TECHNO INDIA GROUP PUBLIC SCHOOLS

Dt. 04-08-2025

JEE (Main)-XII

Monthly Mock Test - 1 (August-2025)

Time Allowed: **3 hours** Maximum Marks: **300**

General Instructions:

1. There are three subjects in the question paper consisting of Physics (Q. no. 1 to 25), Chemistry (Q, no. 26 to 50), and Mathematics (Q. no. 51 to 75).
2. Each subject is divided into two sections. Section A consists of 20 multiple-choice questions & Section B consists of 5 numerical value-type questions.
3. There will be only one correct choice in the given four choices in Section A. For each question for Section A, 4 marks will be awarded for correct choice, 1 mark will be deducted for incorrect choice questions and zero marks will be awarded for not attempted questions.
4. For Section B questions, 4 marks will be awarded for correct choice, 1 mark will be deducted for incorrect choice questions and zero marks will be awarded for not attempted questions.
5. Any textual, printed, or written material, mobile phones, calculator etc. is not allowed for the students appearing for the test.
6. All calculations/written work should be done in the rough sheet, provided with the Question Paper.

PHYSICS

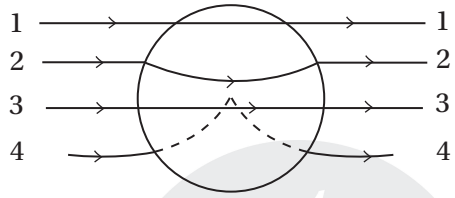
SECTION A

Section A consists of 20 questions of 4 marks each.

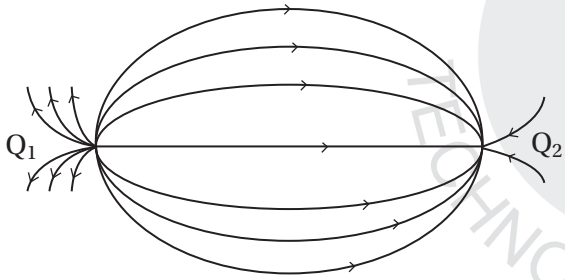
1. An electric dipole has a fixed dipole moment P, which makes an angle θ with respect to x-axis. When subjected to an electric field $E\hat{i}$, it experiences a torque $\tau\hat{k}$. When subjected to another electric field $\sqrt{3}\,E\,\hat{j}$, it experiences a torque $-\tau\hat{k}$. The angle θ is [4]

① 45° ② 60° ③ 90° ④ 30°

2. A metallic solid sphere is placed in a uniform electric field. The lines of force follow the path(s) shown in figure as [4]



① 1 ② 2 ③ 3 ④ 4

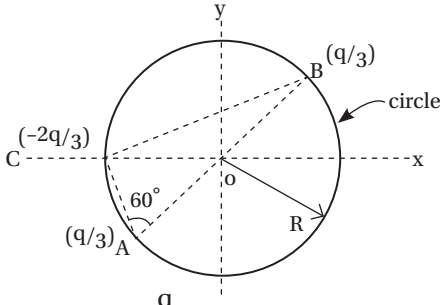
3. 

[4]

① $|Q_1| > |Q_2|$ ② $|Q_1| < |Q_2|$

③ at a finite distance to the left of Q_1, the electric field is zero

④ at infinite distance to the right of Q_2, the electric field is zero.

4. 

[4]

① $E_0 = \dfrac{q}{8\pi \in_0 R^2}$ ② P. E. of the system is zero

③ $|F_{BC}| = \dfrac{q^2}{54\pi\xi_0 R^2}$ (Magnitude of the force between the charges at C and B)

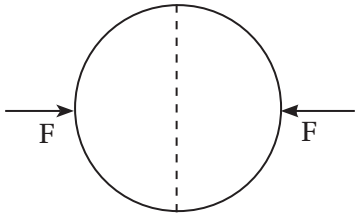
④ P. E at point 0 is $\dfrac{q}{12\pi \in_0 R}$

Cont...4

5. An electric dipole is formed by two equal and opposite charges q with separation d the charges have same mass m. It is kept in uniform electric field E. If it is slightly rotated from its equilibrium orientation, then its angular frequency ω is [4]

① $\sqrt{\frac{2qE}{md}}$ ② $2\sqrt{\frac{qE}{md}}$ ③ $\sqrt{\frac{qE}{md}}$ ④ $\sqrt{\frac{qE}{2md}}$

6. A uniformly charged thin spherical shell of radius R carries uniform charge density of σ per unit area. It is made of two hemispherical shells, held together by pressing them with force F, then F α [4]

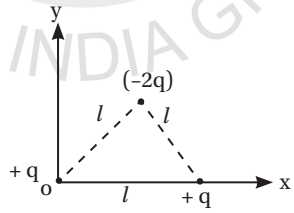


① $\frac{\sigma^2 R^2}{\epsilon_0}$ ② $\frac{\sigma^2 R}{\epsilon_0}$ ③ $\frac{\sigma^2}{R\epsilon_0}$ ④ $\frac{1}{\epsilon_0}\cdot\frac{\sigma^2}{R^2}$

7. A point dipole $P = -P_0\hat{x}$ is kept at the origin. The potential and electric field of this dipole on the y-axis at a distance d are, respectively [take, V = 0 at ∞] [4]

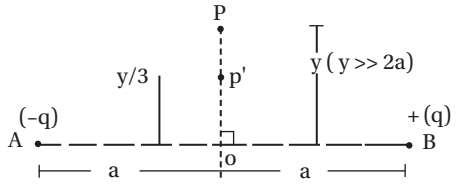
① $\frac{|P|}{4\pi\epsilon_0 d^2}, \frac{P}{4\pi\epsilon_0 d^3}$ ② $0, \frac{-P}{4\pi\epsilon_0 d^3}$ ③ $0, \frac{P}{4\pi\epsilon_0 d^3}$ ④ $\frac{|P|}{4\pi\epsilon_0 d^3}, \frac{P}{4\pi\epsilon_0 d^3}$

8. Determine the electric dipole moment of the system of three charges, placed on the vertices of an equilateral triangle as shown in the figure. [4]



① $\sqrt{3}\ ql\frac{\hat{j}-\hat{i}}{\sqrt{2}}$ ② $29\,l\,\hat{j}$ ③ $-\sqrt{3}\ ql\,\hat{j}$ ④ $(ql)\frac{\hat{i}+\hat{j}}{\sqrt{2}}$

9. A charge Q is placed at point P, it experiences a force F. If Q is now moved along the equatorial line to P' (as $\frac{y}{3} >> 2a$), then the force on Q will be [4]

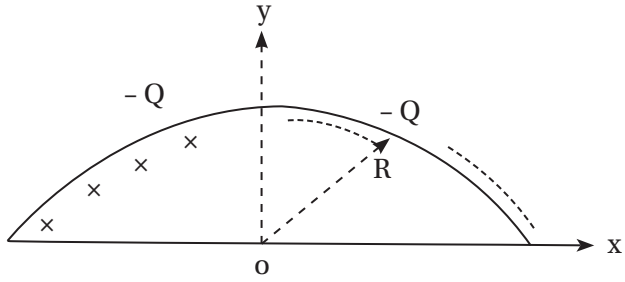


① F/3 ② 3F ③ 9F ④ 27F

10. For a uniformly charged ring of radius R the electric field on its axis has the largest magnitude at a distance h from its centre. Then h = [4]

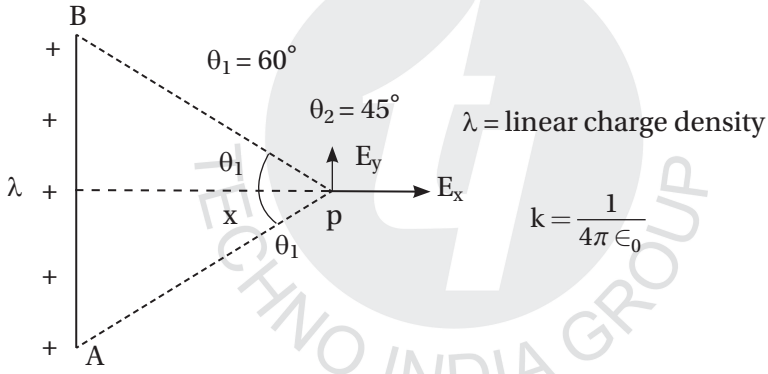
① $\frac{R}{\sqrt{2}}$ ② $R\sqrt{2}$ ③ R ④ $\frac{R}{\sqrt{5}}$

11. A wire of length L (= 20 cm) is bent into a semicircular arc . If the two equal halves of the arc, were each to be uniformly charged with charges ± Q, then E_{net} = [4]



① $\frac{Q}{\xi_0}\cdot\frac{1}{L^2}\hat{i}$ ② $\frac{Q}{2t_0}\cdot\frac{1}{L^2}\hat{i}$ ③ $\frac{2Q}{\xi_0}\cdot\frac{1}{L^2}(-\hat{i})$ ④ $\frac{Q}{4t_0}\cdot\frac{1}{L^2}(-\hat{i})$

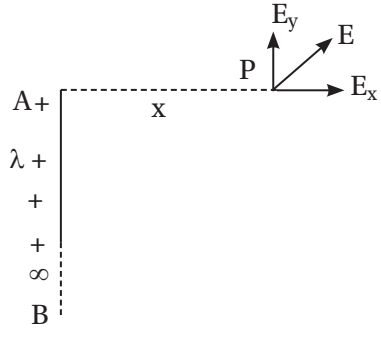
12. For a short straight wire AB [4]



① $E_x = \frac{k\lambda}{x}$ ② $E_y = \frac{k\lambda}{y}$

③ $E_x = \frac{k\lambda}{x}\left(\frac{\sqrt{3}}{2}+\frac{1}{\sqrt{2}}\right); E_y = \frac{k\lambda}{x}\left(\frac{1}{2}-\frac{1}{\sqrt{2}}\right)$ ④ None of the above

13. For a semi infinite wire AB [4]

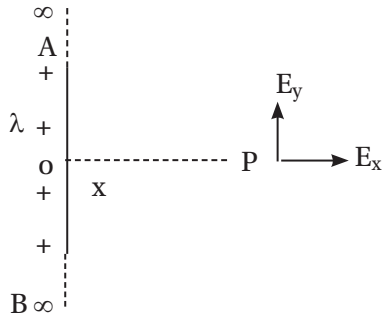


① $E_x = \frac{k\lambda}{x}$ ② $E_y = \frac{k\lambda}{x}$

③ $E = \sqrt{2}\cdot\frac{k\lambda}{x}$ at 45° with AP ④ All of the above

Cont...6

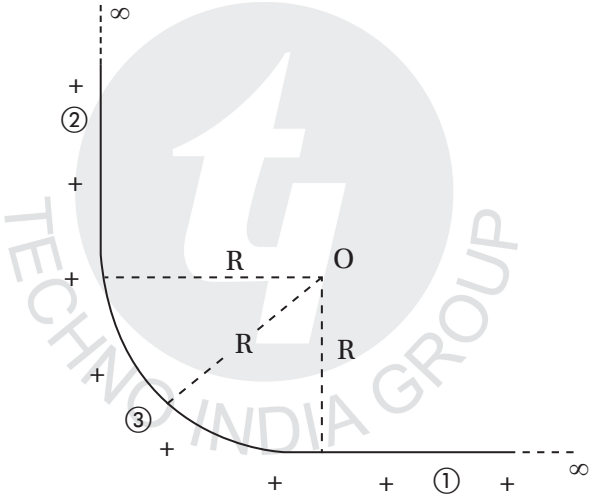
14. For a infinite ω [4]



① $E_x = \frac{k\lambda}{x}.2$ ② $E_y = 0$

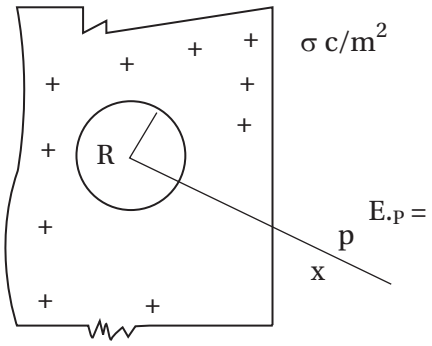
③ both A & b are correct ④ None of the above

15. A thread carrying a uniform line charge + λ c per unit length. Electric field at 0 [4]



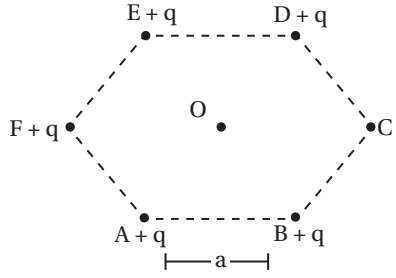
① $\sqrt{2}\,\frac{\lambda}{4\pi \in_0 R}$ ② $\frac{2\lambda}{4\pi \in_0 R}$ ③ $\frac{\lambda}{4\pi \in_0 R}$ ④ None of the above

16. [4]



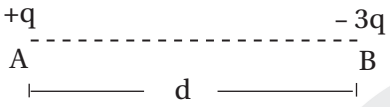
① $\frac{\sigma x}{\in_0 \sqrt{R^2 + x^2}}$ ② $\frac{\sigma . x}{2 \in_0 \sqrt{R^2 + x^2}}$ ③ $\frac{\sigma . x}{2 \in_0 (R^2 + x^2)}$ ④ None of the above

17. Electric field at the centre of regular hexagon of the given charge configuration is [4]



① $\frac{kq}{a^2}$ along co ② $\frac{kq}{a^2}$ along oc ③ $\sqrt{3}\frac{kq}{a^2}$ along co ④ $\frac{\sqrt{3}}{2}\frac{kq}{a^2}$ along oc

18. Two charges q and –3q are placed fixed on x – axis separated by a distance d. Where should a third charge +2q be placed such that it will not experience any force. [4]



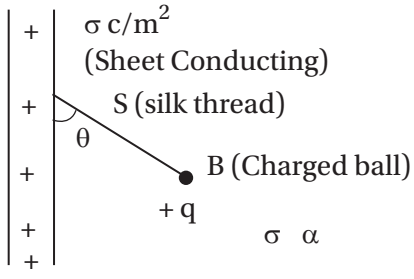
① $\frac{d+\sqrt{3}\,d}{2}$, to the left side of +q ② $\frac{\sqrt{3}\,d-d}{2}$, to the left side of +q

③ $\frac{d}{2}$ to the right side of +q ④ None of the above

19. Force between two identical charges placed at a distance of r in vacuum is F. Now a slab of dielectric constant 4 is inserted between these two charges. If thickness of slab is r/2, then he force between the charges will become [4]

① F ② $\frac{3}{5}$ F ③ $\frac{4}{9}$ F ④ $F/_4$

20.



① $\tan\theta$ ② $\sin\theta$ ③ $\cot\theta$ ④ $\cos\theta$

SECTION B

Section B consists of 5 questions of 4 marks each.

21. Two identical charged spheres are suspended by strings of equal lengths. The strings make an angle of 30° with each other. When suspended in a liquid of density 0.8 g cm^{-3}, the angle remains same. If the density of the material of the sphere is 1.6 gcm^{-3}, the dielectric constant of the liquid is – [4]

22. A copper ball of density p_1 and radius r is immersed in oil of density p_2. What is the charge on he ball, if

Cont...8

it remains just suspended in oil in the electric field of intensity E vm^{-1} acting in the upward direction ?

$q = \frac{4\pi r^3 g(p_1 - p_2)}{nE}$, then n is _____ .

23. An electric dipole of $2\sqrt{3}\times10^{-4}$ cm is placed with its axis making an angle of 30° to a uniform electric field of 10^5 N/C . The potential energy of the dipole is –n (J) then n is _____ . [4]

24. Two small charged spheres contain charges $+q_1$ and $+q_2$ respectively. A changes dq is removed from sphere carrying charge q_1 and is transferred to the other. The charge on each sphere for maximum electric force between them is $\frac{q_1+q_2}{n}$, then n _____ [4]

25. Two identical same radii 'r' conducting spheres are charged by induction and then separated by a large distance, sphere –1 has charge +Q and sphere –2 has charge –Q. A third sphere of radius 2r is initially uncharged. If sphere –3 is touched to sphere –1 and separated, then touched to sphere –2 and separated, if final charge on sphere –3 is $-n\,Q/9$ then n is _____ [4]

CHEMISTRY

SECTION A

Section A consists of 20 questions of 4 marks each.

26. The density of 3 M solution of sodium chloride is 1.252 $g(mL)^{-1}$. The molality of the solution will be [Molar mass of NaCl = 58.5 $g(mol)^{-1}$] [4]

① 2.60 m ② 2.18 m ③ 2.79 m ④ 3.00 m

27. Vapour pressure of pure Benzene is 119 torr and that of toluene is 37.0 torr at the same temperature. Mole fraction of toluene in vapour phase which is in equilibrium with a solution of benzene and toluene having mole fraction of toluene 0.050 will be [4]

① 0.137 ② 0.237 ③ 0.435 ④ 0.205

28. If sodium sulphate is considered to be completely dissociated into cations and anions in aqueous solution, the change in freezing point of water (ΔT_f) when 0.01 mole of sodium sulphate is dissolved in 1 kg of water, is : (k_f = 1.86 k kg mol^{-1}) [4]

① 0.0372 k ② 0.0558 k ③ 0.0744 k ④ 0.0186 k

29. The standard reduction potential for Fe^{2+}/Fe and Sn^{2+}/Sn electrodes are –0.44 V and –0.14 V respectively. For the cell reaction : [4]

$Fe^{2+} + Sn \rightarrow Fe + Sn^{2+}$, the standard e.m.f is : [4]

① +0.30 V ② –0.58 V ③ +0.58 V ④ –0.30 V

30. What will be the standard cell potential of galvanic cell with the following reaction? [4]

$2\,Cr\,(s) + 3Cd^{2+}\,(aq) \rightarrow 2Cr^{3+}\,(aq) + 3Cd\,(s)$

[Given : $E^{\circ}_{Cr^{3+}/Cr} = -0.74V$; $E^{\circ}_{Cd^{2+}/Cd} = -0.40V$]

① +0.74 V ② +1.14 V ③ 0.34 V ④ –0.34 V

31. In the cell, [4]

$Zn\,|\,Zn^{2+}\,(C_1)\;||\;Cu^{2+}\,(C_2)\,|\,Cu$

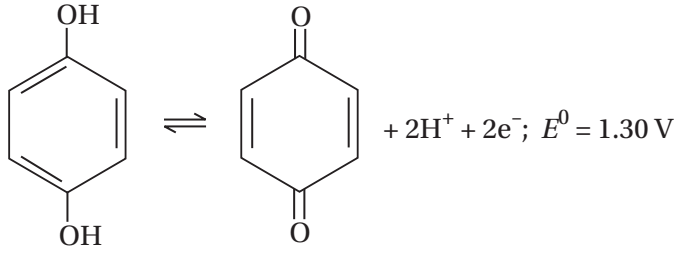
$E_{un} - E^0_{cell} = 0.0591$ V. The ratio of $\frac{C_1}{C_2}$ at 298 k is

① 2.0 ② 100 ③ 10^{-2} ④ 1.0

32. A 110 watt 1110 Volt lamp is connected in series with an electrolytic cell containing $CdSO_4$. What mass of Cadmium will be deposited by the current flowing for 10 hours? [Atomic mass of Cd = 112.4] [4]

① 20.9 g ② 9 g ③ 17 g ④ 26 g

33. The cell reaction involving quinhydrone electrode is : [4]



$+ 2H^+ + 2e^-$; $E^0 = 1.30$ V

What will be the electrode potential at pH = 3?

① 1.48 V ② 1.20 V ③ 1.10 V ④ 1.30 V

34. The specific conductance of a saturated solution of AgCl is $k\,Q^{-1}\,cm^{-1}$. The limiting conductances of Ag^+ and Cl^- are x and y respectively. The solubility product AgCl is : [4]

① $\frac{1000k}{x+y}$ ② $\left(\frac{1000k}{x+y}\right)^2$ ③ $\frac{1000\times143.5\times k}{x+y}$ ④ $\frac{40^3\times143.6\times k}{x+y}$

35. At 25°C, the equivalent conductance at infinite dilution of HCl, CH_3COONa and NaCl are 426.1, 91.0 and 126.45 $cm^2\,\Omega^{-1}\,(eq\,V)^{-1}$ respectively. $A_m{}^{\alpha}$ for CH_3COOH [in $cm^2\,\Omega^{-1}\,(eq\,V)^{-1}$] is : [4]

① 391.6 ② 390.6 ③ 380.6 ④ 309.6

36. 0.5 Faraday of electricity was passed to deposit all the copper present in 500 ml of $CuSO_4$ solution. What was the molarity of this solution? [4]

① 1 M ② 0.5 M ③ 0.25 M ④ 2.5 M

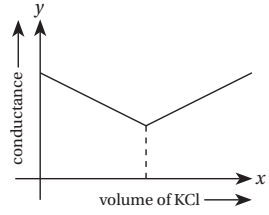
37. $E^0_{Na^+/Na} = -2.71V$; $E^0_{Mg^{2+}/Mg} = -2.37V$

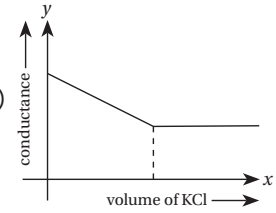
$E^0_{Fe^{2+}/Fe} = -0.44V$; $E^0_{Cr^{3+}/Cr} = -0.41V$

Based on this data, which is the poorest reducing agent? [4]

① Na^+ ② Mg^{2+} ③ Fe^{2+} ④ Cr^{3+}

38. Which of the following type of plot would you expect from the titration of $AgNO_3$ against KCl solution?

① 

② 

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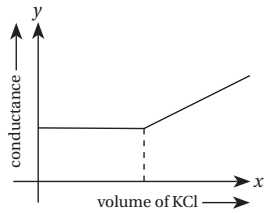
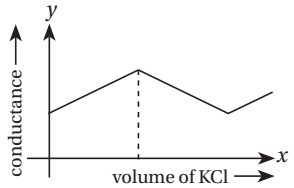
③ 

④ 

39. The equivalent conductances of CH_3COONa, HCl and NaCl at infinite dilution are 91, 426 and 126 $s\,cm^2(eq)^{-1}$ respectively at 25°C. The equivalent conductance of 1 (M) CH_3COOH solution is 19.55 s^1 $cm^2\,(eq)^{-1}$. The pH of solution is : [4]

① 5.3 ② 4.3 ③ 2.3 ④ 1.3

40. Cell reaction is spontaneous, when [4]

① E^0_{red} is negative ② ΔG^0 is negative ③ $E^0_{oxidation}$ is positive ④ ΔG^0 is positive

41. $Zn|Zn^{2+}(C_1)||Zn^{2+}(C_2)|Zn$ for this cell ΔG is negative if [4]

① $C_1 = C_2$ ② $C_1 > C_2$ ③ $C_2 > C_1$ ④ none of these

42. The spin only magnetic moment value of $Cr(CO)_6$ is (in B.M.): [4]

① 0 ② 2.84 ③ 4.90 ④ 5.92

43. The colour of $KMnO_4$ is due to [4]

① L → M change transfer transition ③ $\sigma \rightarrow {}^*\sigma$ transition

© M → L charge transfer transition ④ d — d transition

44. Arrange Ce^{3+}, La^{3+}, Pm^{3+} and Yb^{3+} in increasing order of their ionic radii. [4]

① $Yb^{3+} < Pm^{3+} < Ce^{3+} < La^{3+}$ ② $Ce^{3+} < Yb^{3+} < Pm^{3+} < La^{3+}$

③ $Yb^{3+} < Pm^{3+} < La^{3+} < Ce^{3+}$ ④ $Pm^{3+} < La^{3+} < Ce^{3+} < Yb^{3+}$

45. Which of the following arrangements does not represent the correct order of the property stated against it? [4]

① Sc < Ti < Cr < Mn : No. of oxidation states

② $V^{2+} < Cr^{2+} < Mn^{2+} < Fe^{+2}$: Paramagnetic behavior

③ $Ni^{2+} < Co^{2+} < Fe^{2+} < Mn^{2+}$: Ionic size

④ $Co^{3+} < Fe^{3+} < Cr^{3+} < Sc^{+3}$: Stability in aqueous solution

SECTION B

Section B consists of 5 questions of 4 marks each.

46. 12 g of a non-volatile solute dissolved in 108 g of water produces the relative lowering of vapour pressure of 0.1. The molecular mass of the solute is — [4]

47. k_f for water is 1.86 k $kg(mol)^{-1}$. If your automobile radiator holds 1 kg of water, how many grams of ethylene glycol ($C_2H_6O_2$) must you add to get the freezing point of the solution lowered to 2·8°C— [4]

48. A 2% sucrose is isotonic with 1.5% solution of an unknown substance. Calculate the molecular mass of unknown substance (nearest whole no.)— [4]

49. The E^0_{cell} of the reaction : [4]
$MnO_4^- + Fe^{2+} + H^+ \rightarrow Mn^{2+} + Fe^{3+} + H_2O$ is 0.59 V at 25°C. The equilibrium constant for the reaction is— [4]

50. How many moles of acidified $FeSO_4$ solution can be completely oxidised by one mole of $KMnO_4$— [4]

Mathematics

SECTION A

Section A consists of 20 questions of 4 marks each.

51. If f : {1, 2, 3, 4} $\longrightarrow$ {1, 4, 9, 16} and g; {1, 4, 9, 16} $\longrightarrow \left\{1, \frac{1}{2}, \frac{1}{3}, \frac{1}{4}\right\}$ are two bijective functions such that $x_1 > x_2 \Rightarrow f(x_1) < f(x_2)$, $g(x_1) > g(x_2)$, then $f^{-1}\left(g^{-1}\left(\frac{1}{2}\right)\right)$ is equal to [4]

① 1 ② 4 ③ 16 ④ None of these

52. If the function $f(x)$ is defined by $f(x) = a + bx$ and $f^r = fff$ repeated r times then $f^r(x)$ is equal to [4]

① $a + b^r x$ ② $ar + b^r x$

③ $\frac{a\left(b^r - 1\right)}{b-1} + b^r x$ ④ $a(b^r - 1) + b^r x$

53. Let $f(x) = 2^{10}x + 1$ and $g(x) = 3^{10}x - 1$. If fog(x) = x, then x is equal to [4]

① $\frac{3^{10} - 1}{3^{10} - 2^{-10}}$ ② $\frac{2^{10} + 1}{2^{10} - 3^{-10}}$ ③ $\frac{1 - 3^{-10}}{2^{10} - 3^{-10}}$ ④ $\frac{1 - 2^{-10}}{3^{10} - 2^{-10}}$

54. Let A be set containing n distinct elements. The number of symmetric relations that can be defined on A is [4]

① $2n^2$ ② n^{n^2} ③ $2^{(n^2 + n)/2}$ ④ none of these

55. If R be a relation "less than" from A = {1, 2, 3, 4} to B = {1, 3, 5}, i.e., $(a, b) \in R$ iff $a < b$, then RoR^{-1} is [4]

① {(1, 3), (1, 5), (2, 3), (2, 5), (3, 5), (4, 5)} ② {(3, 1), (5, 1), (3, 2), (5, 2), (5, 3), (5, 4)}

③ {(3, 3), (3, 5), (5, 3), (5, 5)} ④ {(3, 3), (3, 4), (4, 5)}

56. Sum of infinite terms of the series $\cot^{-1}\left(1^2 + \frac{3}{4}\right) + \cot^{-1}\left(2^2 + \frac{3}{4}\right) + \cot^{-1}\left(3^2 + \frac{3}{4}\right) + \cdots$ is [4]

① $\frac{\pi}{4}$ ② $\tan^{-1}(2)$

③ $\tan^{-1} 3$ ④ None of these

Cont...12

57. The minimum value of function $f(x)=8^{\sin^{-1}x}+8^{\cos -1x}$ is [4]

① $2^{1+\frac{\pi}{4}}$ ② $2^{-1+\frac{3\pi}{4}}$ ③ $2^{1+\frac{3\pi}{4}}$ ④ $2^{-1+\frac{\pi}{2}}$

58. If $\tan^{-1}\frac{a}{x}+\tan^{-1}\frac{b}{x}+\tan^{-1}\frac{c}{x}+\tan^{-1}\frac{d}{x}=\frac{\pi}{2}$, then $x^4-x^2\left(\sum ab\right)+abcd=$ [4]

① –1 ② 0 ③ 1 ④ 2

59. If $A=\begin{bmatrix}1 & 2 & -2\\ -2 & 2 & 1\\ 2 & 1 & 2\end{bmatrix}$, then $A^{-1}=$ [4]

① A ② A^T ③ $\frac{1}{9}A$ ④ $\frac{1}{9}A^T$

60. If A is a symmetric matrix and B is a skew-symmetric matrix such that $A+B=\begin{bmatrix}2 & 3\\ 5 & -1\end{bmatrix}$, then AB is equal to [4]

① $\begin{bmatrix}4 & -2\\ -1 & -4\end{bmatrix}$ ② $\begin{bmatrix}4 & -2\\ 1 & -4\end{bmatrix}$ ③ $\begin{bmatrix}-4 & 2\\ 1 & 4\end{bmatrix}$ ④ $\begin{bmatrix}-4 & -2\\ -1 & 4\end{bmatrix}$

61. If $A=\begin{bmatrix}\cos\theta & -\sin\theta\\ \sin\theta & \cos\theta\end{bmatrix}$, then the matrix A^{-50} when $\theta=\pi/12$ is equal to [4]

① $\begin{bmatrix}\frac{\sqrt{3}}{2} & -\frac{1}{2}\\ \frac{1}{2} & \frac{\sqrt{3}}{2}\end{bmatrix}$ ② $\begin{bmatrix}\frac{1}{2} & -\frac{\sqrt{3}}{2}\\ \frac{\sqrt{3}}{2} & \frac{1}{2}\end{bmatrix}$ ③ $\begin{bmatrix}\frac{\sqrt{3}}{2} & \frac{1}{2}\\ -\frac{1}{2} & \frac{\sqrt{3}}{2}\end{bmatrix}$ ④ $\begin{bmatrix}\frac{1}{2} & \frac{\sqrt{3}}{2}\\ -\frac{\sqrt{3}}{2} & \frac{1}{2}\end{bmatrix}$

62. If $\Delta=\begin{vmatrix}a-b-c & 2a & 2a\\ 2b & b-c-a & 2b\\ 2c & 2c & c-a-b\end{vmatrix}$ is $k(a+b+c)^3$, then $k=$ [4]

① 0 ② 1 ③ 2 ④ 3

63. If x is a complex root of the equation $\begin{vmatrix}1 & x & x\\ x & 1 & x\\ x & x & 1\end{vmatrix}+\begin{vmatrix}1-x & 1 & 1\\ 1 & 1-x & 1\\ 1 & 1 & 1-x\end{vmatrix}=0$, then $x^{2007}+x^{-2007}=$ [4]

① 1 ② –1 ③ –2 ④ 2

64. $f(x)=\dfrac{\left(a^x-1\right)^3}{\sin(x\log a)\log\left(1+x^2\log a^2\right)}$ is continuous at $x=0$, then $f(0)=$ [4]

① $\log a$ ② $2\log a$ ③ $\log a^{-1}$ ④ $\log\sqrt{a}$

65. If $f(x)=\sqrt{x+2\sqrt{2x-4}}+\sqrt{x-2\sqrt{2x-4}}$, then $f(x)$ is differentiable on [4]

① $(-\infty, \infty)$ ② $[2, \infty) - \{4\}$

③ $[2, \infty)$ ④ None of these

66. If $y=-\frac{x}{1+8x^3}+\frac{1}{12}\log\frac{(1+2x)^2}{1-2x+4x^2}+\frac{\sqrt{3}}{6}\tan^{-1}\left(\frac{4x-1}{\sqrt{3}}\right)$, then $\frac{dy}{dx}=$ [4]

① $\frac{24x^3}{\left(1+8x^3\right)^2}$ ② $\frac{x^3}{\left(1+8x^3\right)^2}$ ③ $\frac{-12x^3}{\left(1+4x^3\right)^2}$ ④ $\frac{-x^3}{\left(1-4x^3\right)^2}$

67. Function $f(x)=\frac{\lambda\sin x+6\cos x}{2\sin x+3\cos x}$ is monotonically increasing, if [4]

① $\lambda > 1$ ② $\lambda < 1$ ③ $\lambda < 4$ ④ $\lambda > 4$

68. If $ax^2+\frac{b}{x}\geq c$ for all positive x, where $a, b > 0$, then [4]

① $27ab^2 \geq 4c^3$ ② $27ab^2 < 4c^3$

③ $4ab^2 \geq 27c^3$ ④ None of these

69. AOB is a sector of a unit circle with bounding radii OA and OB and bounding arc AB. It is folded into a cone by making OA and OB coincide. The maximum volume (in cu. unit) of the cone is [4]

① $\frac{2\pi}{3}$ ② $\frac{2\pi}{3\sqrt{3}}$ ③ $\frac{2\pi}{9\sqrt{3}}$ ④ $\frac{\pi}{5\sqrt{3}}$

70. The minimum value of $f(x)=(\cos x)^{\cos x}$ *for* $-\frac{\pi}{2}<x<\frac{\pi}{2}$ occurs at [4]

① 0 ② $\cos^{-1}\left(\frac{1}{e}\right)$ ③ $\cos^{-1}\left(\frac{1}{e^2}\right)$ ④ – 1

SECTION B

Section B consists of 5 questions of 4 marks each.

71. If $f(x)=\left(100^5-x^{10}\right)^{\frac{1}{10}}$, then find the value of $\frac{1}{2^{10}}f\left(f(1024)\right)$. [4]

72. If $\sum_{r=1}^{10}\tan^{-1}\left(\frac{3}{9r^2+3r-1}\right)=\cot^{-1}\left(\frac{m}{n}\right)$ (where m and n are coprime), then find $(2m + n)$. [4]

73. Let $A=\begin{bmatrix}1 & a & a\\ 0 & 1 & b\\ 0 & 0 & 1\end{bmatrix}, a, b\in R$. If for some n ∈ N, $A^n=\begin{bmatrix}1 & 48 & 2160\\ 0 & 1 & 96\\ 0 & 0 & 1\end{bmatrix}$, then $n + a + b$ is equal to ____. [4]

74. $\Delta_k = \begin{vmatrix} 1 & n & n \\ 2k & n^2+n+1 & n^2+n \\ 2k-1 & n^2 & n^2+n+1 \end{vmatrix}$ and $\sum_{k=1}^{n} \Delta_k = 56$, then n is equal to_____. [4]

75. If $y = \left(1+\frac{1}{x}\right)^x$, then $\frac{2\sqrt{y_2(2)+\frac{1}{8}}}{\left(\log\frac{3}{2}-\frac{1}{3}\right)}$ is equal to_____. [4]