodic table
    (b) Nitrogencan't form $d\pi$-$p\pi$ bond
    (c) Single N-N bond is weaker than the single P-P bond
    (d) N_2O_4 has two resonance structure

34. Phenol is heated with a solution of mixture of KBr and $KBrO_3$. The major product obtained in the above reaction is
    (a) 2-bromophenol
    (b) 3-bromophenol
    (c) 4-bromophenol
    (d) 2, 4, 6tribromophenol

35. A 5.2 molal aqueous solution of methyl alcohol, CH_3OH, is supplied. What is the mole fraction of methyl alcohol in the solution?
    (a) 0.100
    (b) 0.90
    (c) 0.086
    (d) 0.050

36. The hybridization of orbitals of N atom in NO_3^-, NO_2^+ and NH_4^+ are respectively
    (a) sp, sp^2, sp^3
    (b) sp^2, sp, sp^3
    (c) sp, sp^3, sp^2
    (d) sp^2, sp^3, sp

37. Ethylene glycol is used as an antifreeze in a cold climate. Mass of ethylene glycol which should be added to 4 kg of water to prevent it from freezing at -6°C will be
    (K_f for water = 1.86 Kg mol^{-1} and molar mass of ethylene glycol = 62 g mol^{-1})
    (a) 804.32 g
    (b) 204.30 g
    (c) 400.00 g
    (d) 304.60 g

38. The reduction potential of hydrogen half-cell will be negative if
    (a) $p(H_2)$ = 1atm and $[H^+]$ = 2.0 M
    (b) $p(H_2)$ = 1atm and $[H^+]$ = 1.0 M
    (c) $p(H_2)$ = 2 atm and $[H^+]$ = 1.0 M
    (d) $p(H_2)$ = 2 atm and $[H^+]$ = 2.0 M

39. Which of the following reagents may be used to distinguish between phenol and benzoic acid?
    (a) Aqueous NaOH
    (b) Tollen's reagent
   (c) Molisch reagent
    (d) Neutral $FeCl_3$

40. Trichloroacetaldehyde was subjected to Cannizzaro's reaction by using NaOH. The mixture of the products contains sodium trichloracetate ion and another compound. The other compound is

(a) 2, 2, 2-trichloroethanol
(b) trichloromethanol
(c) 2, 2, 2-trichloropropanol
(d) chloroform

41. Which one of the following orders present the correct sequence of the increasing basic nature of the given oxides?

(a) $Al_2O_3 < MgO < Na_2O < K_2O$
(b) $MgO < K_2O < Al_2O_3 < Na_2O$
(c) $Na_2O < K_2O < MgO < Al_2O_3$
(d) $K_2O < Na_2O < Al_2O_3 < MgO$

42. A gas absorbs photon of 355 nm and emits at two wavelengths. If one of the emission is at 680 nm, the other is at

(a) 1035 nm
(b) 325 nm
(c) 743 nm
(d) 518 nm

43. Which of the following statements regarding sulphur is incorrect?

(a) S_2 molecule is paramagnetic.
(b) The vapour at 200°C consists mostly of S_8 rings.
(c) At 600°C, the gas mainly consists of S_2 molecules.
(d) The oxidation state of sulphur is never less than +4 in its compounds.

44. The entropy change involved in the isothermal reversible expansion of 2 moles of an ideal gas from a volume of 10 dm^3 to a volume of 100 dm^3 at 27°C is

(a) 38.3 J $mol^{-1}K^{-1}$
(b) 35.8 J $mol^{-1}K^{-1}$
(c) 32.3 J $mol^{-1}K^{-1}$
(d) 42.3 J $mol^{-1}K^{-1}$

45. Which of the following facts about the complex $[Cr(NH_3)_6]Cl_3$ is wrong?

(a) The complex involves d^2sp^3 hybridization and is octahedral in shape
(b) The complex is paramagnetic
(c) The complex is an outer orbital complex
(d) The complex gives white precipitate with solver nitrate solution

46. The structure of IF_7 is

(a) square pyramid
(b) trigonal bipyramid
(c) octahedral
(d) pentagonal bipyramid

47. The rate of a chemical reaction doubles for every 10°C rise of temperature. If the temperature is raised by 50°C, the rate of the reaction increases by about

(a) 10 times
(b) 24 times
(c) 32 times
(d) 64 times

48. The strongest acid amongst the following compounds is
    (a) CH_3COOH
    (b) HCOOH
    (c) $CH_3CH_2CH(Cl)CO_2H$
    (d) $ClCH_2CH_2CH_2COOH$

49. Identify the compound that exhibits tautomerism
    (a) 2-butene (b) lactic acid
    (c) 2-pentanone (d) phenol

50. A vessel at 1000 K contains CO_2 with a pressure of 0.5 atm. Some of the CO_2 is converted into CO on the addition of graphite. If the total pressure at equilibrium is 0.8 atm, the value of K_p is
    (a) 1.8 atm (b) 3 atm
    (c) 0.3 atm (d) 0.18 atm

51. In context of the lanthanoids, which of the following statements is not correct?
    (a) There is a gradual decrease in the radii of the members with increasing atomic number in the series
    (b) All the members exhibit + 3 oxidation state
    (c) Because of similar properties the separation of lanthanoids is not easy
    (d) Availability of 4f electrons results in the formation of compounds in +4 state for all the members of the series

52. A and b are van der Waals' constants for gases. Chlorine is more easily liquefied than ethane because
    (a) a and b for Cl_2 > a and b for C_2H_6
    (b) a and b for Cl_2 < a and b for C_2H_6
    (c) a for Cl_2 < a for C_2H_6 but b for Cl_2 > b for C_2H_6
    (d) a for Cl_2 > a for C_2H_6 but b for Cl_2 < b for C_2H_6

53. The magnetic moment (spin only) of $[NiCl_4]^{2-}$ is
    (a) 1.82 BM (b) 5.46 BM
    (c) 2.82 BM (d) 1.41 BM

54. In a face centred cubic lattice, atom A occupies the corner positions and atom B occupies the face centre position. If one atom of B is missing from one of the face centred points, the formula of the compound is
    (a) A_2B (b) AB_2
    (c) A_2B_2 (d) A_2B_5

55. The outer electron configuration of Gd (At.No. 64) is
    (a) $4f^3\ 5d^5\ 6s^2$ (b) $4f^8\ 5d^0\ 6s^2$
    (c) $4f^4\ 5d^4\ 6s^2$ (d) $4f^7\ 5d^1\ 6s^2$

56. Boron can't form which one of the following anions?
    (a) BF_6^{3-} (b) BH_4^-
    (c) $B(OH)_4^-$ (d) BO_2^-

57. Ozonolysis of an organic compound gives formaldehyde as one of the products. This confirms the presence of
(a) two ethylenic double bonds
(b) a vinyl group
(c) an iso-propyl group
(d) an acetylenic triple bond

58. Sodium ethoxide has reacted with ethanyl chloride. The compound that is produced in the above reaction is
(a) diethyl ether
(b) 2-butanone
(c) ethyl chloride
(d) ethyl ethanoate

59. 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) $\alpha = \dfrac{x+y+1}{i-1}$

60. Silver mirror test is given by which one of the following compounds?
(a) Acetaldehyde
(b) Acetone
(c) Formaldehyde
(d) Benzophenone
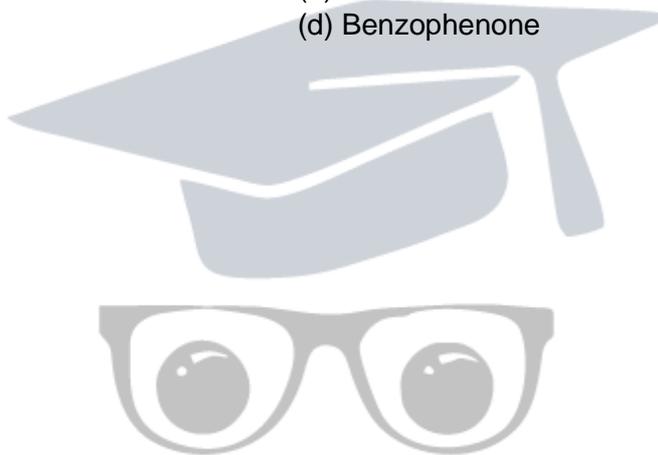
61. The lines $L_1 : y - x = 0$ $L_2 : 2x + y = 0$ intersect the line $L_3 : y + 2 = 0$ at P and Q respectively. The bisector of the acute angle between L_1 and L_2 intersects L_3 at R.
    Statement I The ratio PR: RQ equals $2\sqrt{2} : \sqrt{5}$.
    Statement II In any triangle, bisector of an angle divides the triangle into two similar triangles.
    (a) Statement I is true, Statement II is true; Statement II is not a correct explanation of Statement I
    (b) Statement I is true, Statement II is false;
    (c) Statement I is false, Statement II is true
    (d) Statement I is true, Statement II is true; Statement II is a correct explanation for Statement I

62. If $A = \sin^2 x + \cos^4 x$, then for all real x
    (a) $\frac{13}{16} \le A \le 1$
    (b) $1 \le A \le 2$
    (c) $\frac{3}{4} \le A \le \frac{13}{16}$
    (d) $\frac{3}{4} \le A \le 1$

63. The coefficient of x^7 in the expansion of $(1 - x - x^2 + x^3)^6$ is
    (a) -132
    (b) -144
    (c) 132
    (d) 144

64. $(\sqrt{1 - \{\cos 2 (x - 20)\}} / x - 2$
    (a) equals $\sqrt{2}$
    (b) equals $-\sqrt{2}$
    (c) equals $\frac{1}{\sqrt{2}}$
    (d) does not exist

65. **Statement I** The number of ways distributing 10 identical balls in 4 distinct boxes such that no box is empty is $^9C_3$.
    Statement II The number of ways of choosing any 3 places from 9 different places is $^9C_3$.
    (a) Statement I is true, Statement II is true; Statement II is not a correct explanation of Statement I
    (b) Statement I is true, Statement II is false
    (c) Statement I is false, Statement II is true
    (d) Statement I is true, Statement II is true; Statement II is not the correct explanation of Statement I

66. d^2x/dy^2 equals
    (a) $-(d^2y/dx^2)^{-1} (dy/dx)^{-3}$
    (b) $(d^2y/dx^2) (dy/dx)^{-2}$
    (c) $-(d^2y/dx^2)(dy/dx)^{-3}$
    (d) $(d^2y/dx^2)^{-1}$

67. if $\frac{dy}{dx} = y + 3 > 0$ and $y(0) = 2$, then $y(\log 2)$ is equal to
    (a) 5
    (b) 13
    (c) -2
    (d) 7

68. Let R be the set of real numbers.
   Statement I A = {(x,y) Ɛ R x R : y – x is an integer} is an equivalence relation on R.
   Statement II B = {(x,y) Ɛ R x R : x = αy for some rational number α} is an equivalence relation on R.
   (a) Statement I is true, Statement II is true; Statement II is not a correct explanation of Statement I
   (b) Statement I is true, Statement II is false
   (c) Statement I is false, Statement II is true
   (d) Statement I is true, Statement II is true; Statement II is not the correct explanation of Statement I

69. The value of 8 log (1 + x) / 1 + x^2 dx is
   (a) $\frac{\pi}{8}$ log2
   (b) $\frac{\pi}{2}$ log2
   (c) log 2
   (d) π log 2

70. Let α, β be real and z be a complex number. If z^2 + αz + β = 0 has two distinct roots on the line Re (z) = 1, then it is necessary that
   (a) β Ɛ (-1,0)
   (b) |β| = 1
   (c) β Ɛ (1,∞)
   (d) β Ɛ (0,1)

71. Consider 5 independent Bernoulli's trials each with probability of success p. if the probability of atleast one failure is greater than or equal to $\frac{31}{32}$, then p lies in the interval
   (a) (3/4 , 11/12)
   (b) (0, 1/2)
   (c) (11/12, 1)
   (d) (1/2, 3/4)

72. A man saves ₹200 in each of the first three months of his service. In each of the subsequent months, his saving increases by ₹ 40 more than the saving of immediately previous month. His total saving from the start of service will be ₹11040 after
   (a) 19 months
   (b) 20 months
   (c) 21 months
   (d) 18 months

73. The domain of the function
   F(x) = $\frac{1}{\sqrt{|x|-x}}$
   (a) (0, ∞)
   (b) (-∞, 0)
   (c) (-∞, ∞)
   (d) (-∞,∞)

74. If the angle between the line x = $\frac{y-1}{2}$ = $\frac{z-3}{\lambda}$ and the plane x + 2y + 3z = 4 is cos^{-1} ($\sqrt{5/14}$), then λ equals
   (a) $\frac{3}{2}$
   (b) $\frac{2}{5}$
   (c) $\frac{5}{3}$
   (d) $\frac{2}{3}$

75. If a = $\frac{1}{\sqrt{10}}$ (3i + k) and b = $\frac{1}{7}$ (2i + 3j – 6k), then the value of (2a – b).[(a x b) x (a + 2b)] is
   (a) -3
   (b) 5
   (c) 3
   (d) -5

76. Equation of the ellipse whose axes are the axes of coordinates and which passes through the point (-3, 1) and has eccentricity $\sqrt{\frac{2}{5}}$ is

(a) $5x^2 + 3y^2 - 48 = 0$

(b) $3x^2 + 5y^2 - 15 = 0$

(c) $5x^2 + 3y^2 - 32 = 0$

(d) $3x^2 + 5y^2 - 32 = 0$

77. Let I be the purchase value of an equipment and V(t) be the value after it has been used for t years. The value V(t) depreciates at a rate given by differential equation $\frac{dV(t)}{dt}$ = -k (T-t), where k > 0 is a constant and T is the total life in years of the equipment. Then, the scrap value V (T) of the equipment is

(a) $I - kT^2/2$

(b) $I - k(T - t)^2/2$

(c) e^{-kT}

(d) $T^2 - 1/k$

78. The vectors a and b are not perpendicular and c and d are two vectors satisfying b x c = b x d and a . d = 0. Then, the vector d is equal to

(a) c + (a.c/a.b)b

(b) b + (b.c/a.b)c

(c) c − (a.c/a.b)b

(d) b − (b.c/a.b)c

79. The two circles $x^2 + y^2 = ax$ and $x^2 + y^2 = c^2$ (c>0) touch each other, if

(a) |a| = c

(b) a = 2c

(c) |a| = 2c

(d) 2 |a| = c

80. If C and D are two events such that C ⊂ D and P(D) ≠ 0, then the correct statement among the following is

(a) P(C| D) ≥ P (C)

(b) P (C|D < P (C)

(c) P (C| D) = $\frac{P(D)}{P(C)}$

(d) P (C|D) = P(C)

81. The number of values of k for which the linear equations 4x + ky + 2z = 0, kx + 4y + z = 0 and 2x + 2y + z = 0 posses a non-zero solution is

(a) 2

(b) 1

(c) zero

(d) 3

82. Consider the following statements

P : Suman is brilliant.

Q : Suman is rich.

R : Suman is honest.

The negative of the statement. "Suman is brilliant and dishonest if and only if Suman is rich" can be expressed as

(a) ~[Q↔(P∧~R)]

(b) ~Q↔P∧R

(c) ~(P∧~R) ↔ Q

(d) ~P∧(Q↔~R)

83. The shortest distance between line y-x = 1 and curve $x = y^2$ is

(a) $\frac{3\sqrt{2}}{8}$

(b) $\frac{8}{3\sqrt{2}}$

(c) $\frac{4}{\sqrt{3}}$

(d) $\frac{\sqrt{3}}{4}$

84. If the mean deviation about the median of the numbers a, 2a, …, 50a is 50, then |a| equals
   (a) 3
   (b) 4
   (c) 5
   (d) 2

85. **Statement I** The point A(1, 0, 7) is the mirror image of the point B(1, 6, 3) in the line $\frac{x}{1} = \frac{Y-1}{2} = \frac{Z-2}{3}$.
   Statement II The line $\frac{x}{1} = \frac{y-1}{2} = \frac{z-2}{3}$ bisects the line segment joining A (1, 0, 7) and B(1, 6, 3).
   (a) Statement I is true, Statement II is true; Statement II is not a correct explanation of Statement I
   (b) Statement I is true, Statement II is false
   (c) Statement I is false, Statement II is true
   (d) Statement I is true, Statement II is true; Statement II is a correct explanation of Statement I.

86. Let A and B be two symmetric matrices of order 3.
   Statement I A (BA) and (AB)A are symmetric matrices.
   Statement II AB is symmetric matrix, if matrix, if matrix multiplication of A with B is commutative.
   (a) Statement I is true, Statement II is true; Statement II is not a correct explanation of Statement I
   (b) Statement I is true, Statement II is false
   (c) Statement I is false, Statement II is true
   (d) Statement I is true, Statement II is true; Statement II is a correct explanation of Statement I.

87. If ω(≠1) is a cube root of unity and $(1 + ω)^7 = A + Bω$. Then, (A, B) equals
   (a) (1, 1)
   (b) (1, 0)
   (c) (-1, 1)
   (d) (0, 1)

88. The values of p and q for which the function
   Is continuous for all x in R, are
   (a) $p = \frac{5}{2}, q = \frac{1}{2}$
   (b) $p = -\frac{3}{2}, q = \frac{1}{2}$
   (c) $p = \frac{1}{2}, q = \frac{3}{2}$
   (d) $p = \frac{1}{2}, q = -\frac{3}{2}$

89. The area of the region enclosed by the curves y = x, x = e, $y = \frac{1}{x}$ and the positive X-axis is
   (a) 1 sq unit
   (b) $\frac{3}{2}$ sq units
   (c) $\frac{5}{2}$ sq units
   (d) $\frac{1}{2}$ sq unit

90. For x Ɛ (0, 5π/2), define f(x) = $\sqrt{t}$ sin t dt.
    Then, f has
    (a) local minimum at π and 2π
    (b) local minimum at π and local maximum at 2π
    (c) local maximum at π and local minimum at 2π
    (d) local maximum at π and 2π