FIITJEE

ALL INDIA TEST SERIES

CONCEPT RECAPITULATION TEST – IV

JEE (Main)-2025

TEST DATE: 21-03-2025

Time Allotted: 3 Hours **Maximum Marks: 300**

General Instructions:

- The test consists of total 75 questions.
- Each subject (PCM) has 25 questions.
- This question paper contains **Three Parts.**
- **Part-A** is Physics, **Part-B** is Chemistry and **Part-C** is Mathematics.
- Each part has only two sections: **Section-A and Section-B**.

  Section-A (01 – 20, 26 – 45, 51 – 70) *contains 60 multiple choice questions which have* ***only one correct answer****. Each question carries* ***+4 marks*** *for correct answer and* ***–1 mark*** *for wrong answer.*

  Section-B (21 – 25, 46 – 50, 71 – 75) *contains 15 Numerical based questions. The answer to each question is rounded off to the nearest integer value. Each question carries* ***+4 marks*** *for correct answer and* ***–1 mark*** *for wrong answer.*

Physics

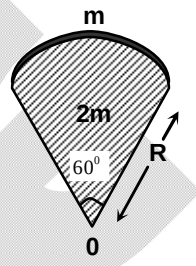
PART – A

SECTION – A

(Single Choice Answer Type)

This section contains **20 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

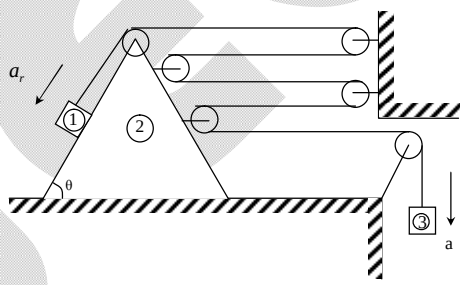
1. What is the distance of centre of mass of the combined system as shown in figure from 'O'. System consists of a uniform sector of mass 2m and radius R, fixed with a uniform arc of mass m and radius R along the edge of the sector. (System is making an angle $\theta = 60^0$ at their common centre)



(A) $\frac{5R}{3\pi}$ (B) $\frac{4R}{3\pi}$

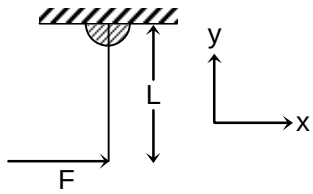
(C) $\frac{7R}{3\pi}$ (D) none of these

2. In the figure shown, all the three bodies 1, 2, 3 can move. If acceleration of body 1 w.r.t 2 is $a_r = 6\,m/s^2$ and acceleration of 3 w.r.t ground is $a = 4\,m/s^2$, then magnitude of acceleration wedge 2 w.r.t. ground is



(A) 2 m/s^2
(B) 0.8 m/s^2
(C) 0.4 m/s^2
(D) 1 m/s^2

3. A rod of mass m, length L is kept in a vertical plane such that upper end is fixed. A force F is applied at bottom as shown. The hinge reaction in the given position will be :



(A) $F\left(+\hat{i}\right)+mg\left(+\hat{j}\right)$ (B) $mg\left(+\hat{j}\right)$

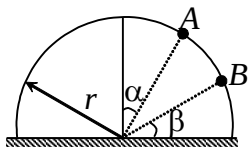
(C) $\frac{F}{2}\hat{i}+mg\left(+\hat{j}\right)$ (D) $\frac{9F}{7}\hat{i}+mg(+\hat{j})$

4. From a circle of radius *a*, an isosceles right angled triangle with the hypotenuse as the diameter of the circle is removed. The distance of the centre of mass of the remaining part from the centre of the circle is

(A) $3(\pi-1)a$ (B) $\frac{(\pi-1)a}{6}$

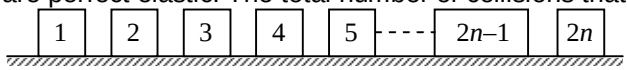
(C) $\frac{a}{3(\pi-1)}$ (D) $\frac{a}{3(\pi+1)}$

5. A particle moves from rest at *A* on the surface of a smooth circular cylinder of radius r as shown. At *B* it leaves the cylinder. The equation relating α and β is



(A) $3\sin\alpha = 2\cos\beta$
(B) $2\sin\alpha = 3\cos\beta$
(C) $3\sin\beta = 2\cos\alpha$
(D) $2\sin\beta = 3\cos\alpha$

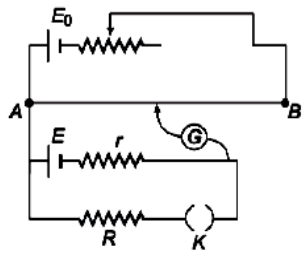
6. 2*n* identical cubical blocks are kept in a straight line on a horizontal smooth surface. The distance between the consecutive blocks is same. The blocks 1, 3, 5, …, (2*n* – 1) are given velocity *v* to the right whereas blocks 2, 4, 6, …, 2*n* are given velocity to the left. All collisions between blocks are perfect elastic. The total number of collisions that will take place is



(A) n (B) $n+1$

(C) $\frac{n(n+1)}{2}$ (D) $n(n+1)$

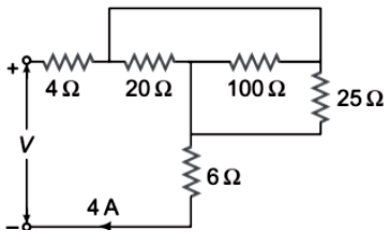
7. The given figure represents an arrangement of potentiometer for the calculation of internal resistance (r) of the unknown battery (E). The balance length is 70.0 cm with the key opened and 60.0 cm with the key closed. R is 132.40Ω. The internal resistance (r) of the unknown cell will be



(A) 22.1 Ω (B) 113.5 Ω

(C) 154.5 Ω (D) 10 Ω

8. In the circuit shown in figure, V must be



(A) 50 V (B) 80 V

(C) 100 V (D) 1290 V

9. A galvanometer of resistance 50 Ω is connected to a battery of 3 V along with resistance of 2950 Ω in series. A full scale deflection of 30 divisions is obtained in the galvanometer. In order to reduce this deflection to 20 divisions, the above series resistance should be

(A) 4450 Ω (B) 5050 Ω

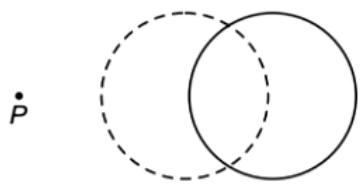
(C) 5550 Ω (D) 6050 Ω

10. Two identical coaxial rings each of radius R are separated by a distance of $\sqrt{3}$ R. They are uniformly charged with charges +Q and –Q respectively. The minimum kinetic energy with which a charged particle (charge +q) should be projected from the centre of the negatively charged ring along the axis of the rings such that it reaches the centre of the positively charged ring is

(A) $\frac{Qq}{4\pi\varepsilon_0 R}$ (B) $\frac{3Qq}{2\pi\varepsilon_0 R}$

(C) $\frac{Qq}{2\pi\varepsilon_0 R}$ (D) $\frac{3Qq}{4\pi\varepsilon_0 R}$

11. Figure shows a closed dotted surface which intersects a conducting uncharged sphere. If a positive charge is placed at the point P, the flux of the electric field through the closed surface



(A) will remain zero

(B) will become positive

(C) will become negative

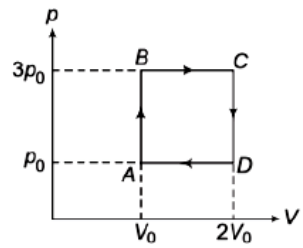
(D) data insufficient

12. A gas is found to be obeyed the law p^2V = constant. The initial temperature and volume are T_0 and V_0. If the gas expands to a volume $3V_0$, then the final temperature becomes

(A) $\sqrt{3}T_0$ (B) $\sqrt{2}T_0$

(C) $\frac{T_0}{\sqrt{3}}$ (D) $\frac{T_0}{\sqrt{2}}$

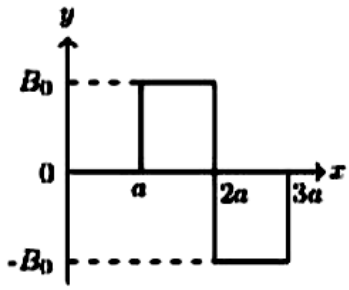
13. An ideal monoatomic gas is carried around the cycle ABCDA as shown in the figure. The efficiency of the gas cycle is



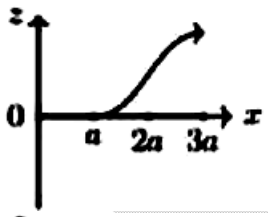
(A) $\frac{4}{21}$ (B) $\frac{2}{21}$

(C) $\frac{4}{31}$ (D) $\frac{2}{31}$

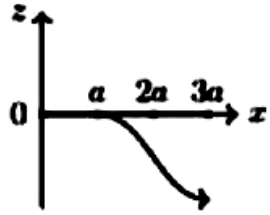
14. A magnetic field vector $\vec{B} = B_0\hat{j}$ exists in the region a < x < 2a and vector $\vec{B} = -B_0\hat{j}$, in the region 2a < x < 3a, where B_0 is a positive constant. A positive point charge moving with a velocity vector $\vec{v} = v_0\hat{i}$, where v_0 is a positive constant, enters the magnetic field at x = a. The trajectory of the charge in this region can be like



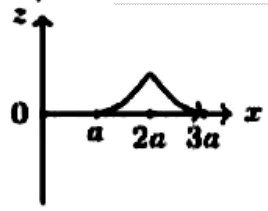
(A)



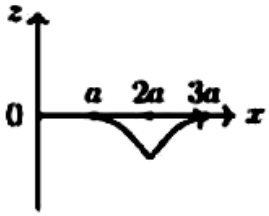
(B)



(C)



(D)

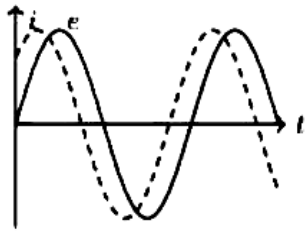


15. Two identical circular loops of metal wire are lying on a table without touching each other. Loop A carries a current which increases with time. In response, the loop B

(A) remains stationary (B) is attracted by the loop A.

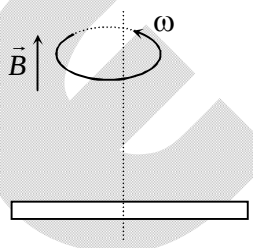
(C) is repelled by the loop A. (D) rotates about its CM, with CM fixed.

16. When an AC source of emf e = $e_0\sin(100t)$ is connected across a circuit, the phase difference between the emf e and the current i in the circuit is observed to be $\pi/4$, as shown in the diagram. If the circuit consists possibly R-C or R-L or L-C in series, find the relationship between the two elements.



(A) R = 1 kΩ, C = 10 μF
(B) R = 1 kΩ, C = 1 μF
(C) R = 1 kΩ, L = 10 H
(D) R = 1 kΩ, L = 1 H

17. A conducting rod of length 2*l* is rotating with constant angular speed ω about its perpendicular bisector. A uniform magnetic field $\vec{B}$ exists parallel to the axis of rotation. The emf induced between two ends of the rod is



(A) $B\omega l^2$ (B) $\frac{1}{2}B\omega l^2$

(C) $\frac{1}{8}B\omega l^2$ (D) zero

18. The energy that should be added to an electron, to reduce its de-Broglie wavelengths from 10^{-10}m to 0.5×10^{-10} m, will be
(A) four times the initial energy (B) thrice the initial energy
(C) equal to the initial energy (D) twice the initial energy

19. The wavelength of a certain line in the x-ray spectrum for tungsten (*Z* = 74) is 200 Å. What would be the wavelength of the same line for platinum (*Z* = 78)? The screening constant *a* is unity.
(A) 179.76 Å (B) 189.76 Å
(C) 289.76 Å (D) 379.76 Å

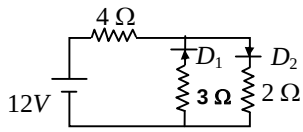
20. Two radioactive substances *X* and *Y* initially contain equal number of nuclei. *X* has a half life of 1 hour and *Y* has half life of 2 hours. After two hours the ratio of the activity of *X* to the activity of *Y* will be
(A) 1 : 4 (B) 1 : 2
(C) 1 : 1 (D) 2 : 1

SECTION – B

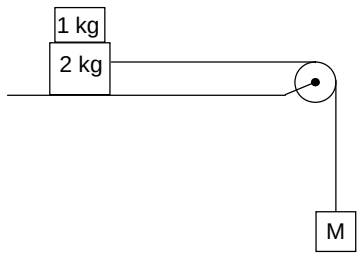
(Numerical Answer Type)

This section contains **5** Numerical based questions. The answer to each question is rounded off to the nearest integer value.

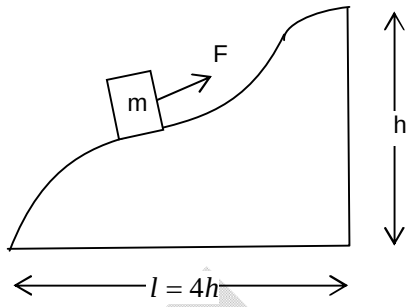
21. The circuit has two oppositely connected ideal diodes in parallel. What is the current flowing in the circuit?



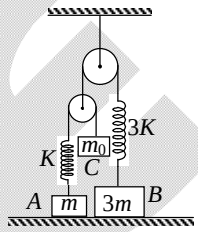
22. Find minimum value of mass suspended M for which 1 kg block start toppling. Assume 1 kg block does not slip over smooth 2 kg block. Length of 1 kg block is 4 cm and height is 8 cm. (ground is smooth).



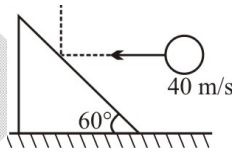
23. A body of mass 'm' is slowly hauled up a hill by an external force which is always acting along the surface as shown. The coefficient of friction between the body and the surface is $\mu = 0.5$. If work done by friction and gravity on the body are ΔW_{fr} and ΔW_g respectively during the process. Find the ratio $\frac{\Delta W_{fr}}{\Delta W_g}$



24. A spring mass system arrangement in vertical plane is as shown. Initially springs are in natural length and blocks *A* & *B* are resting on the ground. Determine the minimum mass (in kg) of block *C* so that block *A* leaves contact with the ground after releasing block *C*. (Take *m* = 10 kg)



25. Inclined surface of a smooth wedge of mass 6 kg makes an angle of 60° with horizontal as shown. A ball hits the wedge horizontally and elastically with a velocity of 40 m/s and moves vertically with respect to ground after the collision. Find the mass (in kg) of the ball if the wedge can also move on the smooth floor.



Chemistry

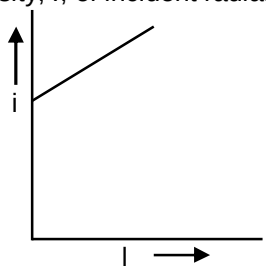
PART – B

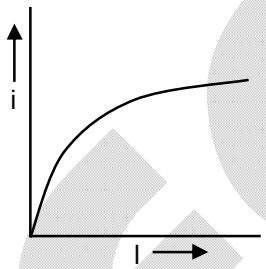
SECTION – A

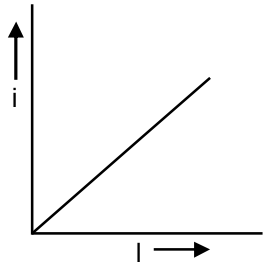
(Single Choice Answer Type)

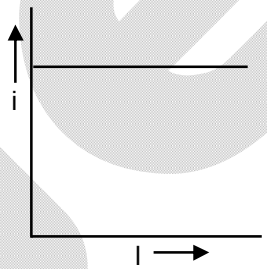
This section contains **20 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

26. Which of the following graphs depicts correctly the variation of photoelectric current *i*, with the intensity, *I*, of incident radiation?

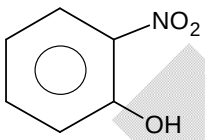
(A) 

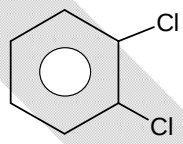
(B) 

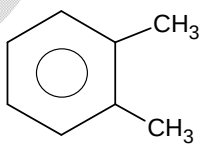
(C) 

(D) 

27. Which is the correct order of dipole moments of the compounds

(I) 

(II) 

(III) 

(A) I > II > III
(B) II > I > III
(C) III > I > II
(D) III > II > I

28. The compressibility factor of helium as a real gas is

(A) unity
(B) $1-\frac{a}{RTV}$
(C) $1+\frac{Pb}{RT}$
(D) $\frac{RTV}{1-a}$

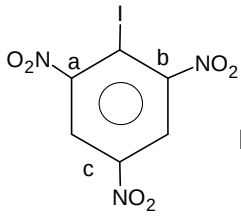
29. 20 ml of a solution containing Na_2CO_3 and $NaHCO_3$ requires 10 ml of 0.1 N H_2SO_4 for neutralization using phenolphthalein as an indicator. Methyl orange is then added when a further 10 ml of 0.2 N H_2SO_4 is required. Molar concentration of Na_2CO_3 and $NaHCO_3$ in the solution respectively are

(A) 0.05 M and 0.05 M
(B) 0.1 M and 0.05 M
(C) 0.05 M and 0.10 M
(D) 0.1 Mj and 0.1 M

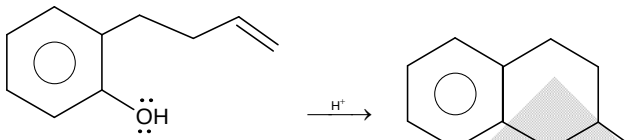
30. Time required for 99.9% completion of a first order reaction is nearly

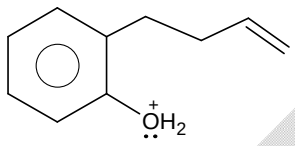
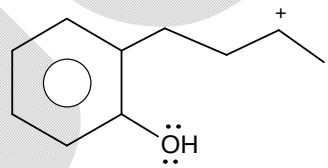
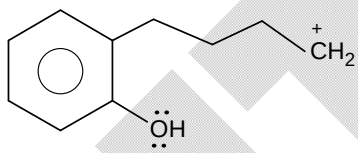
(A) 10 times that required for 25% of the reaction
(B) 10 times that required for 50% of the reaction
(C) 20 times that required for 50% of the reaction
(D) 100 times that required for 90% of the reaction

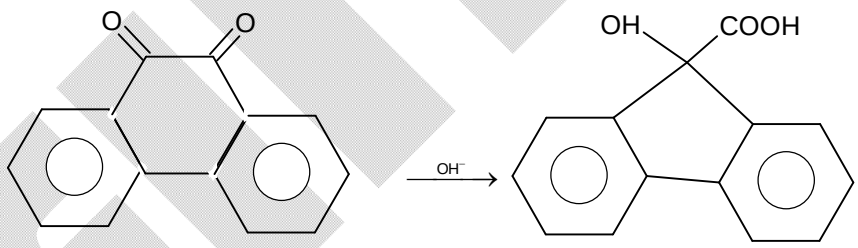
31. A 1.0 M with respect to each of metal halides AX_3, BX_2, CX_3 and DX_2 is electrolysed using platinum electrodes. If $E^{\circ}_{A^{3+}/A} = 1.50\,V, E^{\circ}_{B^{2+}/B} = +0.34, E^{\circ}_{C^{3+}/C} = -0.74V$ $E^{\circ}_{D^{2+}/D} = -2.37V$, the correct sequence in which the various metals are deposited at the cathode, is:
(A) A, B, C, D
(B) D, C, B, A
(C) A, B, C
(D) C, B, A

32. 2, 4, 6– Trinitroiodobenzene has three C–N bonds  labelled as a, b and c. The correct bond length of three bonds is
(A) a = b = c
(B) a > b > c
(C) a = b > c
(D) a = b < c

33. Which of the following ion is formed in the following reaction?



(A) 
(B) 
(C) 
(D) All the three

34. 

The above reaction is an example of
(A) Baeyer – Villiger rearrangement
(B) Benzilic acid rearrangement
(C) Cannizzaro reaction
(D) Pinacol – pinacolone rearrangement

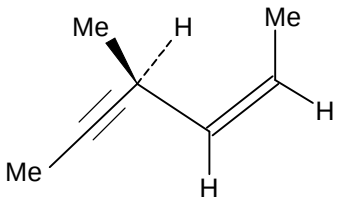
35. Oxide which can not be a reducing agent is
(A) NO_2
(B) CO_2
(C) ClO_2
(D) SO_2

36. The number of S – S bonds in sulphur trioxide trimer (S_3O_9) is
(A) 3
(B) 2
(C) 1
(D) 0

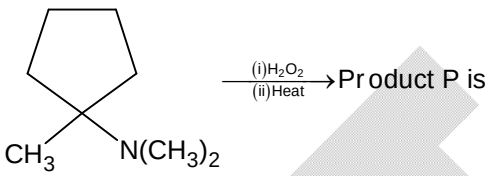
37. The number of geometrical isomers for octahedral $[Co(NH_3)_2Cl_4]^-$,square planar $AuCl_2Br_2^-$ and $[Co(No_2)\ (NH_3)_5]^{2+}$ are
(A) 2, 2, 2
(B) 2, 2, no isomerism
(C) 3, 2, 2
(D) 2, 3, no isomerism

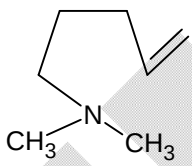
38. For the correct assignment of electronic configuration of a complex, the valence bond theory often requires the measurement of
(A) molar conductance
(B) optical activity
(C) magnetic moment
(D) dipole moment

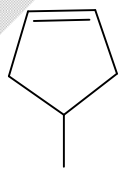
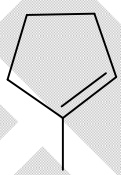
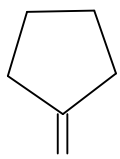
39. Which of the following pairs can be distinguished by Fehling's solution?
(A) Glucose and fructose
(B) Glucose and sucrose
(C) Methanal and ethanal
(D) Hydroxypropanone and benzaldehyde

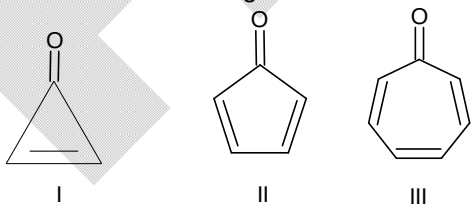
40. 

Hydrogenation of the above compound in the presence of poisoned palladium catalyst gives
(A) an optically active compound
(B) an optically inactive compound
(C) a racemic mixture
(D) a diastereomeric mixture

41. 

(A) 

(B) 
(C) 
(D) 

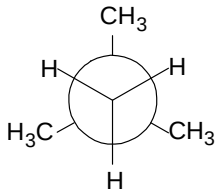
42. Which of the following is least stable?


(A) I
(B) II
(C) III
(D) All are equally stable

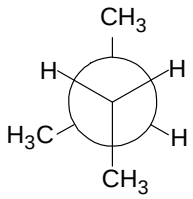
43. A mixture of CH_4, N_2 and O_2 is enclosed in a container of 1 litre capacity at 0ºC. Total pressure of gaseous mixture is 2660 mm Hg. If the ratio of partial pressure of the gases is 1 : 4 : 2 respectively, the number of moles of oxygen present in the vessel is:

(A) $\frac{1}{22.4}$ (B) 1.0

(C) 0.1 (D) None of these

44. 

(I)



(II)

(A) Conformational isomers (B) Stereoisomers

(C) Constitutional isomers (D) Identical

45. In zone refining method the molten zone

(A) moves to either side

(B) contains the purified metal only

(C) contains more impurity than the original metal

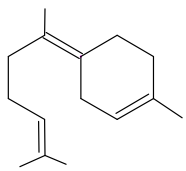
(D) consists of impurities only

SECTION – B

(Numerical Answer Type)

This section contains **5** Numerical based questions. The answer to each question is rounded off to the nearest integer value.

46. Consider the reaction: $AB_{2(g)} \rightleftharpoons AB_{(g)} + B_{(g)}$. If the initial pressure of AB_2 is 500 torr and equilibrium pressure is 600 torr, equilibrium constant K_p in terms of torr is

47. Reductive ozonolysis of a terpenoid of following structure  gives how many different products

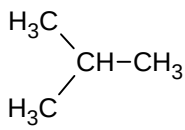
48. For H_2SO_4, K_{a1} = infinite and $K_{a2} = 1.2 \times 10^{-2}$. The molarity of H_2SO_4 solution of pH 2.0 is 'xM'. The value of '1000000x' is

49. In how many of the following compound 'd' orbital (which contains no nodal plane) is used in hybridisation of central atom/ions?

$Fe(CO)_5$, MnO_4^- $Co(C_2O_4)_3^{-3}$

$NiCl_2(PPh_3)$ $PtCl_4^{2-}$ $Ni(CN)_4^{-2}$

$Ni(CN)_4^{-4}$

50. The number of monohalogenated alkanes formed by the reaction of  with Cl_2 in presence of light is

Mathematics

PART – C

SECTION – A

(Single Choice Answer Type)

This section contains **20 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE is correct.**

51. The angle between the line $\frac{x-2}{2}=\frac{y+1}{-1}=\frac{z-3}{2}$ and the plane $3x + 6y – 2z + 5 = 0$ is

(A) $\cos^{-1}\left(\frac{4}{21}\right)$ (B) $\sin^{-1}\left(-\frac{4}{21}\right)$

(C) $\sin^{-1}\left(\frac{6}{21}\right)$ (D) $\sin^{-1}\left(\frac{4}{21}\right)$

52. The slope of the tangent to the curve $y=\int_{x}^{x^2}\cos^{-1}t^2dt$ at $x=\frac{1}{(2)^{1/4}}$ is

(A) 0 (B) $\pi/2$

(C) $\left(\frac{(8)^{1/4}}{3}-\frac{1}{4}\right)\pi$ (D) $\left(\frac{(8)^{1/4}}{6}-\frac{1}{4}\right)\pi$

53. Area bounded by $f(x) = \max.\{\sin x, \cos x\}$; $0 \le x \le \pi/2$, $x = \pi/2$ and the coordinate axes is equal to

(A) $\sqrt{2}$ sq. units (B) 2 sq. units

(C) $\frac{1}{\sqrt{2}}$ sq. units (D) None of these

54. The co-efficient of x^7 in the expansion of $(1 – x^4)(1 + x)^9$ is

(A) 27 (B) –24

(C) 48 (D) –48

55. The chords of contact of the pair of tangents drawn from each point on the line $2x + y = 4$ to the circle $x^2 + y^2 = 1$ pass through fixed point

(A) (2 , 4) (B) $\left(-\frac{1}{2}, -\frac{1}{4}\right)$

(C) $\left(\frac{1}{2}, \frac{1}{4}\right)$ (D) (-2, -4)

56. The equation of the line through the intersection of the lines $2x + 3y + 4 = 0$ and $6x – 3y + 12 = 0$ and normal to the circle $x^2 + y^2 – 4x – 12 = 0$, is

(A) $x = y$ (B) $x = 0$

(C) $y = 0$ (D) None of these

57. The solution of the differential equation $x\frac{dy}{dx}=-\frac{y}{2}-\frac{\sin 2x}{2y}$ is given by

(A) $xy^2 = \cos^2 x + c$ (B) $xy^2 = \sin^2 x + c$

(C) $yx^2 = \cos^2 x + c$ (D) None of these

58. If a, b, c > 0 and x, y, z $\in$ R, then the determinant $\begin{vmatrix} (a^x + a^{-x})^2 & (a^x - a^{-x})^2 & 1 \\ (b^y + b^{-y})^2 & (b^y - b^{-y})^2 & 1 \\ (c^z + c^{-z})^2 & (c^z - c^{-z})^2 & 1 \end{vmatrix}$ is equal to

(A) $a^x + b^y + c^z$
(B) $a^{-x}\ b^{-y}\ c^{-z}$
(C) $a^{2x}\ b^{2y}\ c^{2z}$
(D) 0

59. $\int_0^{\infty} \left[\frac{3}{x^2+1}\right] dx$ is equal to ([.] denotes the greatest integer function)

(A) $\sqrt{2}$
(B) $\sqrt{2} + 1$
(C) $3/\sqrt{2}$
(D) infinite

60. The value of $\int \frac{\ln x}{(1+\ln x)^2} dx$ is

(A) $\frac{x}{1-\ln x} + c$
(B) $\frac{x \ln x}{1+\ln x} + c$
(C) $\frac{x}{(1+\ln x)} + c$
(D) $\frac{\ln x}{x(1+\ln x)} + c$

61. Domain of $\log_{1/2}\log_4\log_3[(x-4)^2]$ is, [.] denotes the integer function .
(A) $(-\infty, 2] \cup [6, \infty)$
(B) $(-\infty, 2] \cup [6, 8)$
(C) (2, 6)
(D) [2, 6]

62. PQ is a vertical pole with end P on level ground. R is the mid–point of PQ. At a point A on the level ground, the portion QR subtends an angle α at A. If AP = nPQ, then $\tan\alpha$ =

(A) $\frac{n}{2n^2+1}$
(B) $\frac{n}{n^2-1}$
(C) $\frac{n}{n^2+1}$
(D) None of these

63. The line lx + my + n = 0 will be a normal to the hyperbola $b^2x^2 - a^2y^2 = a^2b^2$ if

(A) $\frac{a^2}{l^2} + \frac{b^2}{m^2} = \frac{(a^2+b^2)^2}{n^2}$
(B) $\frac{a^2}{l^2} - \frac{b^2}{m^2} = \frac{(a^2-b^2)^2}{n^2}$
(C) $\frac{a^2}{l^2} - \frac{b^2}{m^2} = \frac{(a^2+b^2)^2}{n^2}$
(D) None of these

64. The coordinates of the point on the parabola $y = x^2 + 7x + 2$, which is nearest to the straight line $y = 3x - 3$ are
(A) (-2, -8)
(B) (1, 10)
(C) (2, 20)
(D) (-1, -4)

65. If AFB is a focal chord of the parabola $y^2 = 4ax$ and AF = 4, FB = 5, then the latus-rectum of the parabola is equal to

(A) $\frac{80}{9}$ (B) $\frac{9}{80}$

(C) 9 (D) 80

66. $\sum_{n=1}^{\infty} \frac{n}{4n^4+1}$ equals to

(A) 2 (B) 1

(C) ∞ (D) 1/4

67. If S denote the sum to infinity and S_n the sum of n terms of the series $1+\frac{1}{3}+\frac{1}{9}+\frac{1}{27}+\ldots$ such that $S - S_n < \frac{1}{300}$, then the least value of n is

(A) 4 (B) 5

(C) 6 (D) 7

68. The set of values of 'a' for which the equation $x^3 - 3x + a$ has three distinct real roots, is

(A) $(-\infty, \infty)$ (B) (-2, 2)

(C) (-1, 1) (D) none of these

69. If the line $y = \sqrt{3}x$ cuts the curve $x^4 + ax^2y + bxy + cx + dy + 6 = 0$ at A, B, C and D, then OA.OB.OC.OD (where O is the origin) is

(A) a – 2b +c (B) $2c^2d$

(C) 96 (D) 6

70. The equation of plane perpendicular to 2x + 6y + 6z – 1 = 0 and passing through the points (2, 2, 1) and (9, 3, 6) is

(A) 3x + 4y + 5z + 9 = 0 (B) 3x + 4y – 5z + 9 = 0

(C) 3x + 4y – 5z – 9 = 0 (D) 3x + 4y + 5z – 9 = 0

SECTION – B

(Numerical Answer Type)

This section contains **5** Numerical based questions. The answer to each question is rounded off to the nearest integer value.

71. Shortest distance between lines $\frac{x-6}{1} = \frac{y-2}{-2} = \frac{z-2}{2}$ and $\frac{x+4}{3} = \frac{y}{-2} = \frac{z+1}{-2}$ is

72. The number of solutions of the equation $x^3 + 2x^2 + 5x + 2\cos x = 0$ in $[0, 2\pi]$ is

73. If the second, third and fourth terms in the expansion of $(a+b)^n$ are 135, 30 and 10/3 respectively, then n =

74. If the equation $|z - z_1|^2 + |z - z_2|^2 = k$ represents the equation of a circle, where $z_1 \equiv 2+3i$, $z_2 \equiv 4+3i$ are the extremities of a diameter, then the value of k is

75. The sum of the distances of any point on the ellipse $3x^2 + 4y^2 = 12$ from its directrix is