Sri Chaitanya's Solutions to

IIT – JEE- 2011

(PAPER– 1)

Time: 3 Hours **Maximum Marks: 240**

Please read the instructions carefully. You are allotted 5 minutes specifically for this purpose

INSTRUCTIONS

A. General :

1. The question paper CODE is printed on the right hand top corner of this sheet and also on the back page (page no 36 of this booklet)
2. No additional sheets will be provided for rough work
3. Blank papers, clipboards, log tables, slide rules, calculators, cellular phones, pagers and electronic gadgets in any form are not allowed
4. Write your name and registration number in the space provided on the back page of this booklet.
5. The answer sheet, a machine - gradable Objective Response Sheet (ORS), is provided separately.
6. DO NOT TAMPER WITH/ MULTILATE THE ORS OR THE BOOKLET
7. Do not break the seals of the question paper booklet before instrucuted to do so by the invigilators.
8. This question paper contains 36 pages having 69 questions.
9. On breaking the seals, please check that all the questions are legible.

B. Filling the bootom half of the ORS :

10. The ORS has **CODE** printed on its lower and upper Parts.
11. Make sure the CODE on the ORS is the same as that on this booklet. **If the Codes do not match, ask for a change of the Booklet.**
12. Write your Registration No., Name and Name of centre and sign with pen in appropriate boxes. **Do not write these anywhere else.** Darken the appropriate bubbles below your registration number with HB pencil.

C. Question paper format and marking scheme :

13. The question paper consists of **3 Parts** (Chemistry, Physics and Mathematics). Each part consists of **four** sections
14. In **Section I** (Total Marks : 21), for each question you will be awarded 3 marks if you darken **ONLY** the bubble corresponding to the correct answer and zero marks if no bubble is darkened. In all other cases, **minus one (–1)** mark will be awarded.
15. In **Section II** (Total Marks : 16), for each question you will be awarded **4 marks** if you darken ALL the bubble(s) corresponding to the correct answer(s) **ONLY** and **zero marks** otherwise. There are **no negative marks** in this section.
16. In **Section III** (Total marks : 15), for each question you will be awarded **3 marks** if you darken **ONLY** the bubble corresponding to the correct answer and **zero marks** if no bubble is darkened. In all other cases, **minus one (–1) mark** will be awarded.
17. In **Section IV** (Total Marks : 28), for each question you will be awarded **4 marks** if you darken ONLY the bubble corresponding to the correct answer and **zero marks** otherwise. There are **no negative marks** in this section

IIT JEE 2011 (PAPER - I)

PART - I ,

PART I : CHEMISTRY

SECTION – I (Total Marks : 21)

(SINGLE CORRECT CHOICE TYPE)

This section contains **7 multiple choice questions.** Each question has four choices A,B,C and D out of which **ONLY ONE** is correct.

1. Dissolving 120 g of urea (mol. wt. 60) in 1000g of water gave a solution of density 1.15 g/mL. The molarity of the solution is

a) 1.78 M b) 2.00M c) 2.05 M d) 2.22 M

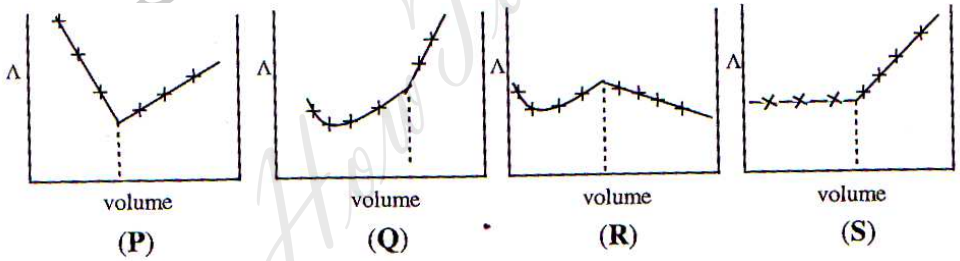
Ans : C

Sol : Molarity = 2m

$$m = \frac{1000M}{1000d_{(g/cc)} - M.MW_{solute}}$$

$$\therefore M = 2.05M$$

2. $AgNO_3$ (aq). was added to an aqueous KCl solution gradually and the conductivity of the solution was measured. The plot of conductance (Λ) versus the volume of $AgNO_3$ is



a) (P) b) (Q) c) (R) d) (S

Ans : D

Sol : Equation : $K^+ + Cl^- + Ag^+NO_3^- \rightarrow K^+ + NO_3^- + AgCl$

In the early stages of the titration, addition of silver nitrate, the conductance does not change very much because the Cl^- ions are replaced by NO_3^- ions; both has almost same ionic conductance. After the end point is passed, the excess of the added salt causes a sharp increase in conductance.

$\Lambda_{K^+} = 73.52\ S\ cm^2\ mole^{-1}$ $\Lambda_{Cl^-} = 76.34\ S\ cm^2\ mole^-$

$\Lambda_{Ag^+} = 61.92\ S\ cm^2\ mole^-$ $\Lambda_{NO_3^-} = 71.44\ S\ cm^2\ mole^-$

3. Among the following compounds, the most acidic is

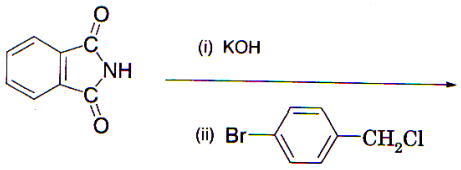
a) p-nitrophenol b) p-hydroxybenzoic acid

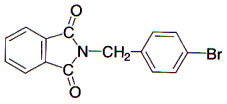
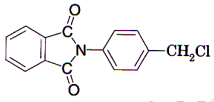
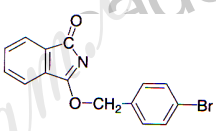
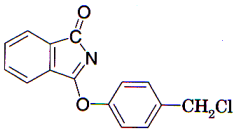
c) o-hydroxybenzoic acid d) p-toulic acid

Ans : C

Sol : Ortho effect present in ortho-hydroxy benzoic acid

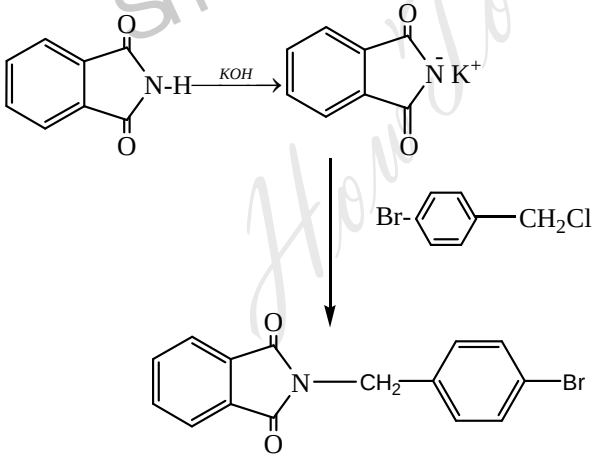
4. The major product of the following reaction is



a)  b)  c)  d) 

Ans : A

Sol :



5. Extra pure N_2 can be obtained by heating

a) NH_3 with CuO b) NH_4NO_3 c) $(NH_4)_2Cr_2O_7$ d) $Ba(N_3)_2$

Ans : D

Sol : Pure N_2 is prepared by heating $Ba(N_3)_2$

$Ba(N_3)_2 \rightarrow 3N_2 \uparrow + Ba$

6. Geometrical shapes of the complexes formed by the reaction of Ni^{2+} with Cl^-, CN^- and H_2O, respectively, are

a) octahedral, tetrahedral and square planar

b) tetrahedral, square planar and octahedral

c) square planar, tetrahedral and octahedral

d) octahedral, square planr and octahedral

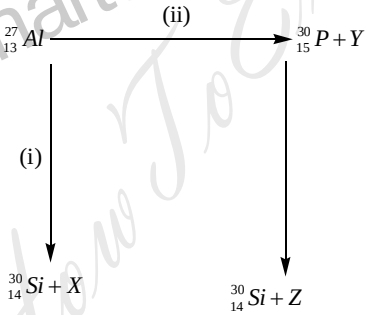
Ans : B

Sol : $[NiCl_4]^{-2} = d^8 = Sp^3 Tetrahedral$

$[NiCN_4]^{-2} = d^8 = dsp^2$ *Square planar*

$[Ni(H_2O)_6]^{+2} = d^8 = sp^3d^2$ *Octahedral Shape*

7. Bombardement of aluminum by α – *particle* leads to its artifical disintegration in two ways, (i) and (II) as shown. Products **X, Y** and **Z** respectively are,



a) proton, neutron, positron

b) neutron, positron, proton

c) proton, positron, neutron

d) positron, proton, neutro

Ans : A

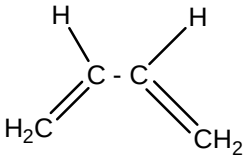
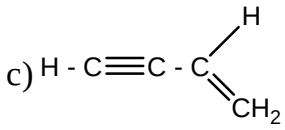
Sol : X= $^1_1$H , Y=$^1_0$n , Z= $^0_{+1}$e

SECTION – II (Total Marks : 16)

(MULTIPLE CORRECT ANSWERS TYPE)

This section contains **4 multiple choice questions.** Each question has four choices A,B,C and D out of which **ONLY or More** may be correct.

8. Amongst the given options, the compound(s) in which all the atoms are in one plane in all the possible conformations (if any), is (are)

a)  b) $H_2C = C = O$ c)  d) $H_2C = C = CH_2$

Ans : ABC

Sol : $CH_2 = C = CH_2$ allene system the compound is non planar

9. According to kinetic theory of gases

a) collisions are always elastic

b) heavier molecules transfer more momentum to the wall of the container.

c) only a small number of molecules have very high velocity

d) between collisions, the molecules move in straight line with constant velocities.

Ans : A,B,C,D

Sol : Conceptual

10. The correct statement(s) pertaining to the adsorption of a gas on a solid surface is (are)

a) Adsorption is always exothermic

b) Physisorption may transform into chemisorption at high temperature

c) Physisorption increases with increasing temperature but chemisorption decreases with increasing temperature

d) Chemisorption is more exothermic than physisorption, however it is very slow due to higher energy of activation.

Ans : ABD

Sol: Physical adsorption decreases with increasing of temperature according Leachtlier 's Principle

11. Extraction of metal from the ore **cassiterite** involves

a) carbon reduction of an oxide re
b) self-reduction of a sulphide ore
c) removal of copper impurity
d) removal iron impurity

Ans : ACD

Sol : Sn is extracted by the reduction of SnO_2 with carbon

$SnO_2 + C \rightarrow Sn + 2CO$

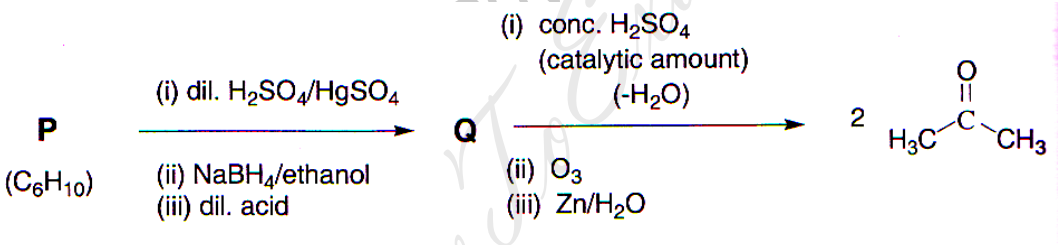
Sn mainly contains Iron impurities which are removed by blowing air to convert Fe into FeO. Sn also contains tracer of Cu

SECTION – III (Total Marks : 15)

(PARAGRAPH TYPE)

This section contains **2 paragraphs**. Based upon one of the paragraphs **2 multiple choice questions** and based on the other paragraph **3 multiple choice questions** have to be answered. Each of these questions has four choices A,B,C and D out of which **ONLY ONE** is correct.

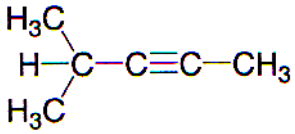
Passage-I :

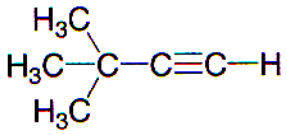


An acylic hydrocarbon **P**, having molecular formula C_6H_{10}, gave acetone as the only organic product through the following sequence of reactions, in which **Q** is an intermediate organic compound.

12. The structure of compound **P** is

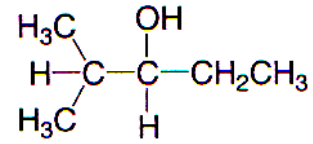
a) $CH_3CH_2CH_2CH_2 - C\equiv C - H$
b) $H_3CH_2C - C\equiv C - CH_2CH_3$

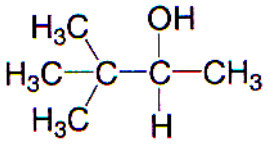
c) 

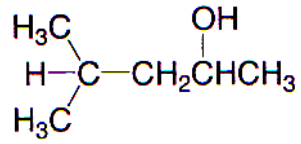
d) 

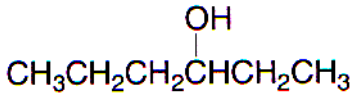
Ans : D

13. The structure of the compound **Q** is

a) 

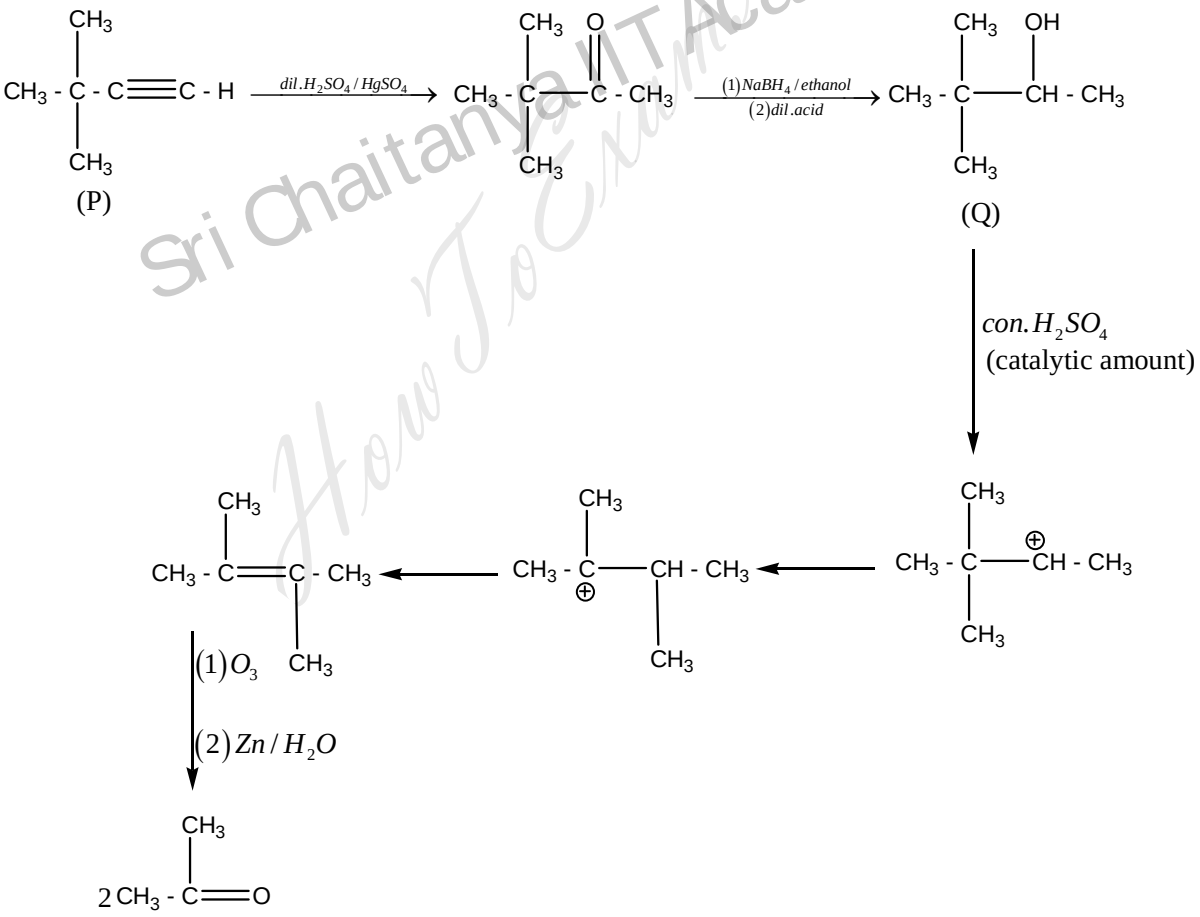
b) 

c) 

d) 

Ans : B

Sol for Q no 12 to 13 :



Passage- II :

When a metal rod **M** is dipped into an aqueous colourless concentrated solution of compound **N**, the solution turns light blue. Addition of aqueous NaCl to the blue solution gives a white precipitate **O**. Addition of aqueous NH_3 dissolves **O** and given an intense blue solution

14. The metal rod M is

a) Fe b) Cu c) Ni d) Co

Ans : B

15. The compound **N** is

a) $AgNO_3$ b) $Zn(NO_3)_2$ c) $Al(NO_3)_3$ d) $Pb(NO_3)_2$

Ans : A

16. The final solution contains

a) $[Pb(NH_3)_4]^{2+}$ and $[CoCl_3)_4]^{2-}$ b) $[Al(NH_3)_4]^{3+}$ and $[Cu(NH_3)_4]^{2+}$

c) $[Ag(NH_3)_2]^{+}$ and $[Cu(NH_3)_4]^{2+}$ d) $[Ag(NH_3)_2]^{+}$ and $[Ni(NH_3)_6]^{2+}$

Ans : C

Sol : for Q. no 14 to 16 :

$$\underset{(M)}{Cu} + 2Ag\,NO_3 \rightarrow Cu\underset{(N)}{(NO_3)_2} + 2Ag^{+}$$

$$NaCl \rightarrow Na^{+}(aq) + Cl^{-}(aq)$$

$$Ag^{+} + Cl^{-} \rightarrow \underset{White(O)}{AgCl}\downarrow$$

$$Cu^{+2} + 4(NH_3) \rightarrow \underset{\text{Deep blue colour}}{\left[Cu(NH_3)_4\right]^{+2}}$$

SECTION – IV (Total Marks : 28)

(INTEGER ANSWER TYPE)

This section contains **7 questions.** The answer to each of the questions is a **single-digit integer,** ranging from 0 to 9. The bubble corresponding to the correct answer is to be darkened in the ORS.

17. The work function (ϕ) of some metals is listed below. The number of metals which will show photoelectric effect when light of 300 nm wavelength falls on the metal is

Metal	Li	Na	K	Mg	Cu	Ag	Fe	Pt	W
$\phi(eV)$	2.4	2.3	2.2	3.7	4.8	4.3	4.7	6.3	4.75

Ans : 4

Sol : $E=\phi+KE$

For photo electric effect, condition is $E > \phi$

Metals exhibits : Li, Na, K, Mg

18. To an evacuated vessel with movable piston under external pressure of 1 atm., 0.1 mol of He and 1.0 mol of an unknown compound (vapour pressure 0.68 atm. at $0\ ^0C$) are introduced. Considering the ideal gas behaviour, the total volume (in litre) of the gases at $0\ ^0C$ is close to

Ans : 7

Sol : Unknon Compound may be Soid (or) liquid

Let given volume of vessel : 'V'

for unknown compound

$PV = nRT$

$0.68 \times V = n_g (0.0821 \times 273)$____ 1

For total gaseous mixture pressure = external. pressure

$PV = nRT$

$1 \times V = (n_g + n_{He})(0.0821 \times 273)$____ 2

from 1 and 2

$n_g = 0.2125$, $n_{total} = 0.3125$

$V = 7$ lit

19. Reaction of Br_2 with Na_2CO_3 in aqueous solution gives sodium bromide and sodium bromate with evolution of CO_2 gas. The number of sodium bromide molecules involved in the balanced chemical equation is

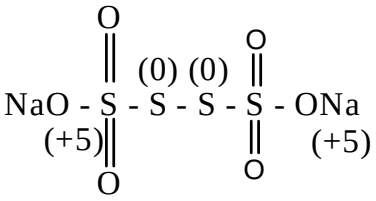
Ans : 5

Sol : $3Br_2 + 3Na_2CO_3 \rightarrow 5NaBr + NaBrO_3 + 3CO_2$

20. The difference in the oxidation numbers of the two types of sulphur atoms in $Na_2S_4O_6$ is

Ans : 5

Sol :



The difference between the O.S of two different types of sulphur atoms = +5

21. A decapeptide (Mol. Wt. 796) on complete hydrolysis gives glycine (Mol. Wt. 75), alanine and phenylalanine. Glycine contributes 47.0% to the total weight of the hydrolysed products. The number of glycine units present in the decapeptide is

Ans : 6

Sol : 100 _____ 958

47 _____ ? $\frac{47}{100} \times 958 = 450.12$

The weight of glycine present in 958 decapeptide is 450.12.

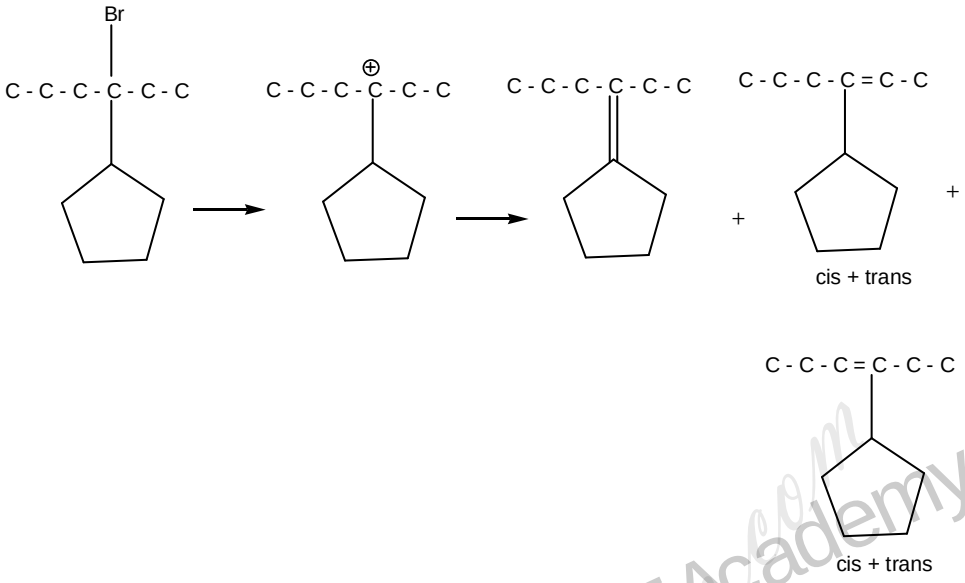
the molecular weight of one glycine is 75

no. of glycines = $\frac{450.12}{75} = 6.00 = 6$

22. The total number of alkenes possible by dehydrobromination of 3-bromo 3-cyclopentylhexane using alcoholic **KOH** is

Ans : 5

Sol :



23. The maximum number of electrons that can have principal quantum number, n=3, and spin quantum number, m_s =-1/2, is

Ans : 9

Sol : In third orbit 3s, 3p, 3d sub levels are present and a total of nine orbitals are present. Each orbital has one electron with $m_s = -1/2$

PART II : PHYSICS

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SECTION – I (Total Marks : 21)

(SINGLE CORRECT CHOICE TYPE)

This section contains **7 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) for its answer, out of which **ONLY ONE** is correct

24. The wavelength of the first spectral line in the Balmer series of hydrogen atom is 6561 $\overset{0}{A}$, The wavelength of the second spectral line in the Balmer series of singly-ionized helium atom is

a) $1215\overset{0}{A}$ b) $1640\overset{0}{A}$ c) $2430\overset{0}{A}$ d) $4687\overset{0}{A}$

Ans : A

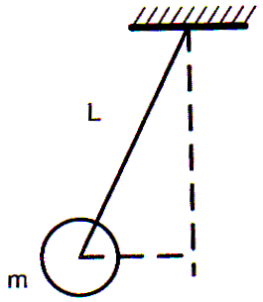
Sol : $\frac{1}{\lambda_1}=(1)^2\left(\frac{1}{2^2}-\frac{1}{3^2}\right)$

$\frac{1}{\lambda_2}=(2)^2\left(\frac{1}{2^2}-\frac{1}{4^2}\right)$

$\frac{\lambda_2}{\lambda_1}=\frac{1}{4}\times\frac{5}{4\times9}\times\frac{4\times16}{12}=\frac{5}{9\times3}$

$\lambda_2=\frac{6561\times5}{9\times3}=1215A^0$

25. A ball of mass (m) 0.5 kg is attached to the end of a string having length (L) 0.5 m. The ball is rotated on a horizontal circular path about vertical axis. The maximum tension that the string can bear is 324 N. The maximum possible value of angular velocity of ball (in radian/s) is

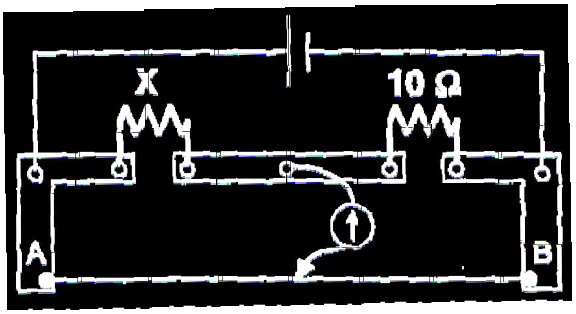


a) 9 b) 18 c) 27 d) 36

Ans : D

Sol : $324=\frac{1}{2}\times\frac{1}{2}w^2$ $w=2\times18$ w= 36

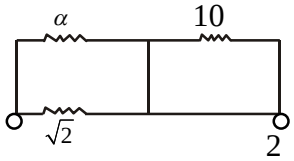
26. A meter bridge is set-up as shown, to determine an unknown resistance 'X' using a standard 10 ohm resistor. The galvanometer shows null point when tapping - key is at 52 cm mark. The end-corrections are 1 cm and 2cm respectively for the ends A and B. The determined value of 'X' is



a) 10.2 ohm b) 10.6 ohm c) 10.8 ohm d) 11.1 ohm

Ans : B

Sol :

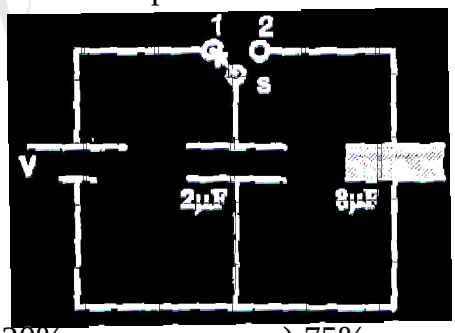


$$\frac{Y}{52+1}=\frac{10}{48+2}$$

$$X=10\times\frac{53}{50}$$

$$X=10.6\Omega$$

27. A $2\mu F$ capacitor is charged as shown in figure. The percentage of its stored energy dissipated after the switch S is turned to position 2 is



a) 0% b) 20% c) 75% d) 80%

Ans : D

Sol : $q_0 = 2V$

$$\frac{q_1}{2}=\frac{q_2}{8}$$

$4q_1 = q_2$

$q_1 + q_2 = 2V$

$5q_1 = 2V$

$q_1 = \left(\frac{2}{5}V\right)$

$q_2 = \left(\frac{8}{5}V\right)$

$$\frac{1}{2}\frac{4V^2}{2} = \frac{1}{2}\frac{\frac{4}{25}V^2}{2} + \frac{1}{2}\frac{\frac{64}{25}V^2}{8}$$

$$4V^2 = \frac{4}{25}V^2 + \frac{16}{25}V^2$$

$$4V^2 = 1 - \frac{1}{2} - \frac{4}{25}$$

$$4V^2 = \frac{25-1-4}{25} = \frac{20}{25}x100 = 80$$

28. A police car with a siren of frequency 8kHz is moving with uniform velocity 36km/hr towards a tall building which reflects the sound waves. The speed of sound in air is 320 m/s. The frequency of the siren heard by the car driver is

a) 8.50 kHz b) 8.25 kHz c) 7.75 kHz d) 7.50 kHz

Ans : A

Aol : frequency reflucted by wall 'f'

$$f' = 8\times10^3\left[\frac{320}{320-10}\right]$$

frequency heared by car driver $f'' = \left[\frac{320+10}{320}\right]f'$

$$f'' = 8\times10^3\frac{32}{31}\times\frac{33}{32}$$

$$= 8\times10^3\times\frac{33}{31}$$

$$\simeq 8.50\,kHz$$

29. 5.6 liter of helium gas at STP is adiabatically compressed to 0.7 liter. Taking the initial temperature to be T_1, the work done in the process is

a) $\frac{9}{8}RT_1$ b) $\frac{3}{2}RT_1$ c) $\frac{15}{8}RT_1$ d) $\frac{9}{2}RT_1$

Ans: A

Sol: $W = \frac{R}{\lambda l}(T_1 - T_2)$

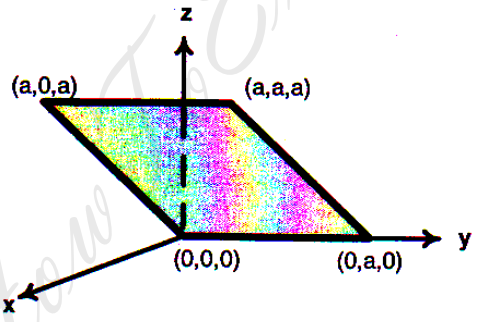
$T_1 V_1^{\gamma l} = k$

$T_1 \, V_1^{\gamma l} = T_2 \left(\frac{V_1}{8}\right)^{\gamma - 1}$

$T_2 = 4T_1$

W= $\frac{9RT_1}{8}$

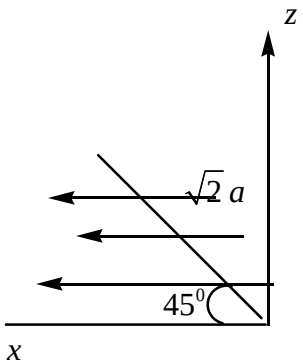
30. Consider an electric field $\vec{E} = E_0 \hat{x}$, where E_0 is a constant. The flux through the shaded area (as shown in the figure) due to this field is



a) $2E_0a^2$ b) $\sqrt{2}E_0a^2$ c) E_0a^2 d) $\frac{E_0a^2}{\sqrt{2}}$

Ans : C

Sol :



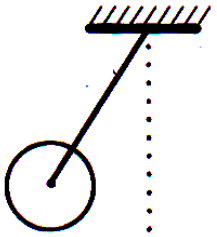
area $= \sqrt{2}a^2$ $\vec{E}.\vec{A} = E\sqrt{2}a^2 \cos 45^0 = Ea^2$

SECTION – II (Total Marks : 16)

(MULTIPLE CORRECT CHOICE TYPE)

This section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) for its answer, out of which **ONE or MORE** may be correct

31. A metal rod of length 'L' and mass 'm' is pivoted at one end. A thin disk of mass 'M' and radius 'R'(<L) is attached at its center to the free end of the rod. Consider two ways the disc is attached; (case A) the disc is not free to rotate about its center and (case B) the disc is free to rotate about its center. The rod - disc system performs SHM in vertical plane after being released from the same displaced position. Which of the following statement(s) is (are) true ?



a) Restoring torque in case A = Restoring torque in case B

b) Restoring torque in case A < Restoring torque in case B

c) Angular frequency for case A > Angular frequency for case B

d) Angular frequency for case A < Angular frequency for case B

Ans : AD

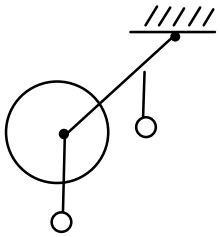
Sol : Torque about point of suspenstion is same in both case

case A : $\tau = \left(\frac{MR^2}{2} + ML^2 + \frac{ml^2}{3}\right)\alpha = k\theta$

case B ; In case B ; Disc is not going to get any torque about its centre.

all of it's point have acceleration that is equal to acceleration of end point of rod.

$$\tau = \left(ML^2 + m\frac{l^2}{3}\right)\alpha = k\theta$$

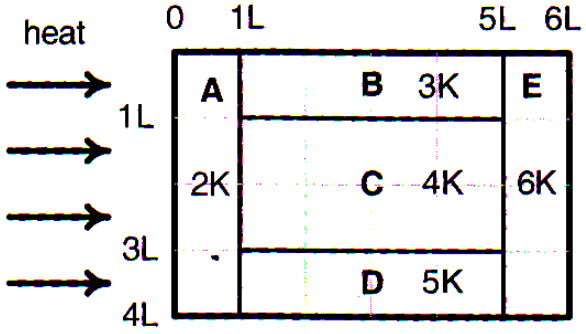


$$\therefore W_2 = \frac{k}{\left[mL^2 + \frac{ml^2}{3}\right]}$$

$$W_1 = \frac{k}{\left[\frac{MR^2}{2} + ML^2 + \frac{ml^2}{3}\right]}$$

$$W_2 > W_1$$

32. A composite block is made of slabs A, B, C, D and E of different thermal conductivities (given in terms of a constant K) and sizes (given in terms of length, L) as shown in the figure. All slabs are of same width. Heat 'Q' flows only from left to right through the blocks. Then in steady state



a) heat flow through A and E slabs are same

b) heat flow through slab E is maximum

c) temperature difference across slab E is smallest

d) heat flow through C = heat flow through B + heat flow through D

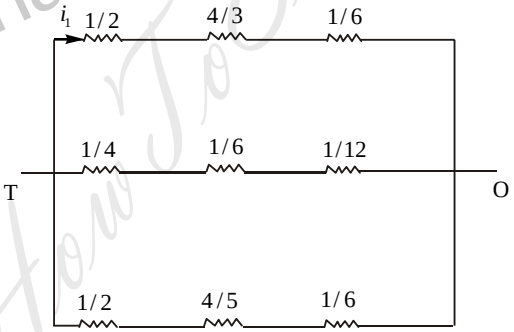
Ans :ABCD

Sol : $i_1 = \frac{T}{2} = 0.5T$

$i_2 = 1.2T$

$i_3 \simeq 0.7T$

$i_2 \simeq i_1 + i_3$



33. An electron and a proton are moving on straight parallel paths with same velocity. They enter a semi-infinite region of uniform magnetic field perpendicular to the velocity. Which of the following statement(s) is/are true ?

a) They will never come out of the magnetic field region

b) They will come out travelling along parallel paths

c) They will come out at the same time

d) They will come out a different times

Ans : BD

Sol : $r = \frac{mv}{qB}$

They go in different direction but come out along parallel paths.

$T = \frac{2\pi m}{qB}$

as 'm' is different 'T' also different

34. A spherical metal shell A of radius R_A and a solid metal sphere B of radius $R_B (< R_A)$ are kept far apart and each is given charge '+Q'. Now they are connected by a thin metal wire. Then

a) $E_A^{inside} = 0$ b) $Q_A > Q_B$ c) $\frac{\sigma_A}{\sigma_B} = \frac{R_B}{R_A}$ d) $E_A^{on\,surface} < E_B^{on\,surface}$

Ans : ABCD

Sol : a) $E_A = 0$

b) $\frac{Q_A}{R_A} = \frac{Q_B}{R_B}$

$R_A > R_B$

$Q_A > Q_B$

c) $\sigma R = V$

d) $E = \frac{\sigma}{2\varepsilon_0}$

so $E \alpha \sigma$

SECTION – III (Total Marks : 15)

(COMPREHENSION TYPE)

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

Paragraph for Question Nos. 35 to 36

A dense collection of equal number of electrons and positive ions is called neutral plasma. Certain solids containing fixed positive ions surrounded by free electrons can be treated as neutral plasma. Let 'N' be the number density of free electrons, each of mass 'm'. When the electrons are subjected to an to electric field, they are displaced relatively away from the heavy positive ions. If the electric field becomes zero, the electrons begin to oscillate about the positive ions with a natural angular frequency 'ω_p' which is called the palsma frequency. To sustain the oscillations, a time varying electric field needs to be applied that has an angular frequency ω, where a part of the energy is absorbed and a part of it is reflected. As ω approaches ω_p, all the free electrons are set to resonance together and all the energy is reflected. This is the explanation of high reflectivity metals.

35. Taking the electric charge as 'e' and the permittivity as 'ε_0', use dimesional analysis to determine the correct expression for ω_p.

a) $\sqrt{\frac{Ne}{m\varepsilon_0}}$ b) $\sqrt{\frac{m\varepsilon_0}{Ne}}$ c) $\sqrt{\frac{Ne^2}{m\varepsilon_0}}$ d) $\sqrt{\frac{m\varepsilon_0}{Ne^2}}$

Ans : C

Sol : $\omega = \frac{\theta}{T} = T^{-1}$

$$D.f.of\ \sqrt{\frac{Ne^2}{m\varepsilon_0}} = \sqrt{\frac{\frac{1}{L^3} \times I^2T^2 \times M^1L^3T^{-2}}{M^1 \times I^2T^2}}$$

D.f. = T^{-1}

36. Estimate the wavelength at which plasma reflection will occur for a metal having the density of electrons $N \approx 4\times10^{27}\ m^{-3}$. Take $\varepsilon_0 \approx 10^{-11}$ and $m \approx 10^{-30}$, where these quantities are in proper SI units.

a) 800 nm b) 600nm c) 300nm d) 200nm

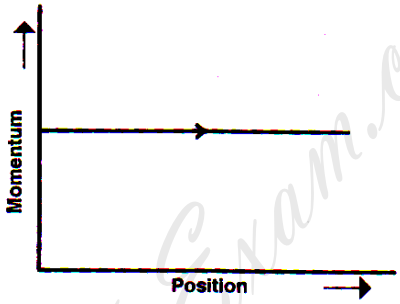
Ans : B

Sol : $\omega = 2\pi n \Rightarrow n = \frac{\omega}{2\pi}$

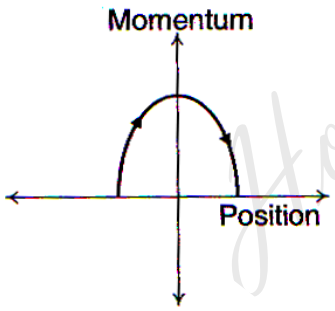
$$c = n\lambda \Rightarrow \lambda = \frac{c}{n} = \frac{c \times 2\pi}{\omega} \quad \lambda = \frac{c \times 2\pi}{\sqrt{\frac{Ne^2}{m\varepsilon_0}}} = \frac{3\times10^8 \times 2\pi}{\sqrt{\frac{4\times10^{27} \times \left(1.6\times10^{-19}\right)^2}{10^{-30} \times 10^{-11}}}} \quad \lambda \approx 585\times10^{-9} \approx 600\,nm$$

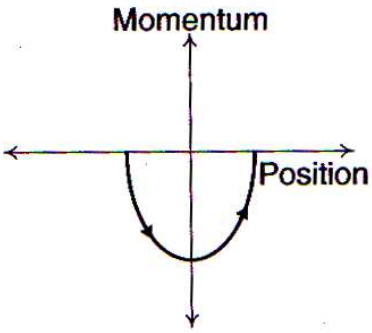
Paragraph for Question Nos. 37 to 39

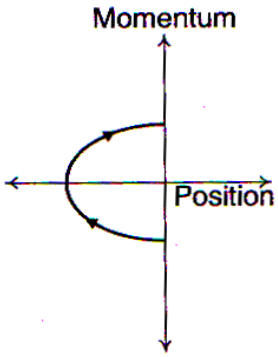
Phase space diagrams are useful tools in analyzing all kinds of dynamical problems. They are especially useful in studying the changes in motion as initial position and momentum are changed. Here we consider some simple dynamical systems in one-dimension. For such systems, phase space is a plane in which position is plotted along horizontal axis and momentum is plotted along vertical axis. The phase space diagram is x(t) vs. p(t) curve in this plane. The arrow on the curve indicates the time flow. For example, the phase space diagram for a particle moving with constant velocity is a straight line as shown in the figure. We use the sign convention in which position or momentum upwards (or to right) is positive and downwards (or to left) is negative

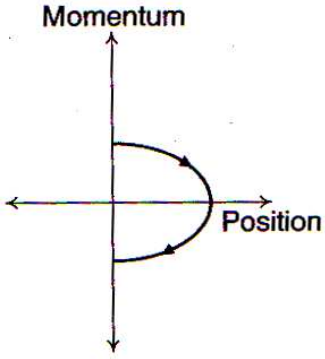


37. The phase spacem diagram for a ball thrown vertically up from ground is

a)


b)


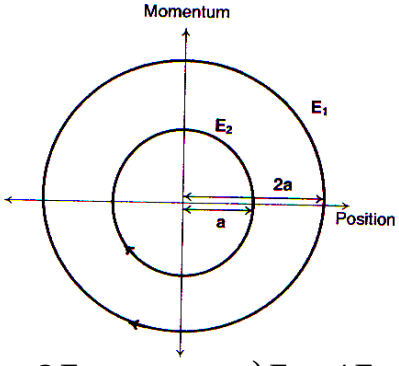
c)


d)


Ans : D

Sol : Vertically thrown particle comes back to original position till the particle reaches the highest position of its path, its momentum is +ve. After that, it terns to zero and them negative

38. The phase space diagram fro simple harmonic motion is a circle centrred at the origin. In the figure, the two circles represent the same oscillator but for different initial conditions, and E1 and E2 are the total mechanical energies respectively. Then



a) $E_1 = \sqrt{2}\,E_2$ b) $E_1 = 2\,E_2$ c) $E_1 = 4\,E_2$ d) $E_1 = 16\,E_2$

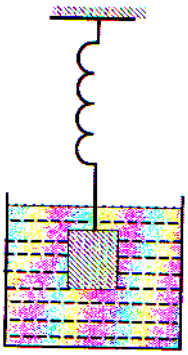
Ans : C

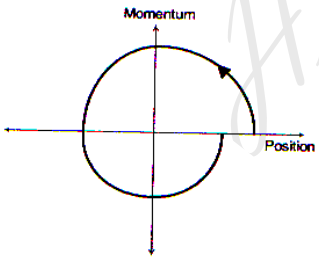
Sol : $Energy = \frac{1}{2}ka^2 \;\alpha\; a^2$

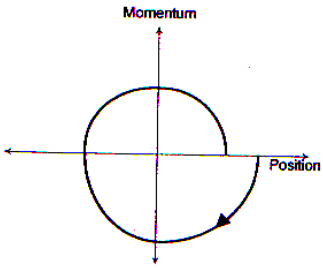
$$\frac{E_1}{E_2} = \frac{a_1^2}{a_2^2} = 4$$

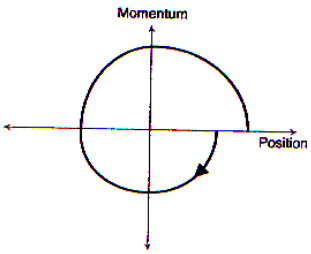
$$\therefore E_1 = 4E_2$$

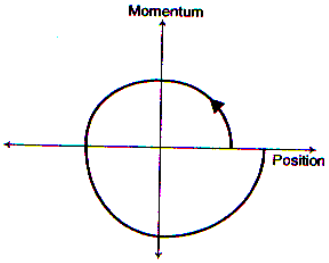
39. Consider the spring-mass system, with the mass submerged in water, as shown in the figure. The phase space diagram for one cycle of this system is



a) 

b) 

c) 

d) 

Ans : A

Sol : As the block oscillates, due to viscous effects, its total energy decreases continuously and so its amplitude decreases continuously. Assuming that the block is initially pulled down and released, its momentum will increase upwards till it reaches the mean position

SECTION –IV

(INTEGER ANSWER TYPE)

This section contains **7 questions**. The answer to each of the questions is a **single -digit integer,** ranging from 0 to 9. The bubble corresponding to the correct answer is to be darkened in the ORS.

40. Steel wire of length 'L' at 40°C is suspended from the ceilling and then a mass 'm' is hung from its free end. The wire is cooled down from 40°C to 30°C to regain its original length 'L'. The coefficient of liner thermal expansion of the steel is 10–5/°C, Young's modulus of steell is 10^{11} N/m^2 and radius of the wire is 1mm. Assume that L>> diameter of the wire. Then the value of 'm' in kg is nearly

Ans : 3

Sol : $Y=\frac{mgL}{Ae}$, $e=\alpha L\ \Delta t$

$$Y=\frac{mgL}{A\alpha L\Delta L}$$

$$10^{11}=\frac{M\times 10}{\frac{22}{7}\times 1\times 10^{-6}\times 10^{-5}\times 10}$$

$$m=3.14\approx 3$$

41. The activity of a freshly prepared radioactive sample is 10^{10} disintegrations per second, whose mean life is 10^9s. The mass of an atom of this radioisotope is 10^{-23} kg. The mass (in mg) of the radioactive sample is

Ans : 1

Sol : $10^{10}=\frac{1}{10^9}\times N$

$$\therefore N=10^{19}$$

$\therefore$ total mass

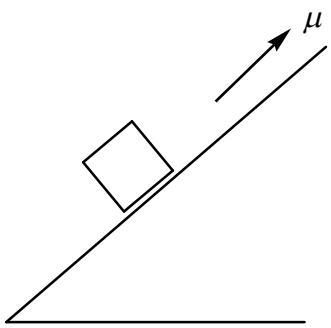
$$=10^{-25}\times 10^{19}\ kg$$

$$=10^{-6}\ kg=1mg$$

42. A block moving on an inclined plane making an angle 45° with the horizontal and the coefficient of friction is μ. The force required to just push it up the inclined plane is 3 times the force required to just prevent from sliging down. If we define $N=10\mu$, then N is

Ans : 5

Sol : $3\left(\frac{mg}{\sqrt{2}}-\mu\frac{mg}{\sqrt{2}}\right)=\left(\frac{mg}{\sqrt{2}}+\frac{\mu mg}{\sqrt{2}}\right)$



$3[1-\mu]=[1+\mu]$

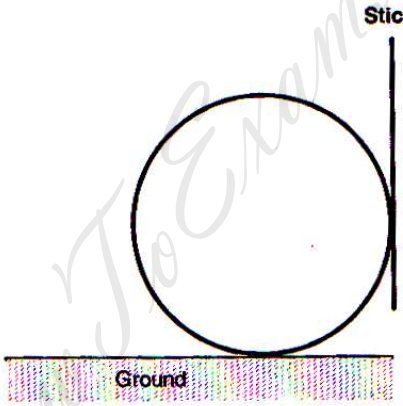
$3-3\mu=1+\mu$

$4\mu=2$

$\mu=1/2$

$10\mu=5$

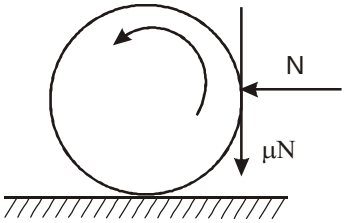
43. A boy is pushing a ring of mass 2 kg and radius 0.5 m with a stick a shown in the figure. The stick applies a force of 2 N on the ring and rolls it without slipping with an acceleration of 0.3m/s^2. The coefficient of friction between the ground and the ring is large enough that olling always occurs and the coefficient of friction between the stick and the ring is (P/10). The value of P is



Ans : 4

Sol : $F=\sqrt{N^2+\mu^2N^2}\rightarrow(i)$

$\tau_p=NR-\mu NR=2mR^2\left(\frac{a}{R}\right)\rightarrow(ii)$



solving (i) and (ii),

$\mu=2.6$ and 0.36

but $\mu=2.6$ is not a possible solution

$\Rightarrow\mu=0.36$

$\therefore p=3.6\approx4$

44. Four solid spheres each of diameter $\sqrt{5}$ cm and mass 0.5 kg are placed with their centers at the corners of a square of side 4cm. The moment of inertia of the system about the diagonal of the square is $N \times 10^{-4}$ kg - m^2, then N is

Ans : 9

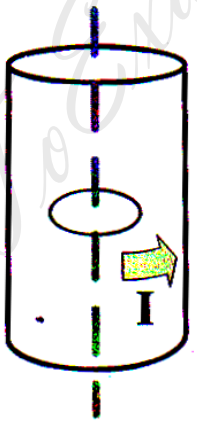
Sol : $4\times\frac{2}{5}MR^2+2\times M\left(\frac{a}{\sqrt{2}}\right)^2=I$

$$4\times\frac{2}{5}\times\cdot5\times\left(\frac{\sqrt{5}}{2}\times10^{-2}\right)^2+2\times\cdot5\times\left(\frac{4\times10^{-2}}{\sqrt{2}}\right)^2$$

$N^{11}\times10^{-4}$

N = 9

45. A long circular tube of length 10 m and radius 0.3 m carries a current I along its curved surface as shown. A wire-loop of resistance 0.005 ohm and of radius 0.1 m is placed inside the tube with its axis coinciding with the axis of the tube. The current varies as $I = I_0 \cos(300\, t)$ where I_0 is constant. If the magnetic moment of the loop is $N\mu_0 I_0 \sin(300\, t)$, then 'N' is



Ans : 6

Sol : $ni=\frac{I}{l}$

$$B=\frac{\mu_0 I_0\cos}{l}300t$$

$$V=\left|\frac{d\phi}{dt}\right|=\frac{\mu_0 I_0(300)}{l}\sin 300t\,\pi R^2$$

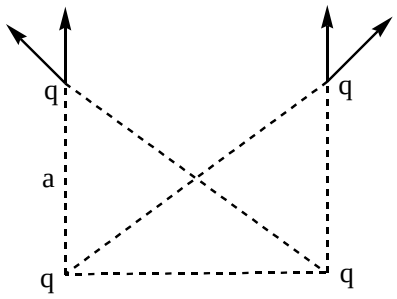
$$V=\frac{\mu_0 I_0\pi R^2(300)}{l}\sin 300t$$

$i=\frac{V}{R}\quad m=i\pi R^2$

46. Four point chargs, each of +q, are rigidly fixed at the four corners of a square planar soap film of side 'α'. The surface tension of the soap film is γ. The system of charges and planar film are in equilibrium, the $a = \left[\frac{q^2}{\gamma}\right]^{1/N}$, where 'k' is a constant. Then N is

Ans : 3

Sol :



$$\frac{2Aq^2}{a^2} + \frac{2\sqrt{2}q^2}{\left(a\sqrt{2}\right)^2} = y.a$$

$$\Rightarrow a \propto \left(\frac{q^2}{y}\right)^{\frac{1}{3}} \quad \therefore N = 3$$

PART III : MATHEMATICS

SECTION – I (Total Marks : 21)

(Single Correct Answer Type)

This section contains **7 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct

47. Let $P=\left\{\theta:\sin\theta-\cos\theta=\sqrt{2}\cos\theta\right\}$ and $Q=\left\{\theta:\sin\theta+\cos\theta=\sqrt{2}\sin\theta\right\}$ be two sets. Then

a) $p\subset Q$ and $Q-P\neq\varnothing$ b) $Q\not\subset P$

c) $P\not\subset Q$ d) P = Q

Ans: D

Sol: $P=\sin\theta-\cos\theta=\sqrt{2}\cos\theta$

$\sin\theta=\sqrt{2}\cos\theta+\cos\theta$

$\sin\theta=\left(\sqrt{2}+1\right)\cos\theta$

$\sin\theta\left(\sqrt{2}-1\right)=\left(\sqrt{2}+1\right)\left(\sqrt{2}-1\right)\cos\theta$

$\sqrt{2}\sin\theta-\sin\theta=\cos\theta$

$\sqrt{2}\sin\theta=\cos\theta+\sin\theta$

$\Rightarrow P=Q$

48. Let the straight line $x=b$ divide the area enclosed by $y=\left(1-x^2\right)$, $y=0$, and $x=0$ into two parts $R_1\left(0\le x\le b\right)$ and $R_2\left(b\le x\le 1\right)$ such that $R_1-R_2=\frac{1}{4}$. Then b equals

a) $\frac{3}{4}$ b) $\frac{1}{2}$ c) $\frac{1}{3}$ d) $\frac{1}{4}$

Ans : B

Sol : $\int_0^b\left(1-x\right)^2dx-\int_b^1\left(1-x\right)^2dx=\frac{1}{4}$

$\Rightarrow b=\frac{1}{2}$

49. Let α and β be the roots of $x^2-6x-2=0$, with $\alpha>\beta$. If $a_n=\alpha^n-\beta^n$ for $n\geq 1$, then the value of $\frac{a_{10}-2a_s}{2a_9}$ is

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

Ans : C

Sol : $a_{10}=\alpha^{10}-\beta^{10}=(\alpha+\beta)(\alpha^9-\beta^9)-\alpha\beta(\alpha^8-\beta^8)$

$\Rightarrow a_{10}=6a_9+2a_8$

50. A straight line L through the point (3,–2) is inclined at an angle 60^0 to the line $\sqrt{3x}+y=1$. also intersects the x–axis, then the equation of L is

a) $y+\sqrt{3}x+2-3\sqrt{3}=0$ b) $y-\sqrt{3}x+2+3\sqrt{3}=0$

c) $\sqrt{3}y-x+3+2\sqrt{3}=0$ d) $\sqrt{3}y+x-3+2\sqrt{3}=0$

Ans : B

Sol : Let 'm' be the slope of the required line

$\pm\sqrt{3}=\frac{m+\sqrt{3}}{1-m\sqrt{3}}$

$\Rightarrow m=0$ or $m=\sqrt{3}$

51. Let (x_0,y_0) be the solution of the following equations

$(2x)^{\ln 2}=(3y)^{\ln 3}$

$3^{\ln x}=2^{\ln y}$

Then x_0 is

a) $\frac{1}{6}$ b) $\frac{1}{3}$ c) $\frac{1}{2}$ d) 6

Ans : C

Sol : $\Rightarrow \log 2(\log 2+\log x)=\log 3(\log 3+\log y)$ --------1

$\log 3(\log x)=\log 2(\log y)$ ----------2

From 1 & 2

$\log x=-\log 2\Rightarrow x=\frac{1}{2}$

52. The value of $\int_{\sqrt{\ln 2}}^{\sqrt{\ln 3}} \frac{x \sin x^2}{\sin x^2 + \sin\left(\ln 6 - x^2\right)} dx$ is

a) $\frac{1}{4}\ln\frac{3}{2}$ b) $\frac{1}{2}\ln\frac{3}{2}$ c) $\ln\frac{3}{2}$ d) $\frac{1}{6}\ln\frac{3}{2}$

Ans : A

Sol : Put $x^2 = t$

$$= \frac{1}{2}\int_{\log 2}^{\log 3} \frac{\sin t}{\sin t + \sin(\log b - t)} dt$$

$$= \frac{1}{2}\left(\frac{\log 3 - \log 2}{2}\right) = \frac{1}{4}\log\left(\frac{3}{2}\right)$$

53. Let $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{b} = \hat{i} - \hat{j} - \hat{k}$ and $\vec{c} = \hat{i} - \hat{j} - \hat{k}$ be three vectors. A vector $\vec{v}$ in the plane of $\vec{a}$ and $\vec{b}$, whose projection on $\vec{c}$ is $\frac{1}{\sqrt{3}}$, is given by

a) $\hat{i} - 3\hat{j} + 3\hat{k}$ b) $3\hat{i} - 3\hat{j} - \hat{k}$ c) $3\hat{i} - \hat{j} + 3\hat{k}$ d) $\hat{i} + 3\hat{j} - 3\hat{k}$

Ans : C

Sol : Let $\vec{v} = \vec{a} + \lambda\vec{b}$

Projection $\vec{v}$ on $\vec{c}$

$$\frac{\left(\vec{a} + \lambda\vec{b}\right).\vec{c}}{\left|\vec{c}\right|} = \frac{1}{\sqrt{3}}$$

$$\Rightarrow \lambda = 2$$

SECTION - II (Total Marks : 16)

(Multiple Correct Answer Type)

This Section contains **4 multiple choice questions**. Each question has four choices (A), (B), (C) and (D) out of which **ONE or MORE** may be correct.

54. Let f : $f:\mathbb{R}\to\mathbb{R}$ be a function such that f(x + y) = f(x) + f(y), $\forall x, y \in \mathbb{R}$.

If f(x) is differentiable at x = 0, then

a) f(x) is differentiable only in a finite interval containing zero

b) f(x) is continuous $\forall x \in \mathbb{R}$

c) $f'(x)$ is constant $\forall x \in \mathbb{R}$

d) f(x) is differentiable except at finitely many points

Ans : B,C

Sol : From the given data $f(x)$ be the linear function.

55. Let the eccentiricty of the hyperbola $\frac{x^2}{a^2}-\frac{y^2}{b^2}=1$ be reciprocal to that of the ellipse $x^2 + 4y^2 = 4$. If the hyperbola passes thorugh a focus of the ellipse, then

a) the equation of the hyperbola is $\frac{x^2}{3}-\frac{y^2}{2}=1$

b) a focus of the hyperbola is (2, 0)

c) the eccentricity of the hyperbola is $\sqrt{\frac{5}{3}}$

d) the equation of the hyperbola is $x^2 - 3y^2 = 3$

Ans : B,D

Sol : Ecentricity of ellipse $\frac{\sqrt{3}}{2}$

$\therefore$ Ecentricity of Hyper bola = $\frac{2}{\sqrt{3}}$

Focus of ellipse = $\left(\sqrt{3},0\right),\left(-\sqrt{3},0\right)$

Focus lies on the hyper bola then $a=\sqrt{3}$, b = 1

56. Let M and N be two 3×3 non - singular skew - symmetric matrices such that MN = NM. If P^T denotes the transpose of P, then $M^2N^2(M^TN)^{-1}(MN^{-1})^T$ is equal to

a) M^2 b) $-N^2$ c) $-M^2$ d) MN

Ans : wrong

Reason : 3×3 non singular skew -symmetrices does't exist.

Sol : Among the given options option C may be correct.

57. The vector(s) which is/are coplanar with vectors $\hat{i}+\hat{j}-2\hat{k}$ and $\hat{i}+2\hat{j}+\hat{k}$, and perpendicular to the vector $\hat{i}+\hat{j}+\hat{k}$ is /are

a) $\hat{j}-\hat{k}$ b) $-\hat{i}+\hat{j}$ c) $\hat{i}-\hat{j}$ d) $-\hat{j}+\hat{k}$

Ans : A,D

Sol: Required vector = $\pm\left\{\left(\vec{a}\times\vec{b}\right)\times\vec{c}\right\}$

SECTION - III (Total Marks : 16)

(Paragraph Type)

This section contains **2 paragraphs**. Based upon one of the paragraphs **2 multiple choice questions** and based on the other paragraph **3 multiple choice questions** have to be answered. Each of these questions has four choices (A), (B), (C) and (D) out of with **ONLY ONE** is correct.

Paragraph for Question Nos. 58 and 59

Let U_1 and U_2 be two urns such that U_1 contains 3 white and 2 red balls, and U_2 contains only 1 white ball. A fair coin is tossed. If head appears then 1 ball is drawn at random from U_1 and put into U_2. However, if fail appears then 2 balls are drawn at random from U_1 and put into U_2. Now 1 ball is drawn at random from U_2.

58. The probability of the drawn ball from U_2 being white is

a) $\frac{13}{30}$ b) $\frac{23}{30}$ c) $\frac{19}{30}$ d) $\frac{11}{30}$

Ans : B

Probability = $\frac{1}{2}\left[\frac{3}{5}\text{x}\frac{2}{2}+\frac{2}{5}\text{x}\frac{1}{2}\right]+\frac{1}{2}\left[\frac{3C_2}{5C_2}\text{x}\frac{3}{3}+\frac{2C_2}{5C_2}\text{x}\frac{1}{3}+\frac{3C_1.2C_1}{5C_2}\text{x}\frac{2}{3}\right]$

$=\frac{23}{30}$

59. Given that the drawn ball from U_2 is white, the probability that head appeared on the coin is

a) $\frac{17}{23}$ b) $\frac{11}{23}$ c) $\frac{15}{23}$ d) $\frac{12}{23}$

Ans : D

Sol : Required conditional Probability = $\frac{\frac{1}{2}\left[\frac{3}{5}x\frac{2}{2}+\frac{2}{5}x\frac{1}{2}\right]}{\frac{23}{30}}$

Paragraph for Question Nos. 60 and 62

Let a, b and c be three real numbers satisfying

$$\begin{bmatrix} a & b & c \end{bmatrix}\begin{bmatrix} 1 & 9 & 7 \\ 8 & 2 & 7 \\ 7 & 3 & 7 \end{bmatrix}=\begin{bmatrix} 0 & 0 & 0 \end{bmatrix} \quad \text{.....(E)}$$

60. If the point P(a, b, c), with reference to (E), lies on the plane $2x + y + z = 1$, then the value of $7a + b + c$ is

a) 0 b) 12 c) 7 d) 6

Ans : D

61. Let ω be a solution of $x^3 - 1 = 0$ with $\text{Im}(\omega)>0$. If a = 2 with b and c satisfying (E), then the value of $\frac{3}{\omega^a}+\frac{1}{\omega^b}+\frac{3}{\omega^c}$ is equal to

a) –2 b) 2 c) 3 d) –3

Ans : A

62. Let b = 6, with a and c satisfying (E). If α and β are the roots of the quadratic equation $ax^2 + bx + c = 0$, then $\sum_{n=0}^{\infty}\left(\frac{1}{\alpha}+\frac{1}{\beta}\right)^n$

a) 6 b) 7 c) $\frac{6}{7}$ d) ∞

Ans : B

Sol : 60, 61, 62.

$a+8b+7c=0$

$9a+2b+3c=0$

$a+b+c=0$

$\Rightarrow a=x,\ b=6\lambda,\ c=-7\lambda$

60. Now $2a+b+c=1$

$\Rightarrow 2\lambda+6\lambda-7\lambda=1$

$\Rightarrow \lambda=1$

Hence a = 1, b = 6, c = –7

$\therefore 7a+b+c=6$

61. $a=2\Rightarrow\lambda=2$

$\Rightarrow b=12,\ C=-14$

$\therefore \frac{3}{W^a}+\frac{1}{W^b}+\frac{3}{W^3}=-2$

62. $b=6\Rightarrow\lambda=1$

$\Rightarrow a=1,\ c=-7$

$\therefore ax^2+bx+c=0\Rightarrow x^2+6x-7=0$

$\Rightarrow \alpha=1,\ \beta=-7$

$\therefore \frac{1}{\alpha}+\frac{1}{\beta}=\frac{6}{7}$

$\Rightarrow \sum_{n=0}^{\infty}\left(\frac{1}{\alpha}+\frac{1}{\beta}\right)^n=7$

SECTION - IV (Total Marks : 28)

(Integer Answer Type)

This section contains **7 questions**. The answer to each of the questions is a **single - digit integer**, ranging from 0 to 9. The bubble corresponding to the correct answer is to be darkened in the ORS.

63. Let f : $[1,\infty)\to[2,\infty)$ be a differentiable function such that f(1) = 2. If

$$6\int_1^x f(t)\,dt = 3x\ f(x)-x^3$$

for all $x\geq 1$, then the value of f(2) is

Ans : 6

Sol : $2.\not{6}+f(x)=\not{3}.xf^1(x)+\not{3}f(x)-\not{3}x^2$

$xf^1(x) - f(x) = x^2$

$f^1(x) - \frac{1}{x} f(x) = x$

$If = \frac{1}{x}$

$f(x).\frac{1}{x} = \int 1dx$

$\frac{f(x)}{n} = x + c$

$f(x) = x^2 + c$

$f(1) = 2$

$2 = 1 + c$

$c = 1$

$f(x) = x^2 + x$

$f(x) = 4 + 2 = c$

64. If z is any complex number satisfying $|z - 3 - 2i| \le 2$, then the minimum value of $|2z - 6 + 5i|$ is

Ans : 5

Sol : $2\left|2 - 3 + \frac{5}{2}i\right| = 2\left|z - 3 - 2i + 2i + \frac{5i}{2}\right|$

$\ge 2|1z - 3 - 2i| - \left|\frac{9i}{2}\right|$

$\ge \left|2 - \frac{9}{2}\right|$

≥ 5

65. Let $a_1, a_2, a_3, \ldots\ldots\ldots, a_{100}$ be an arithmetic progression with $a_1 = 3$ and $S_p = \sum_{i=1}^{p} a_i$, $1 \le p \le 100$.

For any integer n with $1 \le n \le 20$, let m = 5n. If $\frac{S_m}{S_n}$ does not depend on n, then a_2 is

Ans : 9

Sol : $\frac{S_m}{S_n}=\frac{\frac{m}{2}\left[6+(m-1)d\right]}{\frac{n}{2}\left[6+(n-1)d\right]}$

$=\frac{5\left[6+(5n-1)d\right]}{6+(n-1)d}$

Which is independed of n if $d=6a_1=6$

$\therefore a_2=a_1+d=9$

66. Consider the parabola $y^2 = 8x$. Let Δ_1 be the area of the triangle formed by the end points of its latus rectum and the point $P\left(\frac{1}{2}, 2\right)$ on the parabola, and Δ_2 be the area of the triangle formed by drawing tangents at P and at the end points of the latus rectum. Then $\frac{\Delta_1}{\Delta_2}$ is

Ans : 2

Sol : $\Delta_1=\frac{1}{8a}\left|(y_1-y_2)(y_2-y_3)(y_3-y_1)\right|$

$\Delta_1=\frac{1}{16a}\left|(y_1-y_2)(y_2-y_3)(y_3-y_1)\right|$

$\therefore \frac{\Delta_1}{\Delta_2}=2$

67. Let $f(\theta)=\sin\left(\tan^{-1}\left(\frac{\sin\theta}{\sqrt{\cos 2\theta}}\right)\right)$, where $-\frac{\pi}{4}<\theta<\frac{\pi}{4}$. Then the value of $\frac{d}{d(\tan\theta)}\left(f(\theta)\right)$ is

Ans : 1

Sol : Put $\tan^{-1}\left(\frac{\sin\theta}{\sqrt{\cos 2\theta}}\right)=\alpha$

$\Rightarrow \tan\alpha=\frac{\sin\theta}{\sqrt{\cos 2\theta}}$

$\Rightarrow \sin\alpha=\tan\theta$

$\therefore f(\theta)=\tan\theta\Rightarrow\frac{d}{d(\tan)}t(\theta)=1$

68. 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

Ans : 8

Sol : $AM \geq GM$

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

$$\geq 8\sqrt[8]{1} \quad \geq 8$$

69. The positive integer value of n > 3 satisfying the equation $\frac{1}{\sin\left(\frac{\pi}{n}\right)}=\frac{1}{\sin\left(\frac{2\pi}{n}\right)}+\frac{1}{\sin\left(\frac{3\pi}{n}\right)}$ is

Ans : 7

Sol : $Sin\frac{2\pi}{n}.Sin\frac{3\pi}{n}=Sin\frac{\pi}{n}\left[Sin\frac{2\pi}{n}+Sin\frac{3\pi}{n}\right]$

$$\Rightarrow \cos\frac{\pi}{n}-\cos\frac{5\pi}{n}=\cos\frac{\pi}{n}-\cos\frac{3\pi}{n}+\cos\frac{2\pi}{n}-\cos\frac{4\pi}{n}$$

$$\Rightarrow \cos\frac{3\pi}{n}-\cos\frac{5\pi}{n}=\cos\frac{2\pi}{n}-\cos\frac{4\pi}{n}$$

$$\Rightarrow 2\sin\frac{4\pi}{n}\sin\frac{\pi}{n}=2\sin\frac{3\pi}{n}\sin\frac{\pi}{n}$$

$$\Rightarrow \sin 4\frac{\pi}{n}-\sin\frac{3\pi}{n}=0$$

$$\Rightarrow 2\cos\left(\frac{7\pi}{2n}\right)\sin\left(\frac{\pi}{2n}\right)=0$$

$$\Rightarrow \cos\frac{7\pi}{2n}=0 \quad (\because n>3)$$

$$\Rightarrow \frac{7\pi}{2n}=(2k+1)\frac{\pi}{2}$$

$$\Rightarrow \frac{7}{n}=odd \text{ integer}$$

$$\Rightarrow n=7$$