SAMPLE PAPERS

JEE Mains

Maximum Marks: 360

Topics Covered:

Physics : Work Power Energy, Rotational Dynamics, Current Electricity, Magnetic & Mechanical Effect of Current, Electromagnetic Induction, Alternating Current.

Chemistry: Chemical Bonding, Mole Concept, s-Block Elements, Hydrocarbons, Chemical & Ionic Equilibrium, Electro Chemistry, d & f Block Elements, Coordination Compounds

Mathematics: Trigonometric Ratios & Equation, Complex Numbers, Quadratic Equation, Continuity & Differentiability, Application of Derivatives, Vector Algebra, 3-D Geometry.

Important Instruction:

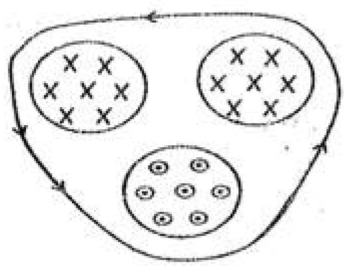
1. Use **Blue / Black Ball** point pen only.
2. There are three sections of equal weightage in the question paper A, B, C (**Physics, Chemistry and Mathematics**) having 30 questions each.
3. You are awarded +4 marks for each correct answer and -1 mark for each incorrect answer.
4. Use of calculator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

PART – A (PHYSICS)

1. Two geometrically identical cycle wheels of a bicycle moving due east have different number of spokes connected from center to rim. Rear wheel has 20 spokes and the front wheel has only 10 (the rim and the spokes are resistances less). A resistance R is connected between center and rim in each wheel. The current R will be :

(a) Double in rear wheel as compared to front wheel
(b) Four times in rear wheel as compared to front wheel
(c) Zero in both these wheels
(d) Equal in both these wheels.

2. Figure shows three regions of magnetic field, each of area A, and in each region magnitude of the field decreases at a constant rate 'α'. If $\vec{E}$ is induced electric field then value of line integral $\oint \vec{E}.\, d\vec{r}$ along the given loop is equal to

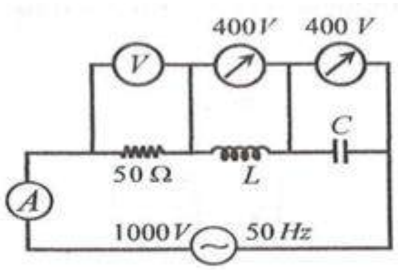


(a) α A (b) – α A (c) 3α A (d) – 3α A

3. A wire of fixed length is wound on a solenoid of length 'ℓ' and radius 'r'. Its self inductance is found to be L. Now if same wire is wound on a solenoid of length $\frac{\ell}{2}$ and $\frac{r}{2}$, then the self inductance will be:

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

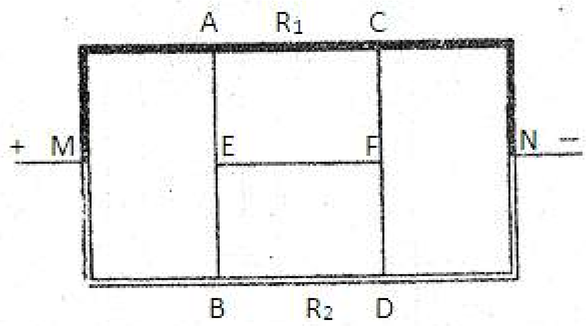
4. In the LCR circuit, the voltmeter and ammeter readings are



(a) 200 volt, 20 A (b) 200 volt, 50 A (c) 1000 volt, 20 A (d) 100 volt, 20 A

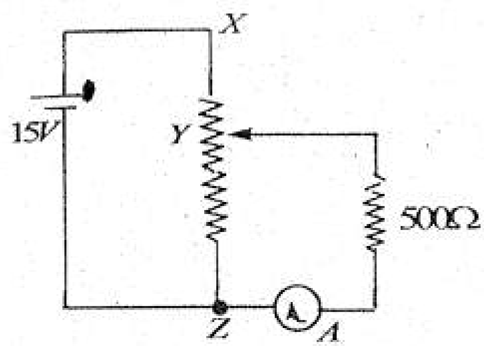
5. A uniform chain of mass 6 kg and length 10 m is placed on a frictionless horizontal table. Due to a small jerk, chain starts to slide down from edge of table. Find the speed of chain when chain is slips off completely. [Height of table is greater than 10m]
(a) 1 m/s (b) 5 m/s (c) 10 m/s (d) 15 m/s

6. Two wires MACN and MBDN, of the same length but of different resistances R_1 and R_2 are connected as shown in the figure. Contacts A, B, C and D are arranged so that there is no current passing through wires AB and CD? Will current pass through AB and CD with this arrangement of contacts if two points E and F on these wires are connected?



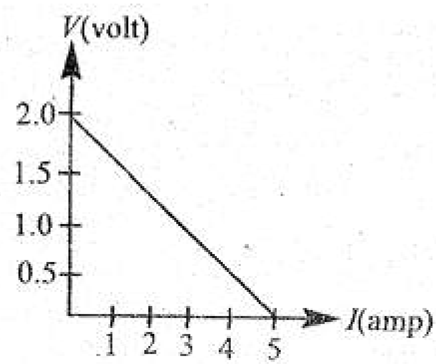
(a) Current will pass through AB, CD
(b) Current will not pass through AB, CD
(c) Current will pass through AB but not CD
(d) Current will pass through CD but not AB

7. A battery of 15V and of negligible internal resistance is connected to a rheostat XZ of 1 kΩ. The resistance of YZ part is 500Ω. The reading of the ammeter will be



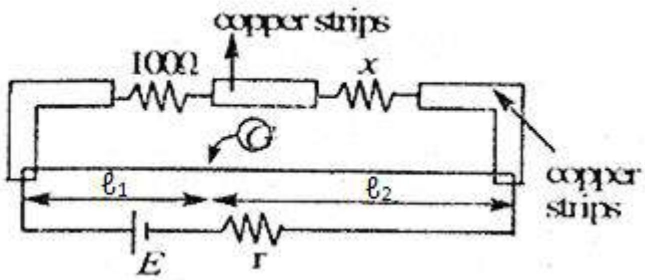
(a) 1A
(b) 0.1 A
(c) 0.01 A
(d) 0.001 A

8. For a cell, a graph is plotted between the potential difference V across the terminals of the cell and the current I drawn from the cell. The e.m.f and the internal resistance of the cell are E and r, respectively. Then



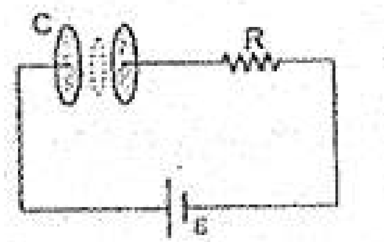
(a) E = 2V, r = 0.5Ω
(b) E = 2V, r = 0.4Ω
(c) E > 2V, r = 0.5Ω
(d) E > 2V, r = 0.4Ω

9. In a meter – bridge circuit as shown, when one more resistance of 100Ω is connected is parallel with unknown resistance 'x', then ratio ℓ_1/ℓ_2 becomes '2'. ℓ_1 is balance length. AB is a uniform wire. Then value of 'x' must be



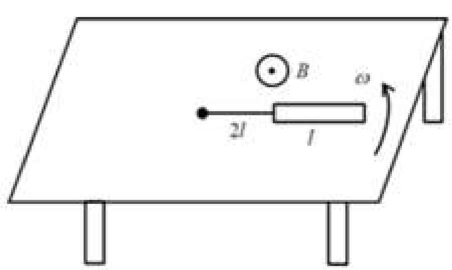
(a) 50 Ω (b) 100 Ω (c) 200 Ω (d) 400 Ω

10. In the circuit shown the capacitor of capacitance C is initially uncharged. Now the capacitor is connected in the circuit as shown. The charge passed through an imaginary circular loop parallel to the plates (also circular) and having the area equal to half of the area of the plates, in one time constant is :



(a) $C\varepsilon\left(1-\frac{1}{e}\right)$ (b) $\frac{C\varepsilon}{2}\left(1-\frac{1}{e}\right)$ (c) $\frac{C\varepsilon}{4}$ (d) zero

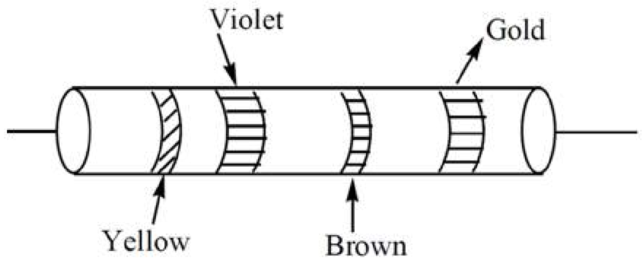
11. A metallic rod of length l is tied to a string of length 2l and made to rotate angular speed ω on a horizontal table with one end of the string fixed. If there is a vertical magnetic field B in the region, the emf induced across the ends of the rod is



(a) $\frac{7B\omega l^2}{2}$ (b) $\frac{3B\omega l^2}{2}$ (c) $\frac{5B\omega l^2}{2}$ (d) $\frac{4B\omega l^2}{2}$

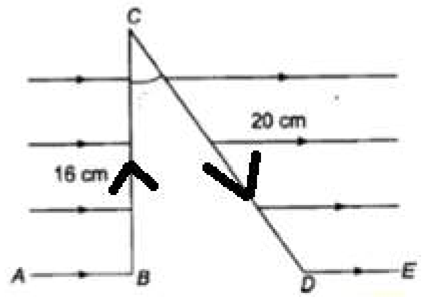
12. When a galvanometer is shunted with a 4Ω resistance, the deflection is reduced to one-fifth. If the galvanometer is further shunted with is further shunted with a 2Ω wire (2Ω and 4Ω resistors are connected in parallel), the further reduction in the deflection will be(the main current remains the same).
(a) (8/13) of the deflection when shunted with 4Ω only
(b) (5/13) of the deflection when shunted with 4Ω only
(c) (3/4) of the deflection when shunted with 4Ω only
(d) (3/13) of the deflection when shunted with 4Ω only

13. The figure shows a color-coded resistor, the resistance of this resistor is



(a) $52 \times 10^3 \pm 20\% \ \Omega$ (b) $47 \times 10^1 \pm 5\% \ \Omega$
(c) $53 \times 10^6 \pm 10\% \ \Omega$ (d) $42K\Omega \pm 10\%$

14. In the figure shown, assume the current in the wire to be 5 A and if B = 0.15T. The force on the section CD.



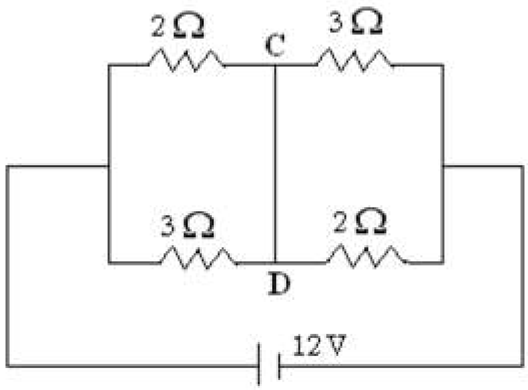
(a) Zero (b) 0.16 N out of page (c) 0.12 N out of page (d) 0.12 N inside page

15. A current of 4A flows in a inductor coil when connected to a 12 V DC source. If the same coil is connected to a 12V, 50 rad/sec AC source a current of 2.4 A flows in the circuit. If a 2500 μF capacitor is connected in series to the coil the power dissipated in the circuit is
(a) 5.76 W (b) 12.47 W (c) 17.28 W (d) 23.46 W

16. A horizontal straight conductor of mass 'm' and length 'l' is placed in a uniform vertical magnetic field of magnitude 'B'. An amount of charge 'Q' passes through the rod in a very short time such that the conductor begins to move only after all the charge has passed through it. Its initial velocity will be
(a) $\frac{BQl}{m}$ (b) $\frac{BQl}{2m}$ (c) $\frac{3BQl}{2m}$ (d) the conductor does not move

17. A solid sphere of mass 'm' and radius R rolls on a horizontal rough surface without slipping due to a horizontal force 'F' acting at the top of the sphere. Then the frictional force acting between the body and the surface is
(a) F (b) Zero (c) $\frac{7}{3}$ F (d) $\frac{3}{7}$ F

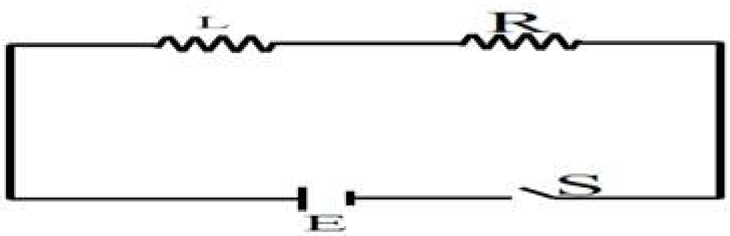
18. In the circuit shown the battery is ideal. The current from C to D is

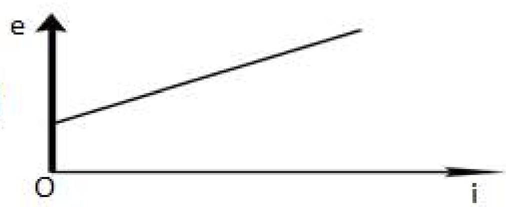


(a) 1A (b) Zero (c) 2/3 A (d) 3/2 A

19. A current is made of two components, a DC component of 3A and AC component of $4\sqrt{2}\sin\omega t$ A. The reading of the hot wire ammeter is
(a) 3A (b) $4\sqrt{2}$ A (c) $(3 + 4\sqrt{2})$A (d) 5A

20. An L-R circuit connected to a battery of a constant emf E. The switch S is closed at time t = 0. If 'e' denotes the induced emf across the inductor which of the graphs represents the variation of e with i?



(a)


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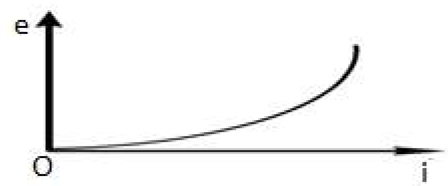
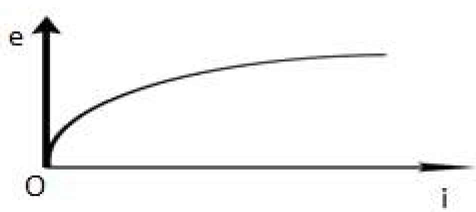
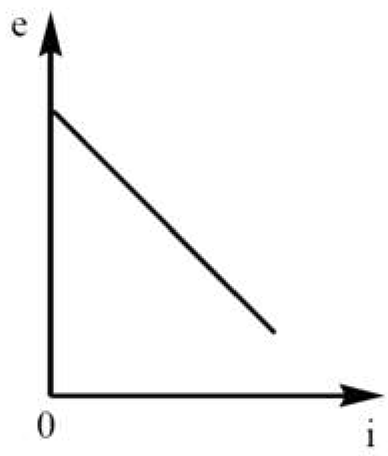
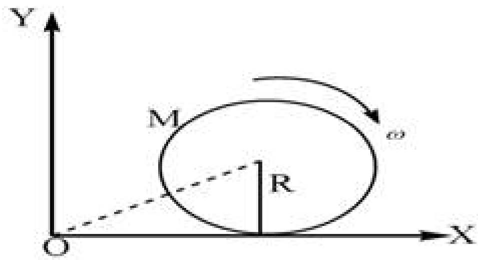


(c)


(d)


21. A disc of mass M and radius R is rolling with angular speed ω on a horizontal plane. The magnitude of angular momentum of the disc about the origin O is

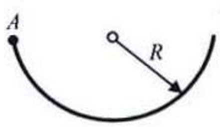


(a) $\frac{1}{2}$ $MR^2\omega$ (b) $MR^2\omega$ (c) $\frac{3}{2}$ $MR^2\omega$ (d) $2MR^2\omega$

22. In an oscillating LC circuit, maximum charge on the capacitor is Q. The charge on this capacitor, when the energy is stored equally distributed between the electric and magnetic fields is

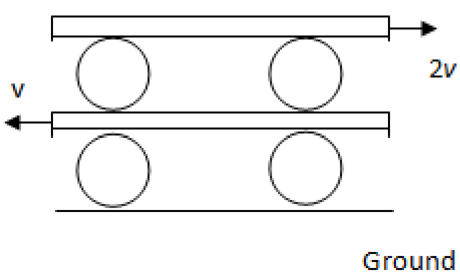
(a) Q (b) $\frac{Q}{2}$ (c) $\frac{Q}{\sqrt{3}}$ (d) $\frac{Q}{\sqrt{2}}$

23. A uniform rod of mass m is bent into the form of a semicircle of radius R. The moment of inertia of the rod about an axis passing through A and perpendicular to the plane of the paper is



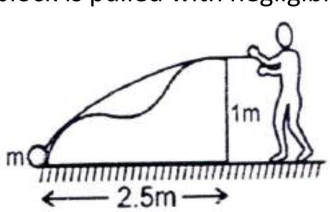
(a) 2/3 mR^2 (b) mR^2 (c) $\frac{1}{2}$ mR^2 (d) $2mR^2$

24. A system of uniform cylinders and plates is shown in. All the cylinders are identical and there is no slipping at any contact. Velocity of lower and upper planets is *V* and 2*V,* respectively as shown in the figure. Then the ratio of angular speeds of the upper cylinders to lower cylinders is.



(a) 1:1 (b) 1:2 (c) 3:2 (d) 3:1

25. As shown in the figure a person is pulling a mass 2 kg from ground on a fixed rough surface up to the top of the surface with the help of a light inextensible string. Find the work done (in Joule) by tension in the string if height of the surface is 1 m from ground, length of base of the surface is 2.5 m and friction coefficient is 0.4. Assume that the block is pulled with negligible velocity.

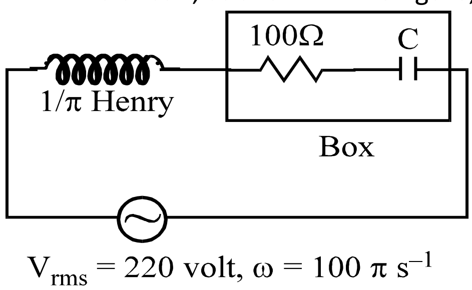


(a) 20 J (b) 30 J (c) 40 J (d) 50 J

26. A 10 kg body is acted upon by a conservative force F = - $2x - 6x^2$ N and x in m. Take potential energy associated with the force to be zero at x = 0. If the object has a velocity of 4m/s in the negative x-direction when at x = 4m, what is its speed as it passes through the origin (in m/s) ?

(a) $\sqrt{\frac{115}{2}}$ (b) $\sqrt{\frac{105}{2}}$ (c) 36 (d) $\sqrt{\frac{224}{5}}$

27. In the circuit, as shown in the figure, if the value of R.M.S current is 2.2 A, the power factor of the box is

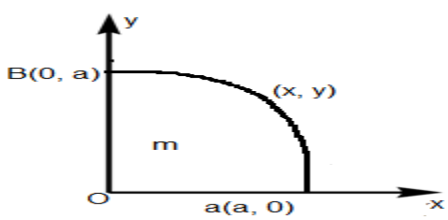


(a) $1/\sqrt{2}$ (b) 1 (c) $\sqrt{3}/2$ (d) 1/2

28. A coil of inductance 8.4 mH and resistance 6Ω is connected to a 12V battery. The current in the coil is 1.0A at approximately the time

(a) 500 sec (b) 25 sec (c) 35 ms (d) 1 ms.

29. A particle of mass m moves along the quarter section of the circular path whose center is the origin. The radius of the circular path is a. A force F = $\overline{F} = y\hat{\imath} - x\hat{\jmath}$ N acts on the particle where x and y denote the coordinates of the position of the particle. The work done by this force in taking the particle from point A (a, 0) to point B (0, a) along the circular path is



(a) $-\sqrt{2a^2}$ J (b) $-\frac{\pi a^2}{4}$ J (c) $-a^2$J (d) $-\frac{\pi a^2}{2}$J

30.A hemispherical vessel of radius R moving with a constant velocity v_0 and containing a ball is suddenly halted. Find the height by which ball rise in the vessel, provided the surface is smooth is

(a) $\frac{v_0^2}{2g}$ (b) $\frac{2v_0^2}{2g}$ (c) $\frac{v_0^2}{g}$ (d) $\frac{v_0^2}{3g}$

PART – B (CHEMISTRY)

31. N_2 and O_2 are converted into monocations, N_2^+ and O_2^+ respectively. Which of the following is wrong ?

(a) In N_2^+, N-N bond weakens

(b) In O_2^+, the O-O bond order increase

(c) In O_2^+, paramagnetism decreases

(d) N_2^+ becomes diamagnetic.

32. A solution of 10 ml $\frac{M}{10}$ $FeSO_4$ was titrated with $KMnO_4$ solution in acidic medium. The amount of $KMnO_4$ used will be:

(a) 5 ml of 0.1 M

(b) 10 ml of 0.1 M

(c) 10 ml of 0.5 M

(d) 10 ml of 0.02 M

33. Which of the following is formed when lithium is heated in air?

(a) Only Li_2O

(b) Only Li_3N

(c) Both Li_2O_2 and Li_3N

(d) Both Li_2O and Li_3N

34. Which of the following, are isoelectronic and isostructural ?

$NO_3^-, CO_3^{2-}, ClO_3^-, SO_3$

(a) NO_3^-, CO_3^{2-}

(b) SO_3, NO_3^-

(c) ClO_3^-, CO_3^{2-}

(d) CO_3^{2-}, SO_3.

35. Which has maximum number of atoms ?

(a) 24 g of C (12)

(b) 56 g of Fe (56)

(c) 27 g of Al (27)

(d) 108 g of Ag (108)

36. A 10 litre box contains O_3 and O_2 at equilibrium at 2000K. $K_P = 4 \times 10^{14}$ atm for $2O_3(g) \rightleftharpoons 3O_2(g)$ Assume that $P_{O_2} > P_{O_3}$ and if total pressure is 8atm, then partial pressure of O_3 will be:

(a) $8 \times 10^{-5} atm$

(b) $11.3 \times 10^{-7} atm$

(c) $9.71 \times 10^{-6} atm$

(d) $9.71 \times 10^{-2} atm$

37. In the system, $LaCI_3(S) + H_2O(g) + heat \rightleftharpoons LaCIO(s) + 2HCI(g)$, equilibrium is established. More water vapour is added to restablish the equilibrium. The pressure of water vapour is doubled. The factor by which pressure of HCI is changed is:

(a) 2

(b) $\sqrt{2}$

(c) $\sqrt{3}$

(d) $\sqrt{5}$ LI

38. A solution gives the following colours with different indicators:

(A) Methyl orange $\Longrightarrow$ yellow

(B) Methyl red $\Longrightarrow$ yellow

(C) Bromo thymol blue $\Longrightarrow$ Orange

What is the pH of the solution?

(a) 5 to 7.5

(b) 6 to 6.3

(c) 4 to 4.5

(d) 5 to 6.5

39. What is solubility of $AI(OH)_3$, $(K_{sp} = 1 \times 10^{-33})$ in a butter solution pH = 4?

(a) $10^{-3}M$

(b) $10^{-6}M$

(c) $10^{-4}M$

(d) $10^{-10}M$

40. If $\Delta_\circ > P$ (P = pairing energy; $\Delta_\circ = change$ in energy of octahedral complexes), the correct electronic configuration for d^4 system will be

(a) $t_{2g}^4\ e_g^0$

(b) $t_{2g}^3\ e_g^0$

(c) $t_{2g}^0\ e_g^4$

(d) $t_{2g}^2\ e_g^2$

41. Match the following

Complex	Structure and magnetic moment
(A) $[Ag\ (CN)_2]^-$	(1) Square planar and 1.73 BM
(B) $[Cu\ (CN)_4]^{-3}$	(2) Linear and zero
(C) $[Cu\ (CN)_6]^{-3}$	(3) Octahedral and zero
(D) $[Cu\ (NH_3)_4]^{+2}$	(4) tetrahedral and zero
(E)	(5) Octahedral and 1.73 BM

(a) A – 2; B – 4; C – 5; D – 1; E – 3
(b) A – 4: B – 2; C – 5 ; D – 1; E – 3
(c) A – 2 ; B – 4 ; C – 1 ; D – 5 ; E – 3
(d) A – 2; B – 4; C – 3; D – 1; E – 5

42. $[PtBrCI(NO_2)NH_3]\ I$ on ionisation gives the ion
(a) CI^- (b) Br^- (c) I^- (d) NO_2^-

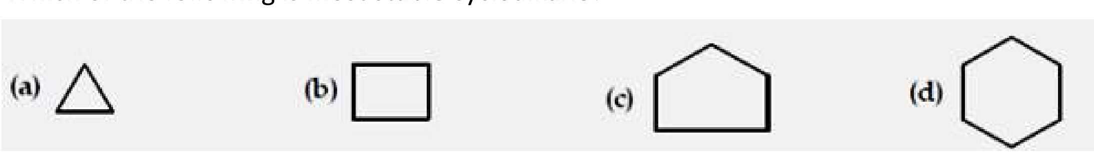
43. Ammonia forms the complex ion $[Cu(NH_3)_4]^{+2}$ with copper ions in alkaline solutions but not in acidic solutions. What is the reason for it?
(a) In acidic solutions, hydration protects copper ion
(b) In acidic solution, protons co – ordinate with ammonia molecules forming NH_4^+ ions and NH_3molecules are not available
(c) In alkaline solutions insoluble Cu(OH_2) is precipitated which is soluble in excess of an alkali
(d) Copper hydroxide is an amphoteric substance

44. Predict the product obtained by chlorination of tert – butyl bromide.
(a) 1 – Bromo – 2 – chloro – 2 – methyl propane
(b) 2 – Bromo – 2 – chloro – 2 – methyl propane
(c) 2 – Bromo – 1 – chloro – 2 – methyl propane
(d) 2 – Bromo – 1 – chloro – 1 – methyl propane

45. Azulene is isomer of Napthalene. It has 2 fused rings. It has aromatic nature due to ___________________
(a) Fused ring of cyclopenta dienylanion is aromatic
(b) Fused ring of cyclohepenta trienyl cation is aromatic
(c) Fused ring of cyclopenta dienylanion is antiaromatic
(d) Both (a) and (b)

46. What are the reagents needed for conversion of benzene to phenyl acetylene?
(a) $CH_3COCI, Zn, Hg, NBS, KOH, Br_2/CCI_4$
(b) $CH_3COCI, KMnO_4/H^+$
(c) $CH_3COCI, K_2Cr_2O_7/H^+, Zn/Hg$
(d) NBS/Light, $NaNH_2/Heat, H_3O^+$

47. Which of the following is most stable cycloalkane?



48. E° for some half cell reactions are given below
$Sn^{+4} + 2e^- \rightarrow Sn^{2+};\ E^\circ = 0.151V$
$2Hg^{2+} + 2e \rightarrow Hg_2^{2+};\ E^\circ = 0.92V$
$PbO_2 + 4H^+ + 2e^- \rightarrow Pb^{2+} + 2H_2O;\ E^\circ = 1.45\ V$
Based on the given data which statement is correct.
(a) Sn^{+4} is a stronger oxidising agent than Pb^{+4}
(b) Sn^{2+} is a stronger reducing agent than Hg_2^{2+}
(c) Hg^{2+} is a stronger oxidising agent than Pb^{+4}
(d) Pb^{+2} is a stronger reducing agent than Sn^{2+}

49. A hydrogen electrode placed in a buffer solution of CH_3COONa and CH_3COOH in the molar ratios x : y and y : x has oxidation potentials E_1 and E_2 volts respectively at 298 K, $(PH_2 = 1atm)$. The pK_a value of acetic acid will be given by

(a) $\frac{E_1 - E_2}{0.118}$ (b) $\frac{E_2 - E_1}{0.118}$ (c) $\frac{E_1 + E_2}{0.118}$ (d) None of these

50. The EMF of the following cell is found to be -0.46V.

$$\text{pt, H}_2 \left| \begin{matrix} \text{NaHSO}_4 \\ (0.4\text{M}) \end{matrix} \right| \begin{matrix} \text{Na}_2\text{SO}_4 \\ (6.44 \times 10^{-3}\text{M}) \end{matrix} \left| \begin{matrix} \text{Zn}^+ \\ (0.3\text{M}) \end{matrix} \right| \text{Zn}$$

if the standard electrode potential of Zincc is – 0.763 V, find the value of $\text{K}_2$of H_2SO_4,

where $\text{K}_2 = \frac{[\text{H}^{\oplus}][\text{SO}_4^{2-}]}{[\text{HSO}_4^-]}$

(a) 6.44×10^{-8} (b) 6.17×10^{-5} (c) 6.23×10^{-3} (d) 6.89×10^{-6}

51. Calculate the potential corresponding to the following cell. Given

Pt$|CO^{2+}\ (2.0M), CO^{3+}\ (0.01M)||Cr^3\ (0.5M), Cr_2O_7^{2-}(4.0M), H^{\oplus}(1.5M)|Pt$

$E^{-}_{Co^{2+}/Co^{3+}} = -1.82\ V$

$E^{-}_{Cr_2O_7^{2-}/Cr^{3+}} = -1.33\ V$

(a) – 0.32 V (b) – 0.17 V (c) + 0.32 V (d) + 0.28 V

52. Given the following molar conductivites at 25$^{\circ}C$; $HCI = 426\Omega^{-1}\ cm^2\ mol^{-1}$; NaCl= 126$\Omega^{-1}\ cm^2 mol^{-1,}$ NaC (sodium crotonate)=83$\Omega^{-1}\ cm^2 mol^{-1}$. The conductivity of 0.001 mol/dm^3 acid solution is 3.83$\times 10^{-5}\Omega^{-1}\ cm^{-1}$. The dissociation constant of crotonic acid is

(a) 4.11$\times 10^{-5}$ M (b) 3.11$\times 10^{-5}$ M (c) 2.11$\times 10^{-5}$ M (d) 1.11$\times 10^{-5}$ M

53. The E° for $\frac{Cu^2}{Cu^+}$; $Cu^+/cu, Cu^{2+}/Cu$ are 0.15V, 0.50 V and 0.325 V respectively. The redox cell showing redox reaction $2Cu^+ \rightarrow Cu^{2+} + Cu$ is made. The E° of this cell reaction and ΔG° may be

(a) $E^{\circ} = 0.175\ V\ or\ E^{\circ} = 0.350\ V$ (b) n = 1 or 2

(c) $\Delta G^{\circ} = 33.775\ kJ$ (d) All of these

54. CaO and NaCI have the same crystal structure and approximately the same ionic radii. If U is the lattice energy of NaCI, the approximate lattice energy of CaO is

(a) U/2 (b) U (c) 2 U (d) 4 U

55. Which of the following statement is correct for $CsBr_3$?

(a) It is a covalent compound (b) It contains Cs^{3+} and Br^- ions

(c) It contains Cs^+ and Br_3^- ions (d) It contains Cs^+, Br^- and lattice Br_2 molecule

56. Which one shows maximum hydrogen bonding?

(a)H_2O (b) H_2Se (c) H_2S (d) HF

57. The following ion shows colour not due to d-d transition

(a) $Cr_2O_7^{2-}$ (b) MnO_4^- (c) CrO_4^{2-} (d) All

58. A metal gives two chlorides 'A' and 'B'. 'A' gives black precipitate with NH_4OH and 'B' gives white precipitate .With KI ,'B' gives a red precipitate soluble in excess of KI. 'A' and 'B' are respectively :

(a) $HgCl_2$ and Hg_2Cl_2 (b) Hg_2Cl_2 and $HgCl_2$ (c) $HgCl_2$ and $ZnCl_2$ (d) $ZnCl_2$ and $HgCl_2$

59. Which of the following metal can not exhibit variable oxidation state

(a) Fe (b) Cu (c) Mn (d) Zn

60. $Ag\left|AgCl\right|Cl^-(C_2)\left|\right|Cl^-(C_1)\left|AgCl\right|Ag$ for this cell ΔG is negative if:

(a) $C_1 = C_2$ (b) $C_1 > C_2$ (c) $C_2 > C_1$ (d) Both (a) and (c)

PART – C (MATHEMATICS)

61. The value of $\sin^3 10^0 + \sin^3 50^0 - \sin^3 70^0$ is equal to

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

62. If $\tan(\alpha - \beta) = \frac{\sin 2\beta}{3 - \cos 2\beta}$, then

(a) $\tan\alpha = 2\tan\beta$ (b) $\tan\beta = 2\tan\alpha$ (c) $2\tan\alpha = 3\tan\beta$ (d) $3\tan\alpha = 2\tan\beta$

63. In a triangle ABC, if angle C is obtuse and angles A and B are given by roots of the equation $\tan^2 x + p\tan x + q = 0$, then the value of q is

(a) greater than 1 (b) less than 1 (c) equal to 1 (d) 0

64. If 2sinx – cos2x = 1, then $\cos^2 x + \cos^4 x$ is equal to

(a) 1 (b) – 1 (c) $-\sqrt{5}$ (d) $\sqrt{5}$

65. $\bar{a}, \bar{b}, \bar{c}$ are the edges of a cube of unit length and $\bar{r}$ be any unit vector inside the cube the $\left|\bar{a} \times \bar{r}\right|^2 + \left|\bar{b} \times \bar{r}\right|^2 + \left|\bar{c} \times \bar{r}\right|^2$ is

(a) 0 (b) 1 (c) 2 (d) 3

66. If $\bar{a}, \bar{b}, \bar{c}$ are non-coplanar and $\bar{d}$ is any unit vector the expression $\left|(\bar{a}\cdot\bar{d})(\bar{b}\times\bar{c}) + (\bar{b}\cdot\bar{d})(\bar{c}\times\bar{a}) + (\bar{c}\cdot\bar{d})(\bar{a}\times\bar{b})\right|$ is independent of the vector

(a) $\bar{a}$ (b) $\bar{b}$ (c) $\bar{c}$ (d) $\bar{d}$

67. The domain of the real function $f(x) = \sqrt{3 - 2^x - 2^{1-x}} + \sqrt{\sin^{-1} x}$ is

(a) $[-1, 0]$ (b) $[0,1]$ (c) $\left[\frac{1}{2}, 1\right]$ (d) [1, 2]

68. Let a, b, c be three real numbers such that a < b < c. Let f(x) be continuous $\forall\ x \in [a, c]$ and differentiable $\forall\ x \in (a, c)$. If $f''(x) > 0\ \forall\ x \in (a, c)$ then

(a) (c – b) f(a) + (b – a) f(c) > (c – a) f(b) (b) (c – b) f(a) + (a – c) f(b) < (a – b) f(c)

(c) f(a) < f(b) < f(c) (d) none of these

69. If $2\sec 2\alpha = \tan\beta + \cot\beta$, then one positive value of $\alpha + \beta$ is

a) $\frac{\pi}{2}$ b) $\frac{\pi}{4}$ c) $\frac{\pi}{3}$ d) 0

70. If z is a complex number such that $-\frac{\pi}{2} \leq \arg z \leq \frac{\pi}{2}$, then which of the following inequality is true

a) $|z - \bar{z}| \leq |z| (\arg z - \arg \bar{z})$ b) $|z - \bar{z}| \geq |z| (\arg z - \arg \bar{z})$

c) $|z - \bar{z}| < (\arg z - \arg \bar{z})$ d) none of these

71. If $f(x) = \left|x^2 + (k-1)|x| - k\right|$ is non differentiable at five real points, then k will lie in

(a) $(-\infty, 0)$ (b) $(0, \infty)$ (c) $(-\infty, 0) - \{-1\}$ (d) $(0, \infty) - \{1\}$

72. Let $f(x) = x^3 + \frac{1}{x^3}$, $x \neq 0$. If the intervals in which f(x) increases are $(-\infty, a)$ and (b, ∞) then min(b – a) is equal to

(a) 0 (b) 2 (c) 3 (d) 4

73. Let y = f(x), f : R $\rightarrow$ R be an odd differentiable function such that $f'''(x) > 0$ and g(α, β) = $\sin^8\alpha + \cos^8\beta + 2 - 4\sin^2\alpha\cos^2\beta$. If $f''(g(\alpha, \beta)) = 0$, then $\sin^2\alpha + \sin^2\beta$ is equal to

(a) 0 (b) 1 (c) 2 (d) 3

74. If $f(x) = \begin{cases} e^{x-1}, & 0 \leq x \leq 1 \\ x + 1 - [x], & 1 < x < 3 \end{cases}$ and g(x) = x^2 – ax + b, such that f(x). g(x) is continuous in [0, 3) then the values of a and b is

(a) 2, 3 (b) 3, 2 (c) 0 $\frac{3}{2}, 1$ (d) none of these

75. If x + y + z = 4, $x^2 + y^2 + z^2 = 14$ and $x^3 + y^3 + z^3 = 34$, then the number of ordered triplet solution (x, y, z) is given by

(a) 2 (b) 3 (c) 6 (d) 9

76. If the equation $x^2 + 2|a|x + 4 = 0$ has integral roots then the minimum value of a is

(a) $-\frac{5}{2}$ (b) – 1 (c) 0 (d) 1

77. $\sum_{r=1}^{16} \sqrt{1+\cos 4r} =$

a) $4\sqrt{2}\sin 1^\circ \cos 2^\circ \cos 17^\circ$
b) $4\sqrt{2}\cos 1^\circ \cos 2^\circ \cos 17^\circ$
c) $4\sqrt{2}\cos 1^\circ \sin 2^\circ \cos 17^\circ$
d) None of these

78. Conditions so that equation $\left(a_1x^2 + b_1x + c_1\right)\left(a_2x^2 + b_2x + c_2\right) = 0$, $\left(a_1a_2 > 0\right)$ have fours real roots if

(i) $c_1c_2 > 0$ (ii) $a_1c_2 < 0$ (iii) $a_2c_1 < 0$

(a) only (i) is sufficient
(b) any one of the three statements is sufficient
(c) either of two statements are sufficient
(d) either of two statements are necessary and sufficient

79. Let A(Z_1), B(Z_2), C(Z_3) be the vertices of an equilateral triangle ABC, then the value of $\arg\left(\frac{Z_2 + Z_3 - 2Z_1}{Z_3 - Z_2}\right)$ is equal to

(a) $\frac{\pi}{3}$ (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{2}$ (d) $\frac{\pi}{6}$

80. If $\left|z - 1 - i\right| = 1$, then the locus of a point represented by the complex number 5(z – i) – 6 is

(a) circle with centre (1, 0) and radius 3
(b) circle with centre (-1, 0) and radius 5
(c) line passing through origin
(d) line passing through (-1, 0)

81. Let a, b, c be complex such that $ab + bc + ca = \frac{1}{2}, \left(a + b + c\right) = 2, abc = 4$ then the value of

$\frac{1}{ab + c - 1} + \frac{1}{bc + a - 1} + \frac{1}{ac + b - 1}$ is

(a) $-\frac{2}{9}$ (b) $\frac{1}{9}$ (c) $\frac{2}{9}$ (d) $-\frac{1}{9}$

82. If $\cot A + 2\tan A = \tan B$ then $\cot A$ is

a) $2\tan\left(A - B\right)$ b) $2\tan\left(B - A\right)$ c) $2\tan\left(A + B\right)$ d) $-2\tan\left(A + B\right)$

83. If $\sin A$ and $\sin B$ of a ΔABC satisfy $c^2x^2 - c\left(a + b\right)x + ab = 0$ then the triangle is

(a) equilateral (b) isosceles (c) right angled (d) acute angled

84. Complete set of values of ‘a’ for which $a\sin^2 x + \left|\cos x\right| - 2a = 0$ has alteast one solution belongs to the interval

(a) $\left[-\frac{1}{2}, 0\right)$ (b) $\left[0, \frac{1}{2}\right]$ (c) $\left(0, \frac{1}{2}\right]$ (d) $\left(0, \frac{1}{2}\right)$

85. The possible value of ‘k’ if the equation $2\cos x + \cos 2kx = 3$ has only one solution

(a) 0 (b) 2 (c) $\sqrt{2}$ (d) $\frac{1}{2}$

86. If a, b $\in$ R distinct numbers satisfying $\left|a-1\right|+\left|b-1\right|=\left|a\right|+\left|b\right|=\left|a+1\right|+\left|b+1\right|$, then the minimum value of $\left|a-b\right|$ is

(a) 3 (b) 0 (c) 1 (d) 2

87. If $(x)=\begin{cases} 3+\left|x-k,\right| & for\ \ x\le k \\ a^2-2+\dfrac{\sin(x-k)}{x-k}, & for\ \ x>k \end{cases}$ has minimum at x = k, then

(a) a $\in$ R (b) $\left|a\right|<2$ (c) $\left|a\right|>2$ (d) $1<\left|a\right|>2$

88. Let $f(x)=\begin{cases} \dfrac{a\,|x^2-x-2|}{2+x-x^2}, & x<2 \\ b, & x=2 \\ \dfrac{x-[x]}{x-2}, & x>2 \end{cases}$

[.] denotes the greatest integer unction) if f(x) is continuous at x = 2, then

(a) a = 1, b = 2 (b) a = 1, b = 1 (c) a = 0, b = 1 (d) a = 2, b = 1

89. Let $f(x)=[x]+\sqrt{x-[x]}$, where [x] denotes the greatest integer function. Then

(a) $f(x)$ is continuous on R^+

(b) $f(x)$ is continuous on R

(c) $f(x)$ is continuous on R - I

(d) $f(x)$ is continuous on (R – I) $\cup$ {0}

90. If $p_1 p=2(q_1+q)$ then which of following statement about the quadratic equations $x^2+px+q=0; x^2+p_1x+q_1=0$ is always true (Here $p,\ p_1, q, q_1, \in R$)

(a) Both the equations have real roots

(b) Both the equations have imaginary roots

(c) at least one of the equations has real roots

(d) exactly one of them has equal roots