SAMPLE PAPERS

JEE Mains

Maximum Marks: 360

Topics Covered:

Physics : SHM, Waves & Sound, Modern Physics, Semiconductors Device, Communication

Chemistry : Chemical Kinetics, States of Matter, Environmental Chemistry, Hydrogen & Compounds, Alcohol Phenols & Ethers, Carbonyl Compounds, Carboxylic Acid, Nitrogen Compounds, Biomolecules & Polymers

Mathematics: Circles, Parabola, Ellipse, Hyperbola, Areas, Differential Equation, Probability, Linear Programming

Important Instruction:

1. Use **Blue / Black Ball** point pen only.
2. There are three sections of equal weightage in the question paper A, B, C (**Physics, Chemistry and Mathematics**) having 30 questions each.
3. You are awarded +4 marks for each correct answer and -1 mark for each incorrect answer.
4. Use of calculator and other electronic devices is not allowed during the exam.
5. No extra sheets will be provided for any kind of work.

PART – A (PHYSICS)

1. A particle is executing SHM on a straight line with zero initial phase. It crosses the point from where the time is considered for the motion at successive intervals t and $2t$ with a speed v . Find the amplitude of the motion:

(a) $2\upsilon t$ (b) υt (c) $\frac{\upsilon t}{\pi}$ (d) $\frac{\upsilon t}{2\pi}$

2. The ratio of intensities between two coherent sound sources is 4 : 1. The difference of loudness in decibel (dB) between maximum and minimum intensities, when they interfere in space is

(a) 10 log2 (b) 20 log 3 (c) 10 log 3 (d) 20 log 2

3. The ratio of molecular mass of two radioactive substance is $\frac{3}{2}$ and the ratio of their decay constant is $\frac{4}{3}$. Then the ratio of their initial activity per mole will be

(a) 2 (b) $\frac{8}{9}$ (c) $\frac{4}{3}$ (d) $\frac{9}{8}$

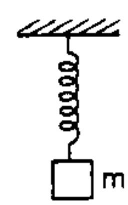
4. A string of length L is stretched by L/20 and speed of transverse wave along it is v. The speed of wave when it is stretched by L/10 will be (assume that Hooke's law is applicable)

(a) 2v (b) $\frac{v}{\sqrt{2}}$ (c) $\sqrt{2}$ v (d) 4 v

5. Two particles P and Q describe S.H.M. of same amplitude and same frequency f along the same straight line. The maximum distance between the two particles is a$\sqrt{2}$. The phase difference between the particles is :

(a) zero (b) π/2 (c) π/6 (d) π/3

6. A mass m is undergoing SHM in vertical direction about the mean position with amplitude A and angular velocity ω . At a distance y from the mean position, the mass detaches from the spring. Assume that the spring contracts and does not obstruct the motion of m . Find the distance y_0 (measured from the mean position) such that the height attained by the block is maximum $(A\omega^2 > g)$ (a) g/ω^2 (b) $2g/\omega^2$ (c) $g/2\omega^2$ (d) $\frac{2\sqrt{2}g}{\omega^2}$



7. The difference between the longest wavelength line of the Balmer series and shortest wavelength line of the Lyman series for a hydrogenic atom (atom number Z) is equal to Δλ. The value of the Rydberg constant for the given atom is :

(a) $\frac{5}{31}\frac{1}{\Delta\lambda Z^2}$ (b) $\frac{5}{36}\frac{Z^2}{\Delta\lambda}$ (c) $\frac{31}{5}\frac{1}{\Delta\lambda Z^2}$ (d) Given information is not sufficient

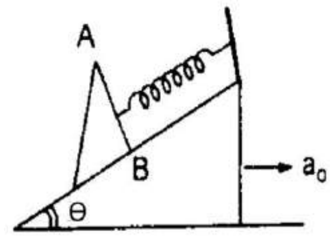
8. At radioactive equilibrium, the ratio between the number of the atoms of two radioactive elements (X) and (Y) was found to be 3.2×10^9 : 1 respectively. If half-life of the element (X) is 1.6×10^{10} years, then half-life of the element (Y) would be

(a) 3.2×10^9 years (b) 5×10^9 years (c) 10 years (d) 5 years

9. A closed organ pipe and an open organ pipe of same length produce 2 beats when they are set into vibrations simultaneously in their fundamental mode. The length of open organ pipe is now halved and of closed organ pipe is doubled, the number of beats produced will be

(a) 8 (b) 7 (c) 4 (d) 2

10. Block A of mass m is executing SHM on block B which moves with acceleration a_0 towards right. All surfaces are frictionless. The spring constant is K. Find the energy of oscillation:



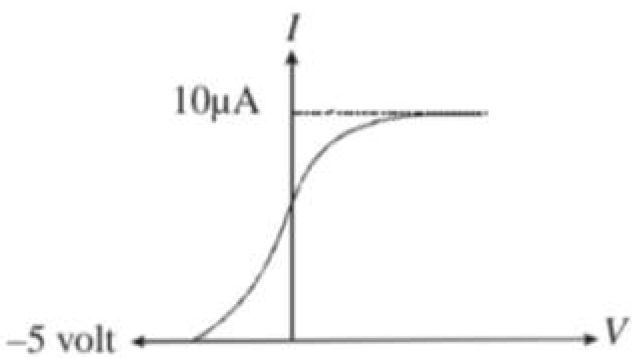
(a) $\frac{m^2 a_0^2 \cos^2\theta}{2K}$ (b) $\frac{m^2 (g \sin\theta + a_0 \cos\theta)^2}{2K}$

(c) $\frac{m^2 \left(g^2 \sin^2\theta + a_0^2 \cos^2\theta\right)}{2K}$ (d) Given information is insufficient

11. A stationary Pb^{200} nucleus emits an alpha-particle with kinetic energy T_α. The fraction of recoil energy of the daughter nucleus to the total energy liberated is :

(a) 1/196 (b) 4/196 (c) 1/20 (d) 1/50

12. In the photoelectric experiment, if we use a monochromatic light, the photoelectric current vs voltage curve is as shown. If work function of the metal is 2eV, estimate the power of light used. (Assume efficiency of photo emission = 10^{-3} %, i.e., number of photoelectrons emitted are 10^{-3} % of number of photons incident on metal)

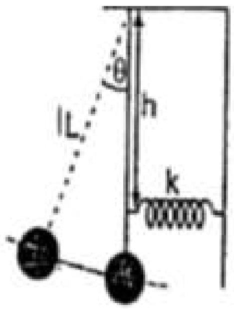


(a) 2W (b) 5W (c) 7W (d) 10W

13. An open organ pipe of length l is sounded together with another open organ pipe of length l + x in their fundamental tones. Speed of sound in air is v. The beat frequency heard will be ($x \ll l$)

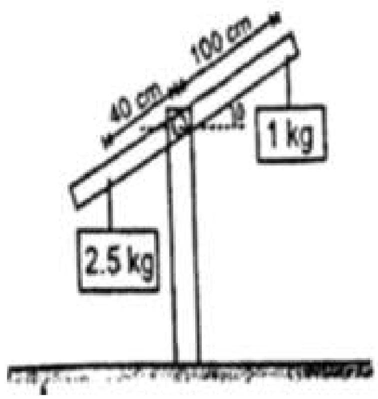
(a) $\frac{vx}{4l^2}$ (b) $\frac{vl^2}{2x}$ (c) $\frac{vx}{2l^2}$ (d) $\frac{vx^2}{2l}$

14. A pendulum of length L and bob of mass m has a spring of force constant k connected horizontally to it at a distance h below its point of suspension. The rod is in equilibrium in vertical position. The frequency of vibration of the system for small values of θ is :



(a) $\frac{1}{2\pi L}\sqrt{gL+\frac{kh}{m}}$ (b) $\frac{1}{2\pi L}\sqrt{\frac{mgL+k}{m}}$ (c) $2\pi\sqrt{\frac{mL^2}{mgL+kh}}$ (d) $\frac{1}{2\pi L}\sqrt{gL+\left(\frac{kh^2}{m}\right)}$

15. A straight rod of negligible mass is mounted on a frictionless pivot and masses 2.5 kg and 1 kg are suspended at distances 40 cm and 100 cm respectively from the pivot as shown. The rod is held at an angle θ with the horizontal and released.



(a) The rod executes periodic motion about horizontal position after the release.
(b) The rod remains stationary after the release
(c) The rod comes to rest in vertical position with 2.5 kg mass at the lowest point.
(d) The rod executes periodic motion about vertical position after the release.

16. A regular hexagonal lamina of side a made up of perfectly absorbing material is kept in a region where a parallel beam of light with intensity I having a large aperture falls on it. If the normal to the surface of the hexagon makes an angle of 30° with the beam then the force experienced by the hexagon will be
(a) $\frac{5a^2I}{4c}$ (b) $\frac{9a^2I}{4c}$ (c) $\frac{a^2I}{c}$ (d) $\frac{6a^2I}{c}$

17. If elements with principal quantum number $n > 4$ were not allowed in nature, the number of possible elements would be
(a) 60 (b) 32 (c) 4 (d) 64

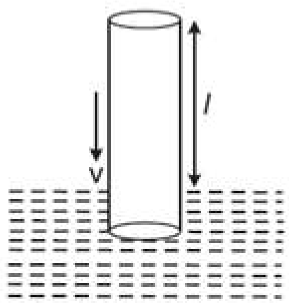
18. When a source of sound of frequency f crosses a stationary observer with a speed v_s($\ll$ speed of sound v), the apparent change in frequency Δf is given by
(a) $\frac{2f\,v_s}{v}$ (b) 2fv v_s (c) $\frac{2f\,v}{v_s}$ (d) $\frac{f\,v_s}{v}$

19. Two masses m_1 and m_2 ($m_1 > m_2$) are suspended by two springs vertically and are in equilibrium, extensions in the springs were same. Both the masses are displaced in the vertical direction by same distance and released. In subsequence motion T_1, T_2 are their periods and E_1, E_2 are the energies of oscillations respectively then :

(a) $T_1 = T_2$; $E_1 < E_2$ (b) $T_1 > T_2$; $E_1 > E_2$ (c) $T_1 < T_2$; $E_1 > E_2$ (d) $T_1 = T_2$; $E_1 > E_2$

20. An open pipe of sufficient length is dipping in water with a speed v vertically. If at any instant l is length of tube above water. Then the rate at which fundamental frequency of pipe changes, is

(speed of sound = c)

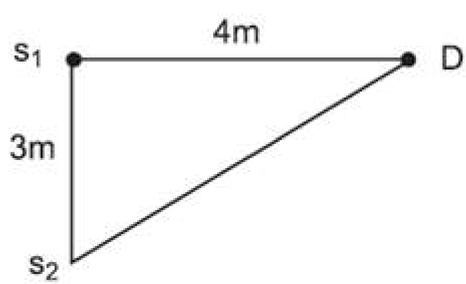


(a) $cv/2l^2$ (b) $cv/4l^2$ (c) $c/2v^2l^2$ (d) $c/4v^2l^2$

21. The activity of a radioactive sample is A_1 at time t_1 and A_2 at time t_2. If τ is average life of sample then the number of nuclei decayed in time $(t_2 - t_1)$ is

(a) $A_1t_1 - A_2t_2$ (b) $\frac{(A_1 - A_2)}{2}\tau$ (c) $(A_1 - A_2)(t_2 - t_1)$ (d) $(A_1 - A_2)\tau$

22. In the figure the intensity of waves arriving at D from two coherent sources s_1 and s_2 is I_0. The wavelength of the wave is $\lambda = 4$ m. Resultant intensity at D will be

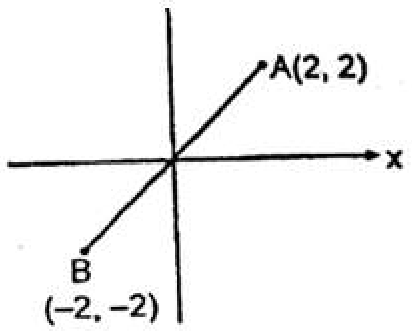


(a) $4I_0$ (b) I_0 (c) $2I_0$ (d) zero

23. If nuclei of a radioactive element is produced at constant rate α and they decay with decay constant λ. At t = 0, number of nuclei is zero than the number of nuclei at time t is

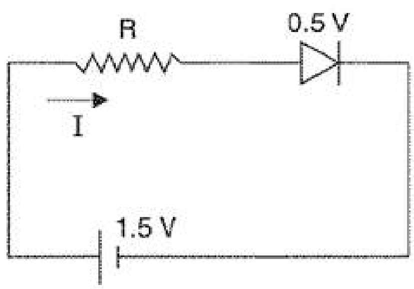
(a) $\frac{\alpha}{\lambda}(1 - e^{-\lambda t})$ (b) $\alpha - \frac{\alpha}{\lambda}e^{-\lambda t}$ (c) $\frac{\alpha}{\lambda}e^{-\lambda t}$ (d) $\alpha(1 - e^{-\lambda t})$

24. A particle of mass = 2 kg executes SHM in xy-plane between points A and B under action of force $\vec{F} = F_x\hat{i} + F_y\hat{j}$. Minimum time taken by particle to move from A to B is 1 sec. At t= 0 the particle is at x = 2 and y = 2. Then F_x as function of time is



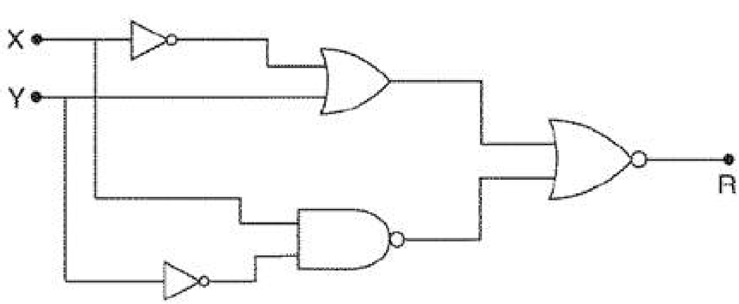
(a) $-4\pi \sin \pi t$ (b) $-4\pi^2 \cos \pi t$ (c) $4\pi^2 \cos \pi t$ (d) $4\pi \cos \pi t$

25. The diode used in the circuit shown in fig. has a constant voltage drop of 0.5 V at all currents and a maximum power rating of 100 milliwatt. What should be the value of the resistor R, connected in series with the diode, for obtaining maximum current?



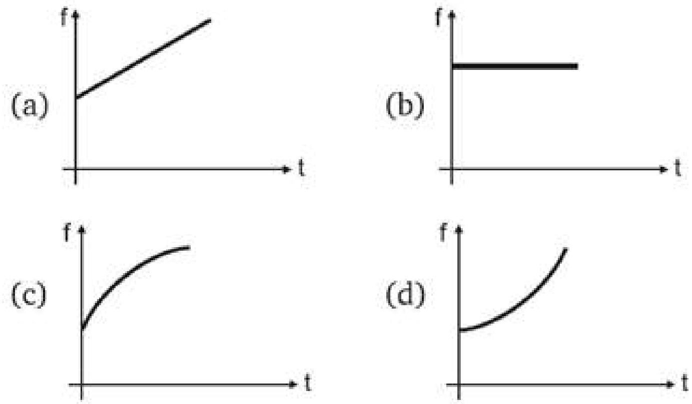
(a) 1.5 Ω (b) 5 Ω (c) 6.67 Ω (d) 200 Ω

26. Refer to the circuit shown in Fig. What inputs X and Y will produce a high output at R?



(a) X = 0, Y = 0 (b) X = 1, Y = 1 (c) X = 0, Y = 1 (d) X = 1, Y = 0

27. An observer starts moving with uniform acceleration a towards a stationary sound source of frequency f_o. As the observer approaches the source, the apparent frequency f heard by the observer varies with time t as



This is an equation of a straight line with positive intercept f_o and positive slope $\frac{f_o a}{v}$, where v is the speed of sound in air.

28. A simple pendulum has a time period of 3.0 s. If the point of suspension of the pendulum starts moving vertically upward with a velocity v = Kt where K = 4.4 ms^{-2}, the new time period will be (Take g = 10 ms^{-2})

(a) $\frac{9}{4}$ s (b) $\frac{5}{3}$ s (c) 2.5 s (d) 4.4 s

29. An object of specific gravity ρ is hung from a thin steel wire. The fundamental frequency (in Hz) is 300Hz. The object is immersed in water with specific gravity ρ_w, so that one half its volume is submerged. The new fundamental frequency (in Hz) is

(a) $300\left(\frac{2\rho-\rho_w}{2\rho}\right)^{1/2}$ (b) $300\left(\frac{2\rho}{2\rho-\rho_w}\right)^{1/2}$ (c) $300\left(\frac{2\rho}{2\rho-\rho_w}\right)$ (d) $300\left(\frac{2\rho-\rho_w}{2\rho}\right)$

30. A common emitter amplifier is designed with n-p-n transistor (α = 0.99). The input impedance is 1kΩ and load is 10 kΩ. The voltage gain will be

(a) 9.9 (b) 99 (c) 990 (d) 9900

PART – B (CHEMISTRY)

31. A definite amount of a gaseous hydrocarbon having less than 5 carbon atoms was burned with sufficient amount of O_2 at a very high temperature. The volume of all reactants was 600 ml, after the explosion the volume of the products was found to be 700 ml under the similar conditions. What is the molecular formula of compound?

(a) C_3H_8 (b) C_2H_6 (c) C_2H_2 (d) C_2H_4

32. Two flasks of equal volume connected by a narrow tube (of negligible volume) are at 27°C and contain 0.70 mole of H_2 at 0.5 atm. One of the flasks is then immersed into a hot bath, kept at 127°C, while the other remains at 27°C. Calculate the final pressure.

(a) 0.5714 atm (b) 0.2713 atm (c) 0.8314 atm (d) 17.24 atm

33. Which of the following reactions increases the production of dihydrogen from synthesis gas?

(a) $CH_4(g) + H_2O(g) \xrightarrow[Ni]{1270K} CO(g) + 3H_2(g)$ (b) $C(s) + H_2O(g) \xrightarrow{1270K} CO(g) + H_2(g)$

(c) $CO(g) + H_2O(g) \xrightarrow[Catalyst]{1270K} CO_2(g) + H_2(g)$ (d) $C_2H_6 + 2H_2O \xrightarrow[Ni]{1270K} 2CO + 5H_2$

34. The H – O – O bond angle in H_2O_2 is
(a) 107.28° (b) 97° (c) 104.5° (d) 109°

35. In the reactions of water with F_2, water acts as
(a) oxidant (b) reductant (c) Both (a) and (b) (d) Neither of these

36. Which is the poorest reducing agent?
(a) Atomic hydrogen (b) Nascent hydrogen (c) Di-hydrogen
(d) All have same reducing strength

37. In the absence of hydrogen bonding, boiling point of water would have been
(a) 100°C (b) 0°C (c) – 100°C (d) 373°C

38. Ozone layer is present in
(a) troposphere (b) stratosphere (c) Mesosphere (d) Exosphere

39. The elements present in the core of earth are collectively known as
(a) lithophiles (b) Nucleophiles (c) Chaleophiles (d) Siderophiles

40. A first order reaction is 50% completed in 1.26×10^{14} s. How much time would it take for 100% completion?
(a) 1.26×10^{15} s (b) 2.52×10^{14} s (c) 2.52×10^{28} s (d) Infinite

41. The functionally of propene and adipic aicd are respectively.
(a) 1, 1 (b) 0, 1 (c) 0, 2 (d) 1, 2

42. The polymer used in making synthetic hair wigs is made up of
(a) $CH_2 = CHCl$ (b) $CH_2 = CHCOOCH_3$ (c) $C_6H_5CH = CH_2$ (d) $CH_2 = CH – CH = CH_2$

43. Which of the following has been used in the manufacture of Non-inflammable photographic films?
(a) Cellulose Nitrate (b) Cellulose Xanthate (c) Cellulose perchlorate (d) Cellulose acetate

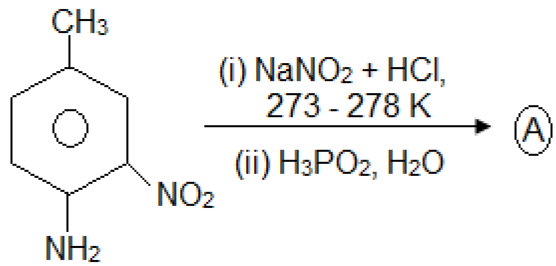
44. Which of the following is involved in the formation of Heme?
(a) Lysine (b) Glycine (c) Tyrosine (d) Arginine

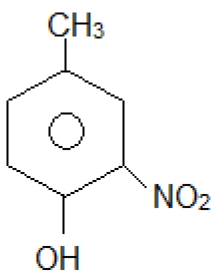
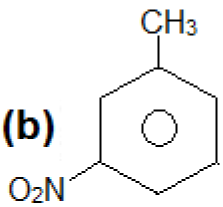
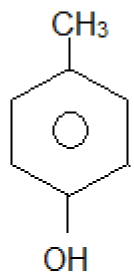
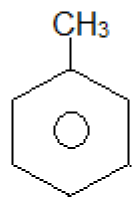
45. Which of the following 'B' group vitamins can be stored in our body?
(a) Vit. B_1 (b) Vit. B_2 (c) Vit. B_6 (d) Vit. B_{12}

46. Which one of the following is the strongest base in aqueous solution?
(a) Trimethylamine (b) Aniline (c) Dimethylamine (d) Methylamine

47. Benzaldehyde condenses with N, N-dimethylaniline in the presence of anhydrous $ZnCl_2$ to give
(a) Azo dye (b) Malachite green (c) Michler's Ketone (d) Buffer yellow.

48. Give the structure of 'A' in the following reaction.

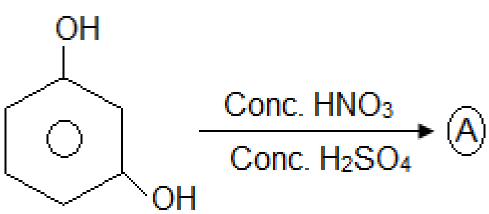


(a)  **(b)**  **(c)**  **(d)** 

49. Which of the following compound will not undergo azo coupling reaction with benzene diazonium chloride?
(a) Anilne (b) Phenol (c) Anisole (d) Nitrobenzene

50. Which of the following has the most acidic hydrogen?
(a) 3-hexanone (b) 2, 4-hexanedione (c) 2, 5-hexanedione (d) 2, 3-hexanedione

51. Consider the following reaction,



Product (A) is
(a) Picric Acid (b) Styphnic Acid (c) Salicylic Acid (d) Benzoic Acid

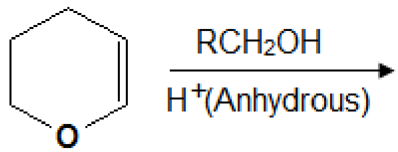
52. Which of the following carboxylic acids undergoes decarboxylation easily?
(a) $C_6H_5COCH_2COOH$ (b) $C_6H_5COCOOH$

(c) $C_6H_5-CH(OH)-COOH$ **(d)** $C_6H_5-CH(NH_2)-COOH$

53. The reagent which does not react with both, Acetone and benzaldehyde is
(a) Sodium hydrogen sulphite (b) Phenyl Hydrazine (c) Fehling's solution (d) Grignard Reagent

54. Iodoform can be prepared from all except
(a) ethyl methyl ketone (b) Isopropyl alcohol
(c) 3-methyl-2-butanone (d) Isobutyl Alcohol

55. The major product of the following reaction is



(a) A Hemiacetal (b) An Acetal (c) An ether (d) An Ester

56. The best method of prepare cyclohexene from cyclohexanol is by using
(a) Conc. HCl + $ZnCl_2$ (b) Conc. H_3PO_4 (c) HBr (d) Conc. HCl

57. In CH_3CH_2OH, the bond that undergoes heterolytic cleavage most readily is
(a) C – C (b) C – O (c) C – H (d) O – H

58. Which of the following will react with water?
(a) $CHCl_3$ (b) Cl_3CCHO (c) CCl_4 (d)$ClCH_2CH_2Cl$

59. Benzoyl chloride is prepared from benzoic acid by
(a) Cl_2, hr (b) SO_2 Cl_2 (c) $SOCl_2$ (d) Cl_2 H_2O

60. Benzamide on treatment with $POCl_3$ gives
(a) Aniline (b) Benzonitrile (c) Chlorobenzene (d) Benzyl amine

PART – C (MATHEMATICS)

61. The equation of the image of the circle $x^2 + y^2 + 16x – 24y + 183 = 0$ by the mirror $4x + 7y + 13 = 0$ is ;
(a) $x^2 + y^2 + 32x – 4y + 235 = 0$ (b) $x^2 + y^2 + 32x + 4y – 235 = 0$
(c) $x^2 + y^2 + 32x – 4y – 235 = 0$ (d) $x^2 + y^2 + 32x + 4y + 235 = 0$

62. The equation of the locus of the point of intersection of two normals to the parabola $y^2 = 4ax$ which are perpendicular to each other is
(a) $y^2 = a(x – 3a)$ (b) $y^2 = a(x + 3a)$ (c) $y^2 = a(x + 2a)$ (d) $y^2 = a(x – 2a)$

63. Four unit circles pass through the origin and have their centres on the coordinate axes. The area of the quadrilateral whose vertices are the points of intersection (in pairs) of the circle, is
(a) 1 sq. unit (b) $2\sqrt{2}$ sq. units (c) 4sq. units (d) Cannot be uniquely determined, insufficient data

64. The area of the region bounded by the curve $y = x^2$ and $y = \sec^{-1} [– \sin^2 x]$, (where [.] denotes the greatest integer function), is
(a) $\pi\sqrt{\pi}$ (b) $\frac{4}{3}\pi\sqrt{\pi}$ (c) $\frac{2}{3}\pi\sqrt{\pi}$ (d) $\frac{1}{3}\pi\sqrt{\pi}$

65. A and B toss a fair coin each simultaneously 50 times. The probability that both of them will not get tail at the same toss is
(a) $\left(\frac{3}{4}\right)^{50}$ (b) $\left(\frac{2}{7}\right)^{50}$ (c) $\left(\frac{1}{8}\right)^{50}$ (d) $\left(\frac{7}{8}\right)^{50}$

66. The solution of the differential equation $\frac{dy}{dx}+\frac{3x^2}{1+x^3}y=\frac{\sin^2 x}{1+x^3}$ is

(a) $y(1+x^3)=x+\frac{1}{2}\sin 2x+c$ (b) $y(1+x^3)=cx+\frac{1}{2}\sin 2x$

(c) $y(1+x^3)=cx-\frac{1}{2}\sin 2x$ (d) $y(1+x^3)=\frac{x}{2}-\frac{1}{4}\sin 2x+c$

67. If the focus of a parabola divides a focal chord of the parabola in segments of length 3 and 2, the length of the latus rectum of the parabola is-
(a) 3/2 (b) 6/5 (c) 12/5 (d) 24/5

68. The degree of the differential equation satisfying the relation
$\sqrt{1+x^2}+\sqrt{1+y^2}=\lambda\left(x\sqrt{1+y^2}-y\sqrt{1+x^2}\right)$ is
(a) 1 (b) 2 (c) 3 (d) none of these

69. Solution to the differential equation $\frac{x+\frac{x^3}{3!}+\frac{x^5}{5!}+\ldots\ldots.}{1+\frac{x^2}{2!}+\frac{x^4}{4!}+\ldots\ldots}=\frac{dx-dy}{dx+dy}$ is

(a) $2y\,e^{2x}=C.e^{2x}+1$ (b) $2y\,e^{2x}=C.e^{2x}-1$ (c) $y\,e^{2x}=C.e^{2x}+2$ (d) $2x\,e^{2y}=C.e^{x}-1$

70. A box contains 100 tickets numbered 1, 2 ...... 100. Two tickets are chosen at random. It is given that the maximum number on the two chosen tickets is not more than 10. The minimum number on them is 5 with probability

(a) $\frac{1}{8}$ (b) $\frac{13}{15}$ (c) $\frac{1}{7}$ (d) None of these

71. The area of the figure bounded by the curves y = lnx and y = $(\ln x)^2$ is
(a) e + 1 (b) e – 1 (c) 3 – e (d) 1

72. Consider the region formed by the lines x = 0, y = 0, x = 2, y = 2. Area enclosed by the curves y = e^x and y = lnx, within this region is removed, then the area of the remaining region is
(a) 2(1 + 2ℓn) (b) 2(2 ℓn2 – 1) (c) (2 ℓn2 – 1) (d) 1 + 2 ℓn

73. 4 persons are asked the same question by an interviewer. If each has independent probability 1/6 of answering the question correctly. The probability that at least one answers correctly is:
(a) 2/3 (b) $(1/6)^4$ (c) $1-(5/6)^4$ (d) $1-(1/6)^4$

74. An integer x is chose from the first 50 positive integers. The probability that, $x+\frac{100}{x}>50$, is:

(a) $\frac{1}{25}$ (b) $\frac{2}{25}$ (c) $\frac{1}{10}$ (d) None of these

75. The area of the region for which $0<y<3-2x-x^2$ & $x>0$ is
(a) $\int_1^3(3-2x-x^2)\,dx$ (b) $\int_0^3(3-2x-x^2)\,dx$ (c) $\int_0^1(3-2x-x^2)\,dx$ (d) none of these

76. The area from 1 to x under a certain graph is given by $A = (1 + 3x)^{1/2} - 1, x \geq 0$. The average value of A w.r.t. x as x increases from 1 to 8 is

(a) 3/7 (b) 1/2 (c) 3/8 (d) 4/7

77. The orthogonal trajectories of the family of curves $a^{n-1}y = x^n$ are given by

(a) $xn + n^2y$ = constant (b) $ny^2 + x^2$ = constant

(c) $n^2x + y^n$ = constant (d) $n^2x - y^n$ = constant

78. If $\tan \theta_1 . \tan \theta_2 = -\frac{a^2}{b^2}$ then the chord joining two points θ_1 and θ_2 on the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ will subtend a right angle at:

(a) Focus (b) Centre (c) End of the major axis (d) End of the minor axis

79. The equation of the normal to the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ at the positive and of latus rectum

(a) $x + ey + e^2a = 0$ (b) $x - ey - e^3a = 0$ (c) $x - ey - e^2a = 0$ (d) None of these

80. Let 'E' be the ellipse $\frac{x^2}{9} + \frac{y^2}{4} = 1$ & 'C' be the circle $x^2 + y^2 = 9$. Let P and Q be the points (1, 2) and (2, 1) respectively. Then:

(a) Q lies inside C but outside E (b) Q lies outside both C and E

(c) P lies inside both C and E (d) P lies inside C but outside E

81. Q is a point on the auxiliary circle of an ellipse. P is the corresponding point on ellipse. N is the foot of perpendicular from focus S, to the tangent of auxillary circle at Q. Then

(a) SP = SN (b) SP = PQ (c) PN = SP (d) NQ = SP

82. The solution of the differential equation $\log \left(\frac{dy}{dx}\right) = 4x - 2y + 2$, y = 1 when x = 1 is:

(a) $2e^{2y+2} = e^{4x} + e^2$ (b) $2e^{2y-2} = e^{4x} + e^4$ (c) $2e^{2y+2} = e^{4x} + e^4$ (d) $3e^{2y+2} = e^{3x} + e^4$

83. A wet porous substance in the open air loses its moisture at a rate proportional to the moisture content. If a sheet hung in the wind loses half its moisture during the first hour, then the time when it would have lost 99.9% of its moisture is: (weather condition remaining same)

(a) More then 100 (b) More than 10 hours

(c) Approximately 10 hours (d) Approximately 9 hours

84. The quadrilateral formed by the lines y = ax + c, y = ax + d, y= bx + c and y = bx + d has area 18. The quadrilateral formed by the lines y = ax + c, y = ax – d, y= bx + c and y = bx – d has area 72. If a, b, c, d are positive integers then the least possible value of the sum a + b + c + d is

(a) 13 (b) 14 (c) 15 (d) 16

85. The area bounded by the curve $(y - \sin^{-1}x)^2 = x - x^2$ is

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

86. Let f(x) = sin x $\int_0^x \cos t\, dt + 2\int_0^x t\, dt + \cos^2 x - x^2$. Then area bounded by xf(x) and ordinate x = 0 and x = 5 with x-axis is

(a) 16 (b) $\frac{25}{2}$ (c) $\frac{35}{2}$ (d) 25

87. The area of the smaller portion enclosed by the curves $x^2 + y^2 = 9$ and $y^2 = 8x$ is

(a) $\frac{\sqrt{2}}{3} + \frac{9\pi}{4} - \frac{9}{2}\sin^{-1}\left(\frac{1}{3}\right)$ (b) $2\left(\frac{\sqrt{2}}{3} + \frac{9\pi}{4} - \frac{9}{2}\sin^{-1}\left(\frac{1}{3}\right)\right)$

(c) $2\left(\frac{\sqrt{2}}{3} + \frac{9\pi}{4} + \frac{9}{2}\sin^{-1}\left(\frac{1}{3}\right)\right)$ (d) $\frac{\sqrt{2}}{3} + \frac{9\pi}{4} + \frac{9}{2}\sin^{-1}\left(\frac{1}{3}\right)$

88. The probability that out of 10 persons, all born in April, at least two have the same birthday is

(a) $\frac{^{30}C_{10}}{(30)^{10}}$ (b) $1 - \frac{^{30}C_{10}}{30!}$ (c) $\frac{(30)^{10} - {}^{30}C_{10}}{(30)^{10}}$ (d) none of these

89. A second order determinant is written down at random using the numbers 1, - 1 as elements. The probability that the value of the determinant is non zero is

(a) 1/2 (b) 3/8 (c) 5/8 (d) 1/8

90. A five digit number is chosen at random. The probability that all the digits are distinct and digits at odd place are odd and digits at even places are even is

(a) 1/ 25 (b) 25/567 (c) 1/37 (d) 1/74