SAMPLE PAPERS

JEE Advanced

PAPER - 1

Maximum Marks: 180

Important Instruction:

A. General: 1. This booklet is your Question Paper.
2. Blank papers, clipboards, log tables, slide rules, calculators, cameras, cellular phones, pagers and electronic gadgets are NOT allowed inside the examination hall.
3. Using a black ball point pen to darken the bubbles.

B. Question Paper Format :
The question paper consists of three parts (Physics, Chemistry and Mathematics).
Each part consists of three sections.
Section 1.Contains 10 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONLY ONE is correct.
Section 2.Contains 5 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE are correct.
Section 3.Contains 5 questions. The answer to each question is a single–digit integer, ranging from 0 to 9 (both inclusive)

C. Marking Scheme: For each question in Section 1, you will be awarded 2 marks if you are darken the bubble corresponding to the correct answer and zero mark if no bubbles are darkened. No negative marks will be awarded for incorrect answers in this section.
For each question in Section 2, you will be awarded 4 marks if you darken all the bubble(s) corresponding to only the correct answer(s) and zero mark if no bubbles are darkened. In all other cases, minus one (–1) mark will be awarded.
For each question in Section 3, you will be awarded 4 marks if you darken the bubble corresponding to only the correct answer and zero mark if no bubbles are darkened. In all other cases, minus one (–1) mark will be awarded.

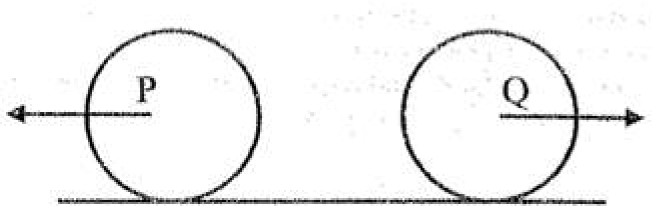
PART – A (PHYSICS)

SECTION – 1

This section contains 10 multiple choice questions. Each question has four choices (a), (b), (c), (d) out of which only one is correct.

1. A rectangular loop of sides of length 'ℓ' = 2m and 'b' = 0.5m is placed in X – Y plane inside a uniform but time varying magnetic field of strength $\vec{B} = 20t\hat{\imath} + 10t^2\hat{\jmath} + 50\hat{k}$ where t is time elapsed. The magnitude of induced e.m.f at time t is :
(a) 20 + 20 t (b) 20 (c) 20 t (d) zero

2. Two identical conducting rings P & Q of radius R are in pure rolling over a horizontal conducting plane with same speed (of center of mass) 'v' but in opposite direction . A constant magnetic field B is present pointing into the plane of paper. Then the potential between the highest points of two rings, is :

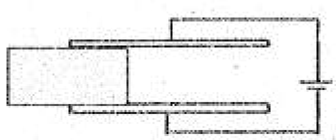


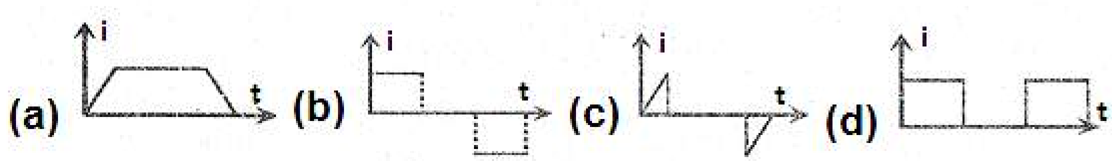
(a) zero (b) 2 Bvr (c) 4 Bvr (d) 8Bvr

3. A rectangular loop of sides 'a' and 'b' is placed in XY plane. A very long wire is also placed in XY plane such that side of length 'a' of the loop is parallel to the wire. The distance between the wire and the nearest edge of the loop is 'd'. The mutual inductance of this system is proportional to :
(a) a (b) b (c) 1/d (d) current in wire

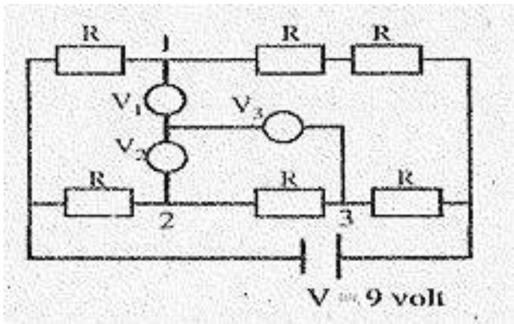
4. An infinite long straight conducting cylindrical shell of radius a is surrounded by a thin coaxial infinite conducting cylindrical shell of radius b. Assuming current flows uniformly through the cylindrical shell and returns through the outer shell, the inductance per unit length for this arrangement is
(a) $\frac{2\mu_0}{\pi}\ln\left(\frac{b}{a}\right)$ (b) $\frac{\mu_0}{\pi}\ln\left(\frac{b}{a}\right)$ (c) $\frac{\mu_0}{2\pi}\ln\left(\frac{b}{a}\right)$ (d) $\frac{\mu_0}{4\pi}\ln\left(\frac{b}{a}\right)$

5. Dielectric slab of area A passes between the capacitor plates of area 2A with a constant speed v. The variation of current (i) through the circuit as function of time (t) can be qualitatively represented as (the length of dielectric slab is half the length of the capacitor plates)





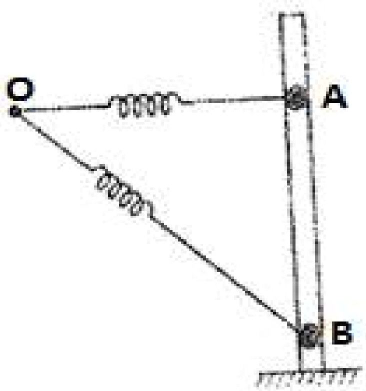
6. In the circuit shown below, all three voltmeters are identical and ideal. Each resistor has the same given resistance R. Voltage V is also given to be 9V. Find the reading of voltmeter V_3 (in volts).



(a) 1 (b) 2 (c) 3 (d) 4

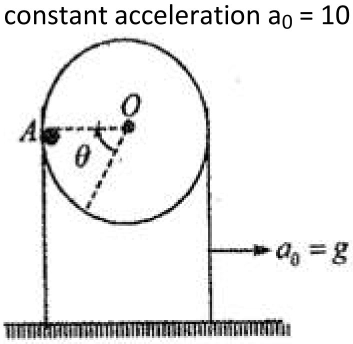
7. A charged particle of specific charge α moves with a velocity v = v_0i in a magnetic field $\vec{B} = \frac{B_0}{\sqrt{2}}(\hat{j} + \hat{k})$. Then the (specific charge = charge per unit mass)
(a) path of the particle is a helix
(b) path of the particle is a parabola
(c) distance moved by the particle in time t = $\frac{\pi}{B_0\alpha}$ is $\frac{\pi v_0}{B_0\alpha}$
(d) velocity of the particle after time t = $\frac{\pi}{B_0\alpha}$ is $\left(\frac{v_0}{2}\hat{\imath} + \frac{v_0}{2}\hat{\jmath}\right)$

8. A collar of mass 10 kg is released from rest from position A, when spring is in natural length and slides along a rough vertical fixed rod. The block comes to rest at point B, 4 m below the point A. The spring constant of spring is 100 N/m and natural length of spring is 3 m. Find work done by friction ('O' is a fixed point)



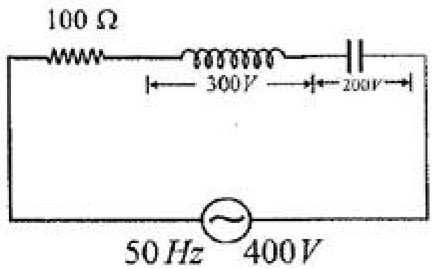
(a) – 100 J (b) – 200 J (c) – 300 J (d) – 400 J

9. Inside a smooth spherical cavity, particles A can slide freely. The block having this cavity is moving horizontally with constant acceleration $a_0 = 10\ m/s^2$.



The particle is released from rest (w.r.t. block) from its initial position as shown in the figure. The angle θ with the horizontal, when the particle will have maximum speed with respect to the block is
(a) 30° (b) 45° (c) 60° (d) 90°

10. In the circuit shown in figure current in the circuit is

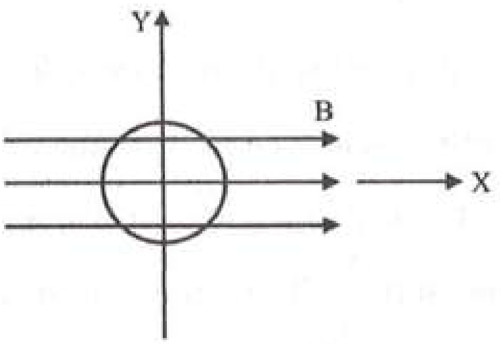


(a) 1.27 A (b) 2.23 A (c) 4.26 A (d) 3.87 A

SECTION – 2

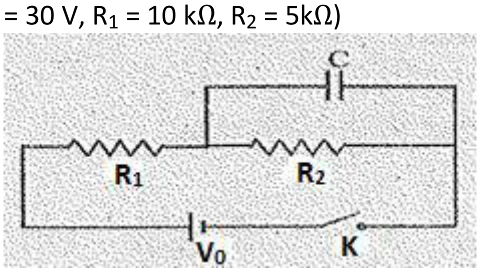
This section Contains 5 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE are correct.

11. A conducting loop of resistance R and radius 'r' has its center at the origin of the co-ordinate system in a magnetic field of induction B. When it is rotated about Y-axis through 90°, net charge flown in the coil is directly proportional to



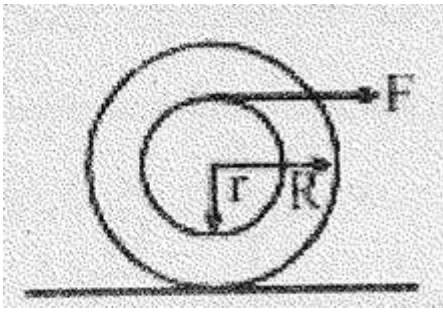
(a) R (b) B (c) r^2 (d) r

12. In the connection shown in the figure the switch K is open and the capacitor is uncharged. Then we close the switch and let the capacitor charge up to the maximum and open the switch again. Then (Use the following data : V_0 = 30 V, R_1 = 10 kΩ, R_2 = 5kΩ)



(a) the current through R_1 immediately after closing the switch is 3 mA
(b) the current through R_2 immediately after the switch was closed in 2 mA
(c) the current through R_2 immediately after reopening the switch 2 mA
(d) the current through R_1 immediately after reopening the switch is zero

13. A heavy homogenous cylinder has mass m and radius R. It is accelerated by a force F which is applied to the cylinder. The coefficient of static friction is sufficient for the cylinder to roll without slipping then



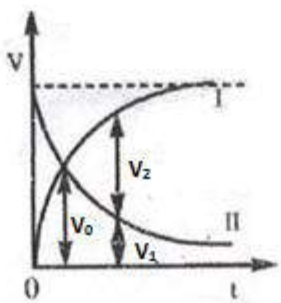
(a) The frictional force is $\frac{2F}{3}$

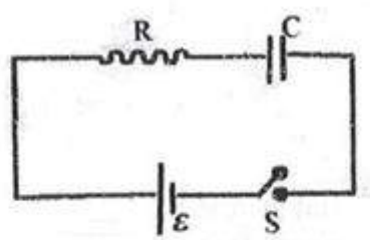
(b) The acceleration of the centre of the cylinder is $\frac{2F}{3mR}$ (R + r)

(c) It is possible to choose 'r' so that acceleration of centre of cylinder is greater than $\frac{F}{m}$

(d) The direction of frictional force is always opposite to F

14. In the given R – C circuit switch S is closed at t = 0 and the variation of potential drop across the resistor (V_R) and across capacitor (V_C) is represented by given plot, then :





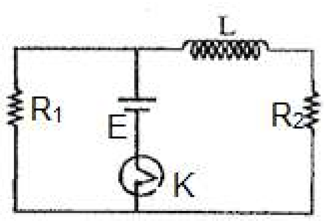
(a) $2V_0 = 2V_1 + V_2$

(b) $2V_0 = V_1 + V_2$

(c) curve I is for V_C and II is for V_R

(d) curve I is for V_R and II is for V_C

15. In the L – R circuit shown in the figure, the key K is closed at time t = 0.



(a) the current through R_1 decreases with time, t

(b) the voltage difference across L increases with t

(c) the magnetic energy stored, in the steady state, equals $\frac{1}{2}$ L $\frac{E^2}{R_2^2}$

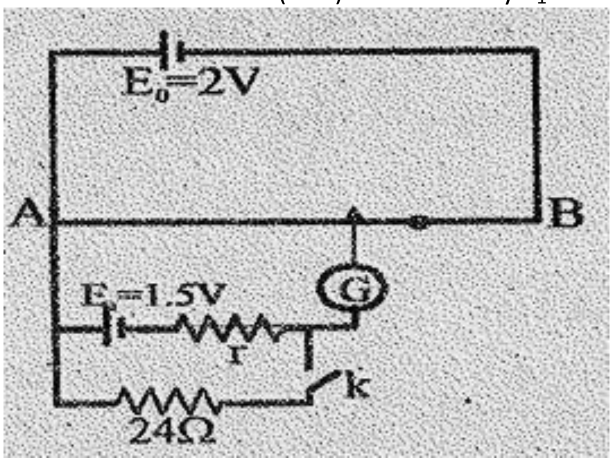
(d) the total current through the battery is $\frac{E}{R_1} + \frac{E}{R_2}$, in steady state

SECTION – 3

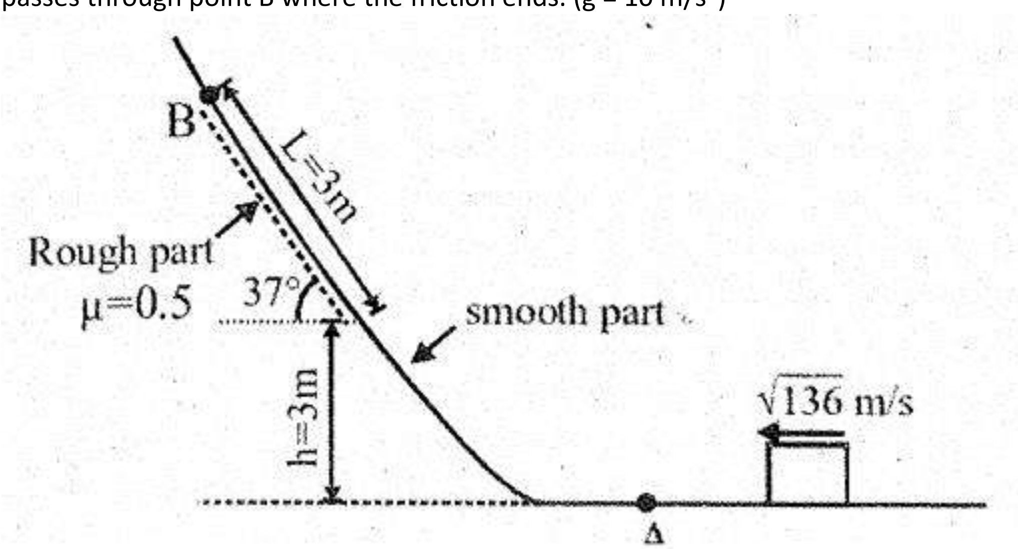
This section Contains 5 questions. The answer to each question is a single–digit integer, ranging from 0 to 9 (both inclusive)

16. A uniformly wound solenoidal coil of self-inductance 1.8×10^{-4} henry and resistance 6 ohm is broken up into two coils having lengths in the ratio 1 : 2. These identical coils are then connected in parallel across a 12 volt battery of negligible resistance. The steady state current through the battery is . . . . . . ampere.

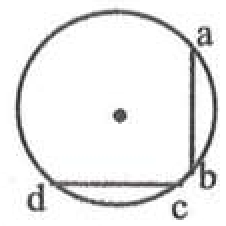
17. For the arrangement of the potentiometer shown in the figure, the balance point is obtained at a distance 75cm from A when the key k is open. The second balance point is obtained at 60 cm from A when the key k is closed. Find the internal resistance (in Ω) of the battery E_1.



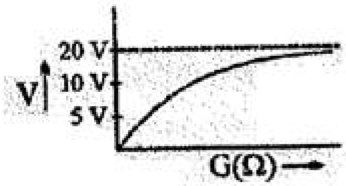
18. A small block slides along a path which is smooth until the block reaches the section of length L = 3m, which begins at height h = 3m on a flat incline of angle 37°, as shown in the figure. In that section, the coefficient of kinetic friction is 0.50. The block passes through point A with a speed of $\sqrt{136}$ m/s. Find the speed (in m/s) of the block as it passes through point B where the friction ends. (g = 10 m/s^2)

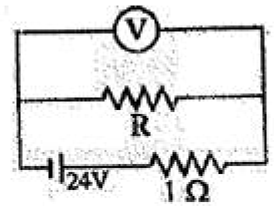


19. The two ends of a uniform thin rod of length $\sqrt{2}$R and of mass 2 kg can move without friction along a vertical circular path of radius R. The rod is released from the vertical position (ab). The force (in N) exerted by an end of the rod on the path when the rod passes the horizontal position (cd) is $\frac{10x}{\sqrt{2}}$. Then x is (Neglect the distance between b and c)



20. A cell of internal resistance 1 Ω is connected across a resistor. A voltmeter having variable resistance G is used to measure p.d across resistor. The plot of voltmeters reading V against G is shown. What is value of external resistor R (in ohm)?





PART – B (CHEMISTRY)

This section contains 10 multiple choice questions. Each question has four choices (a), (b), (c), (d) out of which only one is correct.

21. Ammonium carbonate decomposes as $NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$. For the reaction Kp = 2.9×10^{-5} atm^3. If we start with 1 mole of the compound, the total pressure at equilibrium would be

(a) 0.0766 atm (b) 0.0582 atm (c) 0.0388 atm (d) 0.0194 atm

22. Two weak monobasic organic acids HA and HB have dissociation constants as 3.0×10^{-5} and 1.5×10^{-5}, respectively, at 25°C. If 500 mL of 1M solutions of each of these two acids are mixed to produce 1 L of mixed acid solution, what is the pH of the resulting solution?

(a) pH = 3.32 (b) pH = 4.32 (c) pH = 2.32 (d) pH = 5.23

23. AgCl dissolved in excess NH_3, KCN and $Na_2S_2O_3$ solutions the complex produce ions

(a) $[Ag(NH_3)_2]^+$, $[Ag(CN)_2]^-$, $[Ag(S_2O_3)_2]^{-3}$ (b) $[Ag(NH_3)_2]^{+2}$, $[Ag(CN)_2]^{-3}$, $[Ag_4(S_2O_3)_2]^{+3}$

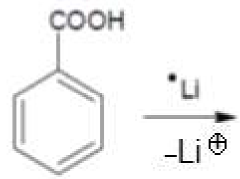
(c) $[Ag(NH_3)_2]^{+2}$; $[Ag(CN)_2]^+$; $[Ag_2(S_2O_3)_2]^{-2}$ (d) $[Ag(NH_3)_4]^+$; $[Ag(CN)_4]^{-3}$; $[Ag(S_2O_3)_2]^{-2}$

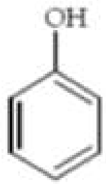
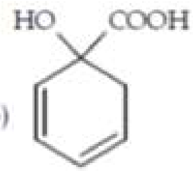
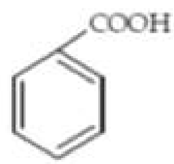
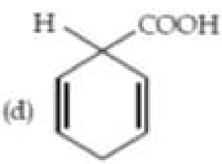
24. Give steps involved in the conversion of 1-iodo 2-methylcylopentane to 1-methylcyclopentanol.

(a) KOH, $Hg(OAC)_2$ and H_2O, $NaBH_4$ (b) KOH, NaOH + CaO, Zn

(c) KOH, $LiAlH_4$, Na (d) KOH, $NaBH_4$, Zn

25. Identify product in the reaction



(a) 
(b) 
(c) 
(d) 

26. Sulphur reacts with chlorine in 1 : 2 ratio and forms X. Hydrolysis of X gives a sulphur compound Y. What is the hybridization state of central atom in the anion of Y?
(a) sp^3 (b) sp (c) sp^2 (d) sp^2d

27. A metal gives two chlorides 'A' and 'B'. 'A' gives black precipitate with NH_4OH and 'B' gives white. 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, $HgCl_2$ (c) $HgCl_2$ and HgCl (d) none of these

28. True or False
S_1 : Interstitial compounds have high melting points, higher than those of pure metals.
S_2 : Permanganate titration in presence of hydrochloric acid are unsatisfactory.
S_3 : $KMnO_4$ does not act as an oxidizing agent in strong alkaline medium.
S_4 : $KMnO_4$ on heating in a current of H_2 gives MnO.
(a) T T F T (b) T F F T (c) T F T T (d) F F T F

29. During the electrolysis of $AgNO_3$, the volume of O_2 formed at STP due to passage of 2A of current for 965 s is
(a) 0.112 L (b) 0.224 L (c) 11.2 L (d) 22.4 L

30. The maximum amount of $BaSO_4$ predicated of moving 20 ml, of 0.5 M $BaCl_2$ with 20 mL of 1M H_2SO_4 is:
(a) 0.25 mole (b) 0.5 mole (c) 1 mole (d) 0.01 mole

SECTION: 2

This section Contains 5 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE are correct.

31. Identify the correct statement(s)
(a) Gypsum contains a lower percentage of calcium than plaster of Paris
(b) Gypsum is $CaSO_4 \cdot 2H_2O$
(c) Plaster of Paris is obtained by hydration of gypsum
(d) Gypsum is obtained by hydration of plaster of Paris

32. Consider the following statements
S_1 : Generally square planar complexes show geometrical isomerism but do not exhibit optical isomerism because they do not possess plane of symmetry

$S_2 : \Delta_t = \frac{4}{9}\ \Delta_0$

S_3 : In octahedral complexes each electron entering the t_{2g} orbtials stabilizes the complex ion by $0.4\Delta_0$ and each electron entering the e_g orbital destabilizes the complex by an amount of $0.6\Delta_0$

(a) S_1 and S_3 are correct
(b) S_2 and S_3 are correct
(c) S_1 is incorrect
(d) S_2 and S_3 are incorrect

33. Select the correct statements(s) with respect to oxides and oxoanions of transition metals.
(a) Among oxides of chromium, CrO is basic, Cr_2O_3 is amphoteric and CrO_3 is acidic
(b) No higher oxides of iron above Fe_2O_3 are found
(c) Ti, V, Cr and Mn form oxides MO and their correct increasing order of acidic character is
$MnO < CrO < VO < TiO$.
(d) Vandium (V) oxide does not react with acids but reacts with alkalies only.

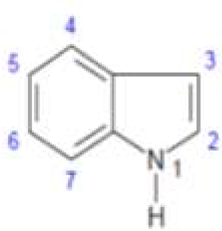
34. 0.1 mol of KMnO4 in acidic medium can oxidise
(a) 0.5 mol of Mohr's salt
(b) 0.25 mol of FeC_2O_4
(c) 0.25 mol of $H_2C_2O_4$
(d) 0.025 mol of ferric alum

35. Which of the following statement(s) is/are correct?
(a) Ethyne gas is more soluble in acetone than in water.
(b) CH_3F is more polar than CD_3F due to deuterium (D) being less electronegative than hydrogen (H)
(c) Silyl isocynate (SiH_3NCO) is linear in shape while methyl isocynate (CH_3NCO) is bent in shape.
(d) All of these

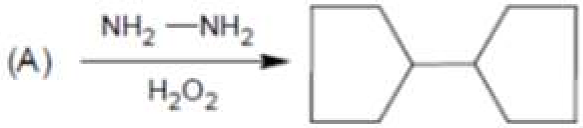
SECTION: 3

This section Contains 5 questions. The answer to each question is a single–digit integer, ranging from 0 to 9 (both inclusive)

36. Which of the following mentioned positions in the given compound is more reactive towards electrophilic substitutions?



37.



Double bond equivalent (degree of unsaturation) of (A) is :

38. k = 4.95×10^{-5} S cm^{-1} for a 0.001 M solution. The reciprocal of the degree of dissociation of acetic acid, if Λ_m^0 for acetic acid is 400 S cm^{-2} mol^{-1} is:

39. How many EDTA (ethylenediamietetra acetic aicd) molecules are required to make an octahedral complex with Ca^{2+}?

40. When $LiNO_3$ is heated, change in oxidation number of N is _________

PART – C (MATHEMATICS)

41. If $x^2 - x - 2$ is factors of $x^4 - \lambda x^2 - \mu$, then $\sqrt{(\lambda^2 - \mu^2)}$ equals

(a) 1 (b) 3 (c) 5 (d) 7

42. The number of solutions of $\sum_{r=1}^{5} \cos rx = 5$ in the interval [0, 2π] is

(a) 0 (b) 1 (c) 5 (d) 10

43. If $\sin^x\theta + \cos^x\theta \geq 1$, $0<\theta<\pi/2$, then

(a) $x \in [2, \infty)$ (b) $x \in (-\infty, 2]$ (c) $x \in [-1, 1]$ (d) $x \in [-2, 2]$

44. The number of real solutions of the equation $27^{1/x} + 12^{1/x} = 2(8^{1/x})$is

(a) one (b) two (c) infinite (d) zero

5. If a = $\sin\frac{\pi}{18}\sin\frac{5\pi}{18}\sin\frac{7\pi}{18}$, and x is the solution of the equation y = 2[x] + 2 and y = 3[x - 2], where [x] denotes the integral part of x, then 'a' is equal to

(a) [x] (b) $\frac{1}{[x]}$ (c) 2[x] (d) $[x]^2$

46. If 1, ω, ω^2 are the three cube roots of unity, then for α, β, γ,δ∈ R, the expression $\left(\frac{\alpha+\beta\omega+\gamma\omega^2+\delta\omega^2}{\beta+\alpha\omega^2+\gamma\omega+\delta\omega}\right)$ is

(a) 1 (b) ω (c) – ω (d) ω^{-1}

47. The number of positive integral solutions of $\frac{x^2(3x-4)^3(x-2)^4}{(x-5)^5(2x-7)^6} \leq 0$ is

(a) four (b) three (c) two (d) only one

48. If the equation $|\sin x|^2 + |\sin x| + b = 0$ has two distinct roots in [0, π], then the number of integers in the range of b is/are equal to

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

49. Set a, b ∈ [–π, π] be such that cos (a – b) = 1 and cos (a + b) = $\frac{1}{e}$. The number of pairs of a, b satisfying the above system of equation is

(a) 0 (b) 1 (c) 2 (d) 4

50. The number of solutions of 3 secθ – 5 = 4 tan θ in [0, 4π] must be

(a) 0 (b) 8 (c) 6 (d) 4

SECTION: 2

This section Contains 5 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE or MORE are correct.

51. The argument and the principal argument of the complex number $\frac{2+i}{4i+(1+i)^2}$, (where i = $\sqrt{-1}$) are

(a) $\tan^{-1}(-2)$ (b) $-\tan^{-1} 2$ (c) $\tan^{-1}\left(\frac{1}{2}\right)$ (d) $-\tan^{-1}\left(\frac{1}{2}\right)$

52. The roots of the equation, $(x^2 + 1)^2 = x(3x^2 + 4x + 3)$, are given by

(a) $2 - \sqrt{3}$ (b) $(-1 + i\sqrt{3})/2$, $i = \sqrt{-1}$ (c) $2 + \sqrt{3}$ (d) $(-1 - i\sqrt{3})/2$, $i = \sqrt{-1}$

53. In a triangle tan A + tan B + tan C = 6 and tan A tan B = 2, then the values of tan A, tan B and tan C are

(a) 1, 2, 3 (b) 2, 1, 3 (c) 1, 2, 0 (d) none of these

54. The common roots of the equations

$z^3 + (1 + i)z^2 + (1 + i) z + i = 0$, (where $i = \sqrt{-1}$) and $z^{1993} + z^{1994} + 1 = 0$ are

(a) 1 (b) ω (c) ω^2 (d) ω^{981}

55. Let a, b, c ∈ R. if $ax^2 + bx + c = 0$ has two real roots A and B where $A < -1$ and $B > 1$, then

(a) $1 + \left|\frac{b}{a}\right| + \frac{c}{a} < 0$ (b) $1 - \left|\frac{b}{a}\right| + \frac{c}{a} < 0$ (c) $|c| < |a|$ (d) $|c| < |a| - |b|$

SECTION: 3

This section Contains 5 questions. The answer to each question is a single–digit integer, ranging from 0 to 9 (both inclusive)

56. Let $f(x) = x^2 - px + q$, p is an odd positive integer and the roots of the equation f(x) = 0 are two distinct prime numbers, If p + q = 35, then the value of $f(10)\left(\sum_{r=1}^{10} f(r)\right) - 878$ equal to

57. If f is a function such that f(0) = 2, f(1) = 3 and f(x + 2) = 2f(x) – f(x + 1) for every real x, then f(5) – 10 =

58. If $\tan\left(\frac{3\pi}{11}\right) + 4\sin\left(\frac{2\pi}{11}\right) = \lambda$ then the value of $\lambda^2 - 9$ is equal to

59. The number of values of x between 0 and 2π that equation sin x + sin 2x + sin 3x = cos x + cos 2x + cos 3x must be

60. If $\frac{1}{\cos 290^\circ} + \frac{1}{\sqrt{3}\sin 250^\circ} = \lambda$, then the value of $3\lambda^2 - 13$ must be