SHIKSHA CLASSES, BHANDARA

TEST-5

CHEMISTRY , PHYSICS, MATHEMATICS

Time : - 3 Hours **Max. Marks:- 300** **Date : .....**

INSTRUCTIONS :

1. The test is of 3 hours duration.
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 Chemistry, Physics and Mathematics having **30questions** in each part of equal weightage. **20 questions** will be **MCQs** and **10 questions** (**ATTEMPT ANY FIVE QUESTIONS OUT OF 10**) will have answer to be filled as **numerical value**.
   Marking Scheme for MCQs
   Correct Answer Four mark (+4), Incorrect Answer Minus one mark (–1), Unanswered No mark (0)
   Marking Scheme for questions for which answer is a **Numerical value**
   Correct Answer Four mark (+4), Incorrect Answer No mark (0), Unanswered No mark (0)
4. There is only one correct response for each question. Filling up more than one response in each question will be treated as wrong response and marks for wrong response will be deducted accordingly.

SYLLABUS

CHEMISTRY: SOLID STATE, SOLUTIONS, ELECTROCHEMISTRY, CHEMICAL KINETICS, SURFACE CHEMISTRY

PHYSICS : ELECTROSTATICS, CURRENT ELECTRICITY, MAGNETIC EFFECTS OF CURRENT AND MAGNETISM

MATHEMATICS : INVERSE TRIGONOMETRIC FUNCTION, MATRICES AND DETERMINANTS.

Logic will get you from A TO Z; imagination will get you anywhere.

A journey of a thousand miles begins with a single step.

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PART A – CHEMISTRY

SECTION - 1 (Q.1 - Q.20)

Each question has FOUR options (1), (2), (3) and (4). ONLY ONE of these four options is correct.

Q.1 The specific conductance of saturated solution of silver bromide is κ S cm^{-1}. The limiting ionic conductance for Ag^+ and Br^- are x and y S cm^2 mol^{-1} respectively then the solubility of silver bromide (in g/L) will be
(Ag = 108, Br = 80]

(1) $\frac{\kappa \times 188}{x+y}$ (2) $\frac{\kappa \times 1000}{x-y}$

(3) $\frac{x+y \times 1000}{\kappa \times 188}$ (4) $\frac{\kappa \times 188 \times 1000}{x+y}$

Q.2 For a certain reaction, 10% of the reactant dissociates in 1 hour, 20% of the reactant dissociate in 2 hour, 30% of the reactant dissociates in 3 hour. Then the units of rate constant is:-

(1) $hour^{-1}$ (2) mol L^{-1} sec^{-1}

(3) L mol^{-1} sec^{-1} (4) mol L sec^{-1}

Q.3 The ratio of $t_{0.75}$ and $t_{0.5}$ for first order reaction is

(1) 4 : 3 (2) 3 : 2

(3) 2 : 1 (4) 1 : 2

Q.4 In a cubic unit cell seven corners are occupied by atoms A and centres of faces are occupied by atoms B. Then formula of compound is :-

(1) A_7B_6 (2) A_7B_{12}

(3) A_7B_{24} (4) $A_{24}B_7$

Q.5 An aqueous solution freezes at –0.186°C (K_f =1.86° ; K_b = 0.512°). What is the elevation in boiling point of the same solution.

(1) 0.186 (2) 0.512

(3) 0.512 / 1.86 (4) 0.0512

Q.6 At 298 K find out the emf for the cell
Al (s) | Al^{+3} (0.1M) | | Fe^{+2} (0.001M) | Fe (s)
If $E°_{Al^{+3}/Al} = -1.66$ V &
$E°_{Fe/Fe^{+2}} = +0.44$ V

(1) 1.29 V (2) 1.15 V

(3) 2.03 V (4) 1.08 V

Q.7 Minimum freezing point will be shown by the solution of 0.1 M concentration :-

(1) Potassium sulphate (2) Sodium chloride

(3) Urea (4) Glucose

Q.8 When temperature is increased from 27°C to 127°C, rate of reaction becomes doubled then E_a will be ?

(1) 1.66 KCal. (2) 3.32 KCal.

(3) 5.33 KCal. (4) 6.64 KCal.

Q.9 In the solid compound $Cu_2Hg\ I_4$ cations occupy tetrahedral holes in a closed packed anion lattice. What fraction of tetrahedral holes is filled ?

(1) 1/4 (2) 3/8

(3) 3/4 (4) 1/2

Q.10 Calculate the molecular weight of a substance whose 7.0% by mass solution in water freezes at –0.93°C. The cryoscopic constant of water is 1.86°C kg $molal^{-1}$:

(1) 140 g mol^{-1} (2) 150.5 g mol^{-1}

(3) 160 g mol^{-1} (4) 155 g mol^{-1}

Q.11 What weight of solute (mol.wt. 60) is required to dissolve in 180 g of water to reduce the vapour pressure to $(5/6)^{th}$ of pure water ?

(1) 120 g (2) 80 g

(3) 200 g (4) 360 g

Q.12 Consider the following two first order reactions occurring at 298 K with same initial concentration of A :

(a) $A \rightarrow B$: Rate constant, k = 0.693 min^{-1}

(b) $A \rightarrow C$: half-life, $t_{1/2}$ = 0.693 min^{-1}

Choose the correct option :

(1) Reaction (a) is faster than Reaction (b).

(2) Reaction (a) is slower than Reaction (b).

(3) Both reaction proceed at the same rate.

(4) Since two different products are formed, rates cannot be compared.

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Q.13 If electrolysis of aqueous $CuSO_4$ solution is carried out using Cu-electrodes, the reaction taking place at the anode is

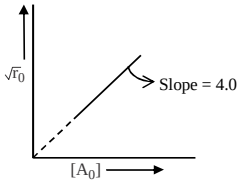
(1) $H^+ + e \rightarrow H$

(2) $Cu^{2+}(aq) + 2e \rightarrow Cu(s)$

(3) $SO_4^{2-}(aq) - 2e \rightarrow SO_4$

(4) $Cu(s) - 2e \rightarrow Cu^{2+}(aq)$

Q.14 The kinetic study of a reaction like $vA \rightarrow P$ at 300K provides the following curve. Where concentration is taken in mol mol^{-3} and time in min.



r_0 = initial rate

$[A_0]$ = initial concentration of A

(1) n = 0, k = 4.0 mol dm^{-3} min^{-1}

(2) n = 1/2, k = 2.0 $mol^{1/2}$ $dm^{3/4}dm^{-3}$ min^{-1}

(3) n = 1, k = 8.0 min^{-1}

(4) n = 2, k = 16.0 dm^3 mol^{-1} min^{-1}

Q.15 Which one of the following compounds show both Schottky and Frenkel defects?

(1) AgCl (2) AgBr

(3) AgI (4) KCl

Q.16 Calculate the standard cell potential in (V) of the cell in which following reaction takes place

$Fe^{2+}(aq) + Ag^+(aq) \rightarrow Fe^{3+}(aq) + Ag(s)$

Given that $E^0_{Ag^+/Ag} = x\ V$, $E^0_{Fe^{2+}/Fe} = y\ V$;

$E^0_{Fe^{3+}/Fe} = z\ V$

(1) x + 2y – 3z (2) x – z

(3) x – y (4) x + y – z

Q.17 A gas undergoes physical adsorption on a surface and follows the given Freundlich adsorption isotherm equation : $\frac{x}{m} = kp^{0.5}$

Adsorption of the gas increases with :

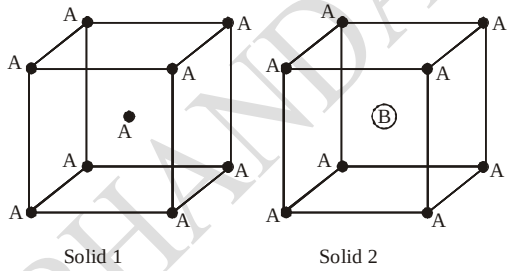
(1) Decrease in p and decrease in T.

(2) Increase in p and increase in T.

(3) Increase in p and decrease in T.

(4) Decrease in p and increase in T.

Q.18 Consider the bcc unit cells of the solids 1 and 2 with the position of atoms as shown below. The radius of atom B is twice that of atom A. The unit cell edge length is 50% more in solid 2 than in 1. What is the approximate packing efficiency in solid 2?

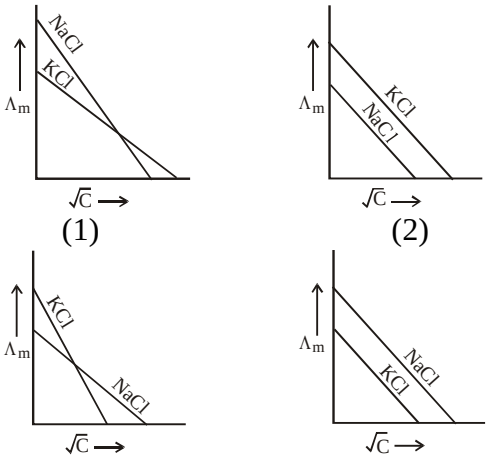


Solid 1 Solid 2

(1) 45% (2) 65%

(3) 90% (4) 75%

Q.19 Which one of the following graphs between molar conductivity (Λ_m) versus $\sqrt{C}$ is correct?



Q.20 Consider the statements S1 and S2 :

S1 : Conductivity always increases with decrease in the concentration of electrolyte.

S2 : Molar conductivity always increases with decrease in the concentration of electrolyte.

The correct option among the following is :

(1) Both S1 and S2 are correct

(2) S1 is wrong and S2 is correct

(3) S1 is correct and S2 is wrong

(4) Both S1 and S2 are wrong

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SECTION - 2 (Q.21 - Q.30)

This section contains TEN (10) questions. ATTEMPT ANY FIVE (05) QUESTIONS. The answer to each question is NUMERICAL VALUE. If the numerical value has more than two decimal places truncate/round-off the value upto TWO decimal places.

Q.21 Among the following how many statements are incorrect :

(1) For coagulation of As_2S_3 sol, +ve ions are effective.

(2) For coagulation of aluminium hydroxide sol Ba^{2+} ions are more effective than Na^+.

(3) Cellulose solution is an example of multimolecular colloid system.

(4) Colloidal sol of metals such as gold, silver etc are prepared by Bredig's arc method.

(5) The migration of colloidal particles under the influence of an electric field is known as electro osmosis.

(6) Physisorption is multi layer.

(7) Adsorption of CO_2 is greater than that of O_2 on a metal surface under similar conditions.

(8) Extent of physisorption increases with increase in pressure.

Q.22 ForABC ABC ABC ..... closed packed structure if the distance between two successive tetrahedral void is 'x' and distance between two successive octahedral voids is y. in an unit cell then $\frac{2y\sqrt{2}}{x}$ is

Q.23 For the elementary reaction $2A + B \rightarrow C + D$, if conc. of reactant A increased to 2 times of initial value and conc. to B decreased to half of initial value then how many times rate of reaction increases?

Q.24 Benzene toluene forms ideal solution equal mol of benzene and toluene added to forms a solution. The ratio of mol of benzene and toluene in vapour phase is
(Given $P°_{benzene} = 180$; $P°_{toluene} = 90$)

Q.25 Conductivity of a saturated solution of $Cu_2[Fe(CN)_6]$ after subtracting the conductivity of water is $1.28 \times 10^{-5}\ \Omega^{-1}\ cm^{-1}$. Calculate value of solubility of $Cu_2[Fe(CN)_6]$.
[$\Lambda_m^\infty(CuSO_4) = 260\ S\ cm^2\ mol^{-1}$,
$\Lambda_m^\infty(K_2SO_4) = 300\ S\ cm^2\ mol^{-1}$,
$\Lambda_m^\infty(K_4Fe(CN)_6) = 720\ Scm^2\ mol^{-1}$]
Report your answer as (solubility) $\times (10^5)$

Q.26 Consider the following pairs of miscible liquids

A & B : Liquid A	+	Liquid B
(i) C_2H_5Br	+	CS_2
(ii) $CHCl_3$	+	CH_3COCH_3
(iii) HCl	+	H_2O
(iv) CH_3COOH	+	C_5H_5N
(v) C_6H_5Cl	+	C_6H_5Br
(vi) CH_3COCH_3	+	CCl_4

If solutions showing $\Delta H_{mixing} > 0 = x$, solutions showing $\Delta S_{mixing} > 0 = y$, solutions showing $\Delta V_{mixing} < 0 = z$. Then find $| x + y - z |$.

Q.27 The half cell potentials of a half cell $A^{(x+n)+}, A^{x+} | Pt$ were found to be as follows :

% of reduced form	25	50
Half cell potential (V)	0.115	0.101

The value of n is: (log 3 = 0.48)

Q.28 The density of FCC of an element (atomic mass = 60.2) is 6.25 gm cm^{-3}. The length of the edge of unit cell is equal to (in Å).

Q.29 A 0.001 molal solution of $[Pt(NH_3)_4Cl_4]$ in water had a freezing point depression of 0.0054°C. If K_f for water is 1.80° $molal^{-1}$,van't Hoff factor 'i' is

Q.30 The molar conductivities at infinite dilution of HCl, NaCl and CH_3COONa are 425, 125 and 100 S cm^2 mol^{-1} respectively. If molar conductivity of 0.1 M aq. solution of acetic acid is 4 S cm^2 mol^{-1} the calculate pH of this solution.

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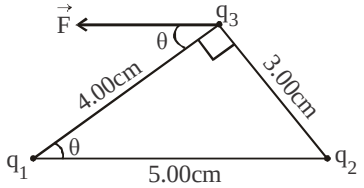
PART B – PHYSICS

SECTION - 1 (Q.31 - Q.50)

Each question has FOUR options (1), (2), (3) and (4). ONLY ONE of these four options is correct.

For problem (Q.31-Q.32)

Q.31 Three charges are placed as shown in figure. The magnitude of q_1 is 2.00 μC, but its sign and the value of the charge q_2 are not known. Charge q_3 is +4.00 μC, and the net force on q_3 is entirely in the negative x-direction.



As per the condition given the sign of q_1 and q_2 will be :

(1) +, + (2) +, –

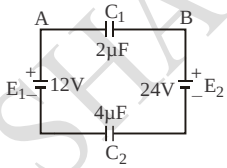
(3) –, + (4) –, –

Q.32 The magnitude of q_2 is :-

(1) $\frac{27}{64}\mu C$ (2) $\frac{27}{32}\mu C$

(3) $\frac{13}{32}\mu C$ (4) $\frac{13}{64}\mu C$

Q.33 Two capacitors C_1 and C_2 are connected in a circuit as shown in figure. The potential difference $(V_A - V_B)$ is :



(1) 8 V (2) –8 V

(3) 12 V (4) – 12 V

Q.34 A solid sphere of radius R has charge 'q' uniformly distributed over its volume. The distance from its surface at which the electrostatic potential is equal to half of the potential at the centre is :-

(1) R (2) 2R

(3) R/3 (4) R/2

Q.35 Two electric bulbs marked 40 W, 220 V and 60W, 220 V when connected in series across same voltage supply of 220 V, the effective power is P_1 and when connected in parallel, the effective power is P_2. Then P_1/P_2 is

(1) 0.5 (2) 0.48

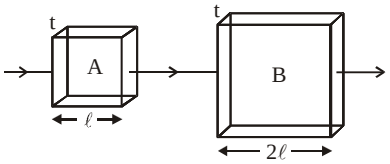
(3) 0.24 (4) 0.16

Q.36 A bar magnet of magnetic moment 1.5 J/T lies aligned with the direction of a uniform magnetic field of 0.22 T. What is the amount of work required by an external torque to turn the magnet so as to align its magnetic moment to perpendicular the field direction :-

(1) 0.66 J (2) 0.44 J

(3) 0.33 J (4) None of these

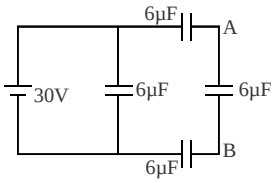
Q.37 Two square metal plates A and B are of the same thickness and material. The side of B is twice that of A. These are connected as shown in series. If the resistances of A and B are denoted by R_A and R_B, then (R_A/R_B) is :



(1) 1/2 (2) 2/1

(3) 1/1 (4) 4/1

Q.38 In the figure shown, the potential difference between points A and B is :-



(1) 10 V (2) 30 V

(3) 7.5V (4) None

Q.39 Consider the two idealised systems (i) a parallel plate capacitor with large plates and small separation and (ii) a long solenoid of length L>>R, radius of cross-section. In (i) E ideally treated as a constant between plates and zero outside. In (ii) magnetic field is constant inside the solenoid and zero outside.

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These idealised assumptions, however, contradict fundamental laws as below :-

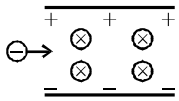
(1) Case (i) contradicts Gauss' law for electrostatic fields.

(2) Case (ii) contradicts Gauss' law for magnetic fields.

(3) Case (i) agrees with $\oint E \cdot d\ell = 0$.

(4) Case (ii) contradicts $\oint H \cdot d\ell = I_{en}$.

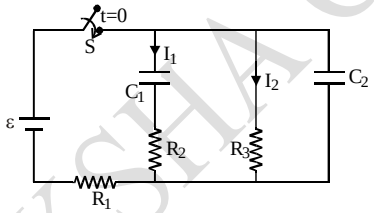
Q.40 An electron enters the space between the plates of a charged capacitor as shown. The charge density on the plate is σ. Electric intensity in the space between the plates is E. A uniform magnetic field B also exists in that space perpendicular to the direction of E. The electron moves perpendicular to both $\vec{E}$ and $\vec{B}$ without any change in direction. The time taken by the electron to travel a distance ℓ is the space is :-



(1) $\frac{\sigma\ell}{\varepsilon_0 B}$ (2) $\frac{\sigma B}{\varepsilon_0 \ell}$

(3) $\frac{\varepsilon_0 \ell B}{\sigma}$ (4) $\frac{\varepsilon_0 \ell}{\sigma B}$

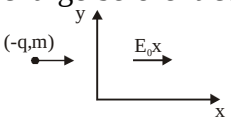
Q.41 Find I_1 and I_2 at steady states :-



(1) $\frac{E}{R_1+R_2}, 0$ (2) $\frac{E}{R_1+R_2}, \frac{E}{R_1+R_3}$

(3) $\frac{E}{R_1+R_2}, \frac{E}{R_2+R_3}$ (4) $0, \frac{E}{R_1+R_3}$

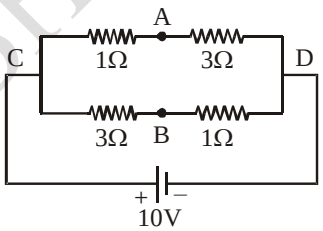
Q.42 A charge (–q, m) is projected with initial velocity V_0 in the direction of unidirectional field E_0x as shown in figure. Find distance covered by charge before it comes to rest.



(1) $V_0\sqrt{\frac{m}{qE_0}}$ (2) $2V_0\sqrt{\frac{m}{qE_0}}$

(3) $V_0\sqrt{\frac{m}{2qE_0}}$ (4) $V_0\sqrt{\frac{2m}{qE_0}}$

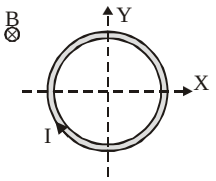
Q.43 A battery of emf 10 V is connected to resistances as shown in the figure. The potential difference between A and B, $(V_A - V_B)$ is :



(1) –2 V (2) 2 V

(3) 5 V (4) 20V

Q.44 A conducting loop carrying a current I is placed in a uniform magnetic field pointing into the plane of the paper as shown. Loop will have a tendency to



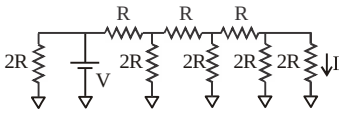
(1) Contract

(2) Expand

(3) Move towards +ve x-axis

(4) Move towards –ve x-axis

Q.45 What is the current I shown in the given circuit?



(1) V / 2R (2) V / R

(3) V / 16R (4) V / 8R

Q.46 A moving coil galvanometer has resistance 50Ω and it indicates full deflection at 4mA current. A voltmeter is made using this

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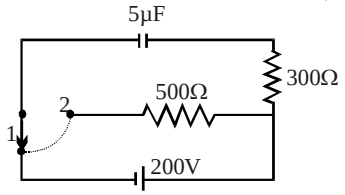
galvanometer and a 5kΩ resistance. The maximum voltage, that can be measured using this voltmeter, will be close to :

(1) 10 V (2) 20 V
(3) 40 V (4) 15 V

Q.47 The electric field in a region is given by $\vec{E} = (Ax + B)\,\hat{i}$, where E is in NC^{-1} and x is in metres. The values of constants are A = 20 SI unit and B = 10 SI unit. If the potential at x = 1 is V_1 and that at x = –5 is V_2, then $V_1 - V_2$ is :

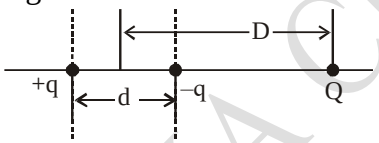
(1) – 48 V (2) –520 V
(3) 180 V (4) 320 V

Q.48 A capacitor of capacitance 5μF is connected to a source of constant emf of 200V for a long time, then the switch was shifted to contact 2 from contact 1. The total amount of heat generated in the 500Ω resistance, thereafter is



(1) 1/32 J (2) 3/32 J
(3) 2/32 J (4) 5/32 J

Q.49 A system of three charges are placed as shown in the figure :

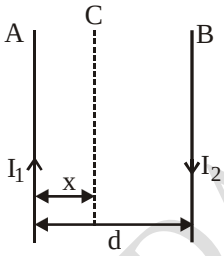


If D >> d, the potential energy of the system is best given by :

(1) $\frac{1}{4\pi\varepsilon_0}\left[-\frac{q^2}{d}-\frac{qQd}{2D^2}\right]$ (2) $\frac{1}{4\pi\varepsilon_0}\left[+\frac{q^2}{d}+\frac{qQd}{D^2}\right]$

(3) $\frac{1}{4\pi\varepsilon_0}\left[-\frac{q^2}{d}+\frac{2qQd}{D^2}\right]$ (4) $\frac{1}{4\pi\varepsilon_0}\left[-\frac{q^2}{d}-\frac{qQd}{D^2}\right]$

Q.50 Two wires A & B are carrying currents I_1 & I_2 as shown in the figure. The separation between them is d. A third wire C carrying a current I is to be kept parallel to them at a distance x from A such that the net force acting on it is zero. The possible values of x are :



(1) $x = \left(\frac{I_1}{I_1 - I_2}\right) d$ and $x = \left(\frac{I_2}{I_1 + I_2}\right) d$

(2) $x = \pm\frac{I_1}{I_1 - I_2} d$

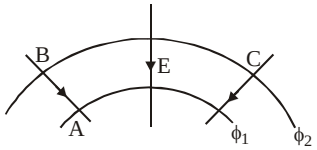
(3) $x = \left(\frac{I_1}{I_1 + I_2}\right) d$ and $x = \left(\frac{I_2}{I_1 - I_2}\right) d$

(4) $x = \left(\frac{I_2}{I_1 + I_2}\right) d$ and $x = \left(\frac{I_2}{I_1 - I_2}\right) d$

SECTION - 2 (Q.51 - Q.60)

This section contains TEN (10) questions. ATTEMPT ANY FIVE (05) QUESTIONS. The answer to each question is NUMERICAL VALUE. If the numerical value has more than two decimal places truncate/round-off the value upto TWO decimal places.

Q.51 In moving from A to B along an electric field line, the work done by the electric field on an electric is 6.4×10^{-19} J. If ϕ_1 and ϕ_2 are equipotential surface, then the potential difference $V_C - V_A$ (in volt) is:



Q.52 In the figure shown, the current (in Ampere) drawn from the battery is (X / 32). Find the value of X.

You are given:

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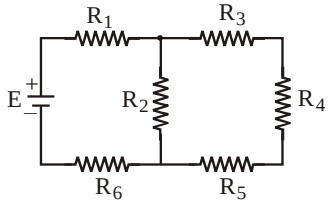
$R_1 = 15\Omega$, $R_2 = 10\Omega$, $R_3 = 20\Omega$, $R_4 = 5\Omega$, $R_5 = 25\Omega$, $R_6 = 30\Omega$, E = 15 V

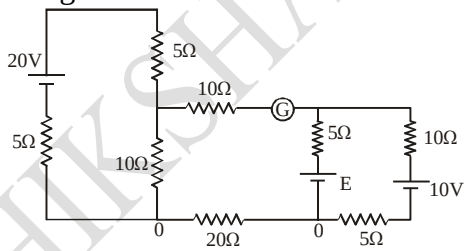


Q.53 An ideal battery of 4V and resistance R are connected in series in the primary circuit of a potentiometer of length 1 m and resistance 5Ω. The value of R, to give a potential difference of 5 mV across 10 cm of potentiometer wire, is (390 + X) Ω. Find the value of X.

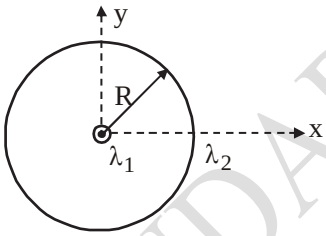
Q.54 The magnitude of the magnetic field at the center of an equilateral triangular loop of side 1m which is carrying a current of 10 A is (6 × A) μT. Find the value of A.
[Take $\mu_0 = 4\pi \times 10^{-7}$ NA^{-2}]

Q.55 A current 'I' is flowing along an infinite, straight wire, in the positive Z-direction and the same current is flowing along a similar parallel wire 5m apart, in the negative Z-direction. A point P is at a perpendicular distance 3m from the first wire and 4 m from the second. The magnitude of the magnetic field $\vec{B}$ at P is $\frac{X \times \mu_0 I}{24\pi}$. Find the value of X.

Q.56 What should be value of (E/2) (in volts) for which galvanometer shows no deflection :

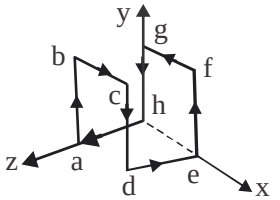


Q.57 Consider a uniformly charged ring having linear charged density λ_2 and an infinite uniformly charged straight wire having linear charge density λ_1, lying along the axis of ring as shown in figure. If force of interaction between wire and any half of the ring is found to be $F = 4k\lambda_1\lambda_2 R^{(\alpha-3)}$. Where α is an integer find α.



Q.58 A 16μF capacitor, initially charged to 5V, is started charging t = 0 by a source at the rate of 40t μCs^{-1}. How long will it take (in sec.) to raise its potential to 10V ?

Q.59 A conductor carries a current of 6.0 A along the closed path abcdefgha involving 8 out of the 12 edges of a cube of side of 10 cm as shown in figure. If the system is in a uniform field of $\vec{B} = (100 \text{ tesla})\,\hat{i}$. Then find the magnitude of torque on the system (in N.m.) at this instant :



Q.60 An iron rod of susceptibility 599 is subjected to a magnetising field of 1200 A m^{-1}. The permeability of the material of the rod is $2.4\pi \times 10^{-X}$ T m A^{-1}. Find the value of X.
($\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1})

PART C – MATHEMATICS

SECTION - 1 (Q.61 - Q.80)

Each question has FOUR options (1), (2), (3) and (4). ONLY ONE of these four options is correct.

SPACE FOR ROUGH WORK

Q.61 If $\alpha = \cos^{-1}\left(\frac{3}{5}\right), \beta = \tan^{-1}\left(\frac{1}{3}\right)$, where $0 < \alpha, \beta < \frac{\pi}{2}$, then $\alpha - \beta$ is equal to :

(1) $\sin^{-1}\left(\frac{9}{5\sqrt{10}}\right)$ (2) $\tan^{-1}\left(\frac{9}{14}\right)$

(3) $\cos^{-1}\left(\frac{9}{5\sqrt{10}}\right)$ (4) $\tan^{-1}\left(\frac{9}{5\sqrt{10}}\right)$

Q.62 Let α and β be the roots of the equation $x^2 + x + 1 = 0$. Then for $y \neq 0$ in R,

$$\begin{vmatrix} y+1 & \alpha & \beta \\ \alpha & y+\beta & 1 \\ \beta & 1 & y+\alpha \end{vmatrix}$$ is equal to –

(1) y^3 (2) $y^3 - 1$

(3) $y(y^2 - 1)$ (4) $y(y^2 - 3)$

Q.63 The total number of matrices

$$A = \begin{pmatrix} 0 & 2y & 1 \\ 2x & y & -1 \\ 2x & -y & 1 \end{pmatrix} (x, y \in R, x \neq y)$$

for which $A^TA = 3I_3$ is :-

(1) 6 (2) 2

(3) 3 (4) 4

Q.64 If $\Delta_1 = \begin{vmatrix} x & \sin\theta & \cos\theta \\ -\sin\theta & -x & 1 \\ \cos\theta & 1 & x \end{vmatrix}$ and

$$\Delta_2 = \begin{vmatrix} x & \sin 2\theta & \cos 2\theta \\ -\sin 2\theta & -x & 1 \\ \cos\theta & 1 & x \end{vmatrix}, x \neq 0$$

then for all $\theta \in (0, \pi/2)$

(1) $\Delta_1 - \Delta_2 = x(\cos 2\theta - \cos 4\theta)$

(2) $\Delta_1 + \Delta_2 = -2x^3$

(3) $\Delta_1 - \Delta_2 = -2x^3$

(4) $\Delta_1 + \Delta_2 = -2(x^3 + x - 1)$

Q.65 Let $A = \begin{pmatrix} \cos\alpha & -\sin\alpha \\ \sin\alpha & \cos\alpha \end{pmatrix}$, $(\alpha \in R)$ such that $A^{32} = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$. Then a value of α is

(1) $\pi/16$ (2) 0

(3) $\pi/32$ (4) $\pi/64$

Q.66 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 :

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

Q.67 $\sin^2(\sin^{-1} 1/2) + \tan^2(\sec^{-1} 2) + \cot^2(\text{cosec}^{-1} 4) = ?$

(1) 73/4 (2) 37/2

(3) 89/4 (4) 19

Q.68 $\begin{vmatrix} 1! & 2! & 3! \\ 2! & 3! & 4! \\ 3! & 4! & 5! \end{vmatrix} = 2016\,K$, then K =

(1) 24 (2) 84

(3) 1/24 (4) 1/84

Q.69 The set of values of x, satisfying the equation $\tan^2(\sin^{-1}x) > 1$ is -

(1) $[-1,1]$

(2) $\left[-\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}\right]$

(3) $(-1,1) - \left[-\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}\right]$

(4) $[-1,1] - \left(-\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}\right)$

Q.70 If the inverse of the matrix

$A = \begin{bmatrix} 1 & 2 & 2 \\ 2 & -1 & 2 \\ 2 & 2 & 1 \end{bmatrix}$ is $\frac{1}{5}\begin{bmatrix} -3 & 2 & 2 \\ 2 & -3 & \alpha \\ 2 & 2 & -3 \end{bmatrix}$, then α =

(1) 3 (2) 4

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(3) 2 (4) –2

Q.71 The value of $\sin^{-1}(12/13) - \sin^{-1}(3/5)$ is equal to:

(1) $\pi - \sin^{-1}(63/65)$ (2) $\pi - \sin^{-1}(33/65)$

(3) $\pi/2 - \sin^{-1}(56/65)$ (4) $\pi/2 - \sin^{-1}(9/65)$

Q.72 Let $d \in R$, and

$$A = \begin{bmatrix} -2 & 4+d & (\sin\theta)-2 \\ 1 & (\sin\theta)+2 & d \\ 5 & (2\sin\theta)-d & (-\sin\theta)+2+2d \end{bmatrix}$$

$\theta \in [0, 2\pi]$. If the minimum value of det (A) is 8, then a value of d is :

(1) –7 (2) $2(\sqrt{2}+2)$

(3) –5 (4) $2(\sqrt{2}+1)$

Q.73 An ordered pair (α, β) for which the system of linear equations $(1+\alpha)x + \beta y + z = 2$

$\alpha x + (1+\beta) y + z = 3$

$\alpha x + \beta y + 2z = 2$ has a unique solution is

(1) (1, –3) (2) (–3,1)

(3) (2, 4) (4) (– 4, 2)

Q.74 Let $A = \begin{pmatrix} 0 & 2q & r \\ p & q & -r \\ p & -q & r \end{pmatrix}$. It $AA^T = I_3$, then $|p|$ is

(1) $1/\sqrt{2}$ (2) $1/\sqrt{5}$

(3) $1/\sqrt{6}$ (4) $1/\sqrt{3}$

Q.75 If $\begin{vmatrix} a-b-c & 2a & 2a \\ 2b & b-c-a & 2b \\ 2c & 2c & c-a-b \end{vmatrix}$

$= (a+b+c)(x+a+b+c)^2$, $x \neq 0$ and $a+b+c \neq 0$, then x is equal to :

(1) $-(a+b+c)$ (2) $2(a+b+c)$

(3) abc (4) $-2(a+b+c)$

Q.76 Considering only the principal values of inverse functions, the

set $A \{x \geq 0 : \tan^{-1}(2x) + \tan^{-1}(3x) = \pi/4\}$

(1) is an empty set

(2) Contains more than two elements

(3) Contains two elements

(4) is a singleton

Q.77 All x satisfying the inequality $(\cot^{-1} x)^2 - 7(\cot^{-1} x) + 10 > 0$, lie in the interval:

(1) $(-\infty, \cot 5) \cup (\cot 4, \cot 2)$

(2) (cot 5, cot 4)

(3) (cot 2, ∞)

(4) $(-\infty, \cot 5) \cup (\cot 2, \infty)$

Q.78 Let $P = \begin{bmatrix} 1 & 0 & 0 \\ 3 & 1 & 0 \\ 9 & 3 & 1 \end{bmatrix}$ and $Q = [q_{ij}]$ be two 3×3 matrices such that $Q - P^5 = I_3$. Then $\frac{q_{21}+q_{31}}{q_{32}}$ is equal to:

(1) 15 (2) 9

(3) 135 (4) 10

Q.79 If $x \neq a$, $y \neq b$, $z \neq c$ and $\begin{vmatrix} a & y & z \\ x & b & z \\ x & y & c \end{vmatrix} = 0$ then $\left(\frac{x+a}{x-a} + \frac{y+b}{y-b} + \frac{z+c}{z-c}\right)$ is equal to –

(1) –1 (2) 1

(3) 2 (4) 0

Q.80 Let A be a periodic matrix with period 5 and $A^{10} + B = I$, then AB =

(1) I (2) 0

(3) A^2 (4) A + I

SECTION - 2 (Q.81 - Q.90)

This section contains TEN (10) questions. ATTEMPT ANY FIVE (05) QUESTIONS. The answer to each question is NUMERICAL VALUE. If the numerical value has more than two decimal places

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truncate/round-off the value upto TWO decimal places.

Q.81 If the system of equations
$x + y + z = 5$; $x + 2y + 3z = 9$
$x + 3y + \alpha z = b$
has infinitely many solutions, then $\beta - \alpha$ equals:

Q.82 If $\theta \in (0, \pi/2)$, then value of

$$\begin{vmatrix} (\sin\theta + \operatorname{cosec}\theta)^2 & (\sin\theta - \operatorname{cosec}\theta)^2 & 1 \\ (\cos\theta + \sec\theta)^2 & (\cos\theta - \sec\theta)^2 & 1 \\ (\tan\theta + \cot\theta)^2 & (\tan\theta - \cot\theta)^2 & 1 \end{vmatrix} =$$

Q.83 If $\cot^{-1}\dfrac{n}{\pi} > \dfrac{\pi}{6}$, $n \in N$, then the maximum value of n is –

Q.84 If $2ax - 2y + 3z = 0$, $x + ay + 2z = 0$ and $2x + az = 0$ have a non-trivial solution, find the value of a.

Q.85 If A is a square matrix of order n such that $|\text{ adj }|\text{ adj (adj A)}|| = |A|^{27}$, then find the possible value of n.

Q.86 For x, y, z, $t \in R$, if $\sin^{-1} x + \cos^{-1} y + \sec^{-1} z \geq t^2 - \sqrt{2\pi}\, t + 3\pi$, then find the value of

$$\sec\left(\tan^{-1} x + \tan^{-1} y + \tan^{-1} x + \tan^{-1}\left(\sqrt{\frac{2}{\pi}}\, t\right)\right).$$

Q.87 If $\begin{vmatrix} \sin^{-1} x & \sin^{-1} 2x & \sin^{-1} 3x \\ \sin^{-1} 3x & \sin^{-1} x & \sin^{-1} 2x \\ \sin^{-1} 2x & \sin^{-1} 3x & \sin^{-1} x \end{vmatrix} = 0$,
then number of values of x satisfying the equation is equal to.

Q.88 Let S be the sum of all possible values of , m, n, p, q , r for which

$$A = \begin{bmatrix} \ell^2 - 3 & p & 0 \\ 0 & m^2 - 8 & q \\ r & 0 & n^2 - 15 \end{bmatrix}$$

be a nonsingular idempotent matrix. Then find value of S + 1.

Q.89 If $a_1, a_2, a_3, a_4, 5, 4, a_6, a_7, a_8, a_9$ are in H.P., then the value of the determinant $\begin{vmatrix} a_1 & a_2 & a_3 \\ 5 & 4 & a_6 \\ a_7 & a_8 & a_9 \end{vmatrix}$ can be expressed in the lowest from as $\dfrac{p}{q}$, find $\left(\dfrac{p-q}{29}\right)$.

Q.90 If $\begin{vmatrix} p & q-y & r-z \\ p-x & q & r-z \\ p-x & q-y & r \end{vmatrix} = 0$, then the value of $\dfrac{p}{x} + \dfrac{q}{y} + \dfrac{r}{z} + 2$ is

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