JEE MAIN

COURSE
NUCLEUS

TEST CODE
1 1 3 0 1

MOCK TEST-10

Class: XII *Time:* 3 Hours. *Max. Marks:* 360

IMPORTANT INSTRUCTIONS

1. The question paper consists of **'90'** objective type questions. There are **'30'** questions each in **Mathematics** , **Physics** and **Chemistry** respectively. **Please fill the OMR answer Sheet accordingly and carefully.**

2. Each question has four choices (1), (2), (3) and (4) out of which **ONLY ONE** is correct.

3. You will be **awarded 4 marks** for each question, if you have darkened only the bubble corresponding to the correct answer and zero mark if no bubble are darkened. In all other cases, **minus one (–1) mark** will be awarded.

4. There is only one correct response for each question. Filling up more than one response in each question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 3 above.

5. Use **Black or Blue Ball Point Pen** only for filling particulars.

6. Use of **Calculator, Log Table, Slide Rule and Mobile** is not allowed.

7. Rough work is to be done on the space provided at the bottom and in end of the booklet for this purpose in the Test Booklet only.

8. On completion of the test, the candidate must hand over the Answer Sheet to the Invigilator. However, the candidates are allowed to take away this Test Booklet with them.

9. Do not fold or make any stray marks on the Answer Sheet.

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USEFUL DATA

Atomic weights: Al = 27, Mg = 24, Cu = 63.5, Mn = 55, Cl = 35.5, O = 16, H = 1, P = 31, Ag = 108, N = 14, Li = 7, I = 127, Cr = 52, K=39, S = 32, Na = 23, C = 12, Br = 80, Fe = 56, Ca = 40, Zn = 65.5, Ti = 48, Ba = 137, U = 238, Co= 59, B =11, F = 19, He = 4, Ne = 20, Ar = 40 , Mo = 96

[Take : $ln\ 2 = 0.693$, $ln\ 1.1 = 0.095$, $ln\ 3 = 1.09$, $e = 1.6 \times 10^{-19}$, $m_e = 9.1 \times 10^{-31}$ kg]

Take: $\in_0 = 8.85 \times 10^{-12}\ C^2/Nm^2$, $g = 10\ m/s^2$, $S_{water} = 1$ cal/gm °C, $L_{ice} = 80$ cal/gm. , $g = 10\ m/s^2$ unless otherwise stated

MATHEMATICS

Q.1 $\int_{-1}^{0} x \cdot ln(x+1)\,dx$ is equal to

(1) $\frac{1}{4}$ (2) $\frac{1}{2}$ (3) $\frac{3}{4}$ (4) $\frac{3}{2}$

Q.2 The number of diagonal matrix A of order n for which $A^3 = A$, such that all entries of matrix A are integers, is

(1) 1 (2) 0 (3) 2^n (4) 3^n

Q.3 If $(1 + x + x^2 + x^3)^{100} = \sum_{r=0}^{300} a_r \cdot x^r$ and $\sum_{r=0}^{300} a_r = k$, then the value of $\sum_{r=0}^{300} r \cdot a_r$ is

(1) 75k (2) 100k (3) 150k (4) 300k

Q.4 Consider a hyperbola $x^2 - y^2 = a^2$, An equilateral triangle is constructed such that vertex A(– a, 0) and vertex B and C lie on other branch of hyperbola such that they are mirror image about x-axis. If side length of ΔABC is k.a, then k is equal to

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

SPACE FOR ROUGH WORK

Q.5 Equation of the straight line with slope 2 and passes through the point A (m + n, 2m), where m, n $\in$ R satisfying the equation $\sec^2(n(m+2)) + (m+1)^2 = 1$, $n \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$, is

(1) y = 2x (2) y = 2x – 1 (3) y = 2x + 3 (4) y = 2x – 2

Q.6 If f (x) = sin x and g (x) = $\underbrace{f(f(f.....f(x)))}_{2018 \text{ times}}$, then the value of g'(0) + g''(0) + g'''(0) is equal to

(1) 0 (2) – 2017 (3) – 2018 (4) 1

Q.7 If $\arg\left(\dfrac{z_1 - \frac{z}{|z|}}{\frac{z}{|z|}}\right) = \dfrac{\pi}{2}$ and $\left|\dfrac{z}{|z|} - z_1\right| = 3$, then $|z_1|$ is equal to

(1) $\sqrt{3}$ (2) $\sqrt{26}$ (3) $\sqrt{10}$ (4) $2\sqrt{2}$

Q.8 If number of function defined from $f : A \to B$ where A = {1, 2, 3, 4, 5, 6} and B = {7, 8, 9, 10} such that the sum f (1) + f(2) + f (3) + f (4) + f (5) + f (6) is odd, is 2^n, then n is equal to
(1) 5 (2) 6 (3) 9 (4) 11

Q.9 A 10 digit number starts with 2 and all its digits are prime, then the probability that the sum of all two consecutive digits of the number is prime, is

(1) $\frac{1}{2^{10}}$ (2) $\frac{1}{2^{13}}$ (3) $\frac{1}{2^{15}}$ (4) $\frac{1}{2^{11}}$

SPACE FOR ROUGH WORK

Q.10 Let $f(x) = \begin{cases} \left(\sin\frac{2x^2}{a} + \cos\frac{3x}{b}\right)^{\frac{ab}{x^2}}, & x \neq 0 \\ e^{2x+3}, & x = 0 \end{cases}$

is a continuous function at x = 0, ∀ b ∈ R, then $\left|\frac{1}{a_{min}}\right|$ is equal to

(1) 2 (2) 3 (3) 4 (4) 6

Q.11 The curve $y = ax^3 + bx^2 + cx + 5$ touches the x-axis at P(–2, 0) and intersect the y-axis at point Q where its gradient is 3, then the value of (a – 2b) is equal to

(1) – 1 (2) 1 (3) $\frac{3}{2}$ (4) $\frac{-3}{4}$

Q.12 If the primitive of $f(x) = \pi \sin \pi x + 2x - 4$ has the value 3 at x = 1, then the number of value(s) of x for which primitive of f (x) vanishes, is

(1) 0 (2) 1 (3) 2 (4) more than 2

Q.13 If area of the region bounded by the parabolas $y = x - bx^2$ and $y = \frac{x^2}{b}$ is maximum, then the positive value of b is

(1) 1 (2) 2 (3) $\frac{1}{2}$ (4) 3

Q.14 If tangent to a curve intersects y-axis at point P and a line perpendicular to this tangent passing through point P is also passes through another point Q (1, 0). Then the differential equation of that curve is

(1) $y\frac{dy}{dx} - x\left(\frac{dy}{dx}\right)^2 = 1$ (2) $x\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^2 = 0$

(3) $y\frac{dx}{dy} + x = 1$ (4) $y\left(\frac{dy}{dx}\right)^2 - x\frac{d^2y}{dx^2} = 1$

SPACE FOR ROUGH WORK

Q.15 Let $\vec{r}$ be a position vector of a variable point in x-y plane such that $\vec{r}\cdot(\vec{r}+8\hat{i}-10\hat{j})+41=0$, then minimum value of $\left|\vec{r}+2\hat{i}-3\hat{j}\right|^2$ is

(1) 2 (2) 4 (3) 8 (4) 16

Q.16 $\lim\limits_{x\to\frac{\pi}{2}}\sqrt{\dfrac{\tan x-\sin\left(\tan^{-1}(\tan x)\right)}{\tan x+\cos^2(\tan x)}}$ is equal to

(1) 0 (2) 1 (3) $\sqrt{2}$ (4) does not exist

Q.17 If $\tan^{-1}(5+2\sin x-\sin^2 x)+\cot^{-1}\left(1+5^{\sec^2 y}\right)=\dfrac{\pi}{2}$, then minimum positive value of $x+y$ is

(1) $\dfrac{\pi}{2}$ (2) π (3) $\dfrac{3\pi}{2}$ (4) 0

Q.18 If $4\cos^2\theta=\dfrac{x^4+2x^2+5}{x^2+1}$ has at least one solution, then sum of all possible value(s) of $x\cos\theta$ is equal to

(1) 0 (2) 1 (3) 2 (4) 4

Q.19 Let $\vec{r}$ be a position vector of a variable point in x-y plane such that $\vec{r}\cdot(6\hat{j}-4\hat{i}+\vec{r})=3$, then the maximum value of $\left|\vec{r}+2\hat{i}-3\hat{j}\right|$ is equal to

(1) $2+\sqrt{13}$ (2) $2\left(2+\sqrt{13}\right)$ (3) $2+2\sqrt{13}$ (4) $4+\sqrt{13}$

Q.20 Let α and β are the roots of the equation $x^2-6x+12=0$. If the value of $(\alpha-2)^{12}+\dfrac{(\beta-6)^{12}}{\alpha^{12}}-1$ is a^b, then minimum value of $(a+b)$ is equal to

(1) 8 (2) 10 (3) 12 (4) 14

SPACE FOR ROUGH WORK

Q.21 Consider three circles $S_1 : x^2 + y^2 - 2\lambda x - 2y + 1 = 0$, $S_2 : x^2 + y^2 - 8\lambda x - 10y + 32 = 0$ and $S_3 : x^2 + y^2 - 14x - 18y + 114 = 0$, then the value of λ for which radical centre of these three circles is not defined, is

(1) 0 (2) – 1 (3) 1 (4) $\frac{3}{2}$

Q.22 Let A is a square matrix, $A = \begin{bmatrix} -1 & 3 & 2 \\ 0 & 1 & 4 \\ -2 & 3 & 2 \end{bmatrix}$ such that matrix A satisfy the equation

$A^{-1} = \frac{1}{10}(\lambda A + 9I - A^2)$, then the value of λ is

(1) – 10 (2) 10 (3) – 2 (4) 2

Q.23 In a restaurant there are four identical circular tables. Each table have four chairs. Two families of 7 members and 8 members come to the restaurant. Then the number of ways these members can be seated (if members of two families do not sit on the same table) is

(1) $\frac{(7!)^2}{4}$ (2) $\frac{(8!)^2}{16}$ (3) $\frac{(7!)^2}{16}$ (4) $(8!)^2$

Q.24 Let $f(x) = 2x^3 - \left(6\sqrt{2}\sin^2\theta\right) \cdot x^2 + (6\sin^2\theta)\, x + 2$ is a non - monotonic function, then the complete set of values of θ is

(1) $\left(2n\pi + \frac{\pi}{4},\ 2n\pi + \frac{3\pi}{4}\right)$, $n \in I$ (2) $\left(n\pi + \frac{\pi}{4},\ n\pi + \frac{3\pi}{4}\right)$, $n \in I$

(3) $\left(2n\pi + \frac{\pi}{4},\ 2n\pi + \frac{3\pi}{4}\right) \cup \{n\pi\}$, $n \in I$ (4) $\left(n\pi + \frac{\pi}{4},\ n\pi + \frac{3\pi}{4}\right) \cup \{n\pi\}$, $n \in I$

Q.25 Let $f : R \to R$ be a function such that $f(3 - x) = f(3 + x)$ and $f(6 - x) = f(6 + x)\ \forall\ x \in R$ and $\int_0^3 f(x)\,dx = 5$, then the value of $\int_{15}^{45} f(x)\,dx$ is equal to

(1) 25 (2) 30 (3) 50 (4) 60

SPACE FOR ROUGH WORK

Q.26 The lines tangent to the curve $y^3 - x^2 y + 5y - 2x = 0$ and $x^4 - x^3y^2 + 5x + 2y = 0$ at the origin, intersect at angle θ , then θ is equal to

(1) $\frac{\pi}{6}$ (2) $\frac{\pi}{4}$ (3) $\frac{\pi}{3}$ (4) $\frac{\pi}{2}$

Q.27 In a set of 20 distinct observations, each of the observations below the median of all observations is increased by 5 and each of the remaining observations is decreased by 3, then the mean of the new set of observations, is

(1) increase by 1 (2) decrease by 1 (3) decrease by 2 (4) increase by 2

Q.28 Number of complex number(s) Z satisfying both the equation $|z + 1 - 2i| = 3$ and $|z - 2 - 6i| = 2$ is/are

(1) 0 (2) 1 (3) 2 (4) more than 2

Q.29 Let s be a non-empty subset of R. Consider the following statement

P : There is a rational number $x \in s$ such that $x > 0$, which of the following statement is the negation of the statement P

(1) There is a rational number $x \in s$ such that $x \leq 0$

(2) There is no rational number $x \in s$ such that $x \leq 0$

(3) Every rational number $x \in s$ satisfy $x \leq 0$

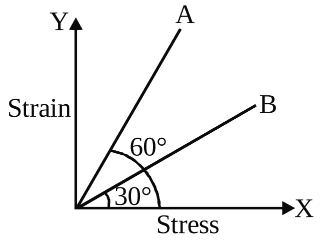
(4) $x \in s$ and $x \leq 0 \Rightarrow x$ is not raitonal

Q.30 The angle of elevation of the sun, when length of the shadow of a tree is equal to the height of the tree, is

(1) 30° (2) 45° (3) 60° (4) 90°

SPACE FOR ROUGH WORK

Q.31 The stress versus strain graphs for wires of two materials A and B are as shown in the figure. If Y_A and Y_B are the young's modulii of the materials, then



(1) $Y_B = 2Y_A$ (2) $Y_A = Y_B$ (3) $Y_B = 3Y_A$ (4) $Y_A = 3Y_B$

Q.32 A body is thrown vertically up to reach its maximum height in t second. The total time taken from the instant of projection, to reach a point at half of its maximum height while returning (in sec) is:

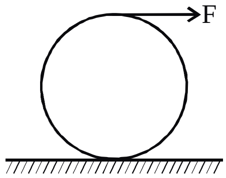
(1) $\left(1+\frac{1}{\sqrt{2}}\right)t$ (2) $\sqrt{2}t$ (3) $\frac{3t}{2}$ (4) $\frac{t}{\sqrt{2}}$

Q.33 A paramagnetic substance of susceptibility 3×10^{-4} is placed in a magnetic field of 4×10^{-4} Am^{-1}. Then, the intensity of magnetisation in the unit of Am^{-1} is:
(1) 1.33×10^{8} (2) 0.75×10^{-8} (3) 12×10^{-8} (4) 14×10^{-8}

Q.34 By sucking through a straw, a student can reduce the pressure in his lungs to 750 mm of Hg (density = 13.6 gcm^{-3}) Using the straw, he can drink water from a glass upto a maximum depth of (Atmospheric pressure = 760 mm of Hg)
(1) 10 cm (2) 75 cm (3) 13.6 cm (4) 1.36 cm

SPACE FOR ROUGH WORK

Q.35 A thin ring of mass m and radius R rolls on a horizontal rough surface without slipping due to an applied force 'F'. The friction force acting on ring is



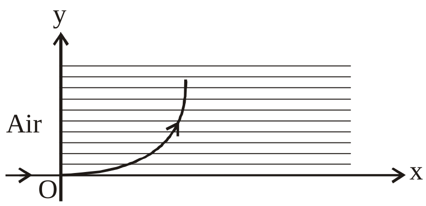
(1) $\frac{F}{3}$ (2) $\frac{2F}{3}$ (3) $\frac{F}{4}$ (4) zero

Q.36 A double convex lens forms a real image of an object on a screen which is fixed. Now the lens is given a constant velocity v_L along its axis and away from the screen. For the purpose of forming the image always on the screen, the object is also required to be given an appropriate velocity. Find the velocity of the object at the instant when the image size is n times the size of the object (n < 1)

(1) $\left(\frac{1-n^2}{n^2}\right)v_L$ towards the screen (2) $\left(\frac{1+n^2}{n^2}\right)v_L$ towards the screen

(3) $\left(\frac{1-n^2}{2n}\right)v_L$ towards the screen (4) $\left(\frac{1-n^2}{n^2}\right)v_L$ away from the screen

Q.37 The refractive index of the medium within a certain region, x > 0, y > 0 changes with y, A thin light ray travelling in the x-direction in air, strikes the medium at origin and moves through the medium along a circular arc, as shown :

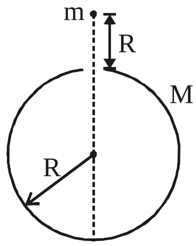


How does the refractive index n(y) depend on y?

(1) $n(y)=\frac{R}{R+y}$ (2) $n(y)=-\frac{R}{R+y}$ (3) $n(y)=\frac{R}{R-y}$ (4) none of these

SPACE FOR ROUGH WORK

Q.38 A thin spherical shell of total mass M and radius R is held fixed. There is a small hole in the shell. A particle of mass m is released from rest at a distance R from the hole as shown. This particle subsequently moves under gravitational force of the shell. How long does it take to travel from the hole to the point diametrically opposite?

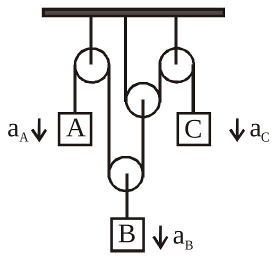


(1) $\sqrt{\frac{2R^3}{GM}}$ (2) $2\sqrt{\frac{2R^3}{GM}}$ (3) $2\sqrt{\frac{R^3}{GM}}$ (4) None of these

Q.39 Two beams of light having intensities I and 4I interfere to produce a fringe pattern on a screen. The phase difference between the beams is $\pi/2$ at point A and π at point B on the screen. Then the difference between resultant intensities at A and B is :

(1) 2I (2) 4I (3) 5I (4) 7I

Q.40 Determine the constraint equation which relates the accelerations of bodies A, B and C as shown:



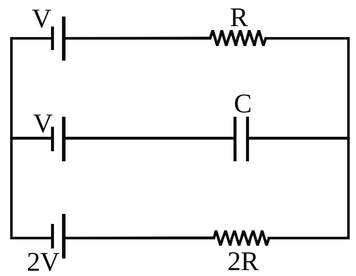
(1) $a_A + 4a_B + a_C = 0$ (2) $2a_A + a_B + a_C = 0$
(3) $2a_A - 4a_B + a_C = 0$ (4) $2a_A + 4a_B + a_C = 0$

SPACE FOR ROUGH WORK

Q.41 Three spherical conductors S_1, S_2 and S_3 of radii a, b and d respectively (a < b < d) are arranged concentrically. S_1 and S_2 are connected and S_3 is grounded. Find the equivalent capacitance of the system

(1) $\frac{4\pi\varepsilon_0 abd}{(b-a)(d-b)}$ (2) $\frac{4\pi\varepsilon_0 ab}{(b-a)}$ (3) $\frac{4\pi\varepsilon_0 bd}{(d-b)}$ (4) $\frac{4\pi\varepsilon_0 ad}{(d-a)}$

Q.42 In the given circuit, under steady state, the potential drop across the capacitor must be



(1) V (2) $\frac{V}{2}$ (3) $\frac{V}{3}$ (4) $\frac{2V}{3}$

Q.43 The maximum kinetic energy of photoelectrons emitted from a metal surface, when photons of energy 6eV fall on it is 4eV. The stopping potential in volts is

(1) 2 (2) 4 (3) 6 (4) 10

Q.44 The time period of a simple pendulum is 2 sec. Initial amplitude is 10 degrees and becomes 5 degrees in 100 oscillations. The quality factor of the weakly damped oscillation will be

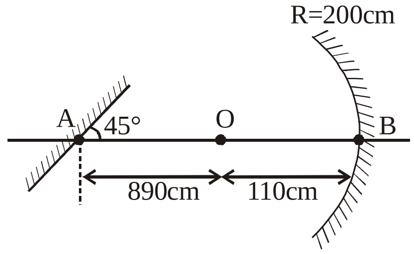
(1) $\pi 200 / \ln 2$ (2) $\pi 100 / \ln 2$ (3) $\pi 300 / \ln 2$ (4) None

Q.45 A satellite is taken to a height h = 10 R (where R is the radius of earth) above the surface of the earth radially and is given a velocity of $\sqrt{\frac{3gR^2}{(R+h)}}$ perpendicular to h. Then, the satellite will subsequently:

(1) revolve around earth in circular orbit
(2) escape the earth's gravity along a hyperbolic path
(3) fall on earth
(4) revolve around earth in an elliptical orbit

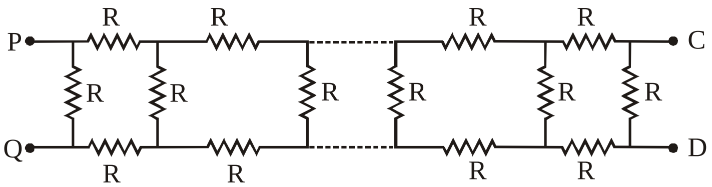
SPACE FOR ROUGH WORK

Q.46 A plane mirror and a concave mirror are arranged as shown in figure and O is a point object. Find the position of image formed by two sucessive reflections, first one taking place at concave mirror



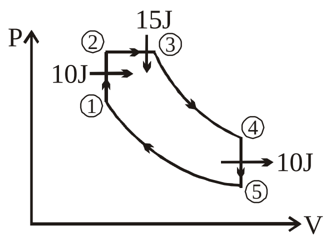
(1) 110 cm vertically below A
(2) 200 cm vertically below A
(3) 300 cm vertically below A
(4) 100 cm vertically below A

Q.47 The resistance between the terminal point P and Q of the given infinitely long circuit will be



(1) $(\sqrt{3}-1)R$
(2) $(\sqrt{3}+1)R$
(3) $(4-\sqrt{3})R$
(4) $(4-\sqrt{2})R$

Q.48 A gas undergoes cyclic process as shown in the figure, 5-1 and 3-4 are adiabatic processes, 1-2 and 4-5 are isochoric process, 2-3 is isobaric process. Find efficiency of the cycle.



(1) 15 %
(2) 30%
(3) 45%
(4) 60%

SPACE FOR ROUGH WORK

Q.49 If acceleration and velocity of a particle at an instant are $\left(5\vec{j}\right)ms^{-2}$ and $\left(3\vec{i}+4\vec{j}\right)ms^{-1}$ respectively, then the radial acceleration and radius of curvature at that point of the path where particle is present, will be:

(1) $3\,ms^{-2}, \frac{25}{3}m$ (2) $4\,ms^{-2}, \frac{4}{25}m$ (3) $5\,ms^{-2}, \frac{1}{25}m$ (4) None

Q.50 The diameter of the outer conductor of a cylindrical capacitor is D_2. What should be the diameter of the core (inner cylinder) D_1 of this capacitor be, so that for a given potential difference between the outer conductor and the core, the electric field strength at the core is minimum

(1) $\frac{2D_2}{e}$ (2) $\frac{D_2}{e}$ (3) $\frac{D_2}{e^2}$ (4) None of these

Q.51 A particle of specific charge α (charge per unit mass) is released at time t = 0 from origin with an initial velocity of $\vec{v} = v_0\hat{i}$ in a uniform magnetic field $\vec{B} = -B_0\hat{k}$. Find the velocity of particle at any time t.

(1) $v_0 \cos(B_0 \alpha t)\hat{i} - v_0 \sin(B_0 \alpha t)\hat{j}$ (2) $v_0 \cos(B_0 \alpha t)\hat{i} + v_0 \sin(B_0 \alpha t)\hat{j}$

(3) $-v_0 \cos(B_0 \alpha t)\hat{i} - v_0 \sin(B_0 \alpha t)\hat{j}$ (4) None of these

Q.52 A particle of mass 2kg has potential energy $U = (8x^2 - 4x^4)J$. Then its angular frequency for small oscillation about its equilibrium position will be

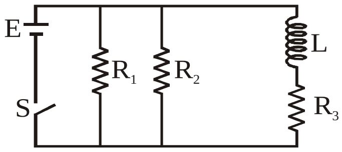
(1) $2\sqrt{2}$ rad/sec (2) 2 rad/sec (3) 1 rad/sec (4) 4 rad/sec

Q.53 If a carrier wave of 1000 kHz is used to carry a signal, the minimum length of transmitting antenna will be equal to

(1) 3m (2) 30 m (3) 75 m (4) 7.5 m

SPACE FOR ROUGH WORK

Q.54 A inductor of inductance L = 400 mH and three resistors of resistance $R_1 = 4\Omega$, $R_2 = 2\Omega$ and $R_3 = 10\Omega$ are connected to a battery of emf E = 10V as shown in the figure. The internal resistance of the battery is negligible. The switch S is closed at time t = 0. What is the potential drop across L as a function of time?



(1) $10e^{-25t}$ volt (2) $20e^{-5t}$ (3) $5e^{-5t}$ (4) $30e^{-16t}$ volt

Q.55 Equation of a longitudinal wave is given as

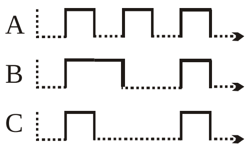
$$s = 10^{-2} \sin 2\pi \left(1000\,t + \frac{50x}{17}\right) \text{ (all SI units),}$$

At t = 0, change in pressure is maximum (in modulus) at x = ?

(1) 0.34 (2) 0.255 (3) 0.085 (4) All of these

Q.56 The following figure shown a logic gate circuit with two inputs A and B and output C. The voltage waveforms of A, B and C are as shown in second figure below.

(i) (ii)



The logic circuit gate is

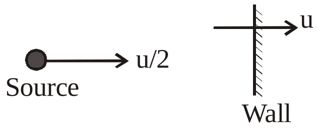
(1) OR gate (2) AND gate (3) NAND gate (4) NOR gate

Q.57 If time period measured are 8.01 sec and 8.41 sec using a stop watch having least count 0.01 sec then find best reported time in second

(1) 8.2 ± 0.2 (2) 8.41 ± 0.01 (3) 8.01 ± 0.01 (4) 2 ± 0.01

SPACE FOR ROUGH WORK

Q.58 A wall is moving with velocity u and a source of sound moves with velocity $\frac{u}{2}$ in the same direction as shown in the figure. Assuming that sound travels with a velocity 10 u. The ratio of incident sound wavelength on the wall to the reflected sound wavelength by the wall, is equal to



(1) 9 : 11 (2) 11 : 9 (3) 4 : 5 (4) 5 : 4

Q.59 An unpolarised beam of light of intensity I is incident on a set of four polarising plates such that each plate makes an angle $\pi/3$ with preceding sheet. The intensity of light transmitted through the combination is :

(1) $\frac{1}{64}$ (2) $\frac{1}{128}$ (3) $\frac{1}{32}$ (4) $\frac{1}{256}$

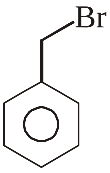
Q.60 A light emitting diode has a voltage drop of 2 volt across it and passes a current of 10 mA when it operates with 6 volt battery through a limiting resistor R. The value of R is:

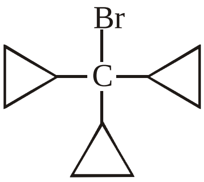
(1) 40 Ω (2) 4 kΩ (3) 200 Ω (4) 400 Ω

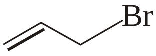
SPACE FOR ROUGH WORK

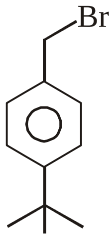
Q.61 Sodium peroxide which is a yellow solid, when exposed to air becomes white due to the formation of :
(1) Na_2O (2) H_2O_2 (3) NaOH and H_2O_2 (4) NaOH and Na_2CO_3

Q.62 Consider the S_N1 solvolysis of the following halides in aqueous formic acid :

(a) 

(b) 

(c) 

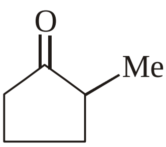
(d) 

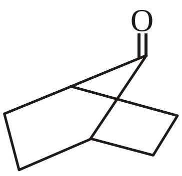
Which one of the following is correct sequence of the halides given above in the decreasing order of their reactivity ?
(1) d > a > b > c (2) b > d > a > c (3) c > b > d > a (4) b > a > d > c

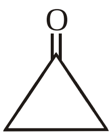
Q.63 Decomposition of a certain mass of $CaCO_3$ produce 11.2 dm^3 of $CO_2(g)$ at 1atm and 273 K. After decomposition, residue is dissolved in water to produce $Ca(OH)_2$, what mass of HCl is required to completely neutralise the base -
(1) 18.25 g (2) 27.375 g (3) 36.5 g (4) 71 g

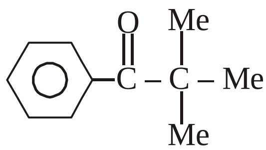
Q.64 Highest oxidation state of manganese in fluoride is +4 (MnF_4) but highest oxidation state in oxides is +7 (Mn_2O_7) because ____________.
(1) fluorine is more electronegative than oxygen.
(2) fluorine does not possess d-orbitals.
(3) fluorine stabilises lower oxidation state.
(4) in covalent compounds fluorine can form single bond only while oxygen forms double bond.

Q.65 Which compound give aldol condensation :

(1) 

(2) 

(3) 

(4) 

SPACE FOR ROUGH WORK

Q.66 Electron present in excited state of H-atom emits a photon of wavelength (λ) and returns to ground state. The principal quantum number(n) of excited state is -

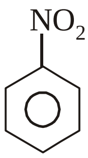
(1) $\dfrac{\lambda}{\sqrt{\lambda R(\lambda R-1)}}$ (2) $\sqrt{\dfrac{\lambda R}{\lambda R-1}}$ (3) $\sqrt{\lambda R(\lambda R-1)}$ (4) $\sqrt{\dfrac{\lambda R-1}{\lambda R}}$

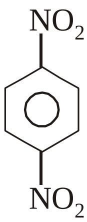
Q.67 Which of the following order of energies of molecular orbitals of N_2 is correct?

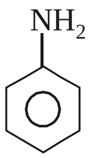
(1) $\pi_{2p_x} < \sigma_{2p_z} < \pi^*_{2p_x}$ (2) $\pi_{2p_x} > \sigma_{2p_z} > \pi^*_{2p_x}$

(3) $\sigma_{2p_z} < \pi_{2p_x} < \pi^*_{2p_x}$ (4) $\sigma_{2p_z} < \pi_{2p_x} = \pi^*_{2p_x}$

Q.68 Which of the following compounds will not give Friedel-Craft reaction ?

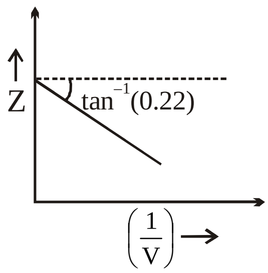
(1) 

(2) 

(3) 

(4) All of these

Q.69 In certain low pressure region for 1 mol of real gas curve of Z v/s $\dfrac{1}{V}$ is plotted at constant temperature as follows -



then temperature (T) of above mentioned real gas is -
[**Given :** a = 5.5 atmL^2/mol^2 , R = 0.08 atm-L/mol-K]

(1) 273.15 K (2) 300 K (3) 312.5 K (4) 230.4 K

SPACE FOR ROUGH WORK

Q.70 Zone refining is based on the principle that __________.

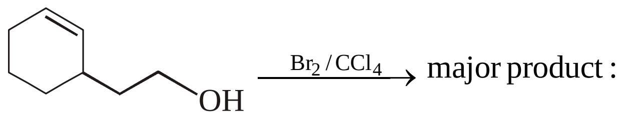
(1) impurities of low boiling metals can be separated by distillation.

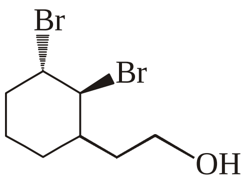
(2) impurities are more soluble in molten metal than in solid metal.

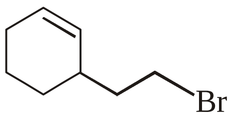
(3) different components of a mixture are differently adsorbed on an adsorbent.

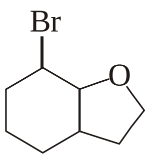
(4) vapours of volatile compound can be decomposed in pure metal.

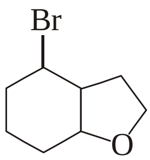
Q.71 Find the major product of following reaction:



(1) 

(2) 

(3) 

(4) 

Q.72 An ionic compound XY crystallises in ideal ZnS type structure. If the edge length of unit cell is 654 pm then **correct** statement about this compund is-

(1) It has BCC type unit cell.

(2) Zn^{2+} is present at body centre.

(3) Number of tetrahedral and octahedral voids are 4 and 8 respectively.

(4) Closest distance between X^+ and Y^- is 283.15 pm.

Q.73 In qualitative analysis when H_2S is passed through an aqueous solution of a salt acidified with dil. HCl, a black precipitate is obtained. On boiling the precipitate with dil. HNO_3, it forms a solution of blue colour. Addition of excess of aqueous solution of ammonia to this solution gives _________.

(1) deep blue precipitate of $Cu(OH)_2$

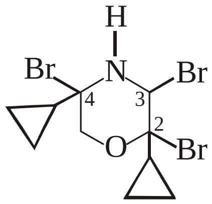
(2) deep blue solution of $[Cu(NH_3)_4]^{2+}$

(3) deep blue solution of $Cu(NO_3)_2$

(4) deep blue solution of $Cu(OH)_2.Cu(NO_3)_2$

SPACE FOR ROUGH WORK

Q.74 In the given reaction



Br will be replaced by OCH_3 at carbon :

(1) 2 (2) 3 (3) 4 (4) Anyone

Q.75 Boiling point of water at 750 mm Hg is 99.63ºC. Find the mass of water present in a solution containing 121.67 g sucrose, if this solution boils at 100ºC $\left(K_{b(H_2O)} = 0.52\ K - Kg/mol\right)$

(1) 50 g (2) 500 g (3) 100 g (4) 1000 g

Q.76 In which of the following complex formation the bond length of the ligand (mentioned in brackets) increases as compared to its isolated state.

(1) $[Fe(CO)_5]$: (CO) (2) $Na_2[Fe(CN)_5(NO)]$: (NO)

(3) $[BF_3.CO]$: (CO) (4) $[Ni(PF_3)_4]$: (PF_3)

Q.77 Find the total number of aldol products in given reaction ?

$$CH_2O + Me - CHO \xrightarrow[\Delta]{\text{dil.NaOH}}$$

(1) 2 (2) 3 (3) 4 (4) 5

Q.78 For a first order gas phase reaction : $A \longrightarrow 2B + C$, total pressure observed after time t was P_T and after long time P_∞, then **correct** relation of k.

(1) $k = \frac{1}{t}\ln\left(\frac{P_\infty}{3(P_\infty - P_t)}\right)$ (2) $k = \frac{1}{t}\ln\left(\frac{2P_\infty}{(P_\infty - P_T)}\right)$

(3) $k = \frac{1}{t}\ln\left(\frac{3P_\infty}{2P_\infty - P_t}\right)$ (4) $k = \frac{1}{t}\ln\left(\frac{2P_\infty}{3(P_\infty - P_T)}\right)$

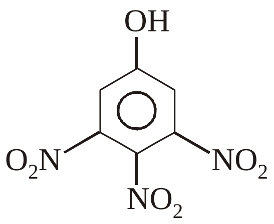
SPACE FOR ROUGH WORK

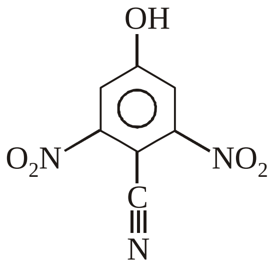
Q.79 The first ionisation enthalpies of Na, Mg, Al and Si are in the order:

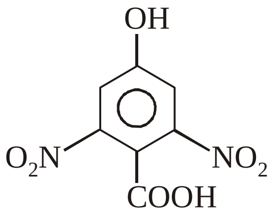
(1) Na < Mg > Al < Si (2) Na > Mg > Al > Si

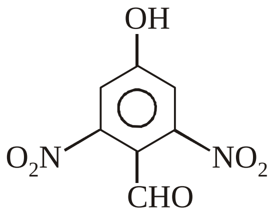
(3) Na < Mg < Al < Si (4) Na > Mg > Al < Si

Q.80 Among the following compounds which is strongest acid.

(1) 

(2) 

(3) 

(4) 

Q.81 Select the **incorrect** statement

(1) Activation energy is required in physisorption

(2) Extent of physisorption increases as temperature decreases

(3) Extent of adsorption for solute in a solution on solid adsorbent surface depends upon its concentration

(4) Chemisorption is highly specific in nature

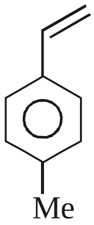
Q.82 The compounds $[Co(NH_3)_5(SO_4)]Cl$ and $[Co(NH_3)_4(SO_4)]Cl$ represent

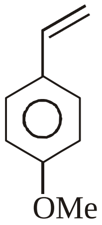
(1) linkage isomerism (2) ionisation isomerism

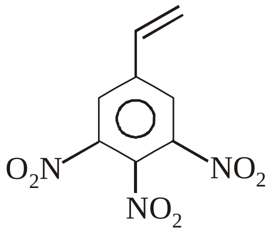
(3) coordination isomerism (4) no isomerism

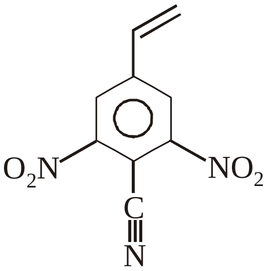
SPACE FOR ROUGH WORK

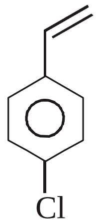
Q.83 Arrange the given alkene in decreasing order of their rate towards epoxydation.

(a) 

(b) 

(c) 

(d) 

(e) 

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

Q.84 For the following homogeneous gas phase equilibrium,

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

degree of dissociation (d) of PCl_5 is related to total pressure at equilibrium by which expression. (d << 1)

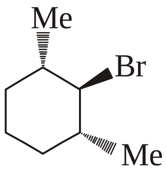
(1) $d \propto P$
(2) $d \propto \frac{1}{\sqrt{P}}$
(3) $d \propto \frac{1}{P^2}$
(4) $d \propto \frac{1}{\sqrt{P}}$

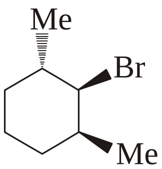
Q.85 Hydrogen gas will not reduce:

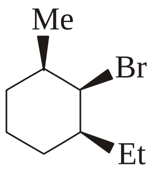
(1) heated cupric oxide
(2) heated ferric oxide
(3) heated stannic oxide
(4) heated aluminium oxide

SPACE FOR ROUGH WORK

Q.86 Arrange the following in decreasing order of E_2 reaction :

(x) 

(y) 

(z) 

(1) x > y > z (2) x > z > y (3) y > z > x (4) z > y > x

Q.87 For the following concentration cell :

Pt(s) | H_2(g) | H^+(aq) || HA(aq) | H_2(g) | Pt(s)

1 bar 10^{-8} M 0.1M 1 bar

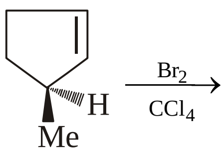
If E_{cell} = 0.180 Volt then pOH of solution in cathode compartment is -

(1) 1 (2) 5 (3) 9 (4) 14

Q.88 Which of the following nitrate salt solution produce precipitate with excess both NaOH and with excess NH_4OH solution ?

(1) $Pb(NO_3)_2$ (2) $Zn(NO_3)_2$ (3) $Cr(NO_3)_3$ (4) $Hg(NO_3)_2$

Q.89 Identify number of chiral centre present in product obtained by following reaction.



(1) 4 (2) 3 (3) 5 (4) 6

Q.90 For a process, pressure of fixed amount of diatomic ideal gas remains directly proportional to cube of its absolute temperature, then value of molar heat capacity for gas is -

[Assume vibrational degree of freedom to be inactive]

(1) $\frac{3R}{2}$ (2) $\frac{R}{2}$ (3) $\frac{5R}{2}$ (4) 2R

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TEST CODE				
1	1	3	0	1

Q.No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Ans	3	4	3	2	1	2	3	4	2	3	2	2	1	1	3
Q.No.	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
Ans	2	1	1	2	2	3	4	3	2	3	4	1	2	3	2
Q.No.	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**
Ans	3	1	3	3	4	1	3	3	2	4	3	3	2	2	2
Q.No.	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
Ans	4	1	4	1	2	2	1	3	1	1	2	1	1	2	4
	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC
Q.No.	**61**	**62**	**63**	**64**	**65**	**66**	**67**	**68**	**69**	**70**	**71**	**72**	**73**	**74**	**75**
Ans	4	2	3	4	1	2	1	4	3	2	3	4	2	3	2
	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC
Q.No.	**76**	**77**	**78**	**79**	**80**	**81**	**82**	**83**	**84**	**85**	**86**	**87**	**88**	**89**	**90**
Ans	1	2	4	1	3	1	4	2	2	4	4	3	4	2	2

HINTS & SOLUTIONS

MATHEMATICS

Q.1 Let x + 1 = t

$$\int_0^1 (t-1)\cdot \ln t\, dt$$

$$= \left(\frac{t^2}{2} - t\right)\cdot \ln t\Big|_0^1 - \int_0^1 \left(\frac{t}{2} - 1\right) dt$$

$$= 0 - \left[\frac{t^2}{4} - t\right]_0^1 = \frac{3}{4}$$

Q.2 Each diagonal element of matrix A has three choices.

Q.3 $(1 + x + x^2 + x^3)^{100}$
$= a_0 + a_1x + a_2 x^2 + ... + a_{300}\cdot x^{300}$ ....(1)
By differentiating both side
$100\cdot(1 + x + x^2 + x^3)^{99}\cdot(1 + 2x + 3x^2)$
$= a_1 + 2a_2 x + ... + 300\cdot a_{300}\cdot x^{299}$

If x = 1
$100\,(4)^{99}$ .... +

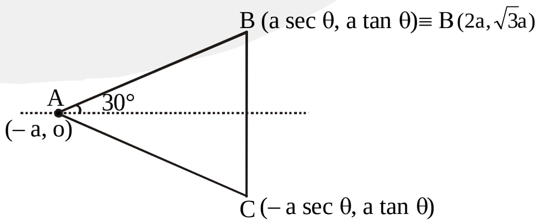
a_r .... (2)

a_{300} = k .... (3)

$\sum_{r=0} \cdot a_r$

a tan θ

$\theta + \quad = \frac{1}{\sqrt{3}} = \theta = \frac{\pi}{3}$



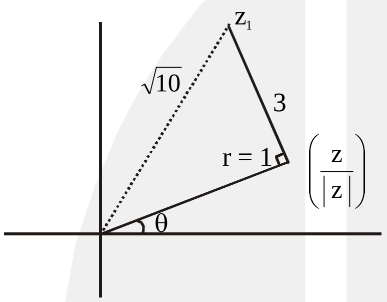
Now, $AB = \sqrt{(2a+a)^2 + \left(\sqrt{3}a\right)^2}$

$= \sqrt{12a^2} = 2\sqrt{3}a$

Q.5 $\sec^2((n(m+2)) = 1-(m+1)^2$
only possible value of $m = -1$
$\Rightarrow \sec^2(n) = 1$
$\Rightarrow n = 0$
$\Rightarrow A(-1, -2)$
So, straight line passing through
$A(-1, -2)$ and with slpoe $m = 2$ is
$y + 2 = 2(x + 1)$
$y = 2x$

Q.6 $g'(0) = 1,\ g''(0) = 0,\ g'''(0) = -2018$

Q.7



Q.8

1 odd	5 even	$^6C_1$	×	2^6
3 odd	3 even	$^6C_3$	×	2^6
5 odd	1 even	$^6C_5$	×	2^6

$= (^6C_1 + {}^6C_3 + {}^6C_5)\cdot 2^6 = 32 \times 2^6 = 2^{11}$

Q.9 Prime number = 2, 3, 5, 7
Total outcomes

= | 2 | · | · | · | · | · | · | · | · | · | $= 4^9 = 2^{18}$

favourable out comes

= | 2 | · | 2 | · | 2 | · | 2 | · | 2 | · |

Requried probability $= \frac{2^5}{2^{18}} = \frac{1}{2^{13}} = 2^5$

Q.10 $\lim\limits_{x\to 0} f(x) = e^{\frac{4b^2-9a}{2b}} = e^3$
$\Rightarrow 4b^2 - 6b - 9a = 0\ \forall\ b \in R$

$D \geq 0 \Rightarrow a \geq \frac{-1}{4}$

Q.11 $y = ax^3 + bx^2 + cx + 5$
$0 = -8a + 4b - 2c + 5$ .... (1)
$y' = 3ax^2 + 2bx + c$
$0 = 12a - 4b + c$ .... (2)
[∵ parallel to x-axis]
and $3 = 3a(0) + 2b(0) + c$ .... (3)
[∵ intersect y-axis]
by equation (1), (2) and (3)

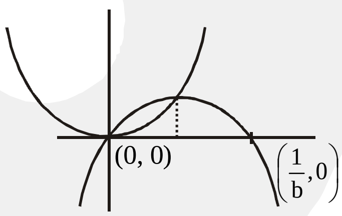
$a = -\frac{1}{2}$ and $b = -\frac{3}{4}$

So, $a - 2b = -\frac{1}{2} + 2\times\frac{3}{4} = 1$

Q.12 $g(x) = \int \pi\sin\pi x + 2x - 4)\ dx$
$= -\cos\pi x + x^2 - 4x + 5$ (∵ $g(1) = 3$)
$= (x-2)^2 + (1 - \cos\pi x)$

Q.13 Area $= \int_0^{\frac{b}{b^2+1}} \left[\left(-bx^2 + x\right) - \left(\frac{x^2}{b}\right)\right]dx$

$= \frac{b^2}{6\left(b^2+1\right)^2}$



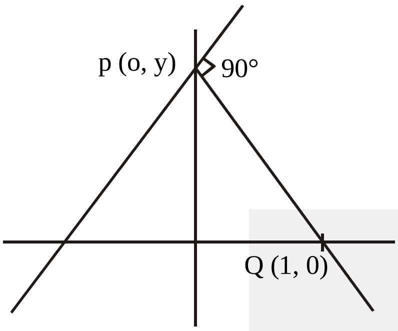
Let $f(b) = \frac{b^2}{6(b^2+1)^2} \Rightarrow f(b)_{max}$ at $b = \pm 1$

Q.14 Equation of tangent

$y - y_1 = \frac{dy}{dx}\ (x - 0)$

$y = y_1 + x\frac{dy}{dx}$ ....(1)

Now, $\left(\frac{y_1 - 0}{0-1}\right)\left(\frac{dx}{dy}\right) = -1$



$y_1 = \dfrac{dx}{dy}$ .... (2)

By equation (1) and (2)

$\Rightarrow\ y\dfrac{dy}{dx} - x\left(\dfrac{dy}{dx}\right)^2 = 1$

Q.15 $(x\hat{i} + y\hat{j})\cdot(x\hat{i} + y\hat{j} + 8\hat{i} - 10\hat{j}) + 41 = 0$

$x^2 + y^2 + 8x - 10y + 41 = 0$

centre $(-4, 5)$, $r = \sqrt{16+25-41} = 0$

So, minimum value of $\left|-4\hat{i} + 5\hat{j} + 2\hat{i} - 3\hat{j}\right|^2$

$= \left|-2\hat{i} + 2\hat{j}\right|^2 = \left(\sqrt{4+4}\right)^2 = 8$

Q.16 $\lim\limits_{x\to\frac{\pi}{2}} \sqrt{\dfrac{\tan x - \sin\left(\tan^{-1}(\tan x)\right)}{\tan x + \cos^2(\tan x)}}$

$= \lim\limits_{h\to 0} \sqrt{\dfrac{\cot h - \cos h}{\cot h + \cos^2(\cot h)}} = 1$

Q.17 $5 + 2\sin x - \sin^2 x = 1 + 5^{\sec^2 y}$

$\Rightarrow (\sin x - 1)^2 = (5 - 5^{\sec^2 y})$

$\Rightarrow \sin x = 1$ and $\sec y = 1$

So, $(x + y)_{min} = \dfrac{\pi}{2}$.

Q.18 $4\cos^2\theta = \dfrac{x^4 + 2x^2 + 1}{x^2+1} + \dfrac{4}{x^2+1}$

$4\cos^2\theta = (x^2 + 1) + \dfrac{4}{(x^2+1)}$

$x^2 + 1 + \dfrac{4}{x^2+1} \ge 4$ and $4\cos^2\theta \in [0, 4]$

So, $x^2 + 1 = \dfrac{4}{x^2+1}$

$\Rightarrow x = \pm 1$ and $\cos\theta = 1$

So, $x\cos\theta = \pm 1$

Q.19 $(x\hat{i} + y\hat{j})\cdot(6\hat{j} - 4\hat{i} + x\hat{i} + y\hat{j}) = 3$

$x^2 + y^2 - 4x + 6y - 3 = 0$

centre $(2, -3)$, $r = \sqrt{4+9+3} = 4$

So, $|\vec{r} + 2\hat{i} - 3\hat{j}|_{max} = 2\left(2 + \sqrt{13}\right)$.

Q.20 $\left[(\alpha-2)^3\right]^4 + \dfrac{(12)^{12}}{(\alpha\beta)^{12}} - 1$ $[\therefore\ \beta - 6 = -\dfrac{12}{\beta}]$

$= [\alpha^3 - 8 - 6\alpha(\alpha - 2)]^4$

$= [\alpha[\alpha^2 - 6\alpha + 12] - 8]^4 = 8^4$

So, a^b may be 2^{12}, 4^6, 8^4 etc.

So, $(a + b)_{min} = 4 + 6 = 10$

Q.21 At $\lambda = 1$, radical axis of circles are parallel.

Q.22 $AA^{-1} = \dfrac{1}{10}[\lambda A^2 + 9A - A^3]$

$10I = \lambda A^2 + 9A - A^3$

After solving above $\lambda = 2$

Q.23 $\left(\dfrac{7!}{4!\cdot 3!}\times 3!\cdot 3!\right)\left(\dfrac{8!}{4!\cdot 4!\cdot 2!}\times 3!\cdot 3!\right) = \dfrac{(7!)^2}{16}$

Q.24 $f'(x) = 6x^2 - 6\cdot 2\sqrt{2} \times \sin^2\theta + 6\sin^2\theta$

$D \ge 0$

$\Rightarrow 36\cdot 8\cdot \sin^4\theta - 4\cdot 6\cdot 6\sin^2\theta \ge 0$

$\Rightarrow \sin^2\theta\,(2\sin^2\theta - 1) \ge 0$

$\Rightarrow \sin^2\theta \ge \dfrac{1}{2}$

Q.25 One of its period is 3.

So that $\displaystyle\int_{15}^{25} f(x)\,dx = 10\int_{0}^{3} f(x)\,dx = 50$.

Q.26 Equation of tangents are $y = \frac{2x}{5}$ and $y = \frac{-5x}{2}$

Here, $m_1 m_2 = -1$.

Q.27 Let $x_1 > x_2 > x_3 > x_4$ .... $> x_{20}$

Median $= \frac{x_{10} + x_{11}}{2}$

$x_1 - 3, x_2 - 3, x_3 - 3, \ldots\ldots, x_{10} - 3, x_{11} + 5, x_{12} + 5, \ldots\ldots, x_{20} + 5$

Median $= \frac{x_{10} - 3 + x_{11} + 5}{2} = \frac{x_{10} + x_{11}}{2} + 1$

Q.28 $| z + 1 - 2i | = 3$

Centre C_1 $(-1, 2)$, $r_1 = 3$

$| z - 2 - 6i | = 2$

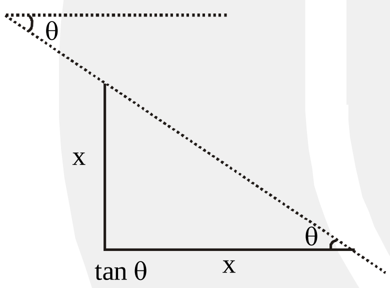
Centre C_2 $(2, 6)$, $r_2 = 2$

$\Rightarrow C_1C_2 = r_1 + r_2 = 5$

Q.29

Q.30 $\tan\theta = \frac{x}{x} = 1$

$\theta = 45°$.



PHYSICS

Q.31 $\frac{\tan 60°}{\tan 30°} = \frac{Y_B}{Y_A} \Rightarrow Y_B = 3Y_A$

Q.32 From kinematics and symmetry in vertical ascent and descent motion of the ball,

required time $= \sqrt{\frac{2h}{g}} + \sqrt{\frac{2h/2}{g}} = t + \frac{t}{\sqrt{2}}$

Q.33 $(\chi) = \frac{\text{Intensity of magnetisation (I)}}{\text{Magnetizing field (H)}}$

or, $I = \chi H$

Q.34 Pressure difference between lungs of student and atmosphere

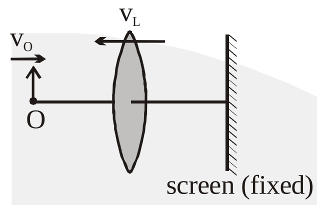
= (760 – 750) mm of Hg = 1cm of Hg = 13.6 cm of water

Hence h = 13.6 cm.

Q.35 No friction is required for pure rolling of ring.

Q.36 $\vec{v}_{I,L} = m^2(\vec{v}_{O,L})$

$\Rightarrow 0 - (-v_L) = n^2 (v_O - (-v_L))$

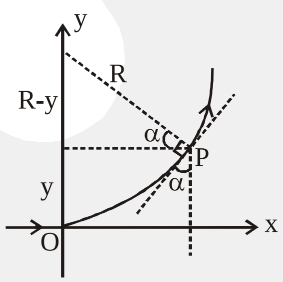


$\Rightarrow v_O = \left(\frac{1-n^2}{n^2}\right) v_L$ towards screen

Q.37 Applying Snell's law at O and P

$1 \times \sin 90° = n(y) \sin\alpha$

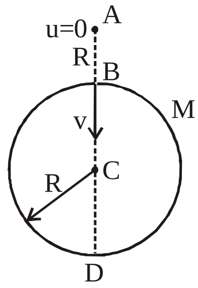
$\Rightarrow n(y) = \text{cosec}\,\alpha = \frac{R}{R-y}$



Q.38 Let v be the velocity of the particle at point B. Applying conservation of mechanical energy at point A and B, we have

$$-\frac{GMm}{2R} = -\frac{GMm}{R} + \frac{1}{2} m v_B^2$$

$$\Rightarrow v_B = \sqrt{\frac{GM}{R}}$$



Thereafter $v = \sqrt{\frac{GM}{R}}$ = constant

($\because$ inside shell, $\vec{F}_g = m\vec{E}_g = 0$)

$\therefore t_{BD} = \frac{2R}{v}$

Q.39 $I_1 = I$ and $I_2 = 4I$

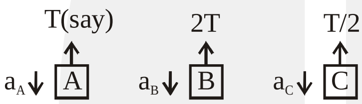
$\therefore I_{net} = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$

$\therefore I_A = I + 4I = 5I$ ($\because \phi_A = \pi/2$)

& $I_B = I + 4I - 2\sqrt{4I.I} = I$ ($\because \phi_B = \pi$)

$\Rightarrow I_A - I_B = 4I$

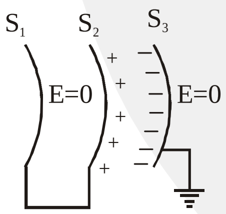
Q.40



$\Sigma\vec{T}.\vec{a} = 0 \quad \therefore -Ta_A - 2Ta_B - \frac{T}{2}a_C = 0$

$\Rightarrow 2a_A + 4a_B + a_C = 0$

Q.41

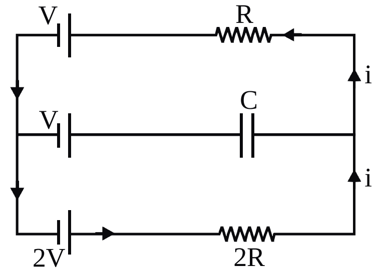


$\therefore C_{eq} = C_{between\ S_2 \& S_3} = \frac{4\pi\in_0 bd}{d-b}$

Q.42 In a steady state no current will pass through the capacitor. In the outer loop

$2V - 2iR - iR - V = 0 \Rightarrow i = \frac{V}{3R}$

For the upper loop,



$V - V_C - iR - V = 0$

$\Rightarrow |V_C| = iR = \frac{V}{3}$

Q.43 $eV_0 = K.E_{max} \Rightarrow V_0 = \frac{K.E_{max}}{e}$

Q.44 $\because \theta = \theta_0 e^{-\gamma t} \Rightarrow 5 = 10e^{-\gamma(100 \times 2)}$

$\Rightarrow \gamma = \frac{\ln 2}{200}$ and Q.F. $= \frac{\omega_0}{2\gamma} = \left(\frac{2\pi}{T}\right).\frac{1}{2\gamma}$

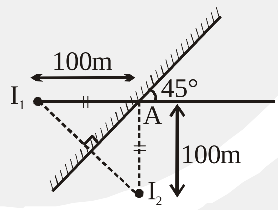
Q.45 v_e = Escape velocity (from height h) $= \sqrt{\frac{2GM}{R+h}} = \sqrt{\frac{2gR^2}{R+h}}$

$\because v_{satellite} > v_e \Rightarrow$ it escapes earth's gravity along a hyperbolic path.

Q.46 For concave mirror

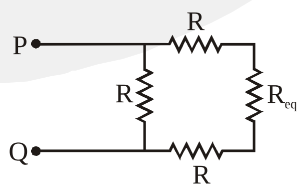
$v = \frac{fu}{u-f} = -1100$ cm

$\Rightarrow I_1$ is 100 cm left of A



$\therefore I_2$ will be formed as shown

Q.47 The circuit can be redrawn as shown in the figure



$\Rightarrow R_{eq} = \dfrac{(2R + R_{eq})R}{R + (2R + R_{eq})}$

$\Rightarrow R^2_{eq} + (2R)\, R_{eq} - 2R^2 = 0$

$\therefore R_{eq} = (\sqrt{3} - 1)R$

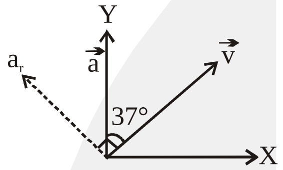
Q.48 $W_{net} = (\Sigma\Delta Q)_{cycle} = 10 + 15 - 10 = 15$ J

$\Delta Q_{in} = 10 + 15 = 25$ J

$\Rightarrow \eta = \dfrac{15}{25} \times 100 = 60\%$

Q.49 $a_r = a \sin 37° = 3 m/s^2$.

Also, $r = \dfrac{v^2}{a_r} = \dfrac{25}{3}$ m



Q.50 Capacitance per unit length is given by

$C = \dfrac{\lambda}{V} = \dfrac{2\pi\varepsilon_0}{\ln(D_2/D_1)}$

where λ = charge per unit length

$E_{core} = \dfrac{\lambda}{2\pi\varepsilon_0 r_{core}} = \dfrac{\lambda}{\pi \in_0 D_1}$

$= \dfrac{2V}{D_1 \ln(D_2/D_1)}$

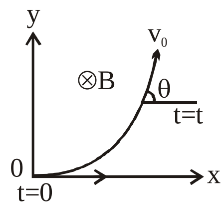
$\therefore$ for $E_{min} \Rightarrow \dfrac{dE_{core}}{dD_1} = 0 \Rightarrow D_1 = \dfrac{D_2}{e}$

Q.51 Magnetic field is in –Z-direction. $\vec{v} \perp \vec{B}$

$\Rightarrow$ path of particle will be a circle in XY plane.

Angular speed $\omega = \dfrac{qB_0}{m} = \alpha B_0$

In time t, the particle will rotate an angle $\theta = \omega t = B_0 \alpha t$ as shown in figure.



Hence velocity of particle at time t would be

$\vec{v} = v_0 \cos\theta \hat{i} + v_0 \sin\theta \hat{j}$

or $\vec{v} = v_0 \cos(B_0 \alpha t)\hat{i} + v_0 \sin(B_0 \alpha t)\hat{j}$

Q.52 $U = 8x^2 - 4x^4$

$\dfrac{dU}{dx} = 16x - 16x^3 = 0$

$\Rightarrow x = 1, 0 \rightarrow$ positions of equilibrium

$\because$ x = 0 is stable equilibrium position

$\left(\dfrac{d^2U}{dx^2} > 0\right)$

$\therefore F = \dfrac{-dU}{dx} = 16x^3 - 16x \approx -16x$

(for small x).

$\Rightarrow \omega = \sqrt{\dfrac{16}{2}} = \sqrt{8}$ rad/sec

Q.53 The minimum length of transmitting antenna is

$l_{min} = \dfrac{\lambda}{4} = \dfrac{1}{4}\dfrac{c}{f} = 75m$

Q.54 $I = I_{max}(1 - e^{-t/\tau})$

$\varepsilon = L\dfrac{dI}{dt}$

Q.55 We know that c hange in pressure =

$\partial P = \dfrac{-B\partial S}{\partial x}$ & will be maximum at t = 0 when

$\cos\left(\dfrac{100\pi x}{17}\right) = +1$

Use option in above equation to justify it.

Q.56 From the given input and output waveforms, the truth table can be constructed as given

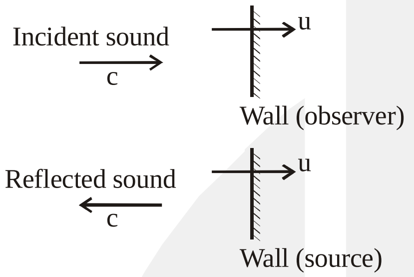
A	B	C
0	0	0

1	1	1
0	1	0
1	0	0

the logic circuit is hence an AND gate.

Q.57 Mean absolute error is greater then the least count hence we consider mean absolute error as error in place of least count in the reported data.

Q.58 Speed of sound is c = 10u. If frequency of source is f



$$f_{in} = f\left(\frac{c-u}{c-u/2}\right) = \frac{18f}{19}$$

$$\therefore \lambda_{in} = \frac{v_{rel}}{f_{in}} = \frac{c-u}{18f/19} = \frac{19u}{2f}$$

$$\lambda_{ref} = \frac{v_{rel}}{f_{ref}} = \frac{(c+u)}{f_{in}} = \frac{(11)(19)u}{18f}$$

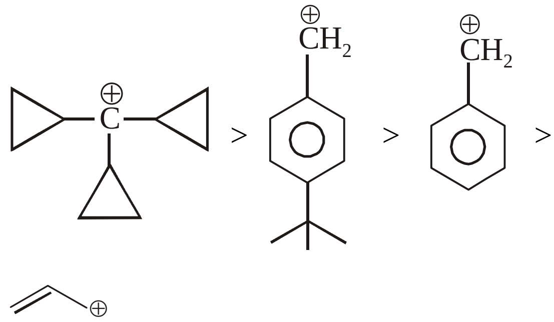
Q.59 Use $I = I_0/2$ When unpolarised light pass through a polariser and use $I = I_0 \cos^2\theta$ when polarised light passes through a polariser.

Q.60 $R = \frac{V}{I} = \frac{6-2}{10\times10^{-3}} = 400\ \Omega$

CHEMISTRY

Q.61 Na_2O_2(yellow solid) + Moist air → Na_2CO_3 + NaOH

Q.62 Rate of S_N1 solvolysis α stability of $C^{\oplus}$



Q.63 $CaCO_3(s) \xrightarrow{\Delta} CaO(s) + CO_2(g)$

$$\frac{11.2}{22.4} = n_{CO_2}$$

moles 0.5 0.5

$CaO(s) + H_2O(l) \longrightarrow Ca(OH)_2(aq)$

0.5 - 0.5

$Ca(OH)_2(aq) + 2HCl(aq) \longrightarrow CaCl_2(aq) + 2H_2O(l)$

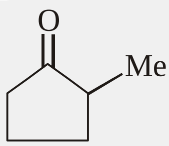
0.5

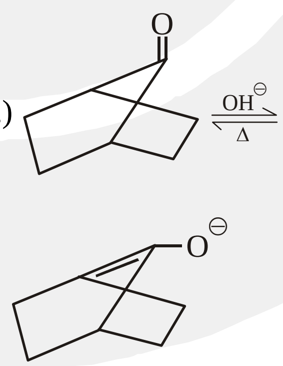
Required moles of HCl = 1

Required mass of HCl = 1 × 36.5 = 36.5 g

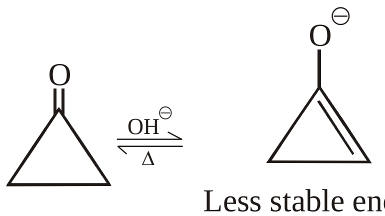
Q.64 Theory based

Q.65 Atleast one α-H should be present for aldol condensation.

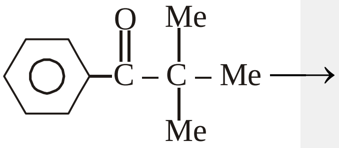
(1)  ⟶ α–H present

(2) 

Unstable enolate ion

(3) 

Less stable enolate ion

(4) 

No α-H present

Q.66 $\dfrac{1}{\lambda} = RZ^2\left(\dfrac{1}{1^2} - \dfrac{1}{n^2}\right)$

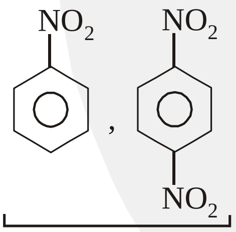
$\dfrac{1}{\lambda} = R\left(1 - \dfrac{1}{n^2}\right)$

$n = \sqrt{\dfrac{\lambda R}{\lambda R - 1}}$

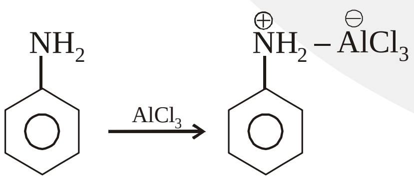
Q.67 Energy order of molecular orbital of N_2 is

$(\sigma_{1s}) < (\sigma^*_{1s}) < (\sigma_{2s}) < (\sigma^*_{2s}) <$

$\pi_{2p_x} = \pi_{2p_y} < \sigma_{2p_z} < \pi^*_{2p_x} = \pi^*_{2p_y} < \sigma^*_{2p_z}$

Q.68 

Deactivating group present



After Lewis base–Lewis acid reaction, it becomes deactivating group.

Q.69 $\left(P + \dfrac{a}{V^2}\right)(V) = RT$

$PV + \dfrac{a}{V} = RT$

$Z = 1 - \dfrac{a}{VRT}$

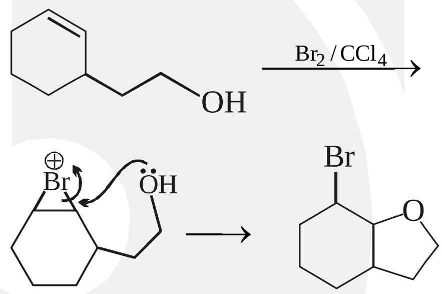
$\text{Slope} = \dfrac{a}{RT} = 0.22$

$\dfrac{5.5}{0.08T} = 0.22$

$T = \dfrac{5.5}{0.08 \times 0.22}$

= 312.5 K **Ans.**

Q.70 Zone refining is based on the principle that impurities are more soluble in molten metal than in solid metal.

Q.71 

Q.72 $(r_{x^+} + r_{y^-}) = \dfrac{\sqrt{3}a}{4} = \dfrac{\sqrt{3}}{4} \times 654 = 283.15$

Ans.

Q.73 Group II radicals
$(Pb^{2+}, Cu^{2+}, Bi^{3+}, Ag^{2+}, Cd^{2+})$

↓ H_2S + HCl

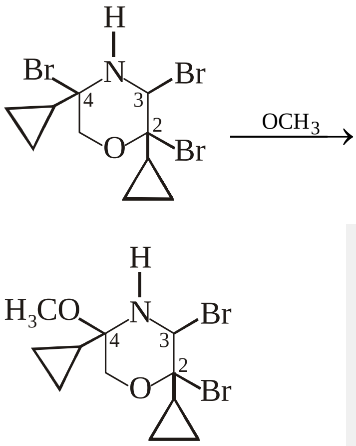
PbS, CuS, Bi_2S_3, HgS (Black), CdS (Yellow)

↓ Hot & dil. HNO_3

Insoluble Hg^{2+} ; Pb^{2+}, Bi^{3+}, $\mathbf{Cu^{2+}}$ (blue colour)

↓ excess NH_4OH

$[Cu(NH_3)_4]^{2+}$ (deep blue)

Q.74 

More stable $C^{\oplus}$ forms at carbon 4.

Q.75 $\Delta T_b = K_b.m$

$100 - 99.63 = (0.52)\ (m)$

$$m = \frac{0.37}{0.52}$$

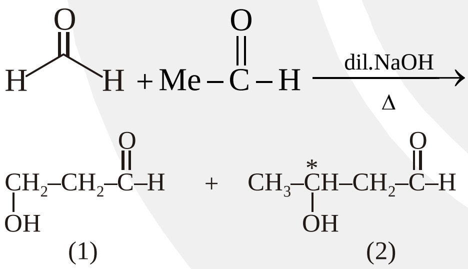
$$m = \frac{n_{sucrose}}{w_{H_2O(g)}} \times 1000 = \frac{0.37}{0.52}$$

$$w_{H_2O} = \frac{121.67}{342} \times \frac{1000}{0.37} \times 0.52$$

$$w_{H_2O} = 500 \text{ g}$$

Q.76 (1) $[Fe(CO)_5]$: (CO)

Due to synergic bonding

Q.77 

Total product will be (3)

Q.78 $A \longrightarrow 2B + C$

P_0

$P_0 - x \quad 2x \quad x$

$- \quad 2P_0 \quad P_0$

$P_\infty = 3P_0$

$P_0 = P_\infty/3$

$P_T = P_0 - x + 3x$

$$x = \frac{P_T - \frac{P_\infty}{3}}{2}$$

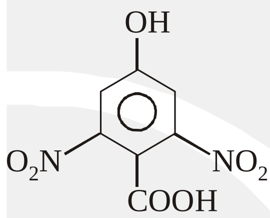
$$k = \frac{1}{t}\ln\frac{P_0}{P_0 - x}$$

$$k = \frac{1}{t}\ln\left(\frac{2P_\infty}{3(P_\infty - P_T)}\right)$$

Q.79 1st I.E. order : Na < Mg > Al < Si

$3s^1 \quad 3s^2 \quad 3p^1 \quad 3p^2$

(fully filled)

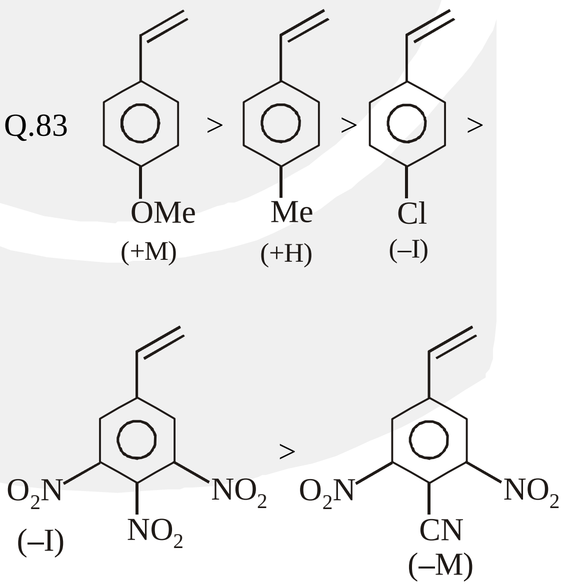
Q.80 

Strongest acid due to S.I.R. effect

Q.81 Theory based

Q.82 $[Co(NH_3)_5(SO_4)]Cl$ and $[Co(NH_3)_4(SO_4)]Cl$

Has no isomerism because molecular formula is different.

Q.83 

Q.84 $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

1	-	-
1–d	d	d

$$K_P = \frac{\left(\frac{d}{1+d}.P\right)^2}{\left(\frac{1-d}{1+d}.P\right)^1}$$

$$K_P = \frac{d^2.P}{1-d^2}$$

$\therefore$ d << 1

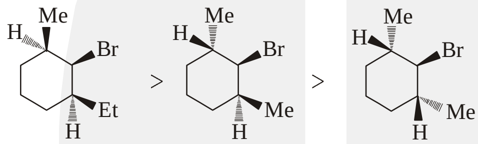
$\therefore$ $1 - d^2 = 1$

$$d^2 = \frac{K_P}{P}$$

$$d \propto \frac{1}{\sqrt{P}}$$

Q.85 Aluminium itself is a very strong reducing agent.

Q.86



Both side anti β-H present | Only one anti β-H present | No anti β-H

Q.87 $H_2(g) + 2H^+(aq) \xrightleftharpoons{n=2} 2H^+(aq) + H_2(g)$

1	xM	10^{-8}	1

$$0.180 = \frac{0.06}{2}\log\frac{[H^+]^2}{[10^{-8}]^2}$$

$[H^+] = 10^{-5}$

pH = 5

pOH = 9

Q.88 (1) $Pb(NO_3)_2 \rightarrow$

$Pb^{2+} \xrightarrow{\text{excess NaOH}} Na_2PbO_2$(soluble)

$Pb^{2+} \xrightarrow{\text{excess } NH_4OH} Pb(OH)_2\downarrow$

(2) $Zn(NO_3)_2 \rightarrow$

$Zn^{2+} \xrightarrow{\text{excess NaOH}} Na_2ZnO_2$(clear)

$Zn^{2+} \xrightarrow{\text{excess } NH_4OH} [Zn(NH_3)_4]^{2+}$(clear)

(3) $Cr(NO_3)_3 \rightarrow$

$Cr^{3+} \xrightarrow{\text{excess NaOH}} NaCrO_3$

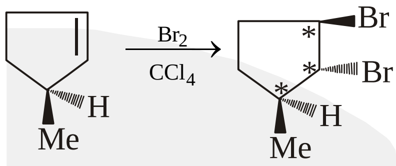
$Cr^{3+} \xrightarrow{\text{excess } NH_4OH} [Cr(NH_3)_6]^{2+}$(Pink)

(4) $Hg(NO_3)_2 \rightarrow$

$Hg^{2+} \xrightarrow{\text{excess NaOH}} Hg(OH)_2\downarrow$

$Hg^{2+} \xrightarrow{\text{excess } NH_4OH} HgO.HgNH_2\downarrow$

Q.89



(3 chiral centre)

Q.90 $C_m = C_{v_1m} + \frac{R}{1-x}$

During process $P \propto T^3$

$P'T^{-3} = K$

$P^{1-x}\,T^x = K$

$PT^{x/1-x} = K$

$$\frac{x}{1-x} = -3$$

$x = -3 + 3x$

$$x = \frac{3}{2}$$

$$C_m = \frac{5R}{2} + \frac{R}{1-\frac{3}{2}}$$

$$= \frac{5R}{2} - 2R = \frac{R}{2}$$