EENADU
PRATHIBHA NET
JEE-ADVANCED-2017
MODEL PAPER-I

Time: 9:00 A.M to 12:00 P.M **Max Marks: 252**

CHEMISTRY

SECTION-I

Single correct Choice Type

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE is correct.

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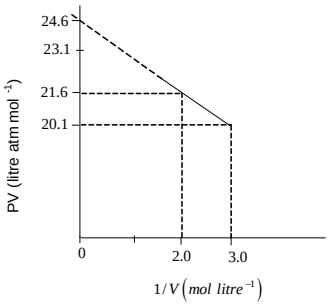
1. 0.84g of a divalent metal carbonate required 80ml of 0.125 M H_2SO_4 to react completely. The atomic weight of metal is
   A) 42 B) 84 C) 12 D) 24

2. For one mole of a vander waal's gas when $b = 0$ and $T = 300K$, the PV vs. 1/V plot is shown below. The value of the vander waal's constant 'a' $\left(atm\ L^2\ mol^{-2}\right)$



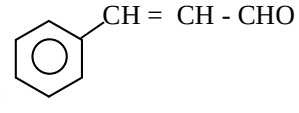
   A) 1.0 B) 4.5 C) 1.5 D) 3.0

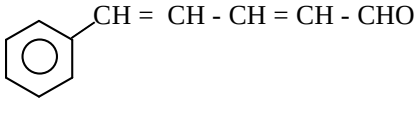
3. Which of the following is wrong about silicones?
   A) They are formed by hydrolysis of $R_2\ SiCl_2$
   B) They are polymers, made up of Si- O- Si linkages
   C) They are made up of SiO_4^{4-} units D) They are macromolecules

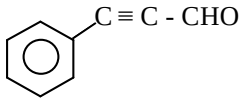
4. A black, water insoluble powder (A) liberates yellowish green gas (B) on treatment with conc. HCl and (A) dissolves to give a clear solution. Solid (A) when heated with PbO_2 and HNO_3 (or) sodium bismuthate & H_2SO_4 gives a purple solution (C). The purple solution is due to the formation of
   A) MnO_4^- B) MnO_4^{2-} C) Mn^{+4} D) Mn_2O_3

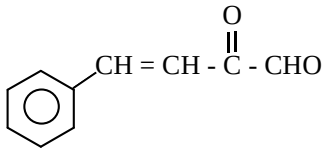
5. Identify the statement which is not correct regarding $CuSO_4$.
   A) It reacts with KI to give iodine
   B) It reacts with NaOH and glucose to give Cu_2O
   C) It reacts with KCl to give Cu_2Cl_2
   D) It gives CuO on strong heating

6. An aldehyde, (P) which does not undergo self aldol condensation gives benzaldehyde and two moles of (Q) on ozonolysis. Compound (Q), on oxidation with silver ions gives oxalic acid. The structure of (P) is given as

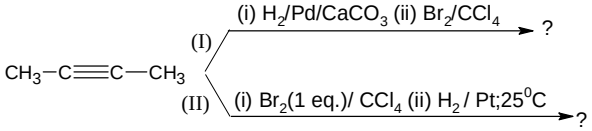
A) 

B) 

C) 

D) 

7. The product of the following I and II sequence are related as



A) Diastereomers B)Identical

C) Enantiomers D) Geometrical isomers

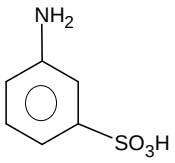
8. A white crystalline solid 'X' give following chemical test:

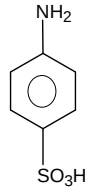
(i) It liberates CO_2 with $NaHCO_3$

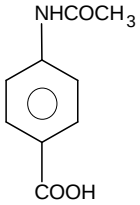
(ii) It forms a coloured dye on diazotization and coupling with β – Naphthol

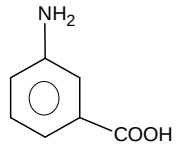
(iii) With Br_2 water it forms white precipitate of 2, 4, 6 – tribromo aniline.

'X' can be identified as:

A) 

B) 

C) 

D) 

SECTION – II

Multiple Correct Choice Type

This section contains 5 multiple correct answer(s) type questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONE OR MORE may be correct.

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9. Select the correct statements.

A) Chelation effect is maximum for five and six membered ring.

B) greater the charge on the central metal cation greater the value of CFSE (Δ_O).

C) In complex ion $\left[CoF_6\right]^{3-}$. F^- is weak field ligand so that Δ_{oct} < pairing energy and it is low spin complex

D) $\left[CoCl_2\left(NH_3\right)_2\left(en\right)\right]^+$ complex ion will have four different isomers.

10. In a hydrogen like atom, electron is in 2^{nd} excited state, the binding energy of fourth state of this atom is 13.6 eV, then

A) A 25 eV photon can set free the electron from the second excited state of this sample.

B) 3 different types of photon will be observed if electrons make transition up to ground state from the second excited state

C) If 23 eV photon is used then K.E. of the ejected electron is 1 eV.

D) 2^{nd} line of balmer series of this sample has same energy value as 1^{st} excitation energy of H-atoms

11. The incorrect statements among the following is

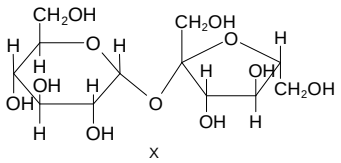
A) Out of PO_4^{3-}, $\left[Fe(CN)_6\right]^{4-}$, SO_4^{2-} *and* Cl^-, flocculating value of $\left[Fe(CN)_6\right]^{4-}$ ion is maximum in the flocculation of $Fe(OH)_3$ sol .

B) During adsorption of a gas on a solid surface, entropy increases

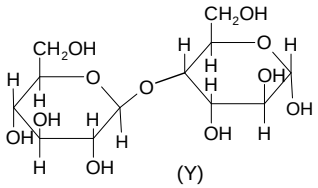
C) The higher the ease of liquefaction of a gas, the greater will be its extent of physisorption

D) Zeolite catalyst ZSM – 5 converts alcohols directly into gasoline.

12. The correct statement(s) about the following sugars X and Y is/are



X



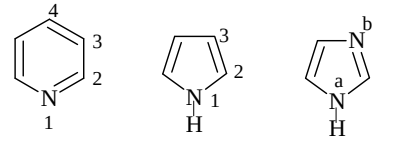
(Y)

A) X is a non-reducing sugar and Y is a reducing sugar

B) Both X and Y shows muta rotation.

C) X does not show muta rotation and Y shows muta rotation.

D) X show muta rotation and Y does not shows muta rotation.

13. 

Pyridine (I) Pyrrole (II) Imidazole (III)

Which one/s is/are true about the above compounds?

A) I and III are modest bronsted bases whereas II is not.

B) In III N^a is more basic than N^b

C) When II is protonated in presence of a strong acid, protonation occurs at C(2)

D) All the nitrogens present in (I), (II) and (III) are sp^2 hybridised.

SECTION – III

Paragraph Type

This section contains 2 paragraphs. Based upon the first paragraph 3 multiple choice questions and based upon the second paragraph 2 multiple choice question have to be answered. Each of these questions has four choice (A), (B), (C) and (D), out of which ONLY ONE is correct.

Paragraph for Questions Nos. 14 to 16

Electrical energy produced by a reversible electrochemical cell is given by the free energy decrease $(-\Delta G)$ of the reaction occurring in the cell. According to Gibbs- Helmholtz equation, decrease in free energy is given by $-\Delta G = -\Delta H - T\left[\frac{\partial(\Delta G)}{\partial T}\right]_P$ where $-\Delta H$ is the decrease in enthalpy of the cell reaction at constant pressure. EMF of the cell, $E = \frac{-\Delta H}{nF} + T\left[\frac{\partial E}{\partial T}\right]_P$. By measuring the emf of the cell and its temperature co-efficient, thermodynamic quantities like $\Delta H, \Delta G$ *and* ΔS can be determined. Standard emf of the cell is related to equilibrium constant of the cell reaction as $E^0 = \frac{2.303RT\log k}{nF}$.

14. EMF of the cell, $\underset{(s)}{A}\left|\underset{\substack{(aq)\\1M}}{A^{2+}}\right|\left|\underset{\substack{(aq)\\0.1M}}{B^{+}}\right|\underset{(s)}{B}$ is found to be 1.475 Volt. The equilibrium constant of the cell reaction at 25^0C is (approximately)

A) 1×10^{27} B) 1×10^{52} C) 1×10^{48} D) 1×10^{23}

15. From the following values of electrode potentials,

i) $(fumarate)^{2-} + 2H^+ + 2e^- \rightarrow (succinate)^{-2}, E_1^0 = 0.03V$ and

ii) $(pyruvate)^- + 2H^+ + 2e^- \rightarrow (lactate)^-, E_2^0 = -0.18V$. Calculate ΔG^0 for the reaction,

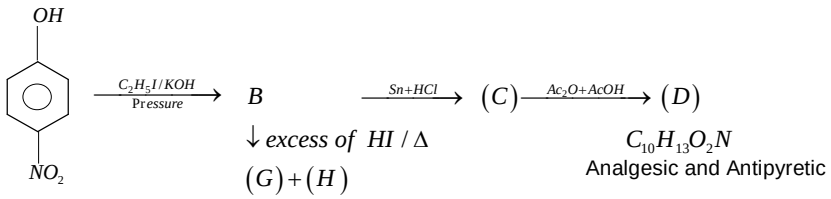
$(fumarate)^{2-} + (lactate)^- \rightarrow (succinate)^{-2} + (pyruvate)^-$

A) -28.95 kJ B) +40.53 kJ C) -75.27 kJ D) -40.53 kJ

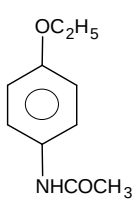
16. The standard emf of the cell, $\underset{(s)}{Zn}\left|\underset{(aq)}{Zn^{+2}}\right|\left|\underset{(aq)}{Fe^{+3}}, \underset{(aq)}{Fe^{+2}}\right| Pt$ *at* 25^0C is 1.53 V and at 50^0C is 1.55 V. The value of ΔS^0 for the overall reaction is

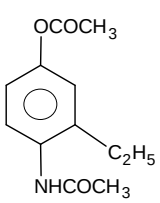
A) 154.4 JK^{-1} B) –154.4 JK^{-1} C) 154.4 $KJ\ K^{-1}$ D) 77.2 JK^{-1}

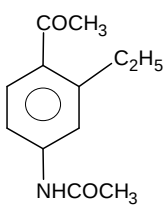
Paragraph for Questions Nos. 17 to 18

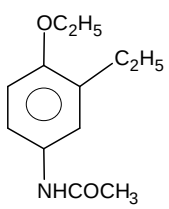


17. The compound (D) is :

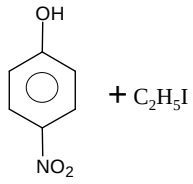
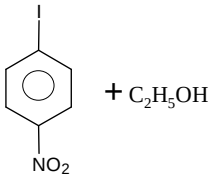
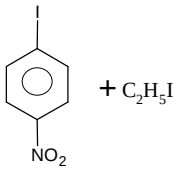
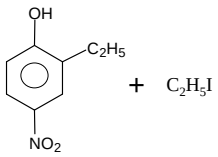
A) 

B) 

C) 

D) 

18. The compounds (G) and (H), respectively, are ;

A)  B)  C)  D) 

SECTION – IV
(Integer Type)

This section contains 10 questions. The answer to each question is a single-digit integer, ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

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19. In a borax molecule the number of boron atoms having sp^3 hybridised are ------

20. When 400 ml of 0.2 M acetic acid is mixed with 800 ml of 0.5 M $NaOH$ solution, 4.416KJ of heat is liberated. The amount of heat utilised for complete dissociation of acetic acid is (0.3 ×y)kJ/mol. The value of 'y' is _____

21. The length of a side of a unit cell of cesium chloride as determined by X ray diffraction pattern is 412.1 pm. What is the density of caesium chloride (in g/cc)? Caesium chloride crystallizes as a body centered cubic lattice. (Atomic wt. of Cs = 133).

22. The freezing point of a solution containing 28.335 cm^3 of ethylene glycol in 50 gm water is found to be –34°C. Assuming ideal behaviour, calculate the density of ethylene glycol. K_f for water 1.86 k kg mol^{-1}.

23. In the reaction $xBrO_3^- + yCr^{3+} + zH_2O \rightarrow Br_2 + HCrO_4^- + H^+$, the value of 'x'is------

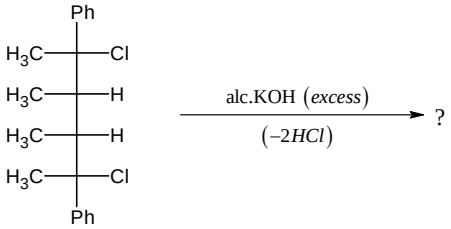
24. For the equilibrium : $LiCl.3NH_3(s) \rightleftharpoons LiCl.NH_3(s) + 2NH_3(g)$, $Kp = 9\ atm^2$ at 27^0C. A 4.92 litre vessel contains 0.1 mole of $LiCl.NH_3$. The number of moles of NH_3 should be added to the flask at this temperature to drive the back ward reaction for completion is $(0.2 \times y)$. The value of 'y' is-----

25. The inversion of Cane sugar proceeds with constant half-life of 500 minutes at $pH = 5$ for any concentration of sugar. However if $pH = 6$, the half-life changes to 50minutes. For this reaction rate equation is rate = k [sugar]^m [H^+]^n. The value of "n" is.

26. Dipole moment of certain diatomic molecule X-Y is 0.38D. If X-Y bond length is 158pm, the Percentage of electronic charge developed on 'X' atom is -----

27. How many moles of acetyl chloride are used per mole of sucrose for esterification

28. What is the number of stereoisomer/s of major product formed in the following reaction?



MATHEMATICS

SECTION – I

Single Correct Choice Type

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE is correct.

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29. $\vec{a}$ and $\vec{b}$ are non zero non–collinear vectors such that $|\vec{a}| = 2$, $\vec{a} \cdot \vec{b} = 1$ and angle between $\vec{a}$ and $\vec{b}$ is $\frac{\pi}{3}$. If $\vec{r}$ is any vector satisfying $\vec{r} \cdot \vec{a} = 2$, $\vec{r} \cdot \vec{b} = 8$, $(\vec{r} + 2\vec{a} - 10\ \vec{b}) \cdot (\vec{a} \times \vec{b}) = 6$ and $\vec{r} + 2\vec{a} - 10\ \vec{b} = \lambda\,(\vec{a} \times \vec{b})$ then $\lambda =$

A) $\frac{1}{2}$ B) 2 C) $\frac{4}{\sqrt{3}}$ D) 3

30. Let 'F' denote the set of all onto functions from $A = \{a_1, a_2, a_3, a_4\}$ to $B = \{x, y, z\}$. A function 'f' is chosen at random from 'F'. The probability that $f^{-1}\{x\}$ consists of exactly one element.

A) $\frac{2}{3}$ B) $\frac{4}{3}$ C) $\frac{1}{3}$ D) $\frac{1}{6}$

31. Let a, b and c be positive constants. The value of 'a' in terms of 'c' if the value of integral $\int_0^1 \left(acx^{b+1} + a^3 bx^{3b+5}\right) dx$ is independent of 'b' equals

A) $\sqrt{\frac{3c}{2}}$ B) $\sqrt{\frac{2c}{3}}$ C) $\sqrt{\frac{c}{3}}$ D) $\sqrt{\frac{3}{2c}}$

32. The equation $x^2 - 2 = [\sin x]$, where $[.]$ denotes the greatest integer function, has

A) infinitely many roots B) only one root which is an integer
C) only one root which is irrational D) exactly two roots

33. O is the circumcentre of ΔABC and R_1, R_2 and R_3 are the radii of the circum circles of Δ^{les} OBC,OCA and OAB, respectively. Let a, b and c be the sides of Δ^{le} ABC. The value of $aR_1^{-1} + bR_2^{-1} + cR_3^{-1}$ is

A) $\frac{abc}{R^3}$ B) $\frac{abc}{4R^3}$ C) $\frac{abc}{2R^3}$ D) $\frac{abc}{R}$

34. The lines $y = -\frac{3}{2}x$ and $y = -\frac{2}{5}x$ intersect the curve $3x^2 + 4xy + 5y^2 - 4 = 0$ at the points P and Q respectively. The tangents drawn to the curve at P and Q

A) Intersect each other at angle of 45° B) are parallel to each other
C) are perpendicular to each other D) Intersect each other at angle of 15°

35. The set of values of 'α' for which three distinct chords drawn from $(\alpha, 0)$ to the ellipse $x^2 + 2y^2 = 1$ are bisected by the parabola $y^2 = 4x$ is

A) $(8, \infty)$ B) $\left(0, -4+\sqrt{17}\right)$ C) $\left(0, 4+\sqrt{17}\right)$ D) $\left(8, 4+\sqrt{17}\right)$

36. The quadrilateral formed by the lines $y = ax + c, y = ax + d, y = bx + c$ and $y = bx + d$ has area 18. The quadrilateral formed by the lines $y = ax + c, y = ax - d, y = bx + c$ and $y = bx - d$ has area 72. If a, b, c, d are positive integers then the least possible value of the sum $a + b + c + d$ is

A) 13 B) 14 C) 15 D) 16

SECTION – II
Multiple Correct Choice Type

This section contains 5 multiple correct answer(s) type questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONE OR MORE may be correct.

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37. If $'A_i'$ is the area bounded by $|x-a_i|+|y|=b_i, i\in N$, where $a_{i+1}=a_i+\frac{3}{2}b_i$ and $b_{i+1}=\frac{b_i}{2}$, $a_1=0,\ b_1=32$ then

A) $A_3=128$ B) $A_3=256$ C) $\lim\limits_{n\to\infty}\sum\limits_{i=1}^{n}A_i=\frac{8}{3}(32)^2$ D) $\lim\limits_{n\to\infty}\sum\limits_{i=1}^{n}A_i=\frac{4}{3}(16)^2$

38. Which of the following statements are true with respect to definite integrals ?

A) $\int\limits_0^{\pi/2}\cos^m x\sin^m x\,dx=2^{-m}\int\limits_0^{\pi/2}(\cos x)^m\,dx,\ m\in N$

B) $\int\limits_0^{\pi}\frac{x\sin x}{1+\cos^2 x}dx=\frac{\pi}{2}\int\limits_0^{1}\frac{dx}{1+x^2}$ C) $\int\limits_0^{\pi/2}\frac{\cos 3x+1}{2\cos x-1}dx=\int\limits_0^{\pi/2}\frac{1-\cos 3x}{1+2\cos x}dx$

D) $\int\limits_0^{\pi/2}\left(\frac{1+\sin 3x}{1+2\sin x}\right)dx=\int\limits_0^{\pi/2}\frac{\cos 3x+1}{2\cos x-1}dx$

39. The equation $a_8X^8+a_7X^7+a_6X^6+.....+a_0=0$ has all its roots positive and real (where $a_8=1,\ a_7=-4,\ a_0=\frac{1}{2^8}$), then which of the following is/are true?

A) $a_1=\frac{1}{2^8}$ B) $a_1=-\frac{1}{2^4}$ C) $a_2=\frac{7}{2^4}$ D) $a_3=\frac{1}{2^2}$

40. The equation $\left(\frac{x}{x+1}\right)^2+\left(\frac{x}{x-1}\right)^2=a(a-1)$ has

A) all real roots if $a>2$ B) two real roots if $1<a<2$

C) no real root if $a<-1$ D) all real roots if $a<-1$

41. Let P and Q be two points denoting the complex numbers α and β respectively on the complex plane. Which of the following equations can represent the equation of the circle passing through P and Q with least possible area ?

A) $\arg\left(\frac{z-\alpha}{z-\beta}\right)=\frac{\pi}{2}$ B) $\mathrm{Re}(z-\alpha)\left(\overline{z-\beta}\right)=0$

C) $|z-\alpha|^2+|z-\beta|^2=\left|\overline{\alpha-\beta}\right|^2$ D) $z\bar{z}+\left(\frac{\bar{\alpha}+\bar{\beta}}{2}\right)z+\left(\frac{\alpha+\beta}{2}\right)\bar{z}+\alpha\bar{\beta}+\bar{\alpha}\beta=0$

SECTION – III

Paragraph Type

This section contains 2 paragraphs. Based upon the first paragraph 3 multiple choice questions and based upon the second paragraph 2 multiple choice question have to be answered. Each of these questions has four choice (A), (B), (C) and (D), out of which ONLY ONE is correct.

Paragraph for Questions Nos. 42 to 44

A rectangle $ABCD$ of dimensions r and $2r$ is folded along diagonal BD such that planes ABD and CBD are perpendicular to each other. Let the position of the vertex A remains unchanged and C_1 is the new position of C.

42. The distance of C_1 from A is equal to

A) $\frac{2\sqrt{5}\,r}{5}$ B) $\frac{2\sqrt{10}\,r}{5}$ C) $\frac{\sqrt{85}\,r}{5}$ D) $\frac{4r}{5}$

43. If $\angle ABC_1 = \theta$, then $\cos\theta$ is equal to

A) $\frac{1}{5}$ B) $\frac{2}{5}$ C) $\frac{2}{\sqrt{5}}$ D) $\frac{4}{5}$

44. The shortest distance between the edge AB and C_1D is equal to..... (in units)

A) $\frac{\sqrt{5}\,r}{3}$ B) $2r$ C) r D) $\frac{4r}{\sqrt{5}}$

Paragraph for Questions Nos. 45 to 46

A slip of paper is given to a person A who marks it either with a plus sign or a minus sign. The probability of his writing a plus sign is 1/3. A passes the slip to B, who may either leave it alone or change the sign before passing it to C. Next C passes the slip to D after perhaps changing the sign. Finally D passes it to a referee after perhaps changing the sign. B, C, D each change the sign with probability 2/3.

45. The probability that the referee observes a plus sign on the slip if it is known that A wrote a plus sign is

A) 14/27 B) 13/41 C) 13/27 D) 27/41

46. If the referee observes a plus sign on the slip then the probability that A originally wrote a plus sign is

A) 14/27 B) 13/41 C) 13/27 D) 27/41

SECTION – IV

(Integer Type)

This section contains 10 questions. The answer to each question is a single-digit integer, ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

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47. The minimum value of the sum of real numbers $a^{-5}, a^{-4}, 3a^{-3}, 1, a^8$ *and* a^{10} With $a > 0$ is

48. Given that $\int_1^y \text{Sec}^{-1}x\,dx = \lambda$ and for $(|y| \geq 1)$,
if $\int_{-y}^{-1}\{\text{Sec}^{-1}x - \text{Tan}^{-1}\left(\sqrt{x^2-1}\right)\}dx + \int_1^y \{\text{Sec}^{-1}x - \text{Tan}^{-1}\left(\sqrt{x^2-1}\right)\}dx =$
$\pi(y-a) - b\lambda$, then a+b = ___

49. A continuous function $y = f(x)$ is defined on $[-7,5]$. $A(-7,-4), B(-2,6), C(0,0)$, $D(1,6)$, $E(5,-6)$ are consecutive points on the graph of 'f' and AB, BC, CD, DE are line segments. The number of real roots of the equation $f[f(x)] = 6$ is

50. In ΔABC Orthocentre is (2,3) Circum centre is (6,10) and equation of side $\overleftrightarrow{BC}$ is $2x + y = 17$. Then the radius of the Circum circle of ΔABC is

51. The integral $\int_{\pi/4}^{5\pi/4}\left(|\cos t|\sin t + |\sin t|\cos t\right)dt$ has the value equal to 'k' then [k] is
([.] denotes the greatest integer function).

52. In a square matrix 'A' of order 3 , $'a_{ii}'s$ are the sum of the roots and $'a_{i,i+1}'s$ are the product of the roots of the equation $x^2 - 5x + 6 = 0$; $'a_{i,i-1}'s$ are all unity and the rest of the elements are all zeros. The value of the determinant (A) is equal to 'k'. The least prime number that divides it is

53. C is the centre of the hyperbola $\frac{x^2}{4} - \frac{y^2}{1} = 1$ and 'A' is any point on it. The tangents at A to the hyperbola meet the line $x - 2y = 0$ and $x + 2y = 0$ at Q and R respectively. The value of $CQ.CR$.

54. Total number of even divisors of '1323000' which are divisible by 105 is $2^k - 10$, then k is

55. The area bounded by $y = 2 - |2 - x|$; $y = \frac{3}{|x|}$ is $\frac{k - 3\ln 3}{2}$, then $k =$_____

56. $f(x)$ is odd differentiable function on $(-\infty, \infty)$ such that $f'(3) = 2$, then $f'(3) + f'(-3)$ is

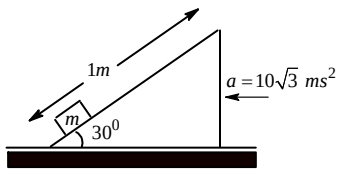
PHYSICS

SECTION – I
Single Correct Choice Type

This section contains 8 multiple choice questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONLY ONE is correct.

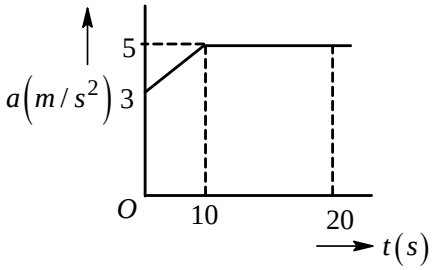
---

57. In the figure, the wedge is pushed with an acceleration of $10\sqrt{3}\,m/s^2$. It is seen that the block starts climbing upon the smooth inclined face of wedge. What will be the time taken by the block to reach the top?



A) $\frac{2}{\sqrt{5}}s$ B) $\frac{1}{\sqrt{5}}s$ C) $\sqrt{5}s$ D) $\frac{\sqrt{5}}{2}s$

58. The graph describes an airplane's acceleration during its take – off. The airplane's velocity when it lifts off at $t = 20s$ is



A) $40m/s$ B) $50m/s$ C) $90m/s$ D) $180m/s$

59. In the formula $X = 3YZ^2$, X and Z have dimensions of capacitance and magnetic induction respectively. What are the dimensions of Y ?

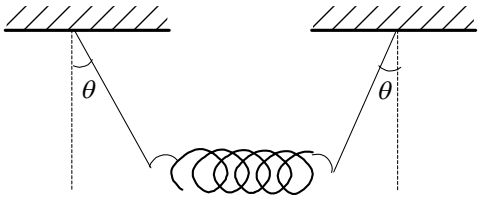
A) $\left[M^{-3}L^{-1}T^3Q^4\right]$ B) $\left[M^{-3}L^{-2}T^4Q^4\right]$

C) $\left[M^{-2}L^{-2}T^4Q^4\right]$ D) $\left[M^{-3}L^{-2}T^4Q\right]$

60. Two identical wires have a fundamental frequency 100 Hz when kept under the same tension. If the tension of one of the wires is increased by 21%,then number of beats produced is

A) 5 B) 10 C) 3 D) 2

61. In the system as shown, a spring of constant K and weight 'W' is suspended with two strings. The extension of the spring is $\frac{W\sqrt{3}}{2K}$. The angle $'\theta'$ in the figure is



A) 30° B) 45° C) 60° D) $22\frac{1}{2}^\circ$

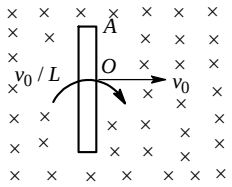
62. A particle is projected from the trolley with a velocity $v\hat{i} + 2v\hat{j} + v\hat{k}$ relative to the ground. x-y plane is horizontal. Trolley moves with a constant velocity $3v\hat{i}$ for some time and then starts moving towards + y axis with constant velocity. After some time the particle drops into the trolley. The magnitude of the velocity of the trolley along y-axis is :

A) 3v B) 2v C) v D) 0.5v

63. A block of mass m moving with speed v collides with another block of mass 2 m at rest. The lighter block comes to rest after collision. The value of coefficient of restitution is

A) $\frac{1}{2}$ B) $\frac{1}{3}$ C) $\frac{3}{4}$ D) $\frac{1}{4}$

64. A conducting rod of length L is moving on a horizontal smooth surface. Magnetic field in the region is vertically downward and of magnitude B_0. If centre of mass of the rod is translating with velocity v_0 and rod rotates about centre of mass with angular velocity v_0 / L then potential difference between points O and A will be



A) $\frac{5}{8}B_0v_0L$ B) $\frac{3}{8}B_0v_0L$ C) $\frac{1}{8}B_0v_0L$ D) $\frac{1}{2}B_0v_0L$

SECTION – II

Multiple Correct Choice Type

This section contains 5 multiple correct answer(s) type questions. Each question has 4 choices (A), (B), (C) and (D), out of which ONE OR MORE may be correct.

---

65. 10 g of ice at 0^0C is mixed with 5g of steam at100^0C. If latent heat of fusion of ice is 80 cal/g and latent heat of vaporization of 540 cal/g. Then at thermal equilibrium

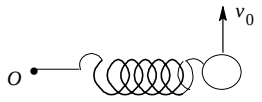
A)Temperature of the mixture is 0^0C

B)Temperature of mixture is 100^0C

C)Mixture contains 13.3g of water and 1.67 g of steam

D)Mixture contains 5.3g of ice and 9.7g of water

66. One end of an ideal spring is fixed at point O and other end is attached to a small disc of mass m which is given an initial velocity v_0 perpendicular to its length on a smooth horizontal surface. If the maximum elongation of the spring is $\frac{l_0}{4}$ then (l_0 = natural length, k = stiffness of the spring)



A) Velocity at maximum elongation is $\frac{4v_0}{5}$

B) Velocity at maximum elongation is $\frac{3v_0}{5}$

C) $v_0 = \frac{5l_0}{12}\sqrt{\frac{k}{m}}$ D) $v_0 = \frac{l_0}{12}\sqrt{\frac{k}{m}}$

67. A charged particle is projected in magnetic field $\vec{B} = 10\hat{k}$ T from origin in X – Y plane. The particle moves in a circle and just touches a line $y = 5m$ at $x = 5\sqrt{3}\,m$. Then (mass of particle = 5 × 105kg and charge $1\mu c$

A) The particle is projected at an angle 60° with X – axis

B) The radius of circle is 10m

C) Speed of particle is 2m/s

D) Work done by magnetic force on the particle is zero

68. The plates of parallel plate capacitor are separated by a solid dielectric. This capacitor and a resistor are connected in series across the terminals of a battery. Now the plates of the capacitor are pulled slightly farther apart. When equilibrium is restored in the circuit, Choose wrong option(s)

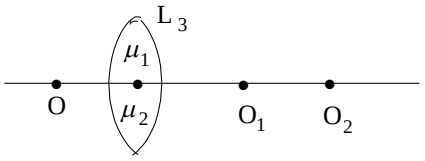
A) The potential difference across the plates has increased

B) The energy stored on the capacitor has increased

C) The capacitance of the capacitor has increased

D) The charge on the plates of the capacitor has decreased

69. Consider three converging lenses L_1, L_2 and L_3 having identical geometrical construction. The refractive index of L_1 and L_2 are μ_1 and μ_2 respectively. The upper half of the lens L_3 has a refractive index μ_1 and the lower half has μ_2. A point O is imaged at O_1 by the lens L_1 and at O_2 by the lens L_2 placed in same position. If L_3 is placed at same place,



A) There will be an image at O_1 B) There will be an image at O_2

C) The only image will form somewhere between O_1 O_2

D) The only image will form away from O_2

SECTION – III

Paragraph Type

This section contains 2 paragraphs. Based upon the first paragraph 3 multiple choice questions and based upon the second paragraph 2 multiple choice question have to be answered. Each of these questions has four choice (A), (B), (C) and (D), out of which ONLY ONE is correct.

Paragraph for Questions Nos. 70 to 72

A radio nuclide with decay constant λ is being produced in a nuclear reactor at a rate q_0t per second, where q_0 is positive constant and t is the time. During each decay E_0 energy is released. The production of radio nuclide starts at time $t = 0$

70. Which differential equation correctly represents the above process

A) $\frac{dN}{dt} + \lambda N = q_0 t$ B) $\frac{dN}{dt} - \lambda N = q_0 t$

C) $\frac{dN}{dt} + q_0 t = \lambda N$ D) $\frac{dN}{dt} + q_0 t = -\lambda N$

71. Instantaneous power developed at time‘t’ due to the decay of the radio nuclide

A) $\left[q_0 t - \frac{q_0}{\lambda} + \frac{q_0}{\lambda} e^{-\lambda t} \right] E_0$ B) $\left[q_0 t + \frac{q_0}{\lambda} - \frac{q_0}{\lambda} e^{-\lambda t} \right] E_0$

C) $\left[q_0 t + \frac{q_0}{\lambda} + \frac{q_0}{\lambda} e^{-\lambda t} \right] E_0$ D) $\left[q_0 t - \frac{q_0}{\lambda} - \frac{q_0}{\lambda} e^{-\lambda t} \right] E_0$

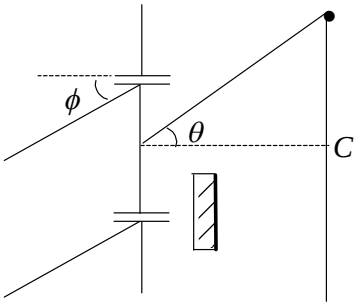
72. Average power developed in time‘t’ due to the decay of the radio nuclide

A) $\left[\frac{q_0 t}{2} - \frac{q_0}{\lambda} + \frac{q_0}{\lambda^2 t} - \frac{q_0}{\lambda^2 t} e^{-\lambda t} \right] E_0$ B) $\left[\frac{q_0 t}{2} + \frac{q_0}{\lambda} + \frac{q_0}{\lambda^2 t} - \frac{q_0}{\lambda^2 t} e^{-\lambda t} \right] E_0$

C) $\left[\frac{q_0 t}{2} - \frac{q_0}{\lambda} + \frac{q_0}{\lambda^2 t} + \frac{q_0}{\lambda^2 t} e^{-\lambda t} \right] E_0$ D) $\left[\frac{q_0 t}{2} + \frac{q_0}{\lambda} + \frac{q_0}{\lambda^2 t} + \frac{q_0}{\lambda^2 t} e^{-\lambda t} \right] E_0$

Paragraph for Questions Nos. 73 to 74

Light of wavelength 500nm falls on two narrow slits placed at a distance d = 0.05 mm apart at angle $\phi = 30^0$ relative to the slits shown in figure. On the lower slit a transparent slab of thickness 0.1mm and refractive index 1.5 is placed. The interference pattern is observed on a screen at a distance D = 2m from the slits.



73. The position of central maximum is at

A) $\theta = 0^0$ B) $\theta = 30^0$ C) $\theta = 45^0$ D) $\theta = 60^0$

74. If we remove the transparent slab from the lower slit, the number of fringes that will pass over C is

A) 50 B) 10 C) 100 D) 500

SECTION – IV

(Integer Type)

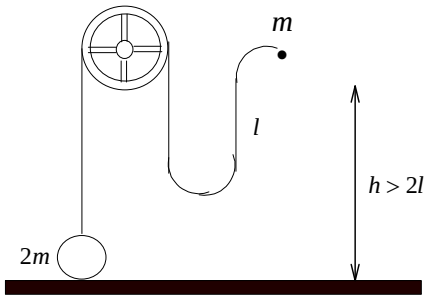
This section contains 10 questions. The answer to each question is a single-digit integer, ranging from 0 to 9. The correct digit below the question number in the ORS is to be bubbled.

---

75. For a certain amount of monoatomic gas undergoes a process for which $U^{\beta} \propto V$ where U is internal energy and V is volume of gas. It is found that the ratio $\frac{\Delta U}{\Delta Q}$ for the process was $\frac{1}{3}$. What is the value of β ?

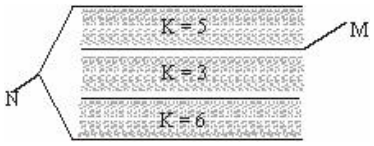
76. Find the root mean square current (in ampere) of one cycle in an AC circuit in which instantaneous current (in ampere) is given by the equation $I = \sqrt{31} + 6\sin wt - 8\cos wt$.

77. A heavy ball of mass 2m rests on the horizontal surface and a lighter ball of mass m is dropped from a height $h > 2l$. At the instant the string gets taut, upward velocity of heavy ball will be $\frac{2x}{3}\sqrt{gl}$. Find the value of 'x'.

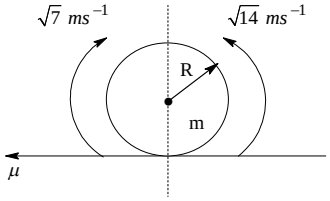


78. The wavelength for k_{β} x-ray of certain material A is 15.53pm. If takes 10 KeV to remove an electron from M – shell of A. What is the minimum accelerating potential that should be applied across the x-ray tube with target material A. So that a k_{α} x-ray would be produced? Express answer in powers of 10^4 ? (Take h = 1242 ev-nm).

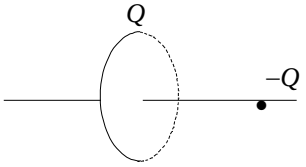
79. In the given arrangement of parallel plates each of plate area A and distance between two consecutive plates is d. Equivalent capacitance of the structure between MN is n times of $\frac{\in_0 A}{d}$ then the value of n is



80. A solid sphere of mass 'm' and radius 'R' is kept on a rough surface. The velocities of air (density ρ) around the sphere area as shown in the figure. Assuming 'R' to be small and $m = \frac{4\pi\rho R^2}{g}\ kg$, the minimum value of coefficient of friction so that the sphere starts pure rolling is $\frac{1}{\beta}$. (Assuming force due to pressure difference is acting on the centre of mass of the sphere). Determine the value of 'β'.

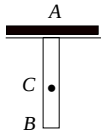


81. A ring of radius 100cm has a uniformly distributed charge Q and uniformly distributed mass m. On the axis a point charge $-Q$ of mass $2m$ is placed at a distance 3cm form its centre. Both are released from rest. Assuming only electric interaction between the ring and particle, find the amplitude (in cm) of SHM of particle.



82. In a spark plug which is connected to the secondary coil if transformer an emf 40000V is induced when in primary coil current changes from 4A to 0 in $10\mu s$. The self inductance of secondary coil is 1000H. Find the minimum value of self inductance of primary coil is $10^{-x}\ \mu H$. Then find x.

83. A wire of uniform cross-section is hanging vertically and due to its own weight its length changes. There is a point C on the wire such that change in length AC is equal to the change in length BC. Points A, B and C are as shown in the figure. Find $\frac{\left(\sqrt{2}+1\right)AC}{BC}$.



84. A radioactive sample decays through two different decay process α decay and β decay. Half-life time for α decay is 3 h and half-life time for β decay is 6 h. what will be the ratio of the number of initial radioactive nuclei to the number of radioactive nuclei present after 6h?

EENADU
PRATHIBHA NET

JEE-ADVANCED-2017
MODEL PAPER-I

Time: 9:00 A.M to 12:00 P.M **Max Marks: 252**

KEY SHEET

CHEMISTRY:

1) D	2) C	3) C	4) A	5) C	6) B	7) B	8) B	9) ABD	10) AB
11) AB	12) AC	13) A	14) B	15) D	16) A	17) A	18) C	19) 2	20) 7
21) 4	22) 2	23) 6	24) 4	25) 0	26) 5	27) 8	28) 3		

MATHEMATICS:

								29) B	30) A
31) A	32) D	33) A	34) C	35) D	36) D	37) AC	38) ACD	39) BC	40) ABD
41) BC	42) C	43) B	44) A	45) C	46) B	47) 8	48) 3	49) 6	50) 5
51) 0	52) 5	53) 5	54) 6	55) 4	56) 4				

PHYSICS:

						57) B	58) C	59) B	60) B
61) C	62) A	63) A	64) A	65) BC	66) AC	67) ABCD	68) ABC	69) AB	70) A
71) A	72) A	73) B	74) C	75) 3	76) 9	77) 1	78) 9	79) 7	80) 4
81) 1	82) 5	83) 1	84) 4						

SOLUTION
PAPER – I

CHEMISTRY

1. $\frac{0.84}{E}=\frac{0.25\times 80}{1000}$

Equivalent weight of metal carbonate $=42=E_M+E_{CO_3^{2-}}=E_M+30$

$\therefore$ Equivalent weight of metal $=12$

$\therefore$ Atomic weight of metal is $=12\times 2=24$

2. The vanderwaal's equation of state is

$$\left(P+\frac{n^2a}{V^2}\right)(V-nb)=nRT$$

For one mole and when $b=0$, the above equation condenses to

$$\left(P+\frac{a}{V^2}\right)V=RT\Rightarrow PV=RT-\frac{a}{V}\quad .....(i)$$

Equation (i) is a straight line equation between PV and $\frac{1}{V}$ whose slope is $'-a'$. Equating with slope of the straight line given in the graph

$$-a=\frac{20.1-21.6}{3-2}=-1.5\Rightarrow a=1.5$$

4. $MnO_2+4HCl\longrightarrow MnCl_2+2H_2O+Cl_2$

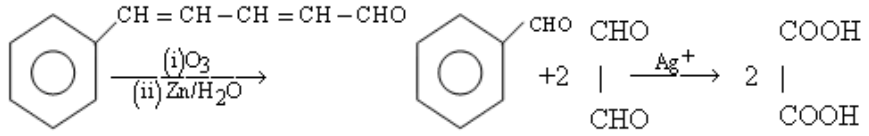
(A) (B)

$$3MnO_2+3PbO_2+6HNO_3\longrightarrow 2HMnO_4+3Pb(NO_3)_2+2H_2O$$

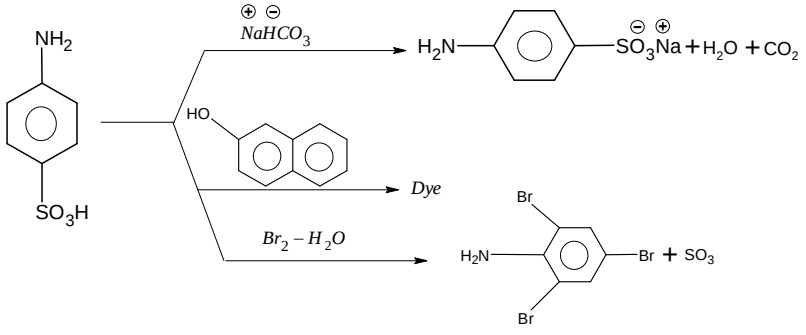
$(Purple)$

$$4MnO_2+6NaBiO_3+10H_2SO_4\longrightarrow 4NaMnO_4+3Bi_2(SO_2)_3+Na_2SO_4+10H_2O$$

6.



8.



10. B.E. of 4th state $=13.6\frac{z^2}{n^2}\Rightarrow 13.6\frac{z^2}{4^2}=13.6\Rightarrow z=4$

Sample is Be^{3+}

$\therefore$ energy of electron in 3rd state $=-24.17\,eV$

Therefore 25 eV photon will cause ionization

14. $E = E^0 - \frac{0.059}{n}.\log\frac{[P]}{[R]}$

$1.475 = \frac{0.059}{2}.\log\ k - \frac{0.059}{2}.\log\frac{1}{(0.1)^2}$ $\quad \left[\Delta G^0 = -2.303\ RT\log K = -nFE^0\right]$

(the cell reaction is $A_{(S)} + 2B^+_{(aq)} \rightarrow A^{2+}_{(aq)} + 2B_{(S)}$)

$\frac{1.475\times 2}{0.059} = \left[\log K - 2\right]$ Or $\quad \log K = 52$

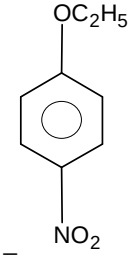
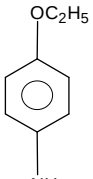
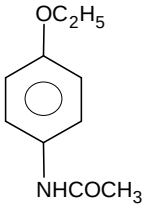
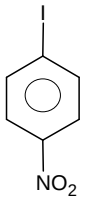
15. For the given reaction $E^0 = E_1^0 - E_2^0 = 0.03 - (-0.18) = 0.21$ V

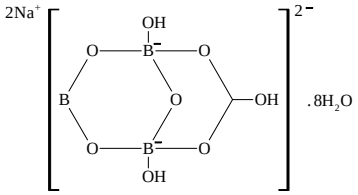
ΔG^0 for the reaction $= -nFE^0$

16. Temperature coefficient $= \left[\frac{\partial E}{\partial T}\right]_P = \frac{0.02}{25}\ V\ K^{-1}$

ΔS^0 for the reaction $= nF\left[\frac{\partial E}{\partial T}\right]_P = 2\times 96500\times\frac{0.02}{25}$

$= 154.4\ JK^{-1}$

17-18. B =  C=  D=  G &H =  + C_2H_5I

19. 

20. No.of equivalents of acid or base nuetralised completely $= 80/1000$

$\frac{80}{1000}$ equivalents give $\rightarrow 4.416KJ$

$\therefore$ 1 equivalent give $\rightarrow \frac{4.416}{80}\times 1000 = 55.2KJ$

$\therefore$ heat of ionisation of $CH_3COOH = -55.2 + 57.3 = +2.1\ kj\ /\ mole$

21. Length of edge of the unit cell = 412.1 pm, = 412.1×10^{-10} cm
Volume of the unit cell = $(412.1 \times 10^{-10})^3 = 7.00 \times 10^{-23}$ cm^3
Formula mass of caesium chloride = 168.5 a.m.u
The number of formula units per unit cell of caesium chloride is 1 as it has body centered cubic lattice.
$\therefore$ Z = 1 formula units / unit cell

Density = $\frac{\text{Formula mass}\times Z}{\text{unit cell volume (cm)}^3\times N_{Avo}} = \frac{168.5\times 1}{7.00\times 10^{-23}\times 6.023\times 10^{23}} = 4\text{g}/\text{cm}^3$

22. $W_{ethyleneglycol} = \frac{M_2 \times \Delta T_f \times W_{water}}{1000 \times k_f} = \frac{62 \times 34 \times 50}{1000 \times 1.86} = 56.67$ gm

$d = \frac{W}{V} = \frac{56.67}{28.335} = 2$

23. $6BrO_3^- + 10Cr^{3+} + 22H_2O \rightarrow 3Br_2 + 10HCrO_4^- + 34H^+$

24. $K_p = p^2,\ p = 3atm$

$PV = nRT$

$3 \times 4.92 = 0.082 \times 300 \times n$

n=0.6

$$LiCl.NH_3(s) + 2NH_3(g) \rightleftharpoons LiCl.3NH_3$$

Initial moles	0.1	*a*	0
moles at equilibrium	0	$(a-0.2)$	0.1

Moles of $NH_3 = (a-0.2) = 0.6$

$a = 0.8$

25. Half life 500 for all concentrations of sugar.
Half life is independent of the conc. of the sugar. So reaction is Ist order W.R.T. sugar
For H^+ conc.

$\frac{t_1}{t_2} = \left(\frac{a_2}{a_1}\right)^{n-1}$

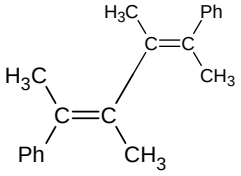
$\frac{500}{50} = \left(\frac{10^{-6}}{10^{-5}}\right)^{n-1}$

$\therefore n = 0$

26. $\delta^+ = \frac{\mu_{xy}}{d_{x-y}} = \frac{0.38 \times 10^{-18}}{158 \times 10^{-10}} = 2.4 \times 10^{-11}$

$\%electronch\arg e = \frac{2.4 \times 10^{-11}}{4.8 \times 10^{-10}} \times 100 = 5\%$

28.



MATHEMATICS

29. Let $\vec{r} = x\vec{a} + y\vec{b} + z(\vec{a} \times \vec{b})$

$\vec{r} \cdot \vec{a} = 2 \quad \Rightarrow 4x + y = 2$

$\vec{r}.\vec{b} = 8$, gives x + y = 8

$\Rightarrow$ x = –2 , y = 10 also by other given condition z = 2

$\Rightarrow \quad \vec{r} + 2\vec{a} - 10\vec{b} = 2(\vec{a} \times \vec{b})$. Hence $\lambda = 2$.

30. Total number of functions from A to B is 3^4=81.The number of functions which do not contain x or y or z in its range is 2^4.Therefore,the number of functions which contain exactly 2 elements in the range is 3.2^4 =48.

The number of functions which contain exactly one element in its range is 3.Hence,the total number of onto functions is 81-48+3=36 => n(F)=36.

Let $f \in F$.We now count the no.of ways in which f^{-1} consists of single element.We can choose pre

image of x in 4 ways. The remaining 3 elements can be mapped onto {y,z} is 2^3-2=6 ways. f^{-1} will consist of exactly one element in 4×6=24 ways. Thus, the probability of the require event is 24/36=2/3

31. If the integral is independent of b, then $I'(b)=0$

$$\Rightarrow I'(b)=\frac{-ac}{(b+2)^2}+D\left(\frac{a^3}{3}.\left(\frac{b+2-2}{b+2}\right)\right)=\frac{-ac}{(b+2)^2}+\frac{a^3}{3}\left(\frac{2}{(b+2)^2}\right)$$

$$=\frac{1}{(b+2)^2}\left(\frac{2a^3}{3}-ac\right)=\frac{2a^3}{3}=ac\Rightarrow a=\sqrt{\frac{3c}{2}}$$

32. Ans:- D

Hint:- We have $[\sin x]=-1,0,1$

So, we have the following cases

Case – I :- when $[\sin x]=-1$, In this case , we have $x^2-2=-1\Rightarrow x\pm1$

$\therefore\ x=-1$ is the solution in this case

Case – II :- when $[\sin x]=0$, In this case, we have $x^2-2=0\ \Rightarrow x=\pm\sqrt{2}$

But, $\left[\sin\sqrt{2}\right]=0$ and $\left[\sin\left(-\sqrt{2}\right)\right]=-1$, $\therefore\ x=\sqrt{2}$ is the solution in this case

Case – III :- when $[\sin x]=1$, In this case, we have $x^2-2=1\Rightarrow x=\pm\sqrt{3}$

But, $\left[\sin\sqrt{3}\right]=0$ and $\left[\sin\left(-\sqrt{3}\right)\right]=-1$., Therefore, there is no solution in this case.

Hence, the given equation has two solutions only, namely, $x=-1$ and $x=\sqrt{2}$

33. We know that R=abc/4Δ,so that Δ_1,Δ_2 andΔ_3 represent the areas of Δs OBC, OCA and OAB respectively. We know OA=OB=OC=R. Then R_1=a.R.R/4Δ_1 or a/R_1=4Δ_1/ R^2 . Similarly,

b/R_2=4Δ_2/ R^2 , c/R_3=4Δ_3/ R^2 .

$aR_1^{-1}+bR_2^{-1}+cR_3^{-1}=4R^{-2}(\Delta_1+\Delta_2+\Delta_3)=4R^{-2}\Delta=4R^{-2}(abc/4R)=abc/R^3$

34. Ans:- C

Given, $3x^2+4xy+5y^2-4=0$, On differentiating w.r.t x, we get

$$\frac{dy}{dx}=-\left(\frac{2y+3x}{2x+5y}\right),\qquad \Rightarrow \left.\frac{dy}{dx}\right]_{(x_1,y_1)}=0 \text{ and } \left.\frac{dy}{dx}\right]_{(x_2,y_2)}=\infty$$

$\Rightarrow$ Tangents are perpendicular to each other

35. Let the middle pt of chord be (t^2, 2t). Mid pt of chord must lie inside the ellipse

$\Rightarrow\ t^4+8t^2-1<0\qquad \Rightarrow t^2\in\left(0,-4+\sqrt{17}\right)$

eqn. of chord is $t^2x+4ty=t^4+8t^2$. This passes through $(\alpha,0)\Rightarrow t^2=0 \text{ or } t^2=\alpha-8$

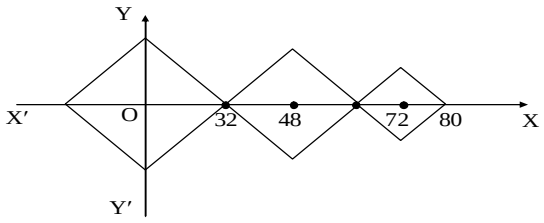
$\therefore \alpha\in\left(8,4+\sqrt{17}\right)$

36. $\dfrac{(c-d)^2}{|a-b|}=18$ and $\dfrac{(c+d)^2}{|a-b|}=72$.

$a=3, b=1, d=3, c=9$ is a solution for which the minimum is attained.

Ans : D

37. (A), (C) $a_1 = 0$, $b_1 = 32$, $a_2 = a_1 + \dfrac{3}{2}b_1 = 48$, $b_2 = \dfrac{b_1}{2} = 16$, $a_3 = 48 + \dfrac{3}{2}\times 16 = 72, b_3 = \dfrac{16}{2} = 8$



So the three loops from i = 1 to i = 3 are alike.

Now area of i^{th} loop (square) = $\dfrac{1}{2}(\text{diagonal})^2$

$A_i = \dfrac{1}{2}(2b_i)^2 = 2(b_i)^2$ So, $\dfrac{A_{i+1}}{A_i} = \dfrac{2(b_{i+1})^2}{2(b_i)^2} = \dfrac{1}{4}$

So the area form a G. P. series

So, the sum of the G. P. upto infinite terms = $A_i\left(\dfrac{1}{1-r}\right) = 2(32)^2 \times \dfrac{1}{1-\frac{1}{4}}$

$= 2(32)^2 \times (4/3) = \dfrac{8}{3} \times (32)^2$ square units.

38. SOL: A,,C,D

(A) L.H.S. $= 2^{-m}\int_0^{\pi/2}(\sin 2x)^m dx = \dfrac{2^{-m}}{2}\int_0^{\pi}(\sin t)^m dt = 2^{-m}\int_0^{\pi/2}(\sin t)^m dt = 2^{-m}\int_0^{\pi/2}(\cos t)^m dt = RHS$

(B) $I = \int_0^{\pi}\dfrac{(\pi - x)\sin x}{1+\cos^2 x}dx \Rightarrow 2I = \pi\int_0^{\pi}\dfrac{\sin x}{1+\cos^2 x}dx \Rightarrow 2I = 2\pi\int_0^{\pi/2}\dfrac{\sin x}{1+\cos^2 x}dx$

$\Rightarrow I = \pi\int_0^{\pi/2}\dfrac{\sin x}{1+\cos^2 x}dx = \pi\int_0^{1}\dfrac{dt}{1+t^2} \neq \dfrac{\pi}{2}\int_0^{1}\dfrac{dt}{1+t^2}$

(C) $\int_0^{\pi/2}\dfrac{1-\cos 3x}{1+2\cos x}dx = \int_0^{\pi/2}\dfrac{1+\cos 3x}{2\cos x - 1}dx = 1$

(D) $I = \int_0^{\pi/2}\dfrac{1+\sin 3x}{1+2\sin x}dx$ Now, using $\int_0^a f(a-x)dx = \int_0^a f(x)dx$

$\int_0^{\pi/2}\dfrac{1+\cos 3x}{2\cos x - 1}dx = \int_0^{\pi/2}(\text{Cos}2x + \cos x)\,dx = 1$

$\therefore \int_0^{\pi/2}\dfrac{1+\sin 3x}{1+2\sin x}dx = \int_0^{\pi/2}\dfrac{1+\cos 3x}{2\cos x - 1}dx$

39. B, C

Let the roots be $\alpha_1, \alpha_2, ..., \alpha_8$. Then,

$\alpha_1 + \alpha_2 + ...\alpha_8 = 4$, $\alpha_1\alpha_2.....\alpha_8 = \frac{1}{2^8} \quad \Rightarrow \left(\alpha_1, \alpha_2, ..., \alpha_8\right)^{1/8} = \frac{1}{2}$

$= \frac{\alpha_1 + \alpha_2 + ... + \alpha_8}{8} \Rightarrow AM = GM \Rightarrow$ all the roots are equal to $\frac{1}{2}$

$\Rightarrow a_1 = -{}^8C_7\left(\frac{1}{2}\right)^7 = -\frac{1}{2^4}$, $a_2 = {}^8C_6\left(\frac{1}{2}\right)^6 = \frac{7}{2^4}$ and $a_3 = -{}^8C_5\left(\frac{1}{2}\right)^5$

40. A, B, D

We have $\left(\frac{x}{x+1}\right)^2 + \left(\frac{x}{x-1}\right)^2 = a(a-1)$

$\Rightarrow \left(\frac{x}{x+1} + \frac{x}{x-1}\right)^2 - 2\left(\frac{x}{x+1}\right)\left(\frac{x}{x-1}\right) = a(a-1) \Rightarrow \left(\frac{2x^2}{x^2-1}\right)^2 - \frac{2x^2}{x^2-1} = a(a-1)$

$\Rightarrow z^2 - z - a(a-1) = 0,$ where $z = \frac{2x^2}{x^2-1} \Rightarrow z = a$ *or* $1-a$

When, $z = a, \frac{2x^2}{x^2-1} = a \Rightarrow 2x^2 = ax^2 - a \Rightarrow x = \pm\sqrt{\frac{a}{a-2}}$

When, $z = 1-a, \frac{2x^2}{x^2-1} = 1-a \Rightarrow 2x^2 = (1-a)x^2 - 1 + a \Rightarrow x = \pm\sqrt{\frac{a-1}{a+1}}$

$\therefore \quad x = \pm\sqrt{\frac{a}{a-2}}, \pm\sqrt{\frac{a-1}{a+1}}$

If $a < -1 \Rightarrow$ *All roots are real.*

If $1 < a < 2 \Rightarrow x = \pm\sqrt{\frac{a}{2-a}}i, \pm\sqrt{\frac{a-1}{a+1}} \Rightarrow$ Only two roots are real.

If $a > 2 \Rightarrow$ All roots are real.

41. B, C

(a) option is not correct as it should be $\pm\frac{\pi}{2}$

(b) Equation of circle is $\frac{z-\alpha}{z-\beta}$ is purely imaginary

$\therefore \quad \text{Re}\left(\frac{z-\alpha}{z-\beta}\right) = 0$ or $\therefore \quad \text{Re}\left(z-\alpha\right)\left(\overline{z-\beta}\right) = 0 \Rightarrow (b)$ *is correct*

(c) Option is obviously correct

(d) Option can not be correct at the centre of required circle is $\left(\frac{\alpha+\beta}{2}\right)$ but from the given equation centre of the circle is coefficient $\bar{z} = -\left(\frac{\alpha+\beta}{2}\right)$

42. Ans:- C

Hint:- Given below

43. Ans:- B

Hint:- Given below

44. Let the rectangle $ABCD$ initially lies in xy plane with B lying at origin BC along x-axis and BA along y-axis.

Equation of BD in xy-plane is $y = 2x$

So, the coordinates of foot N of C on BD are $\left(\frac{r}{5}, \frac{2r}{5}\right)$ and length $CN = \frac{2r}{\sqrt{3}}$

Clearly, $CN = C_1N$

Hence, the coordinates of various points in 3-D are

$A(0,2r,0)$, $C(r,0,0)$, $D(r,2r,0)$, $N\left(\frac{r}{5}, \frac{2r}{5}, 0\right)$ and $C_1\left(\frac{r}{5}, \frac{2r}{5}, \frac{2r}{\sqrt{5}}\right)$.Now, $AC_1 = \frac{\sqrt{85}\, r}{5}$

Direction cosines of $BC_1 = \frac{1}{5}, \frac{2}{5}, \frac{2}{\sqrt{5}} \Rightarrow \cos\theta = \frac{2}{5}$

Any point on $AB\left(x_1, y_1, z_1\right) = (0,0,0)$

Any point on $C_1D\left(x_2, y_2, z_2\right) = (r,2r,0)$

Direction cosines of $AB = 0,1,0 = l_1,\ m_1,\ n_1$

Direction cosines of $C_1D = \frac{2}{5}, \frac{4}{5}, -\frac{1}{\sqrt{5}} = l_2,\ m_2,\ n_2$

Desired shortest distance $= \dfrac{\begin{vmatrix} x_2 - x_1 & y_2 - y_1 & z_2 - z_1 \\ l_1 & m_1 & n_1 \\ l_2 & m_2 & n_2 \end{vmatrix}}{\sqrt{\left(m_1n_2 - m_2n_1\right)^2 + \left(n_1l_2 - n_2l_1\right)^2\left(l_1m_2 - l_2m_1\right)^2}}$

$$= \frac{\begin{vmatrix} r & 2r & 0 \\ 0 & 1 & 0 \\ 2/5 & 4/2 & -1/\sqrt{5} \end{vmatrix}}{\sqrt{\left(\frac{1}{\sqrt{5}}\right)^2 + \left(\frac{2}{5}\right)^2}} = \frac{\sqrt{5}\, r}{3}\ unit$$

Q.NOS: (45,46)

Let E_1 = Event that A wrote a plus sign .

E_2 = Event that A wrote a minus sign .

E = Event that the reference observes a plus sign.

Given $P\left(E_1\right) = \frac{1}{3} \Rightarrow P\left(E_2\right) = \frac{2}{3}$

$P(E/E_1)$ = Probability that none of B,C,D change sign+Probability that exactly two of B,C,D Change sign.

$$= \frac{1}{27} + 3\left(\frac{1}{3}\times\frac{2}{3}\times\frac{2}{3}\right) = \frac{13}{27}$$

$P(E/E_2)$ = Probability that all of B,C,D change the sign+Probability that exactly one of them changes the sign.

$$= \frac{8}{27} + 3\times\left(\frac{2}{3}\times\frac{1}{3}\times\frac{1}{3}\right) = \frac{14}{27}$$

$$\therefore P(E_1/E) = \frac{13}{41}$$ Using Baye's theorem.

47.

$$a>0,\ \frac{a^{-5}+a^{-4}+a^{-3}+a^{-3}+a^{-3}+1+a^{8}+a^{10}}{8} \geq 1$$ (Applying AM GM)

$$\Rightarrow a^{-5}+a^{-4}+3a^{-3}+1+a^{8}+a^{10} \geq 8$$

So, the required minimum value is 8

48.

$$\int_{-y}^{y}\{\mathrm{Sec}^{-1}x - \mathrm{Tan}^{-1}\left(\sqrt{x^2-1}\right)\}dx$$

$$= \int_{-y}^{-1}\{\mathrm{Sec}^{-1}x - (\pi - \mathrm{Sec}^{-1}x)\}dx + \int_{-1}^{y}\{\mathrm{Sec}^{-1}x - \mathrm{Sec}^{-1}x\}\,dx$$

$$= 2\int_{-y}^{-1}\mathrm{Sec}^{-1}x\,dx - \int_{-y}^{-1}\pi\,dx$$

$$= 2\int_{1}^{y}(\pi - \mathrm{Sec}^{-1}x)dx - \pi(y-1) = \pi(y-1) - 2\lambda$$

$$\therefore a+b=3$$

49. $f[f(x)] = 6 \Rightarrow f(x) = -2 \text{ or } f(x) = 1$

$f(x) = -2$ has two roots and $f(x) = 1$ has four roots.

50. Image of orthocenter of ΔABC w.r.t. $\overleftrightarrow{BC}$ lies on the circle.

51. $$I = \int_{\pi/4}^{\pi/2} 2\sin t\cos t\ dt + I = \int_{\pi/2}^{\pi}\left\{\underbrace{(-\sin t\cos t)}_{(zero)} + (\sin t\cos t)\right\}dt + \int_{\pi}^{5\pi/4} -2\sin t\cos t\ \ dt$$

$$= \int_{\pi/4}^{\pi/2}\sin 2t\ dt - \int_{\pi}^{5\pi/4}\sin 2t\ dt = 0$$ these two integrals cancels $\Rightarrow$ k=0

52. Given $a_{11} = a_{22} = a_{33} = a+b$, $a_{12} = a_{23} = ab$

$$\det(A) = \begin{vmatrix} a+b & ab & 0 \\ 1 & a+b & ab \\ 0 & 1 & a+b \end{vmatrix} = \left(a^2+b^2\right)(a+b)$$ (a+b=5,ab=6)

53. The tangent at any point $A\{2\sec\theta, \tan\theta\}$ is given by $\frac{x\sec\theta}{2} - \frac{y\tan\theta}{1} = 1$

It meets the line $x-2y=0$

$$\Rightarrow \frac{x\sec\theta}{2} - \frac{x\tan\theta}{2} = 1 \Rightarrow x = \frac{2}{\sec\theta - \tan\theta} \Rightarrow Q \equiv \left(\frac{2}{\sec\theta-\tan\theta}, \frac{1}{\sec\theta-\tan\theta}\right)$$ .....(i)

Also, the tangent meets the line $x+2y=0$ at R so

$\Rightarrow \frac{x}{2}\sec\theta+\frac{x}{2}\tan\theta=1\Rightarrow x=\frac{2}{\sec\theta+\tan\theta} \Rightarrow R\equiv\left(\frac{2}{\sec\theta+\tan\theta},\frac{-1}{\sec\theta+\tan\theta}\right)$ …….(ii)

Now, $CQ.CR=\sqrt{\frac{2^2+1^2}{(\sec\theta-\tan\theta)^2}}\sqrt{\frac{2^2+1^2}{(\sec\theta+\tan\theta)}} \Rightarrow CQ.CR=5$

54. $1323000=2^3.3^3.5^3.7^2$

For even divisor and divisible by 105, 2, 3, 5, 7 must occur at least one time.

$\therefore$ Total number of divisors are $3\times3\times3\times2=54$

Hence, $2^k-10=54\Rightarrow k=6$

55. $y=\begin{cases}x; & x<2\\ 4-x; & x\geq 2\end{cases}$ and $y=\begin{cases}3/x; & x>0\\ -3/x; & x<2\end{cases}$

Required area $PQRSP=$ area $PQRP+$ area $PRSP$

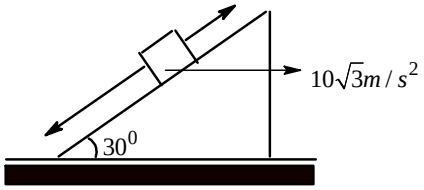
$=\left|\int_{\sqrt{3}}^{2}\left(x-\frac{3}{x}\right)dx\right|+\left|\int_{2}^{3}\left((4-x)-\frac{3}{x}\right)dx\right|=\frac{4-3\ln 3}{2}\,sq\ unit$

56. $f(x)$ is an odd $\therefore \quad f(-x)=-f(x)$

$f'(-x)=f'(x)$ hence $f'(-3)=f'(3)=2 \qquad \therefore \quad f'(-3)+f'(3)=4$

PHYSICS

57. $10\sqrt{3}\cos 30^0=10\sqrt{3}\frac{\sqrt{3}}{2}=15m/s^2$



$g\sin 30^0=5m/s^2$

$\therefore \quad a=15-5=10m/s^2 \qquad \therefore \quad s=\frac{1}{2}at^2$

$1=\frac{1}{2}(10)t^2$ or $t=\frac{1}{\sqrt{5}}s$

58. Area under the graph = Change in velocity

$=\frac{1}{2}[8]\times10+50=90m/s$

59. $Y=\frac{(\text{Capacitance})}{(\text{Magnetic induction})^2}=\left[\frac{M^{-1}L^{-2}Q^2T^2}{M^2Q^{-2}T^{-2}}\right]=\left[M^{-3}L^{-2}Q^4T^4\right]$

60. (B)

61. If T is the tension in the string $2T\cos\theta=w$ and $T\sin\theta=Kx$

Or, $\left(\frac{w}{2\cos\theta}\right)\sin\theta=Kx$ Or, $x=\frac{w\tan\theta}{2K}=\frac{w\sqrt{3}}{2k}\,(given)$

$\tan\theta=\sqrt{3}$ *or* $\theta=60^0$

62. Velocity of particle w.r.t the ground is $v\hat{i}+2v\hat{j}+v\hat{k}$. Time of flight of the particle is $\frac{2v}{g}$.

Co-ordinate of the particle at this instant $x=v\left(\frac{2v}{g}\right),\ y=2v\left(\frac{2v}{g}\right)$.

Time taken by the trolley to reach the x is $3v\times t=x$, in the remaining time it should cover y co-ordinate.

63. Suppose the second block moves at a speed v after collision $mv=2mv'$ or $v'=\frac{v}{2}$

Velocity of separation $=\frac{v}{2}$

Velocity of approach $=v$

By definition, $e=\frac{\text{velocity of separation}}{\text{velocity of approach}}=\frac{1}{2}$

64. Potential difference between O and A is Blv

Where v is the velocity of the mid-point of O and A

Thus, $e=B_0\left(\frac{L}{2}\right)\left[v_0+\frac{L}{4}\left(\frac{v_0}{L}\right)\right]=\frac{5B_0Lv_0}{8}$

65. Heat gain by ice to melt $=mL_f=10\times80=800cal$

Heat gain by 10 g water to raise its temperature from 0^0C to $100^0C=10\times1\times100=1000cal$

Total heat gain $=1800cal$

Mass of steam converted into water

$\therefore\ 1800=m\times540\Rightarrow m=3.33g$

$\therefore$ Equilibrium temperature 100^0C

Amount of water $=10+3.33=13.33g$

Amount of water $=5-3.33=1.67g$

66. $V_0l_0=V\left(\frac{5l_0}{4}\right),\ V=\frac{4v_0}{5},$

$\frac{1}{2}mv_0^{\ 2}=\frac{1}{2}mv^2+\frac{1}{2}k\left(\frac{l_0}{4}\right)^2$

67. $R^2-(R-5)^2=\left(5\sqrt{3}\right)^2$

$R^2-R^2(R-5)^2=\left(5\sqrt{3}\right)^2$

$R^2-R^2-25+10R=75$

$R=10m$

$\sin\alpha=\frac{1}{2},\ a=30^0,\ \theta=90-\alpha=60^0$

$\frac{mv}{qB}=R\Rightarrow v=\frac{RqB}{m}=\frac{10\times10^{-6}\times10}{5\times10^{-5}}=2m/s$

68. A,B,C

69. Focal length of the upper part and lower part does not change

70. $\frac{dN}{dt}=q_0t-\lambda N$

$\frac{dN}{dt}+\lambda N=q_0t$

71. $N = \frac{q_0 t}{\lambda} - \frac{q_0}{\lambda^2} + \frac{q_0}{\lambda^2} e^{-\lambda t}$

$P_{inst} = \lambda N E_0 = \left[q_0 t - \frac{q_0}{\lambda} + \frac{q_0}{\lambda} e^{-\lambda t} \right] E_0$

72. $P_{qv} = \frac{\int_0^t \left[q_0 t - \frac{q_0}{\lambda} + \frac{q_0}{\lambda} e^{-\lambda t} \right] E_0 \, dt}{\int_0^t dt} = \left[\frac{q_0 t}{2} - \frac{q_0}{\lambda} + \frac{\theta_0}{\lambda^2 t} - \frac{q_0}{\lambda^2 t} e^{-\lambda t} \right] E_0$

73. $\Delta x = d \sin\phi + d \sin\theta - (\mu - 1)t$

For central maximum, $\Delta x = 0$

$d \sin\phi + d \sin\theta - (\mu - 1)t = 0$

$\sin\theta = \frac{(\mu - 1)t}{d} - \sin\phi$

$\theta = 30^0$

74. At C, number of fringes shifted

$n = \frac{(\mu - 1)t}{\lambda} = 100$

75. $u^\beta = cv \quad t^\beta v^{-1} = c \qquad tv^{-1/\beta} = c$

Comparing with $tv^{r^1 - 1} = c \quad r^1 - 1 = \frac{-1}{\beta}$

$r^1 = 1 - \frac{1}{\beta}$

$\frac{\Delta U}{\Delta Q} = \frac{R/r - 1}{\frac{R}{r-1} + \frac{R}{1 - r^1}} = \frac{1 - r^1}{r.r^1} = \frac{1}{3}$

$3 - 3r^1 = r - r^1 \qquad 3 - r = 2r^1 \qquad r^1 = \frac{2}{3} = 1 - \frac{1}{\beta} \Rightarrow \beta = 3$

76. $I^2 = 31 + 36$

$< I^2 >= 31 + 36\left(\frac{1}{2}\right) + \frac{64}{2}$

$< I^2 >= 31 + 18 + 32 \Rightarrow \sqrt{< I^2 >} = 9$

77. Just before getting taut, speed of m is

$V_1 = \sqrt{2g \times 2l} = 2\sqrt{gl}$

Just after getting taut let the velocity of m be V_2 (downwards) and so velocity of 2m will be V_2 (upwards) upwards is taken as + ve.

For $m_1 \quad l = \left(-mV_2\right) - \left(-mV_1\right) = mV_1 - mV_2$

For $2m_1 \quad l = \left(2mV_2\right) - (0) = 2mV_2$

$\therefore \quad mV_1 - mV_2 = 2mV_2 \qquad \Rightarrow V_2 = \frac{V_1}{3} = \frac{2}{3}\sqrt{gl}$

78. Energy of K_β a x ray is $\frac{kc}{\lambda} = \frac{1242}{15.53} kev = 80$

kev

$\therefore \quad E_m - E_k = 80 \, kem \quad .....(1)$

It is given that 10 kev energy is required to remove an electron from the M – shell, so that

$E_0 - E_m = 10\,kev$ .....(2)

From (1) and (2) we get $E_\infty - E_k$ 90 kev

Since $E_\infty = 0$, $E_k = -90\,kev$. Thus 90 kev energy is required to knock out an electron from the k shell. Hence the minimum acceleration potential is $9\times10^4 V$. If power of $10^{-4}V$

79. (7)

80. Force due to pressure difference is $F = P \times A$

$$= \frac{1}{2}\rho\left(V_2^2 - V_1^2\right)\times\pi R^2$$

$$F = \frac{1}{2}\rho(14-7)\times\pi R^2 = \frac{7\pi\rho R^2}{2}$$

For translational motion $F - f = ma$ .....(1)

For rotational motion

$$f \times R = I\alpha = \frac{Ia}{R}$$

$$f = \frac{Ia}{R^2} = \frac{2}{5}mR^2 \times \frac{a}{R^2} = \frac{2}{5}ma$$

$$F = ma + f = ma + \frac{2}{5}ma = \frac{7}{5}ma$$

$$ma = \frac{5}{7}F$$

$$f = \frac{2}{5}\times\frac{5}{7}F = \frac{2F}{7} = \frac{2}{7}\times\frac{7\pi\rho R^2}{2}$$

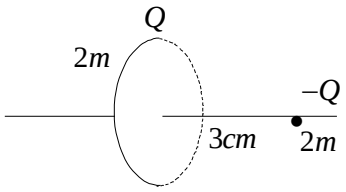
$$f = \pi\rho R^2$$

$$\mu Mg = \pi\rho R^2$$

$$\mu\frac{\pi\rho R^2}{mg} = \frac{1}{4} \Rightarrow \mu = \frac{1}{4} = \frac{1}{\beta} \Rightarrow \beta = 4$$

81.

Since there is no external force, CM will remains at rest. Displacement of the particle till it comes to the centre of the ring is given by



$$x = 3\times\frac{m}{m+2m} = 1cm \qquad \therefore \quad A = 1cm$$

82.

$$E = M.\frac{di}{dt}$$

Using values $M = 0.1$

Now, $M = \sqrt{L_1 L_2}$

$L_1 = 10^{-5} H$

83.

Tension in elementary section of width dx is $T = \lambda xg$ $\left(\lambda = \dfrac{\text{mass}}{\text{length}}\right)$

$\therefore$ Extension of length $x(=Bc)$ of wire is

$$\Delta x = \int_0^x \frac{(\lambda xg)}{YA} dx = \frac{\lambda x^2 g}{2YA} \qquad \text{.....(i)}$$

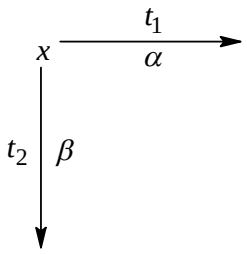
$\Rightarrow$ Extension in total length of wire $l(=AB)$ is

$$2\Delta x = \frac{\lambda l^2 g}{2YA} \qquad \text{.....(ii)}$$

$\therefore$ From equations (i) and (ii) we get $x = \dfrac{l}{\sqrt{2}}$

$$\frac{AC}{PC} = \frac{l-x}{x} = \left(\sqrt{2}-1\right)$$

84.



$$t_{eq} = \frac{t_1 t_2}{t_1 + t_2} = \frac{6 \times 3}{6+3} = 2h$$

$$6h = 3(t_{eq}) \Rightarrow N = \frac{N_0}{(2)^3} \Rightarrow \frac{N_0}{N} = 8$$