Test Code: JS-FT-17-25

Question Number	Answer	Level	Chapter Name
Q1	D	easy	11P3 - Rectilinear Motion
Q2	C	hard	11P19 - Simple Harmonic Motion
Q3	B	easy	12P28 - Geometrical Optics
Q4	A	medium	12P25 - Magnetic effects of electric current and magnetism
Q5	D	medium	11P12 - Gravitation
Q6	B	hard	11P9 - Circular Motion
Q7	B	medium	12P32 - Semiconductor
Q8	D	medium	12P22 - Electrostatics
Q9	C	hard	11P8 - Work, Power & Energy
Q10	B	medium	11P16 - KTG & Thermodynamics
Q11	A	medium	12P31 - Nuclear Physics
Q12	C	medium	12P23 - Current electricity
Q13	D	easy	11P1 - Unit & Dimension
Q14	C	hard	11P6 - Newtons laws of motion
Q15	A	easy	12P27 - Alternating current
Q16	D	medium	11P10 - Centre of mass
Q17	D	hard	12P33 - Electromagnetic Wave
Q18	B	easy	11P1 - Unit & Dimension
Q19	A	hard	12P23 - Current electricity
Q20	A	easy	11P16 - KTG & Thermodynamics
Q21	15	easy	12P22 - Electrostatics
Q22	4	medium	12P31 - Nuclear Physics
Q23	6	medium	11P11 - Rigid Body Dynamics
Q24	12	easy	12P26 - EMI
Q25	6	medium	11P13 - Elasticity and Viscosity
Q26	B	medium	12C27 - Coordination compounds

Question Number	Answer	Level	Chapter Name
Q27	C	medium	11C8 - Ionic Equilibrium
Q28	B	easy	12C25 - p blocks - Halogen & Noble gases
Q29	A	easy	12C39 -Amines
Q30	D	easy	11C2 - Atomic Structure
Q31	B	hard	11C15 - General Organic Chemistry
Q32	C	medium	11C4 - Chemical Bonding
Q33	B	easy	12C18 - Solution and colligative properties
Q34	D	hard	12C27 - Coordination compounds
Q35	D	easy	11C16 - Hydrocarbons
Q36	C	medium	12C18 - Solution and colligative properties
Q37	C	hard	11C3 - Periodic Table
Q38	A	medium	12C35 - Aldehydes, Ketones, Carboxylic Acids
Q39	A	hard	12C35 - Aldehydes, Ketones, Carboxylic Acids
Q40	D	medium	12C21 - Chemical Kinetics
Q41	A	hard	12C38 - Alcohol, Phenol and Ether
Q42	A	medium	11C14 - IUPAC Nomenclature and Isomerism
Q43	C	hard	12C26 - d and f block elements
Q44	A	hard	12C37 - Haloalkanes & Haloarenes
Q45	C	easy	12C26 - d and f block elements
Q46	2	hard	12C20 - Electrochemistry
Q47	0	easy	12C21 - Chemical Kinetics
Q48	80	hard	11C15 - General Organic Chemistry
Q49	100	medium	11C1 - Mole concept
Q50	150	medium	11C6 - Thermodynamics
Q51	C	medium	12M15 - Function & Inverse Trigonometric
Q52	A	easy	Conic Sections - II
Q53	C	easy	11M2 - Sets, Relations and Functions
Q54	C	easy	12M18 - Application of Derivatives

Question Number	Answer	Level	Chapter Name
Q55	B	hard	12M22 - Vector & 3-D
Q56	A	medium	Functions 2
Q57	B	medium	11M7 - Binomial Theorem
Q58	C	easy	12M16 - Matrices & Determinant
Q59	D	medium	11M6 - Permutation & Combination
Q60	B	medium	11M4 - Quadratic Equation
Q61	B	easy	11M12 - Statistics
Q62	D	medium	12M20 - Definite Integration & Its App.
Q63	B	hard	Straight Lines
Q64	D	hard	12M17 - Limits, Continuity & Derivability
Q65	A	medium	Sequence and Series
Q66	A	medium	Differential Equations
Q67	B	easy	12M17 - Limits, Continuity & Derivability
Q68	D	easy	12M22 - Vector & 3-D
Q69	C	medium	Conic Sections - I
Q70	A	medium	11M5 - Complex Number
Q71	9	easy	11M8 - Sequence & Series
Q72	3	hard	12M23 - Probability
Q73	2	medium	12M20 - Definite Integration & Its App.
Q74	43	hard	12M16 - Matrices & Determinant
Q75	10	easy	Trigonometry

Q1:

Solution:

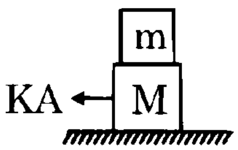
If a be the acceleration of the body, then distance travelled by the body in $2s$ is given as,
$x_1 = ut + \frac{1}{2}at^2 = 0\times2 + \frac{1}{2}a\times(2)^2$
$x_1 = 2a$
Velocity of body at the end of $2s$ is given as,
$v = u + at = 0 + a\times2$
$v = 2a$
Distance travelled by the body in next $2s$ is given as,
$x_2 = vt + \frac{1}{2}at^2$
$= 2a\times2 + \frac{1}{2}a\times(2)^2$ [from Eq. (ii)]

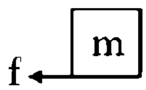
$= 4a + 2a$
$x^2 = 6a = 3 \times 2a$
$\Rightarrow x_2 = 3 \times x_1$ [from Eq. (i)]
$\Rightarrow x_2 = 3x_1$

Q2:

Solution:

(A) As both blocks moving together so
Time period $= 2\pi\sqrt{\frac{m}{K}}$; where $m = M + m$
$T = 2\pi\sqrt{\frac{M+m}{K}}$
(B) Let block is displaced by x in (+ve) direction so force on block will be in $(-$ve) direction
$F = -Kx$
$(M + m)a = -Kx$
$a = -\frac{Kx}{(M+m)}$
(C) As upper block is moving due to friction thus
$f = ma = \frac{mKx}{(M+m)}$
(D) This option is like two block problem in friction for maximum amplitude, force on block is also maximum, for which both blocks are moving together.





$KA = (M + m)a$
$a = \frac{KA}{(M+m)}$
$f = ma = \frac{mKA}{(M+m)}$
$f_{\max} = f_L = \mu mg$
$f = \mu mg$
$\frac{mKA}{(M+m)} = \mu mg$
$A = \frac{\mu(M+m)g}{K}$
(E) Maximum friction can be μmg as force is acting between blocks & normal force here is mg.

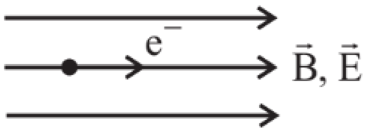
Q3:

Solution:

As, $\mu = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\frac{A}{2}}$
$\Rightarrow \sqrt{2} = \frac{\sin\left(\frac{60^\circ+\delta_m}{2}\right)}{\sin\frac{60^\circ}{2}}$ (as $\mu = \sqrt{2}$)
$\frac{1}{\sqrt{2}} = \sin\left(\frac{60^\circ+\delta_m}{2}\right)$
or $\sin 45^\circ = \sin\left(\frac{60^\circ+\delta_m}{2}\right)$
$\Rightarrow \delta_m = 30^\circ$
$\therefore$ Angle of incidence,
$i = \frac{A+\delta_m}{2} = \frac{60+30}{2} = \frac{90}{2} = 45^\circ$

Q4:

Solution:



$\vec{B}$ will not effect electron and $\vec{E}$ will reduce electron velocity as electric field on it is in direction opposite to field.
So (I) is correct

$\vec{B}_{\text{net}} = \frac{\mu_0 i}{2\pi r} \otimes + \frac{\mu_0 i}{2\pi r} \odot = 0$
So, (II) is correct
No net force acts on rectangular loop placed in magnetic field.
So (III) is correct.

Q5:

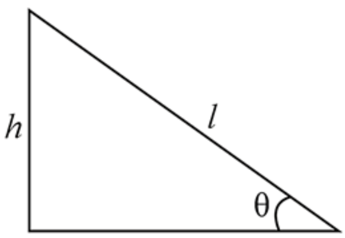
Solution:

The escape velocity for the surface of earth is or
$v_{es(e)} = \sqrt{\frac{2GM_e}{R_e}}$
or $v_{es(e)} = R_e\sqrt{\frac{8}{3}G\pi\rho} \quad \left[\because M_e = \frac{4}{3}\pi R^3\right]$
$v_{es(p)} = 4R_e\sqrt{\frac{8}{3}G\pi 9\rho}$
$\frac{v_{es(e)}}{v_{es(p)}} = \frac{R_e\sqrt{\frac{8}{3}G\pi\rho}}{4R_e\sqrt{\frac{8}{3}G\pi 9\rho}} = \frac{1}{12}$
So, $v_{es(p)} = 12v_{es(e)}$

Q6:

Solution:

We know that angle of banking is given by,
$\tan\theta = \frac{v^2}{rg}$ ...(1)
From triangle, $\sin\theta = \frac{h}{l}$



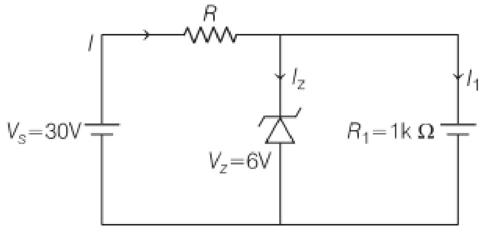
$\Rightarrow \theta = \sin^{-1}\left(\frac{h}{l}\right)$ ...(2)

Putting this value in (1), we get, required expression.
$\therefore \tan\left\{\sin^{-1}\left(\frac{h}{l}\right)\right\} = \frac{v^2}{rg}$.

Q7:

Solution:

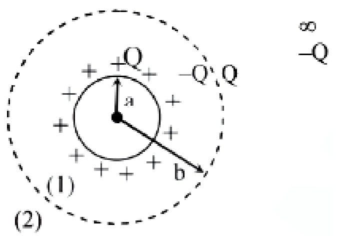
Given that, $R_1 = 1k\Omega$,
Zener breakdown voltage $V_z = 6V$
Let I_1 and I_z be the current passing through R_1 and Zener diode, then using equation,
$I_1 = \frac{V_z}{R_1} = \frac{6}{1000}A$



According to given condition Zener current,
$I_z = 5I_1 = \frac{30}{1000}A$
Let I be the current drawn from source battery $(V_s = 30V)$, then
$I = \frac{V_s - V_z}{R} = I_1 + I_z$
$\frac{30-6}{R} = \frac{6}{1000} + \frac{30}{1000}$
$\Rightarrow R = \frac{2000}{3}\Omega$

Q8:

Solution:



$U_1 = \frac{Q^2}{2C_1} = \frac{Q^2(b-a)}{2\times 4\pi\varepsilon_0 ab}$
$U_2 = \frac{Q^2}{2C_2} = \frac{Q^2}{2\times 4\pi\varepsilon_0 b}$
Now $U_1 = U_2$
$\frac{b-a}{ab} = \frac{1}{b}$
$b - a = a$
$b = 2a$
$\therefore b = 2 \times 20 = 40\ cm$
$= 40\ cm$

Q9:

Solution:

From given graph :
$\vec{F} = \left(\frac{3}{4}x + 10\right)\hat{i} + \left(20 - \frac{4}{3}y\right)\hat{j} + \left(\frac{4}{3}z - 16\right)\hat{k}$
$W = \int \vec{F} \cdot \vec{ds}$

$$= \int_{(0,5,6)}^{(2,10,0)} [\left(\frac{3}{4}x + 10\right)\hat{i} + \left(20 - \frac{4}{3}y\right)\hat{j} + \left(\frac{4}{3}z - 16\right)\hat{k}].\left[dx\hat{i} + dy\hat{j} + dz\hat{k}\right] = \frac{287}{2}J$$

Work done can also be found by finding area under these curves.

Q10:

Solution:

According to problem mass of gases are equal so number of moles will not be equal i.e. $\mu_A \neq \mu_B$
From ideal gas equation $PV = \mu RT \Rightarrow \frac{P_A V_A}{\mu_A} = \frac{P_B V_B}{\mu_B}$
[As temperature of the container are equal]
From the relation it is clear that if $P_A = P_B$ then
$\frac{V_A}{V_B} = \frac{\mu_A}{\mu_B} \neq 1$ i.e. $V_A \neq V_B$
Similarly if $V_A = V_B$ then $\frac{P_A}{P_B} = \frac{\mu_A}{\mu_B} \neq 1$ i.e. $P_A \neq P_B$

Q11:

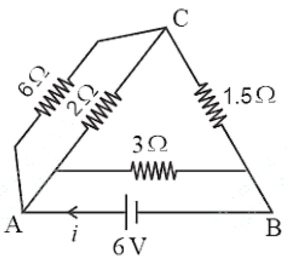
Solution:

B.E. $= \Delta mc^2 = \Delta \times 931\, MeV$
$= [2(1.0087 + 1.0073)—4.0015] \times 931$
$= 28.4\, MeV$

Q12:

Solution:

Let us assume that the battery of $6\ V$ is connected across points A and B. Let the centre point be C.
Using the point-potential method, the points having the same potential should have the same name.
After redrawing the circuit, the figure looks as shown below,



The current supplied by the battery is
$i = \frac{V}{R_{AB}}$
$V = 6\, V$.
Now, to find the equivalent resistance between A and B,
$R_{AB} = 3 \parallel (R_{AC} + R_{CB})$
$R_{AC} = \frac{6\times2}{6+2}$
$R_{AC} = 1.5\, \Omega$
$R_{BC} = 1.5\, \Omega$
$R_{AB} = 3 \parallel (1.5 + 1.5)$
$R_{AB} = 3 \parallel 3$
$R_{AB} = \frac{3\times3}{3+3}$
$R_{AB} = 1.5\, \Omega$
Thus, the net resistance between A and B is $1.5\, \Omega$.
Now, the current flowing through the battery is
$i = \frac{6}{1.5}\ A$.
Hence, the current flowing through the battery is $4\ A$.

Q13:

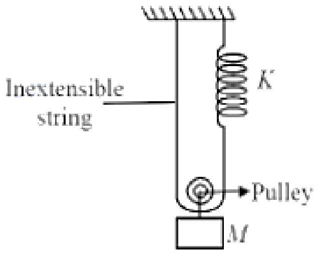
Solution:

Pitch $= \frac{3}{6} = 0.5\,mm$
$L.C. = \frac{0.5\,mm}{50} = \frac{1}{100}\,mm = 0.01\,mm$
$= 0.001\,cm$

Q14:

Solution:

When mass M is



suspended from the given system as shown in figure, let l be the length through which mass M moves down before it comes to rest.
In this situation, both the spring and string will be stretched by length l. Since string is inextensible, so spring is stretched by length $2l$. The tension along the string and spring is the same.
In equilibrium, $Mg = 2(k2l)$ If mass M is pulled down through small distance x, then
$F = Mg - 2k(2l + 2x) = -4kx$ ... (i)
$F \propto x$ and $-ve$ sign shows that it is directed towards mean position. Hence, the mass executes simple harmonic motion.
For SHM, $F = -k\prime x$ ... (ii)
Comparing (i) and (ii), we get $k\prime = 4k$
$\therefore$ Time period, $T = 2\pi\sqrt{\frac{M}{4k}}$

Q15:

Solution:

To find the root mean square (RMS) value of the given alternating current, follow these steps:
The current is represented as:
$i = 5\sqrt{2} + 10\cos\left(650\pi t + \frac{\pi}{6}\right)Amp$
Here, the time-independent DC component is $5\sqrt{2}$ and the AC component is $10\cos\left(650\pi t + \frac{\pi}{6}\right)$.
Calculate the square of the current, i^2 :
$i^2 = (5\sqrt{2})^2 + \left(10\cos\left(650\pi t + \frac{\pi}{6}\right)\right)^2 + 2 \times 5\sqrt{2} \times 10\cos\left(650\pi t + \frac{\pi}{6}\right)$
Simplifying, we have:
$i^2 = 50 + 100\cos^2\left(650\pi t + \frac{\pi}{6}\right) + 100\sqrt{2}\cos\left(650\pi t + \frac{\pi}{6}\right)$
Find the average value $\langle i^2 \rangle$:
The average value of cos terms over a period is zero, simplifying our equation to:
$\left\langle i^2 \right\rangle = 50 + \frac{100}{2} + 0$
This simplifies to:
$\left\langle i^2 \right\rangle = 50 + 50 = 100$
Calculate the RMS current:
The RMS value is the square root of the mean of the squares of the current:
$\langle i \rangle = \sqrt{100} = 10Amp$

Thus, the RMS value of the current is $10 Amps$.

Q16:

Solution:

Path of the centre of mass in a two particle system,
$r(t) = \left[\frac{m_1 r_1(t) + m_2 r_2(t)}{m_1 + m_2}\right]$
or $r(t) = \left[\frac{m(t\hat{i} - t^3\hat{j} + 2t^2\hat{k}) + 2m(t\hat{i} - t^3\hat{j} - t^2\hat{k})}{m + 2m}\right]$
$\Rightarrow r(t) = \frac{3t\hat{i} - 3t^3\hat{j}}{3} = t\hat{i} - t^3\hat{j}$

Q17:

Solution:

Here, $\lambda = 3mm = 3 \times 10^{-3} m, E_0 = 66\,Vm^{-1}$
$\therefore B_0 = \frac{E_0}{c} = \frac{66}{3 \times 10^8} = 2.2 \times 10^{-7} T$
As, electromagnetic wave is propagating along x-axis and electric field oscillation is along y-direction, the magnetic field oscillation is along z-direction using the relation for harmonic wave
$E_y = E_0 \cos \frac{2\pi}{\lambda}(ct - x)$
$E_y = E_0 \cos \frac{2\pi c}{\lambda}(t - x/c)$
$\therefore E_y = 66 \cos \frac{2\pi \times 3 \times 10^8}{3 \times 10^{-3}}(t - x/c)$
$= 66 \cos 2\pi \times 10^{11}(t - x/d)$
and $B_z = B_0 \cos \frac{2\pi c}{\lambda}(t - x/c)$
$= 2.2 \times 10^{-7} \cos 2\pi \times 10^{11}(t - x/c)$

Q18:

Solution:

A) Angular momentum,$L = mvr \Rightarrow [ML^2T^{-1}]$. This matches option 4.

B) Torque, $\vec{\tau} = \vec{r} \times \vec{F} \Rightarrow [ML^2T^{-2}]$. This matches option 3.

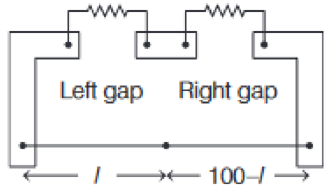
C)Gravitational constant, $G = \frac{Fr^2}{m_1 m_2}$. Its dimensional formula is $[M^{-1}L^3T^{-2}]$. This matches with option 1

D) Tension is a type of force. The dimensional formula for force is $[MLT^{-2}]$. This matches with option 2

Q19:

Solution:

Meter bridge is shown in the figure below,



When $\frac{n}{2}$ resistances are joined in series in left gap each of resistance R_1, then equivalent resistance in left gap.
$R = \frac{R_1}{2} + \frac{R_1}{2} + \frac{R_1}{2} + \ldots \frac{n}{2} \cdot \text{ times } = \frac{R_1 n}{2}$
When $\frac{n}{2}$ resistors are joined in parallel in right gap, then the equivalent resistance in right gap.

$\frac{1}{S}=\frac{1}{R_1}+\frac{1}{R_1}+\frac{1}{R_1}+\ldots \frac{n}{2}$ times $=\frac{n}{2R_1}$
$\Rightarrow S=\frac{2R_1}{n}$
If l be the balancing length in the meter bridge wire, then
$\frac{R}{S}=\frac{l}{100-l} \Rightarrow \frac{\frac{R_1 n}{2}}{\frac{2R_1}{n}}=\frac{l}{100-l}$
$\frac{n^2}{4}=\frac{l}{100-l} \Rightarrow l=\frac{100n^2}{n^2+4}$

Q20:

Solution:

When an ideal gas is compressed adiabatically, its temperature and the average kinetic energy of the gas molecule increases because of collision of molecules with wall. Hence, Both A and R are true and R is the correct explanation of A.

Q21:

Solution:

To calculate the area of the surface through which the electric flux is determined, we use the given electric field and the specified surface orientation. The electric field is expressed as $\overrightarrow{E}=(2\hat{i}+4\hat{j}+6\hat{k}) \times 10^3\ N/C$.

Since the surface is parallel to the $x-z$ plane, its area vector $\overrightarrow{A}$ is directed along the y-axis, making it $A\hat{j}$.
The electric flux ϕ through the surface is given by:
$\phi=\overrightarrow{E} \cdot \overrightarrow{A}=(2\hat{i}+4\hat{j}+6\hat{k}) \times 10^3 \cdot\ A\hat{j}$
Calculating the dot product, the only component contributing to the flux is the y-component:
$\phi=\left(4 \times 10^3\right) A$
Given that the electric flux \phi is 6.0 {Nm}^{2} / {C}, we can equate and solve for A :
$6=4 \times 10^3\ A$
$A=\frac{6}{4 \times 10^3}=1.5 \times 10^{-3}\ m^2$
Converting this area from square meters to square centimeters:
$A=1.5 \times 10^{-3}\ m^2=15\ cm^2$

Q22:

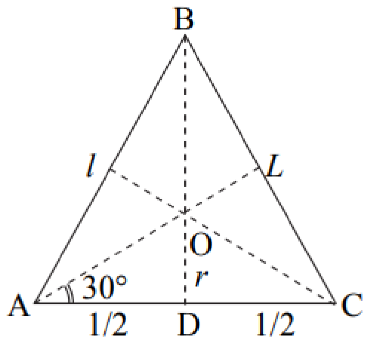
Solution:

Given nuclear reaction is
${}_{92}^{238}U \rightarrow {}_{90}^{234}Th+{}_{2}^{4}He+Q$
Mass defect $=M_U-M_{Th}-M_{He}$
$=238.05079-234.043630-4.002600$
$=0.00456\ u$
Energy released $=(0.00456u) \times(931.5\ MeV)=4.25\ MeV$.

Q23:

Solution:

Let the length of the rod be l.



The moment of inertia of one rod separately about an axis passing through the centre of the rod and perpendicular to its length, $I = I_{Ac} + mr^2$
$= \frac{1}{12}ml^2 + m\left(\frac{l}{2\sqrt{3}}\right)^2$
$= \frac{ml^2}{12} + \frac{ml^2}{12} = \frac{2ml^2}{12}$
Moment of inertia of the system of 3 rods
$= 3 \times \frac{2ml^2}{12} = 6 \times \frac{ml^2}{12} = 6l$
According to the question $\frac{6ml^2}{12} = l = n \cdot \left(\frac{ml^2}{12}\right)$

$n = 6$

Q24:

Solution:

$B = \frac{\mu_0 NI}{l}$
$B \propto NI$
$N_1 I_1 = N_2 I_2$
$N_P I_P = N_Q I_Q$
$I_Q = \frac{N_Q}{N_P} \times I_Q$
$I_P = \frac{300}{200} \times 1 = \frac{3}{2} = k$
$\therefore 8k = 8 \times \frac{3}{2} = 12$

Q25:

Solution:

Bulk modulus, $K = 2 \times 10^9 N/m^2$
Change in volume, $\Delta V = 0.1\%$ of initial volume
$= 0.1\%$ of $V = \frac{V \times 0.1}{100} = V \times 10^{-3}$
$\therefore K = \frac{pV}{\Delta V}$
$2 \times 10^9 = \frac{p \times V}{V \times 10^{-3}}$
$p = 2 \times 10^9 \times 10^{-3}$
$= 2 \times 10^6 N/m^2$

Q26:

Solution:

The correct IUPAC name of $[Mn(CN)_5]^{2-}$ Pentacyanomangnate (III)

Q27:

Solution:

In the saturated solution of sparingly soluble electrolyte, the ionic product of ions is constant at constant temperature and it is known a Solubility Product.
Here,
$Mg(OH)_2 \rightarrow [Mg^{2+}][OH^-]^2$
Given,
K_{sp} for $Mg(OH)_2 = 5.6 \times 10^{-12}$
$[Mg^{2+}] = 10^{-10} M$
Substituting the value, we get :
$K_{sp} = [Mg^{2+}][OH^-]^2 \Rightarrow 5.6 \times 10^{-12} = [10^{-10}][OH^-]^2$
$\Rightarrow OH^- = 0.24\ M$
Hence, the concentration of $[OH^-] = 0.24\ M$

Q28:

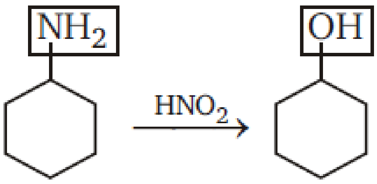
Solution:

(A) Helium is lighter than air, so used in airship balloons.
(B) Argon is completely inert to other elements, so used to provide inert atmosphere.
(C) Due to larger size of Xe, the outer electron and nucleus attraction is weak. So, it reacts with highly electronegative element, i.e. fluorine and oxygen.
D) Radon is formed from the natural decay of uranium and radium, so, it is radioactive.
The correct match is A-IV, B-I, C-III and D-II.

Q29:

Solution:

Diazotization of amine, 1° amine converted into alcohol



Q30:

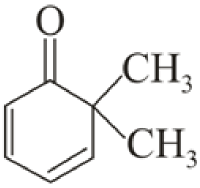
Solution:

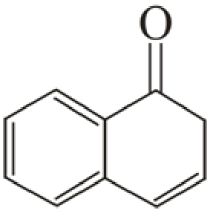
The order of increase of energy can be calculated from $(n+l)$ rule. If two orbitals have same value of $(n+l)$, the orbital with lower value of n will be filled first.
(i) For $n = 4, l = 1, (n+l) = 4+1 = 5$
(ii) For $n = 4, l = 0, (n+l) = 4+0 = 4$
(iii) For $n = 3, l = 2, (n+l) = 3+2 = 5$
(iv) For $n = 3, l = 1, (n+l) = 3+1 = 4$
Therefore correct order is
(iv) < (ii) < (iii) < (i).

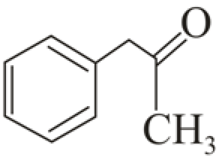
Q31:

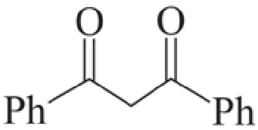
Solution:

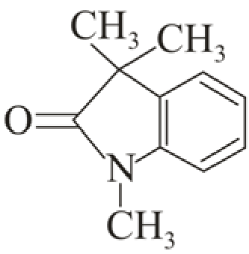
For the enolization carbonyl compound. Carbonyl compound must contain at least one $\alpha - H$
Compunds (i) , (v) not have alpha hydrogen so these compounds will not show enolization.
Compounds (ii),(iii),(iv) have alpha hydrogen so these compound will show enolization.

(i) 

(ii) 

(iii) 

(iv) 

(v) 

(i) compound will not shows enolization.

(ii) compound $= 2(\alpha - H)$

(iii) compound $= 5(\alpha - H)$

(iv) compound $= 2(\alpha - H)$

(v) compound $= 0(\alpha - H)$

Q32:

Solution:

Since, ionic character is inversely proportional to polarising power of cation therefore correct order is $AlCl_3 > GaCl_3 > BCl_3$

Q33:

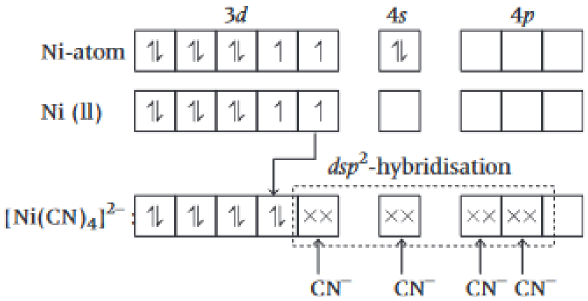
Solution:

The boiling point of an azeotropic mixture of water and ethyl alcohol is less than that of theoretical value of water and alcohol mixture. Hence, the mixture shows positive deviation from Raoult's law.
Positive deviations from Raoult's law are noticed when
(i) Exp. vaue of vapour pressure of mixture is more than calculated value.
(ii) Exp. value of boiling point of mixture is less than calculated value.
(iii) $\Delta H_{\text{mixing}} = +ve$
(iv) $\Delta V_{\text{mixing}} = +ve$

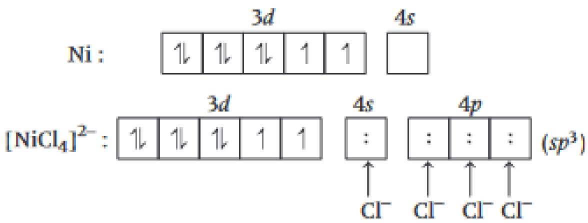
Q34:

Solution:

A) $[Fe(CN)_6]^{3-}$ has d^2sp^3 (inner d- complex) hybridisation with one electron unpaired.
B) The Fe^{2+} ion in $[Fe(CN)_6]^{4-}$ has outer electronic configuration of $3d^6$. The complex is a low spin complex. It contains 0 unpaired electrons with magnetic moment of $0BM$ Therefore, under the influence of the octahedral crystal field, the possible electronic arrangement of Fe (II) ion is t_{2g}^6, e_g^0.
C) $[Ni(CN)_4]^{2-}$ is a square planar geometry formed by dsp^2 hybridisation. $[Ni(CN)_4]^{2-}$ is diamagnetic, so Ni^{2+} ion has $3d^8$, outer configuration with two unpaired electrons.
For the formation of the square planar sructure by structure by dsp^2 - hybridisation, two unpaired d-electrons are paired up due to energy made available by the approach of ligands, making one of the $3d$-orbitals empty.



(d) In $[NiCl_4]^{2-}$, there is 2 unpaired electrons.



$\therefore Cl^-$ is a weak ligand so, there is no pairing of electrons.
Number of unpaired $= 2$
Hence, the correct option is D).

Q35:

Solution:

During electrolysis, two molecules of the potassium salt of monocarboxylic acid combine to form alkane along with the loss of two COO^- group. Hence alkane formed will contain $= 2n - 2$ (no of C-atom).

Q36:

Solution:

H_2SO_4 is 98% by weight.

Weight of $H_2SO_4 = 98\ g$
Weight of solution $= 100g$
$\therefore$ Volume of solution $= \frac{\text{mass}}{\text{density}} = \frac{100}{1.80} mL$
$55.55 mL = 0.0555 L$
Molarity of solution $= \frac{98}{98 \times 0.0555} M = \frac{1}{0.0555} M$
Let $V mL$ of this H_2SO_4 are used to prepare 1 litre of $0.1 M H_2SO_4$.
$\therefore mM$ of concentrated $H_2SO_4 = mM$ of dilute H_2SO_4
or, $V \times \frac{1}{0.0555} = 1000 \times 0.1$
or, $V = 1000 \times 0.1 \times 0.0555$ =5.55 mL

Q37:

Solution:

Assertion (A) Electronic configuration of boron $(Z = 5)$ is $[He]2s^2 2p^1$. So, in first ionisation $(1IE_1$ or $\Delta_i H_1)$ removal will take place from unpaired p^1-electron. Whereas that of Be will be from paired $2s^2$ -electrons which requires more energy.
Electronic configuration of $Be(Z = 4) : [He]2s^2$. So, the Assertion is a correct statement.
Reason (R) s-orbital is being symmetrical in shape (spherical), it shields nuclear force (nuclear charge) strongly. So, $2p^1$-electron of B is experiences lesser nuclear attractive force for ionisation. As a result,
IE_1 or $\Delta_i H_1 : B < Be$
So, the Reason is correct explanation for Assertion.

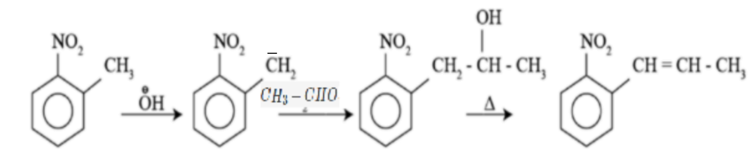
Q38:

Solution:

(i) $CH_3 - CH_2 - COOH$
(ii) $CH_3 - COOH$
(iii) $C_6H_5 - COOH$
(iv) $C_6H_5 - CH_2 - COOH$
Due to $-I$ effect (iii) is most acidic and order will be (iii) > (iv) > (ii) > (i).

Q39:

Solution:



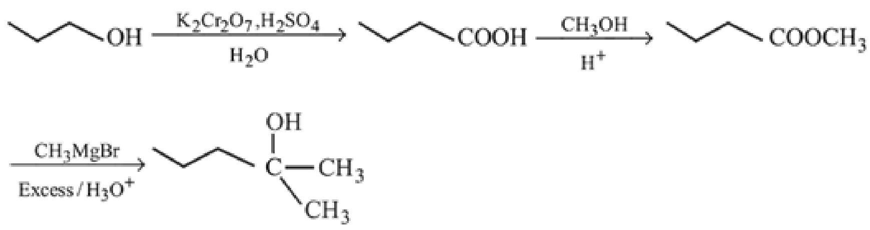
Q40:

Solution:

If a plot is drawn between $1/T$ and $\ln k$, then according to Arrhenius equation,
$\ln k = ln\ A - \frac{E_a}{RT}$
Here, slope $= -\frac{E_a}{R} \Rightarrow -1 \times 10^4 = -\frac{E_a}{8.314}$
$\therefore E_a = 8.314 \times 10^4\ J = 83\ kJ$

Q41:

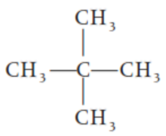
Solution:

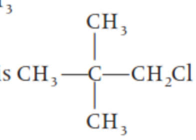


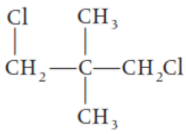
Q42:

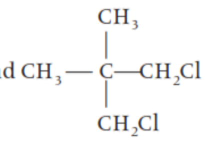
Solution:

C_5H_{12}, pentane has molecular mass 72 g i.e. the isomer of pentane which yields single monochloro derivative and two dichloro derivative is 2, 2-dimethyl propane as it has all equivalent hydrogens.

The compound A is 

One mono chloro derivative is 

Two di chloro derivatives are 

and 

Q43:

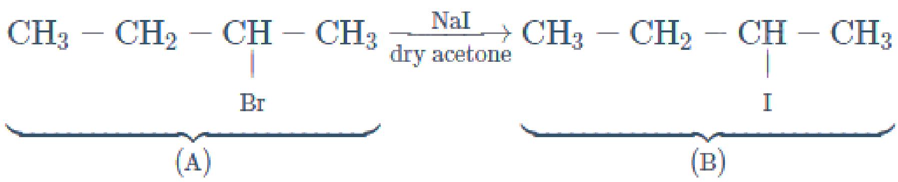
Solution:

A) When $NaCl$ and $K_2Cr_2O_7$ warmed with H_2SO_4 (i.e. in acidic medium), they produce deep red vapors of chromyl chloride (CrO_2Cl_2)
B) When $NaOH$ is passed,(CrO_2Cl_2) will react with $NaOH$ and gives yellow color solution
C) Chlorine gas is not evolved, thus false
D) In the given reaction, chromyl chloride (CrO_2Cl_2) is formed. All reactions are as follows
(i) $K_2Cr_2O_7 + 4NaCl + 6H_2SO_4 \longrightarrow 2KHSO_4 + 2CrO_2Cl_2 + 4NaHSO_4 + 3H_2O$
(ii) $CrO_2Cl_2 + 4NaOH \longrightarrow Na_2CrO_4 + 2NaCl + 2H_2O$

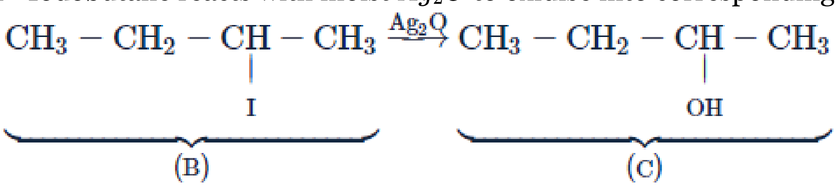
Q44:

Solution:

When 2$-$bromobutane is treated with NaI in the presence of dry acetone then, iodine is substituted in the place of the bromine atom and formation of 2$-$ iodobutane (B) takes place. This reaction is known as the Finkelstein reaction.



2−Iodobutane reacts with moist Ag_2O to oxidise into corresponding alcohol, i.e., butan$-2-ol(C)$.



Butan$-2-ol$ is unsymmetrical and has one chiral carbon, therefore, the number of optical isomers $= 2^n$, where $n =$ the number of chiral centres.
So, the number of optical isomers $= 2^1 = 2$.

Q45:

Solution:

Actinides exhibit larger oxidation states than lanthanides because of the very small energy gap between $5f$,$6d$ and $7s$ subshells. Thus, the outermost electrons get easily excited to the higher energy levels, giving variable oxidation states. Hence, Assertion is correct, Reason is incorrect. Thus, the correct option is C).

Q46:

Solution:

At anode: $H_2(g) \rightleftharpoons 2H^+(aq) + 2e^-$
At cathode: $M^{4+}(aq) + 2e^- \rightleftharpoons M^{2+}(aq)$
Net cell reaction:
$H_2(g) + M^{4+}(aq) \rightleftharpoons 2H^+(aq) + M^{2+}(aq)$
Now, $E_{\text{cell}} = \left(E^0_{M^{4+}/M^{2+}} - E^0_{H^+/H_2}\right) - \frac{0.059}{n} \cdot \log \frac{[H^+]^2[M^{2+}]}{PH_2[M^{4+}]}$
Or, $0.092 = (0.151 - 0) - \frac{0.059}{2} \cdot \log \frac{1^2 \times [M^{2+}]}{1 \times [M^{4+}]}$
$\therefore \frac{[M^{2+}]}{[M^{4+}]} = 10^x = 10^2 \Rightarrow x = 2$

Q47:

Solution:

From two data, (for zero order kinetics)
$K_I = \frac{x}{t} = \frac{0.25}{0.05} = 5$
$\Rightarrow K_{\text{II}} = \frac{X}{t} = \frac{0.60}{0.12} = 5$

Q48:

Solution:

$\%$ of N in the compound $= 1\%$
$\therefore$ mass of N in the compound $= \frac{1}{100} \times 2.8g$
Number of moles of N in the compound $= \frac{1}{100} \times \frac{2.8}{14} = \frac{0.2}{100}$ mol
Number of mmol of NH_3 formed $= \frac{0.2}{100} \times 1000 = 2$
Total number of mmol of H_2SO_4 added $= 60 \times \frac{1}{20} = 3$
meq of $H_2SO_4 = 3 \times 2 = 6$

Let the volume of $NaOH$ used be V_{mL}
meq of $H_2SO_4 = meq$ of $NH_3 + meq$ of $NaOH$
$6 = 2 + (\frac{1}{20} \times V_{mL}) \Rightarrow 4 \times 20 = V_{mL} \Rightarrow 80mL = V_{mL}$

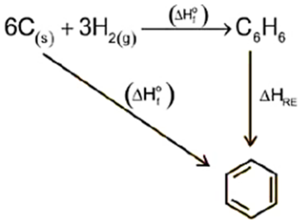
Q49:

Solution:

Let two oxide be
M_2O_x and M_2O_y
As per question
$\frac{2a}{16x} = \frac{25}{4}$ and $\frac{2a}{16y} = \frac{25}{6}$
$x = \frac{a}{50}, y = \frac{3a}{100}$ where $a =$ atomic mass of Metal
As x and y to be an integer,
If we take $a = 50$, then $x = 1, y = 1.5$ (not possible)
If we take $a = 100$ then $x = 2, y = 3$ (possible)
$\therefore$ Minimum Atomic Mass $= 100\ u$

Q50:

Solution:



$\left(\Delta H_f^o\right)_1 = (BE)_R - (BE)_P$
$= [6(716.8) + 3(436.9)] - [3(620) + 3(340) + 6(490)]$
$\left(\Delta H_f^o\right)_1 = -208.5\ kJ/mole$
$\left(\Delta H_f^o\right)_1 + (\Delta H_{RE}) = \left(\Delta H_f^o\right)$
$-208.5 + \Delta H_{RE} = -358.5$
$\Delta H_{RE} = -150\ kJ/mole$

Q51:

Solution:

Given function $f(x) = \sqrt{\frac{4-x^2}{[x]+2}}$, is define if
$\frac{4-x^2}{[x]+2} \geq 0 \Rightarrow \frac{x^2-4}{[x]+2} \leq 0$
So, either $x^2 - 4 \leq 0$
and $[x] + 2 > 0$ (i)
or $x^2 - 4 \geq 0$
and $[x] + 2 < 0$ (ii)
From Eq. (i),
$x \in [-2, 2]$ and $x \in [-1, \infty)$
So, $x \in [-1, 2]$ (iii)
From Eq. (ii),
$x \in (-\infty, -2] \cup [-2, -\infty)$ and $x \in (-\infty, -2)$
So, $x \in (-\infty, -2)$ (iv)
From intervals Eqs. (iii) and (iv),

$x \in (-\infty, -2) \cup [-1, 2]$

Q52:

Solution:

$(x+2)^2 = 3\left(y + \frac{13}{3}\right) =$ latus rectum $= 3$
Other conic is $\frac{(x-3)^2}{7^2} + \frac{(y+2)^2}{\left(\frac{7}{2}\right)} = 1$ which an ellipse is
Latus rectum $= \frac{2b^2}{a} = \frac{2.49}{4.7} = \frac{7}{2}$
Positive difference $\frac{7}{2} - 3 = \frac{1}{2}$

Q53:

Solution:

$\because (x, y) \in R \Rightarrow x^y = y^x$
$\therefore (x, x) \in R$ as $x^x = x^x \forall x \in I - \{0\}$
$\therefore R$ is reflexive
Now $(x, y) \in R \Rightarrow x^y = y^x \Rightarrow y^x = x^y$
$\Rightarrow (y, x) \in R \therefore R$ is symmetric
Now $(x, y) \in R \Rightarrow x^y = y^x$ and $(y, z) \in R \Rightarrow y^z = z^y$
$\because x^y = y^x \Rightarrow y = x^{\frac{y}{x}}$
$\Rightarrow y^z = z^x \Rightarrow \left(x^{\frac{y}{x}}\right)^z = z^x \Rightarrow x^{\frac{yz}{x}} = z^x$
$\Rightarrow x^{yz} = z^{x^2} \Rightarrow (x, z) \notin R$
R is not transitive.

Q54:

Solution:

Given rectangle perimeter $= 48\ cm$;
Let the sides of rectangle be $x,\ y$;
$\Rightarrow 2x + 2y = 48\ cm\ \Rightarrow x + y = 24\ cm$;
Area of the rectangle will be $A = xy$;
For area to be maximum, $dA/dx = 0$
We have $y = A/x\ \Rightarrow x + A/x = 24$;
$\Rightarrow x^2 - 24x = A$
$dA/dx = 0\ \Rightarrow 2x - 24 = 0 \Rightarrow x = 12\ cm\ \Rightarrow y = 12\ cm$;

Q55:

Solution:

We have,
$\vec{a} = 2\hat{i} + \hat{k}$
$\vec{b} = \hat{i} + \hat{j} + \hat{k}$
$\vec{c} = 4\hat{i} - 3\hat{j} + 7\hat{k}$
Then,
$\vec{a} \cdot \vec{c} = (2\hat{i} + \hat{k}) \cdot (4\hat{i} - 3\hat{j} + 7\hat{k}) = 15$
$\vec{a} \cdot \vec{b} = (2\hat{i} + \hat{k}) \cdot (\hat{i} + \hat{j} + \hat{k}) = 3$
Now,
$\vec{r} \times \vec{b} = \vec{c} \times \vec{b}$
$\Rightarrow \vec{a} \times (\vec{r} \times \vec{b}) = \vec{a} \times (\vec{c} \times \vec{b})$

$\Rightarrow (\vec{a}\cdot\vec{b})\vec{r} - (\vec{a}\cdot\vec{r})\vec{b} = (\vec{a}\cdot\vec{b})\vec{c} - (\vec{a}\cdot\vec{c})\vec{b}$
$\Rightarrow (\vec{a}\cdot\vec{b})\vec{r} = (\vec{a}\cdot\vec{b})\vec{c} - (\vec{a}\cdot\vec{c})\vec{b}$
$[\because (\vec{a}\cdot\vec{r}) = 0]$
$\Rightarrow (\vec{a}\cdot\vec{b})\vec{r} = (\vec{a}\cdot\vec{b})\vec{c} - (\vec{a}\cdot\vec{c})\vec{b}$
$\Rightarrow 3\vec{r} = 3\vec{c} - 15\vec{b}$
$\Rightarrow \vec{r} = \vec{c} - 5\vec{b}$
$\Rightarrow \vec{r} = (4\hat{i} - 3\hat{j} + 7\hat{k}) - 5(\hat{i} + \hat{j} + \hat{k})$
$\Rightarrow \vec{r} = (-\hat{i} - 8\hat{j} + 2\hat{k})$
Then,
$\vec{r}\cdot\vec{b} = (-\hat{i} - 8\hat{j} + 2\hat{k})\cdot(\hat{i} + \hat{j} + \hat{k})$
$= -1 - 8 + 2 = -7.$

Q56:

Solution:

Since $\sin^{-1}\left(3x - 4x^3\right) = 3\sin^{-1}x \ \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$
i.e., $\sin^{-1}\ x \in \left[-\frac{\pi}{6}, \frac{\pi}{6}\right]$ or $x \in \left[-\frac{1}{2}, \frac{1}{2}\right]$ so f is onto.
Also $f'(x) = \frac{3}{\sqrt{1-x^2}} > 0$ for $-\frac{1}{2} < x < \frac{1}{2}$.
Therefore, f, increases on $\left[\frac{-1}{2}, \frac{1}{2}\right]$ and hence f is one-one.

Q57:

Solution:

Let
$S_1 = \left(\alpha x^2 - 2x + 1\right)^{35}$
$S_2 = (x - \alpha y)^{35}$
Put $x = y = 1$. Then, we get
$S_1 = (\alpha - 1)^{35}$
$\Rightarrow S_1 = C_0^{35}(\alpha)^{35}(-1)^0 + C_1^{35}(\alpha)^{34}(-1)^2 + \ldots + C_{35}^{35}(-1)^{35}$
And,
$S_2 = (1 - \alpha)^{35} = -(\alpha - 1)^{35}$
$\Rightarrow 2(\alpha - 1)^{35} = 0$
$\Rightarrow \alpha = 1$

Q58:

Solution:

$\because A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix}$
Now
$AB = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}\begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix} = \begin{bmatrix} a & 2b \\ 3a & 4b \end{bmatrix}$
and $BA = \begin{bmatrix} a & 0 \\ 0 & b \end{bmatrix}\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} = \begin{bmatrix} a & 2a \\ 3b & 4b \end{bmatrix}$
If $AB = BA \Rightarrow a = b$
Hence $AB = BA$ is possible for infinitely many B's

Q59:

Solution:

There are ${}^{7}C_{5}$ ways of selecting the rings to be worn. If a, b, c, d are the number of the rings on the fingers, we need to find the non-negative integers such that $a+b+c+d=5$.
The numbers of such quadruples is ${}^{5+4-1}C_{4-1}={}^{8}C_{3}$. For each set of 5 rings, there are 5! arrangements. So, the total number of required arrangements is
${}^{7}C_{5}\times{}^{8}C_{3}\times 5!=141120$

Q60:

Solution:

Given: $(\ell-m)x^2+\ell x+1=0$
Let roots be $r, 2r$
So $3r=\frac{-\ell}{(\ell-m)}$ and $2r^2=\frac{1}{(\ell-m)}$
$\Rightarrow\left[\frac{\ell}{3(\ell-m)}\right]^2=\frac{1}{2(\ell-m)}$
$\Rightarrow 2\ell^2-9\ell+9m=0$
if ℓ is real, then $D\geq 0$
$81\geq 8\times 9m$
$\Rightarrow m\leq\frac{9}{8}$, Hence maximum value of $m=\frac{9}{8}$

Q61:

Solution:

$\sum_{i=1}^{10}\frac{(x_i-\bar{x})^2}{10}=\sigma^2\ldots(1)$
$\frac{\sum_{i=1}^{9}(x_i+10-\bar{x})^2+(x_{10}-90-\bar{x})^2}{10}=\sigma^2\ldots(2)$
From (1) and (2)
$\frac{\sum_{i=1}^{10}(x_i-\bar{x})^2}{10}=\frac{\sum_{i=1}^{10}(x_i-\bar{x})^2+20\sum_{i=1}^{9}(x_i-\bar{x})-180(x_{10}-\bar{x})+100\times 9+8100}{10}$
$2\times\sum_{i=1}^{9}(x_i-\bar{x})+2(x_{10}-\bar{x})-20(x_{10}-\bar{x})+90+810=0$
$\Rightarrow 900=20(x_{10}-\bar{x})\Rightarrow x_{10}-\bar{x}=45$

Q62:

Solution:

$I_1=\int_0^{\frac{\pi}{4}}f(\cos 2x)\cos x\,dx+\int_{\frac{\pi}{4}}^{\frac{\pi}{2}}f(\cos 2x)\cos x\,dx$
$x=\frac{\pi}{4}-t$ in the first integral and $x=\frac{\pi}{4}+t$ in the second integral,
$I_1=\int_0^{\pi/4}f(\sin 2t)\cos\left(\frac{\pi}{4}-t\right)dt+\int_0^{\pi/4}f(\sin 2t)\cos\left(\frac{\pi}{4}+t\right)dt$
$=\int_0^{\frac{\pi}{4}}f(\sin 2t)\left[\cos\left(\frac{\pi}{4}-t\right)+\cos\left(\frac{\pi}{4}+t\right)\right]dt$
$=\sqrt{2}\int_0^{\frac{\pi}{4}}f(\sin 2t)\cos t\,dt=\sqrt{2}I_2\Rightarrow\frac{I_1}{I_2}=\sqrt{2}.$

Q63:

Solution:

It is given that the lines $ax+by+p=0$ and $x\cos\alpha+y\sin\alpha=p$ are inclined at an angle $\frac{\pi}{4}$.
Therefore $\tan\frac{\pi}{4}=\frac{-\frac{a}{b}+\frac{\cos\alpha}{\sin\alpha}}{1+\frac{a\cos\alpha}{b\sin\alpha}}$
$\Rightarrow a\cos\alpha+b\sin\alpha=-a\sin\alpha+b\cos\alpha$ ..... (1)'
It is given that the lines $ax+by+p=0, x\cos\alpha+y\sin\alpha-p=0$ and $x\sin\alpha-y\cos\alpha=0$ are concurrent.
$\therefore\begin{vmatrix}a & b & p\\ \cos\alpha & \sin\alpha & -p\\ \sin\alpha & -\cos\alpha & 0\end{vmatrix}=0$
$\Rightarrow -ap\cos\alpha-bp\sin\alpha-p=0\Rightarrow -a\cos\alpha-b\sin\alpha=1$

$\Rightarrow a\cos\alpha + b\sin\alpha = -1$ ..... (2)
From (1) and (2), $-a\sin\alpha + b\cos\alpha = -1$......(3)
From (2) and (3), $(a\cos\alpha + b\sin\alpha)^2 + (-a\sin\alpha + b\cos\alpha)^2 = 2$
$\Rightarrow a^2 + b^2 = 2$

Q64:

Solution:

$$f(x) = \begin{Bmatrix} 3 & x < 1 \\ 3 & x = 1 \\ 3 - x^2 + x & x > 1 \end{Bmatrix}$$
L.L $=$ R.L $= f(1) \Rightarrow$ Cont. at $x = 1$
$$f'(x) = \begin{Bmatrix} 0, & x \leq 1 \\ -2x + 1 & x > 1 \end{Bmatrix}$$
$\text{L. D.} = 0\ \text{R. D} = -1$
$\therefore$ Not differentiable at $x = 1$
$\therefore f^{'}(x)$ is discontinuous at $x = 1$
Also $f^{'}\left(\frac{3}{2}\right) + f^{'}(0) = -2\left(\frac{3}{2}\right) + 1 + 0 = -2$

Q65:

Solution:

$T_n = \frac{(3+(n-1)\times 3)(1^2+2^2+\ldots+n^2)}{(2n+1)}$
$T_n = \frac{3n\cdot\frac{n(n+1)(2n+1)}{6}}{2n+1} = \frac{n^2(n+1)}{2}$
$S_{15} = \frac{1}{2}\sum_{n=1}^{15}\left(n^3 + n^2\right) = \frac{1}{2}\left[\left(\frac{15(15+1)}{2}\right)^2 + \frac{15\times 16\times 31}{6}\right]$
$= 7820$

Q66:

Solution:

$f'(x) = 7 - \frac{3}{4}\frac{f(x)}{x} \qquad (x > 0)$
Given $f(1) \neq 4 \qquad \lim_{x\to 0^+} xf\left(\frac{1}{x}\right) = ?$
$\frac{dy}{dx} + \frac{3}{4}\frac{y}{x} = 7$ (This is LDE)
$\text{IF} = e^{\int \frac{3}{4x}dx} = e^{\frac{3}{4}\ln|x|} = x^{\frac{3}{4}}$
$y \cdot x^{\frac{3}{4}} = \int 7 \cdot x^{\frac{3}{4}}dx$
$y \cdot x^{\frac{3}{4}} = 7 \cdot \frac{x^{\frac{7}{4}}}{\frac{7}{4}} + C$
$f(x) = 4x + C \cdot x^{-\frac{3}{4}}$
$f\left(\frac{1}{x}\right) = \frac{4}{x} + C \cdot x^{\frac{3}{4}}$
$\lim_{x\to 0^+} xf\left(\frac{1}{x}\right) = \lim_{x\to 0^+}\left(4 + C \cdot x^{\frac{7}{4}}\right) = 4$

Q67:

Solution:

$\min(y^2 - 4y + 11) = \min[(y-2)^2 + 7] = 7$
or $L = \lim_{x\to 0}[\min(y^2 - 4y + 11)\frac{\sin x}{x}]$
$= \lim_{x\to 0}\left[\frac{7\sin x}{x}\right]$
$= [a$ value slightly lesser than $7(|\sin x| < |x|$, when $x \to 0)$

$= \lim_{x\to 0}[7\frac{\sin x}{x}] = 6$

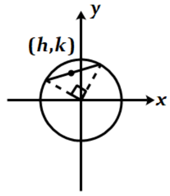
Q68:

Solution:

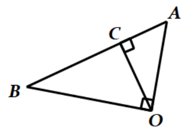
Point on the line $= (2t, 2+3t, 3+4t)$
Equating to $B(q,5,7)$ we get $t=1$ and hence $q=2$
$\therefore B=(2,5,7)$
D.R.s of AB are $=(p-1,-6,4)$
$AB \perp$ to the line $\Rightarrow (p-1)(2)+(-6)(3)+(4)(4)=0$
$\therefore p=2$ and $p-q=0$

Q69:

Solution:



Let (h,k) be the mid-point of the chord.
$\therefore$ Equation of chord can be written as $T=S_1$
$\Rightarrow hx+ky-4=h^2+k^2-4 \Rightarrow hx+ky=h^2+k^2$
$\therefore$ Distance of origin from this chord
$d=\dfrac{(h^2+k^2)}{\sqrt{h^2+k^2}}=\sqrt{h^2+k^2}$ (i)



Also, $OA=OB$
$\Rightarrow AC=OC$ (similar triangles)
$\Rightarrow AC^2+OC^2=4 \Rightarrow 2OC^2=4 \Rightarrow OC^2=2$
$\Rightarrow OC=\sqrt{2}=d$ (ii)
from (i) & (ii)
$\sqrt{h^2+k^2}=\sqrt{2} \Rightarrow h^2+k^2=2 \Rightarrow x^2+y^2=2$

Q70:

Solution:

We have $|z-(1+i)|^2=2$
$\Rightarrow (x-1)^2+(y-1)^2=2$(Put $z=x+iy$)
$\Rightarrow x^2+y^2=2(x+y)\ldots(1)$
Let $\omega=h+ik=\frac{2}{z}=\frac{2}{x+iy}=\frac{2(x-iy)}{x^2+y^2}$, so
$h=\frac{2x}{x^2+y^2}, k=\frac{-2y}{x^2+y^2}$
$\Rightarrow h-k=\frac{2(x+y)}{x^2+y^2}=1$ (from equation (1))
$\therefore$ Locus of the point $\omega(h,k)$ will be $x-y=1$

Q71:

Solution:

Let 'a' and 'd' be first term and common difference of A.P.
$\therefore a_4+a_7+a_{10}=17$
$3\mathrm{a}+18\mathrm{~d}=17$
and $a_4+a_5+\ldots+a_{14}=77$
$\therefore \mathrm{a}+8\mathrm{~d}=7$
solving (1) and (2) $a=\frac{5}{3},\ d=\frac{2}{3}$
$a+(k-1)d=13, \frac{5}{3}+(k-1)\frac{2}{3}=13$
$k=18$

Q72:

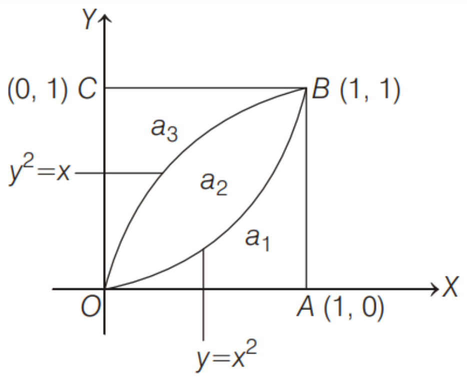
Solution:

p : probability of getting head
q : probability of getting tail
Such that, $p+q=1$
According to question we can get head in 2nd, 4th, 6th ... trail.
Hence required probability $= qp\left(1+q^2+q^4+\ldots\right)=\frac{2}{5}$
$\Rightarrow \frac{qp}{1-q^2}=\frac{2}{5}$
$\Rightarrow 5pq=2-2q^2$
$\Rightarrow 5p(1-p)=2-2(1-p)^2$
$\Rightarrow 5p-5p^2=2-2\left(1+p^2-2p\right)$
$\Rightarrow 5p-5p^2=2-2-2p^2+4p$
$\Rightarrow 3p^2=p$
$\Rightarrow p(3p-1)=0$
$\Rightarrow p=0,\ p=\frac{1}{3}$
$\because p \neq 0$
$\therefore p=\frac{1}{3}$
$\Rightarrow 9p=3$

Q73:

Solution:

$\because a_1+a_2+a_3=1$ ...(i)
and due to symmetry $a_1=a_3$ ...(ii)
$a_2=\int_0^1\left(\sqrt{x}-x^2\right)dx$
Now, $=\left[\frac{2}{3}x^{3/2}-\frac{x^3}{3}\right]_0^1=\frac{2}{3}-\frac{1}{3}=\frac{1}{3}$



So, $a_1+a_3+\frac{1}{3}=1$
$\Rightarrow a_1+a_3=\frac{2}{3}$ ..(iii)
From Eqs. (ii) and (iii),
$a_1=a_3=\frac{1}{3}=a_2$
So, $a_1+2a_2+3a_3=\frac{1}{3}+\frac{2}{3}+\frac{3}{3}=2$

Q74:

Solution:

$\operatorname{Tr}(A)=16, \operatorname{Det}(A)=-17$
$a+d=16$ and ad $-bc=-17$
Given $a<b<c<d$

$(a, d) = (1, 15)(2, 14)(3, 13)(4, 12)(5, 11)(6, 10)(7, 9)$
$bc = ad + 17 = 32, 45, 56, 65, 72, 77, 80$
$(b, c) = (4, 8)(5, 9)(7, 8)(5, 13)(8, 9)(7, 11)(8, 10)$
$(a, b, c, d) = (1, 4, 8, 15)(2, 5, 9, 14)(3, 7, 8, 13)$
$(4, 5, 13, 12)(5, 8, 9, 11)(6, 7, 11, 10)(7, 8, 10, 9)$
Possible values are $(2, 5, 9, 14)(3, 7, 8, 13)(5, 8, 9, 11)$
Exactly two of a, b, c, d are prime and pair wise also coprime
Case-1: $(2, 5, 9, 14)$2 primes but pair wise not coprime
Case-2 : $(3, 7, 8, 13)$3 primes and pair wise coprime (given exactly two are primes)
Case-2 : $(5, 8, 9, 11)$2 primes and pair wise coprime
Only possible answer is $(5, 8, 9, 11)$
$|B| = bd - ac = 88 - 45 = 43$

Q75:

Solution:

$(k+1)\tan^2 x - \sqrt{2}\lambda\ \tan x + (k-1) = 0$
$\tan\alpha + \tan\beta = \frac{\sqrt{2}\lambda}{k+1}$
$\tan\alpha\tan\beta = \frac{k-1}{k+1}$
$\tan(\alpha+\beta) = \frac{\frac{\sqrt{2}\lambda}{k+1}}{1-\frac{k-1}{k+1}} = \frac{\sqrt{2}\lambda}{2} = \frac{\lambda}{\sqrt{2}}$
$\tan^2(\alpha+\beta) = \frac{\lambda^2}{2} = 50$
$\lambda = 10$