Time: 3 hour

CCT - 8 (JEE MAINS)

DATE: 15.12.2023
M. MARKS: 300

TOPICS

PHYSICS: 12th FULL SYLLABUS
CHEMISTRY: 12th FULL SYLLABUS
MATHEMATICS: 12th FULL SYLLABUS

INSTRUCTIONS

1. Duration of Test is 3hrs.
2. The Test booklet consists of 90 questions. The maximum marks are 300.
3. There are three parts in the question paper A, B, C consisting of Physics, Chemistry and Mathematics having 30 questions in each part of equal weightage. Each part has two sections.

   (i) Section-I: This section contains 20 multiple choice questions which have only one correct answer. Each question carries 4 marks for correct answer and -1 mark for wrong answer.

   (ii) Section-II: This section contains 10 questions. In Section II, attempt any five questions out of 10. The answer to each of the questions is a numerical value. Each question carries 4 marks for correct answer and -1 for wrong answer.

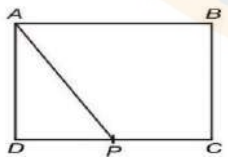
Name of the Candidate (in Capitals):_____

Candidate's Signature:_____ Invigilator's Signature:_____

PHYSICS

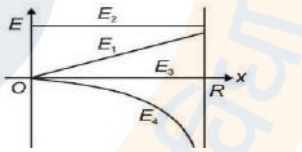
SECTION – A
(SINGLE CORRECT TYPE)

1. A wire of uniform cross section having resistance 8Ω is bent to form a square $ABCD$. End A is connected to a point P on the side DC by a wire AP of resistance 1Ω. When V potential difference is applied between A and C, the resistance of part DP if the points B and P are to be at same potential



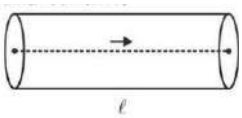
(1) $(2-\sqrt{2})\Omega$ (2) $(\sqrt{5}-1)\Omega$
(3) $(\sqrt{2}-1)\Omega$ (4) $\left(\frac{\sqrt{2}+1}{4}\right)\Omega$

2. The variation of electric field intensity E as a function of x from the centre of a uniformly charged non-conducting solid sphere of radius R is best represented by



(1) E_3 (2) E_2
(3) E_4 (4) E_1

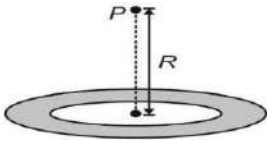
3. A cylindrical conductor of length ℓ and radius a has conductivity near its axis as σ. The conductivity of material increases linearly with the distance from axis and becomes 2σ near the surface. The resistance of conductor for longitudinal current is



(1) $\frac{3\ell}{7\pi a^2\sigma}$ (2) $\frac{3\ell}{5\pi a^2\sigma}$
(3) $\frac{\ell}{2\pi a^2\sigma}$ (4) $\frac{3\ell}{4\pi a^2\sigma}$

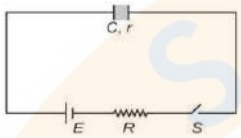
4. An annular disc of inner radius R and outer radius $2R$ has uniformly distributed charge Q.

   Electric field strength at point P is



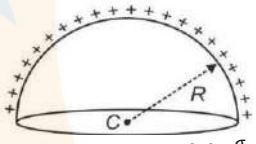
(1) $\frac{Q}{3\pi\varepsilon_0 R^2}$
(2) $\frac{Q}{2\pi\varepsilon_0 R^2}(\sqrt{2}-1)$
(3) $\frac{Q}{6\pi\varepsilon_0 R^2}\left(\frac{1}{\sqrt{2}}-\frac{1}{\sqrt{5}}\right)$
(4) $\frac{Q}{6\pi\varepsilon_0 R^2}(\sqrt{5}-\sqrt{2})$

5. In the given circuit, the capacitor has capacitance C and it is filled with a resistive material of effective resistance r. The switch S is closed at time $t = 0$. The charge on capacitor as a function of time t is



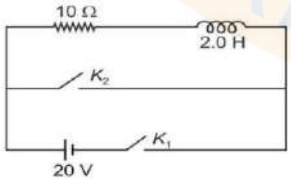
(1) $EC\left(1-e^{-\frac{t}{\tau}}\right), \tau = \frac{CrR}{(R+r)}$
(2) $\frac{CEr}{(R+r)}\left(1-e^{-\frac{t}{\tau}}\right), \tau = (R+r)C$
(3) $\frac{CEr}{(R+r)}\left(1-e^{-\frac{t}{\tau}}\right), \tau = \frac{CRr}{(R+r)}$
(4) $CE\left(1-e^{-\frac{t}{\tau}}\right), \tau = (R+r)C$

6. A hemisphere of radius R as shown in figure is uniformly charged with a surface charge density σ. The electric field at the centre C is



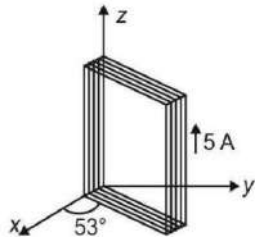
(1) $\frac{\sigma}{\varepsilon_0}$ (2) $\frac{\sigma}{2\varepsilon_0}$
(3) $\frac{\sigma}{4\varepsilon_0}$ (4) $\frac{\sqrt{2}\sigma}{\varepsilon_0}$

7. An inductor of inductance 2.0H and a resistor of resistance 10Ω are connected in series to a battery of EMF 20 V in a circuit as shown The key K_1 has been kept closed for a long time. Then at $t = 0, K_1$ is opened and key K_2 is closed simultaneously. The rate of decrease of current in the circuit at $t = 1.0$ s will be $(e^5 = 150)$



(1) $\frac{1}{15}$ A/s (2) $\frac{2}{15}$ A/s
(3) $\frac{1}{5}$ A/s (4) $\frac{4}{15}$ A/s

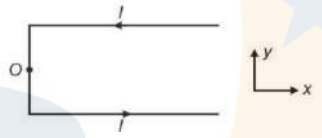
8. A rectangular coil of size $6.0\text{ cm} \times 8.0\text{ cm}$ and having 50 turns is pivoted about the z-axis as shown in the figure. The coil carries an electric current of 5.0 A and a magnetic field of 2.0 T is present along the y-axis. If the side in the $x-y$ plane makes an angle 53° with the x-axis and moment of inertia of the coil about the z-axis is 0.24 kg m^2, then initial angular acceleration of the coil will be



(1) 2.0rad/s^2 (2) 4.0rad/s^2
(3) 4.8rad/s^2 (4) 8.0rad/s^2

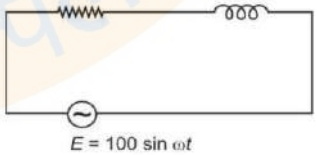
9. A magnetic flux through a stationary loop with resistance $R = 5\Omega$ varies during the time interval of 10 s as $\phi = 4t(10-t)$, where t denotes time and all quantities are in SI units. The amount of heat generated in the loop in 10 s is nearly
(1) 555 J (2) 1067 J
(3) 1555 J (4) 595 J

10. A thin wire, carrying current I is shaped as shown in the figure. The distance between the long parallel segments of the wire is d. The magnetic force on a small length $\Delta\ell$ of the wire at point O (midway between the parallel segments) will be



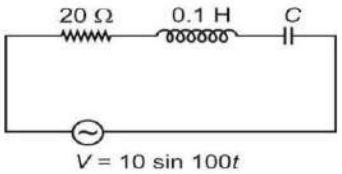
(1) $\frac{\mu_0 I^2 \Delta\ell}{2\pi d}(-\hat{\imath})$ (2) $\frac{\mu_0 I^2 \Delta\ell}{2\pi d}(\hat{\imath})$
(3) $\frac{\mu_0 I^2 \Delta\ell}{\pi d}(-\hat{\imath})$ (4) $\frac{\mu_0 I^2 \Delta\ell}{\pi d}(\hat{\imath})$

11. An AC circuit having supply voltage $E = 100$ sin ωt, (all quantities are in SI units) consists of a resistor of 30Ω and an inductor of reactance 40Ω as shown in the figure. The voltage across the inductor at $t = \frac{\pi}{\omega}$ is



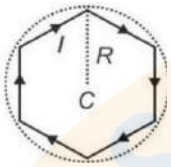
(1) 80 V (2) 64 V
(3) 48 V (4) Zero

12. The applied potential difference in the circuit shown is $V = 10\sin 100t$ where V is in volt and t is in second. If the power factor of the circuit is $\frac{1}{\sqrt{2}}$, then the value of capacitance C of the circuit, nearly is



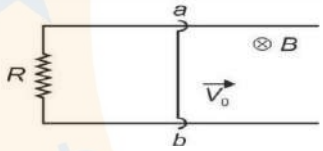
(1) $111\mu F$ (2) $333\mu F$
(3) $222\mu F$ (4) $444\mu F$

13. A conducting wire is in the shape of a regular hexagon, which is inscribed inside an imaginary circle of radius R, as shown. A current I flows through the wire. The magnitude of the magnetic field at the center of the circle is



(1) $\frac{\sqrt{3}\mu_0 I}{2\pi R}$ (2) $\frac{\mu_0 I}{2\sqrt{3}\pi R}$
(3) $\frac{\sqrt{3}\mu_0 l}{\pi R}$ (4) $\frac{3\mu_0 l}{2\pi R}$

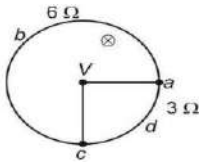
14. A conducting rod ab of mass m can slide over two long frictionless conducting rails separated by distance I. The arrangement is kept in a uniform, inward magnetic field B. At time $t = 0$, the rod is given velocity V_0 towards right. The distance covered by the rod till its velocity becomes $\frac{V_0}{2}$, is



(1) $\frac{mV_0R}{4B^2l^2}$ (2) $\frac{3}{4}\frac{mV_0R}{B^2l^2}$
(3) $\frac{mV_0R}{2B^2l^2}$ (4) $\frac{2mV_0R}{B^2l^2}$

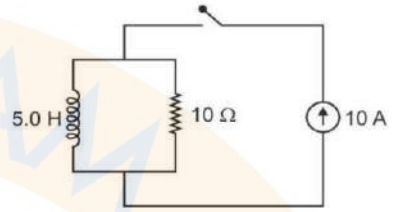
15. A short bar magnet placed in a horizontal plane has its axis aligned along the magnetic north-south direction. There are null points on the axis of the magnet at 10 cm from the centre of the magnet. The earth's magnetic field at the place is 0.40G and the angle of dip is zero. The total magnetic field on the normal bisector of the magnet at 10 cm from the centre of the magnet will be.
(1) 0.80G (2) 0.60G
(3) 0.40G (4) Zero

16. The figure shows a circular loop abcda of area 0.4 m^2. The magnetic field, perpendicular to the plane of the loop is uniform in space and is increasing at a constant rate of 3 T/s. The part cda of the loop forms a quarter of a circle and has resistance 3Ω whereas part abc has resistance 6Ω. An ideal voltmeter is connected between points c and a. The reading of the voltmeter will be



(1) 0.2 V (2) 0.6 V
(3) 1.2 V (4) 0.1 V

17. The circuit shown in the figure consists of a coil of inductance 5.0H, a resistance of 10Ω, a switch and an ideal current source of current 10 A. The total heat dissipated in the resistance after the switch is closed, is



(1) 62.5 J (2) 125 J
(3) 250 J (4) 375 J

18. When light of wavelength λ is incident on a metal surface, the stopping potential is found to be v_0. When light of wavelength $\frac{\lambda}{n}$ is incident on the same metal surface, the stopping potential is found to be n^2V_0. The cut off wavelength for the metal is given by
(1) $\frac{n}{n+1}\lambda$ (2) $\frac{n+1}{n}\lambda$
(3) $\frac{n-1}{n}\lambda$ (4) $\frac{n}{n-1}\lambda$

19. A neutron moving with some kinetic energy collides head-on with a stationary helium ion (He^+)in its ground state. The minimum kinetic energy of neutron so that the collision can be inelastic, is
(1) 54.4eV (2)32.6eV
(3) 51eV (4) 40.8eV

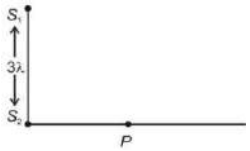
20. A nucleus at rest undergoes α-decay emitting an α-particle of mass m_α and de Broglie wavelength λ. If mass of daughter nucleus is $57m_\alpha$, then the total kinetic energy produced in the decay is given by
(1) $\frac{57}{58}\frac{h^2}{\lambda^2 m_\alpha}$ (2) $\frac{29}{57}\frac{h^2}{\lambda^2 m_\alpha}$
(3) $\frac{87}{56}\frac{h^2}{\lambda^2 m_\alpha}$ (4) $\frac{58}{57}\frac{h^2}{\lambda^2 m_\alpha}$

SECTION – B
(INTEGER/NUMERICAL TYPE)

21. A thin equiconvex lens of refractive index $\frac{3}{2}$ having focal length 20 cm is silvered on one side and an object of height 2 cm is kept at a distance of 30 cm from it. The height of the image is x mm. Value of x is

22. Two coherent point sources S_1 and S_2 emit light of wavelength λ. The separation between the

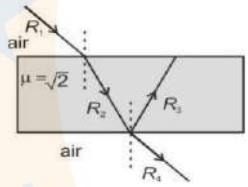
sources is 3λ. Consider a line passing through S_2 and perpendicular to the line S_1S_2. The smallest distance from S_2 where a minimum of intensity will occur is $\frac{11\lambda}{k}$ where k is



23. Assume the binding energy per nucleon for deuteron $_1H^2$ and Helium $_2He^4$ is 1.1MeV and 7.1 MeV respectively. The energy released (in MeV) when two deuterons fuse to form a helium nucleus is n. Then n is

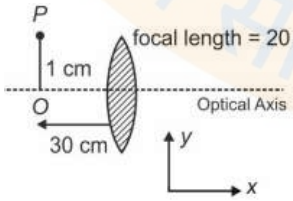
24. The maximum kinetic energy of a photoelectron is E when wavelength of incident light is $\frac{\lambda}{2}$. If maximum kinetic energy becomes $2E$ when wavelength is reduced to $\frac{\lambda}{3}$. The work function of the metal is (Given $\frac{2hC}{\lambda} = 15$)

25. A ray of light (R_1) is incident on a glass slab at an angle equal to critical angle of glass-air system. The refracted ray (R_2) undergoes partial reflection and refraction at other surface of slab. If angle between the reflected ray (R_3) and refracted ray (R_4) is θ° then value of $\frac{\theta}{2}$ is

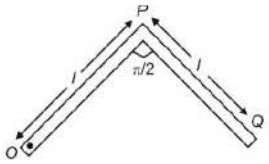


26 In a potentiometer arrangement, a cell of emf 2 V gives a balance point at 40 cm length of the wire. If this cell is replaced by another cell and the balance point shifts to 60 cm, then the emf of the second cell (in volt) is _____.

27 An object P moves in a circle (in yz-plane) of radius 1 cm, with centre O upon optical axis. The radius (in cm) of image formed by convex lens of focal length $= 20$ cm, will be _____.

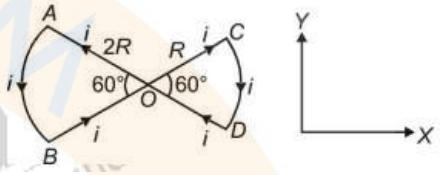


28 A rod OPQ is rotating with angular speed ω about point O. A uniform magnetic field B exists perpendicular to the plane of the rod. Potential difference between points P and Q on the rod is $\frac{4B\omega l^2}{k}$. The value of k is



29. Half life of a radioactive substance A is two times the half life of another radioactive substance B. Initially, the number of nuclei of A and B are N_A and N_B respectively. After three half lives of A, number of nuclei of both are equal. Then ratio of $\frac{N_B}{N_A}$ is _____.

30. Net magnetic field at the point O is $\frac{\mu_0 i}{nR}\hat{k}$. Value of n is



CHEMISTRY

SECTION – A
(SINGLE CORRECT TYPE)

31. A conductometric titration of solution A is done with NaOH. In this experiment, conductance initially decreases upto the point P and then increases slowly (small rate) upto point Q. After point Q, conductance increases with more rate as compared to rate from P to Q. Then A may be
(1) HCl (2) $HCl + CH_3COOH$
(3) $HCl + NaCl$ (4) CH_3COOH

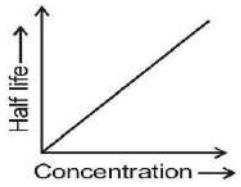
32. Which of the following type of emission occurs for $^{87}_{36}Kr$ changing to $^{87}_{37}Rb$ and how $\frac{n}{p}$ ratio is affected?
(1) Alpha emission $-n/p$ increases
(2) Beta emission - n/p decreases
(3) Positron emission - n/p increases
(4) K-electron capture $-n/p$ decreases

33. Select the incorrect statement.
(1) For 1^{st} order reaction unit of rate constant is second $^{-1}$
(2) All radioactive decay follow 1^{st} order kinetics
(3) Zero order reaction takes finite time to complete
(4) In 1^{st} order reaction, in equal time equal amount of reactant reacts.

34. Reaction

$P \longrightarrow Q$

The half-life of the reaction and concentration of P is given in graph.



Concentration of P decreases from 1M to 0.25 M in 100 minute, the initial rate of reaction (in M/ minute)

(1) 1.25×10^{-3} (2) 4.25×10^{-3}
(3) 7.5×10^{-3} (4) 10^{-2}

35. Consider the following data

Ion	λ_m $(Scm^2\ mol^{-1})$
Li^+	40
Na^+	50
NO_3^-	70

A solution that is 0.1M in $LiNO_3$ and 0.2M in $NaNO_3$ has conductivity $\times\ Scm^{-1}$.

The value of x is

(1) 0.015 (2) 0.028
(3) 0.035 (4) 0.045

36. Molar conductivity of a monobasic acid HA having molar concentration equal to C is λ and the limiting molar conductivity is λ_∞ . The dissociation constant of the acid is.

(1) $\frac{C\lambda^2}{\lambda_\infty^2-\lambda^2}$ (2) $\frac{C\lambda}{\lambda_\infty-\lambda}$
(3) $\frac{C\lambda^2}{\lambda_\infty(\lambda_\infty-\lambda)}$ (4) $\frac{C\lambda^2}{(\lambda_\infty+\lambda)}$

37. Consider a first order reaction at 450 K,

$X(g) \longrightarrow Y(g) + Z(g)$

What is the rate constant of the reaction using given data? [Assume initially only X is present]

Time (s)	0	5
Total Pressure	15	20

(1) 0.5 s^{-1} (2) 0.08 s^{-1}
(3) 0.02 s^{-1} (4) 1.2 s^{-1}

38. Which of the following is correct regarding Valence Bond Theory of co-ordination compounds?

(1) It gives a quantitative interpretation of thermodynamic stability (or kinetic stability) of complexes
(2) It does not distinguish between strong and weak field ligands
(3) It explains the colour exhibited by coordination compounds
(4) It makes exact predictions regarding tetrahedral and square planar geometry

39. CN^- is a strong field ligand. This is due to the fact that

(1) It carries negative charge
(2) It is a conjugate base of weak acid
(3) It can accept electrons from metal species
(4) It forms high spin complexes with metal species

40. A complex (Y) was prepared on reaction of KCl and $PtCl_4$. Select the correct statement about Y.

(1) It gives 2 moles of white ppt with $AgNO_3$
(2) It gives 3 moles of white ppt with $AgNO_3$
(3)It gives electrical conductivity corresponding to 3 ions
(4) The formula of Y is $[KPtCl_2]Cl$

41. Ratio of effective atomic number of Ag in $[Ag(NH_3)_2]Cl$ to Cr in $K_3[Cr(C_2O_4)_3]$ is

(1) $\frac{54}{36}$ (2) $\frac{50}{33}$
(3) $\frac{36}{54}$ (4) $\frac{33}{50}$

42. Which of the following is incorrect about interstitial compounds made by d-block elements?

(1) These compounds are usually non-stoichiometric
(2) These compounds retain metallic conductivity
(3) These compounds have melting point greater than those of pure metals
(4) Atoms trapped inside the lattice make the compound highly reactive

43. Compound A has the molecular formula C_5H_8 and is optically active. On catalytic hydrogenation, A yields B. Compound B has the molecular formula C_5H_{10} and is optically inactive. Compound C has the molecular formula C_6H_{10} and it is optically active. Compound C contains no triple bond. Catalytic hydrogenation of C yields D. Compound D has the molecular formula C_6H_{14} and is optically inactive

Select the correct statement.

(1) A and C both are cyclic compounds.
(2) Compound C may be allene
(3) Compound A may be allene
(4) Compound D has lower boiling point than neohexane

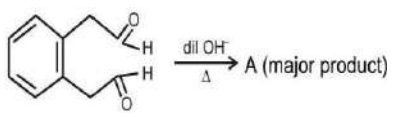
44. Consider the reaction sequence

$CH_3-CH=CH_2+HCl \rightarrow A \xrightarrow{aq.KOH} B$

$B \xrightarrow{PCC} C \xrightarrow{HCN} D \xrightarrow{H^+/H_2O} E$

The functional group present in E are

(1) Alcohol and carboxylic acid
(2) Carboxylic acid and ketone
(3) Aldehyde and amide
(4) Alcohol and amine

45. 

Which is true about (A) ?

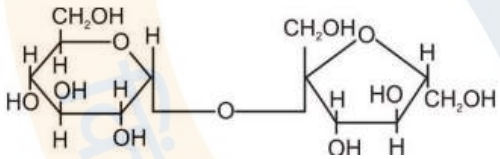
(1) A has acidic proton and loss of it can form aromatic compound
(2) A does not have any acidic proton
(3) A on ozonolysis forms ester
(4) A has 4π bonds in its structure

46. Two aromatic compounds (X) and (Y) which are isomers of each other give the following tests as

	X	Y
DNP test	- Positive	Positive
Fehling test-	Positive	Negative
Tollen's test -	Positive	Positive
Iodoform test -	Negative	Negative

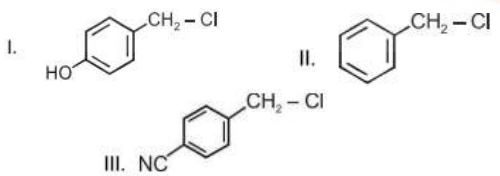
If general formula of (X) and (Y) is C_8H_8O and (Y) after Clemmensen reduction can form only one electrophilic substituted product then which of the following is true for (X) and (Y) ?
(1) (X) on oxidation with hot acidic $KMnO_4$ forms benzoic acid derivative
(2) (Y) on oxidation with $KMnO_4$ forms terephthalic acid
(3) (X) on reduction with LAH forms phenol derivative
(4) (Y) on reduction with LAH forms phenol derivative

47. P is a disaccharide (shown below). Hydrolysis of the disaccharide gives two monosaccharides R and S.



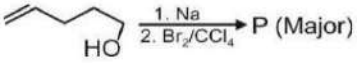
Consider the statements
S_1 : P is non reducing and formed by $C_1 - C_2$ glycosidic linkage of α–D–Glucose and α–D–Fructose .
S_2 : P is dextrorotatory but after complete hydrolysis, solution becomes laevorotatory.
S_3 : Both R and S are reducing sugar

48. Arrange the following in decreasing order of reactivity, towards S_N1 reaction

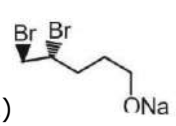


(1) I > II > III (2) II > III > I
(3) III > I > II (4) I > III > II

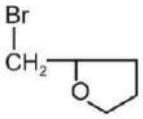
49.



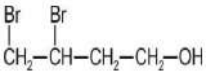
Product formed is



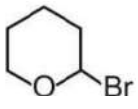
(1)



(2)

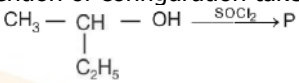


(3)



(4)

50. Out of following reactions, in which reaction retention of configuration takes place?



(1)

(2) $CH_3 - CH_2 - CH_2 - Cl \xrightarrow{NaI/acetone} P$

(3) $CH_3 - CH_2 - CH_2 - Cl \xrightarrow{aq.\ KOH} Product$

(4) $CH_3 - CH_2 - OH + PCl_3 \longrightarrow P$

SECTION – B
(INTEGER/NUMERICAL TYPE)

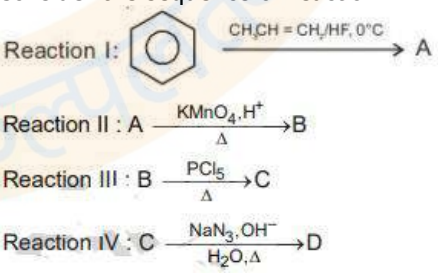
51. An acidic solution of dichromate is electrolyzed for 8 minutes using 2 A current. As per the following equation
$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$
The amount of Cr^{3+} obtained was 0.104 g. The efficiency of the process (in %) is (Take : $F = 96500C$, atomic mass of chromium $= 52$)

52. Calculate the number of faraday used to convert 246 g of nitrobenzene to aniline, if current efficiency is 50%.

53. How many unpaired electrons are present in central atom of $[Co(ox)_3]^{3-}$?

54. A radioactive atom having atomic mass 236 and atomic number 90 disintegrates by emitting $p\alpha$-particles and $q\beta$-particles only. If the atomic mass of final atom is 212 and atomic number is 80 , then the value of $p \times q$ is

55. Consider the sequence of reaction



The sum of degree of unsaturation of A, B, C and D is ___

56 A radioactive sample has activity 80Ci. It reduces to 10Ci in 30 min, then the time taken for activity 160Ci of the same element to reduce to 40Ci is (in min)

57 The total pressure P_T over a binary liquid mixture is given by $P_T = 117 - 31X_B$. Where X_B is the mole

fraction of B in liq. phase. Then the correct value of vapour pressure of pure liquid B is

(assume all pressure in mmHg)

58 During the electrolysis of molten Al_2O_3, the ratio of moles of Aluminium and O_2 liberated at cathode and anode is $x:y$. The value of $\frac{x}{y}$ is

59 Consider the formation of $[Cu(NH_3)_4]^{2+}$ from Cu^{2+}. If the stepwise stability constants are represented as

$$Cu^{2+} + NH_3 \rightleftharpoons [Cu(NH_3)]^{2+}, K_1$$
$$Cu(NH_3)^{2+} + NH_3 \rightleftharpoons [Cu(NH_3)_2]^{2+}, K_2$$
$$[Cu(NH_3)_2]^{2+} + NH_3 \rightleftharpoons [Cu(NH_3)_3]^{2+}, K_3$$
$$[Cu(NH_3)_3]^{2+} + NH_3 \rightleftharpoons [Cu(NH_3)_4]^{2+}, K_4$$

If the values of $\log$ of K_1, K_2, K_3 and the overall stability constant (β) of the complex are

$\log K_1 = 4$, $\log K_2 = 3.2, \log K_3 = 1.8, \log \beta = 11$, then the value of $\frac{[Cu(NH_3)_4^{2+}]}{[Cu(NH_3)_3^{2+}]}$ at equilibrium is ' $a[NH_3]$

The value of $\frac{a}{4}$ is

60. The primary valence of the metal ion in the co-ordination compound $K_2[Ni(CN)_4]$ is

MATHEMATICS

SECTION – A
(SINGLE CORRECT TYPE)

61. The coefficient of y in the determinant

$$\begin{vmatrix} (1+y)^{m_1n_1} & (1+y)^{m_1n_2} & (1+y)^{m_1n_3} \\ (1+y)^{m_2n_1} & (1+y)^{m_2n_2} & (1+y)^{m_2n_3} \\ (1+y)^{m_3n_1} & (1+y)^{m_3n_2} & (1+y)^{m_3n_3} \end{vmatrix}$$

is equal to k, then $\{k\}$ is equal to (where $\{\cdot\}$ denotes fractional part function)
(1) 0 (2) 0.2
(3) 0.4 (4) 0.5

62. Distance of point $P(-2,3,4)$ from the line $\frac{x+2}{3} = \frac{2y+3}{4} = \frac{3z+4}{5}$, measured parallel to the plane $8x + 6y - 9z + 1 = 0$ is
(1) $\frac{\sqrt{301}}{2}$ (2) $\frac{\sqrt{401}}{2}$
(3) $\frac{\sqrt{307}}{2}$ (4) $\frac{\sqrt{1033}}{6}$

63. The area (in sq. units) of the region $A = \{(x,y) : (x-1)[x] \le y \le 2\sqrt{x}\ 0 \le x \le 2\}$, where $[f]$ denotes the greatest integer function, is
(1) $\frac{8}{3}\sqrt{2} - 1$ (2) $\frac{4}{3}\sqrt{2} + 1$
(3) $\frac{8}{3}\sqrt{2} - \frac{1}{2}$ (4) $\frac{4}{3}\sqrt{2} - \frac{1}{2}$

64. $f: (0,\infty) \longrightarrow R$
$f(x) = \max.(x^2, |x|)$
then the number of points where function is non-differentiable is
(1) Zero (2) 1
(3) 2 (4) 3

65. If the system of linear equations
$x + y + 3z = 0$
$x + 3y + k^2z = 0$
$3x + y + 3z = 0$
has a non-zero solution (x,y,z) for some k, then $x + \left(\frac{y}{z}\right)$ is equal to
(1) 9 (2) 3
(3) -9 (4) -3

66. The equation of the tangent to the curve $y = 1 - e^{\frac{x}{2}}$ at the point of intersection with the y-axis, is
(1) $x + 2y = 0$ (2) $2x + y = 0$
(3) $x - y = 2$ (4) $x + y = 2$

67. If $\int_0^1 e^{x^2}(x-\alpha)dx = 0$, then
(1) $1 < \alpha < 2$ (2) $\alpha < 0$
(3) $0 < \alpha < 1$ (4) $\alpha = 0$

68. The general solution of the differential equation $\frac{dy}{dx} + \sin\frac{x+y}{2} = \sin\frac{x-y}{2}$ is
(1) In $\tan\frac{y}{2} = c - 2\sin x$
(2) $\ln\left(\tan\frac{y}{4}\right) = c - 2\sin\left(\frac{x}{2}\right)$
(3) In $\tan\left(\frac{y}{2} + \frac{\pi}{4}\right) = c - 2\sin x$
(4) In $\tan\left(\frac{y}{4} + \frac{\pi}{4}\right) = c - 2\sin\left(\frac{x}{2}\right)$

69. If $\sin^{-1}\left(x - \frac{x^2}{3} + \frac{x^3}{9} - \cdots\infty\right) + \cos^{-1}\left(x^2 - \frac{x^3}{3} + \frac{x^4}{9} - \cdots\infty\right) = \frac{\pi}{2}$

where $0 < |x| < 3$, then the value of x satisfying the equation is
(1) 1 (2) $\frac{1}{2}$
(3) -3 (4) 2

70. If $\int \frac{\cos\theta}{5+7\sin\theta-2\cos^2\theta}d\theta = A\log_e|B(\theta)| + C$, where C is a constant of integration, then $\frac{B}{A}$ can be
(1) $\frac{2\sin\theta+1}{5(\sin\theta+3)}$ (2) $\frac{2\sin\theta+1}{\sin\theta+3}$
(3) $\frac{5(2\sin\theta+1)}{\sin\theta+3}$ (4) $\frac{5(\sin\theta+3)}{2\sin\theta+1}$

71. If $a + x = b + y = c + z + 1$, where a, b, c, x, y, z are non-zero distinct real numbers, then
$\begin{vmatrix} x & a+y & x+a \\ y & b+y & y+b \\ z & c+y & z+c \end{vmatrix}$ is equal to
(1) $y(b-a)$ (2) $y(a-b)$
(3) $y(a-c)$ (4) 0

72. Consider a function $f(x)$ defined as $f: N \to N$, $f(x) = x - (-1)^x$. Then $f(x)$ is
(1) One-one into
(2) Many-one onto
(3) Bijective
(4) Many-one into

73. If $A+B=\begin{bmatrix}1 & 2 & 1\\ 1 & 1 & -1\\ -3 & 2 & 4\end{bmatrix}$ and $A-B=\begin{bmatrix}2 & 3 & 7\\ -4 & 1 & 0\\ 2 & 4 & 1\end{bmatrix}$, then $2A+4B$ equals

(1) $\begin{bmatrix}1 & 3 & 4\\ -7 & 2 & -3\\ -11 & 2 & 11\end{bmatrix}$ (2) $\begin{bmatrix}1 & 3 & -4\\ 7 & 2 & -3\\ -11 & 2 & 11\end{bmatrix}$

(3) $\begin{bmatrix}3 & 2 & 1\\ 7 & 2 & -3\\ -11 & 2 & 11\end{bmatrix}$ (4) $\begin{bmatrix}1 & 3 & 4\\ 7 & 2 & -3\\ 11 & 2 & 11\end{bmatrix}$

74. The value of $\int_0^2 \frac{dx}{x+\sqrt{4-x^2}}$ is equal to

(1) $\frac{\pi}{4}$ (2) $\frac{\pi}{2}$

(3) π (4) $\frac{\pi}{6}$

75. At $x=0$, the function $y=e^{-2|x|}$ is

(1) Continuous but not differentiable

(2) Continuous and differentiable

(3) Differentiable with derivative $=2$

(4) Differentiable with derivative $=-2$

76. Let $y=y(x)$ be the solution of the differential equation $\cos x\frac{dy}{dx}+2y\sin x=\sin 2x, x\in\left(0,\frac{\pi}{2}\right)$. If $y(\pi/3)=0$, then $y(\pi/4)$ is equal to

(1) $\frac{1}{\sqrt{2}}-1$ (2) $\sqrt{2}-2$

(3) $2-\sqrt{2}$ (4) $2+\sqrt{2}$

77. The area bounded by the curves $y=\sec^{-1}(\sec x)$ and $y=|x-\pi|$, is

(1) $\frac{\pi}{2\sqrt{2}}$ (2) $\frac{\pi}{2}$

(3) $\frac{\pi^2}{2}$ (4) $\frac{\pi^2}{4}$

78. A closed cylinder has to be made with $100\ \text{m}^2$ of plastic. If its volume is maximum, then the ratio of its radius to the height, is

(1) $1:1$ (2) $1:2$

(3) $2:1$ (4) $\sqrt{2}:1$

79. Solution of the differential equation $f(x)\frac{dy}{dx}=f^2(x)+f(x)y+f'(x)y$ is

(1) $y=f(x)+ce^x$

(2) $y=-f(x)+ce^x$

(3) $y=-f(x)+\text{ce}^x\ f(x)$

(4) $y=cf(x)+e^x$

80. $$\lim_{x\to 0}\frac{x\left(e^{\left(\sqrt{1+x^2+x^4}-1\right)/x}-1\right)}{\sqrt{1+x^2+x^4}-1}$$

(1)Is equal to 0

(2)Is equal to $\sqrt{2}$

(3) Is equal to 1

(4) Does not exist

SECTION – B
(INTEGER/NUMERICAL TYPE)

81. In a bombing attack, there is 50% chance that a bomb will hit the target. Atleast two independent hits are required to destroy the target completely. Then the minimum number of bombs, that must be dropped to ensure that there is at least 99% chance of completely destroying the target, is

82. Let the vectors $\vec{a},\vec{b},\vec{c}$ be such that $|\vec{a}|=2, |\vec{b}|=4$ and $|\vec{c}|=4$. If the projection of $\vec{b}$ on $\vec{a}$ on is equal to the projection of $\vec{c}$ on $\vec{a}$ and $\vec{b}$ is perpendicular to $\vec{c}$, then the value of $|\vec{a}+\vec{b}-\vec{c}|$ is

83. A bag contains 3 white and 2 black balls. Another bag contains 4 white and 6 black balls. One ball is drawn from each bag, then the probability that one is white and other is black, is λ, then value of λ is

84. Sum of values of absolute maxima and minima of $f(x)=\frac{x^2+x+7}{x^2-x+3}(x\in R)$, is $\frac{\lambda}{11}$, then value of λ is

85. If the range of function $f(x)=\left(\frac{\pi}{\sqrt{2}}+\sin^{-1}\alpha\right)x^2+2(\sin^{-1}\beta)x+\frac{\pi}{\sqrt{2}}-\sin^{-1}\alpha$ is $[0,\infty)$, then the maximum value of $(\alpha^2+\beta^2+\alpha^2\beta^2)$ is equal to

86. If $\vec{a}$ and $\vec{b}$ are any two vectors of magnitudes 3 and 4 respectively, then the maximum value of $|(\vec{a}\cdot\vec{b})|+|2(\vec{a}\times\vec{b})|$ is $m\sqrt{n}$, then $m+n$ equals (where $m,n\in N$ and n is prime)

87. Three couples sit for a photograph in two rows of three people each then the probability that no couple is sitting in the same row next to each other or in the same column one behind other is $\frac{2}{k}$ then k equals

88. The derivative of $\tan^{-1}\left(\frac{\sin x-\cos x}{\sin x+\cos x}\right)$ with respect to $\frac{x}{2}$, where $x\in\left(0,\frac{\pi}{2}\right)$ is

89. If the planes $2x+y-3z=0, px-y-2z=0$ and $qx+2y+z=0$ intersect along a straight line, then $(7p+5q)$ equals

90. If the area (in square units) bounded by the parabola $y^2=4\lambda x$ and the line $y=\lambda x, \lambda>0$ is $\frac{1}{9}$, then λ equals