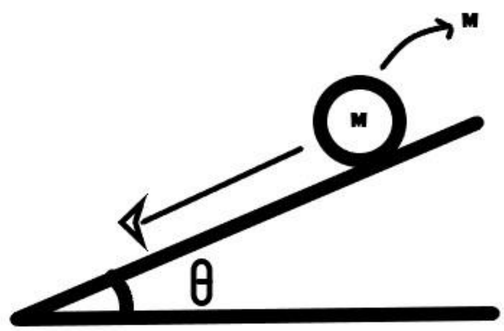
Physics

1. (A),(D)



Case A

Since the liquid is frictionless, it doesn’t rotate

So we have 2 mgsin θ-f= 2ma

$F*R=(2/3)mR^2$

Solving these 2 equations we get a=(3/4) gsin θ

For kinetic energy

$½*2mv^2+ ½* (2/3)*mR^{2} *(v/R)^2$

We get $KE=(4/3)mv^{2}$

CASE B

After the liquid is frozen, it acts as a rigid body.

So we have 2 mgsin θ-f=2ma

$F*R=(2/5)*2mR^{2}*(a/R)^2$

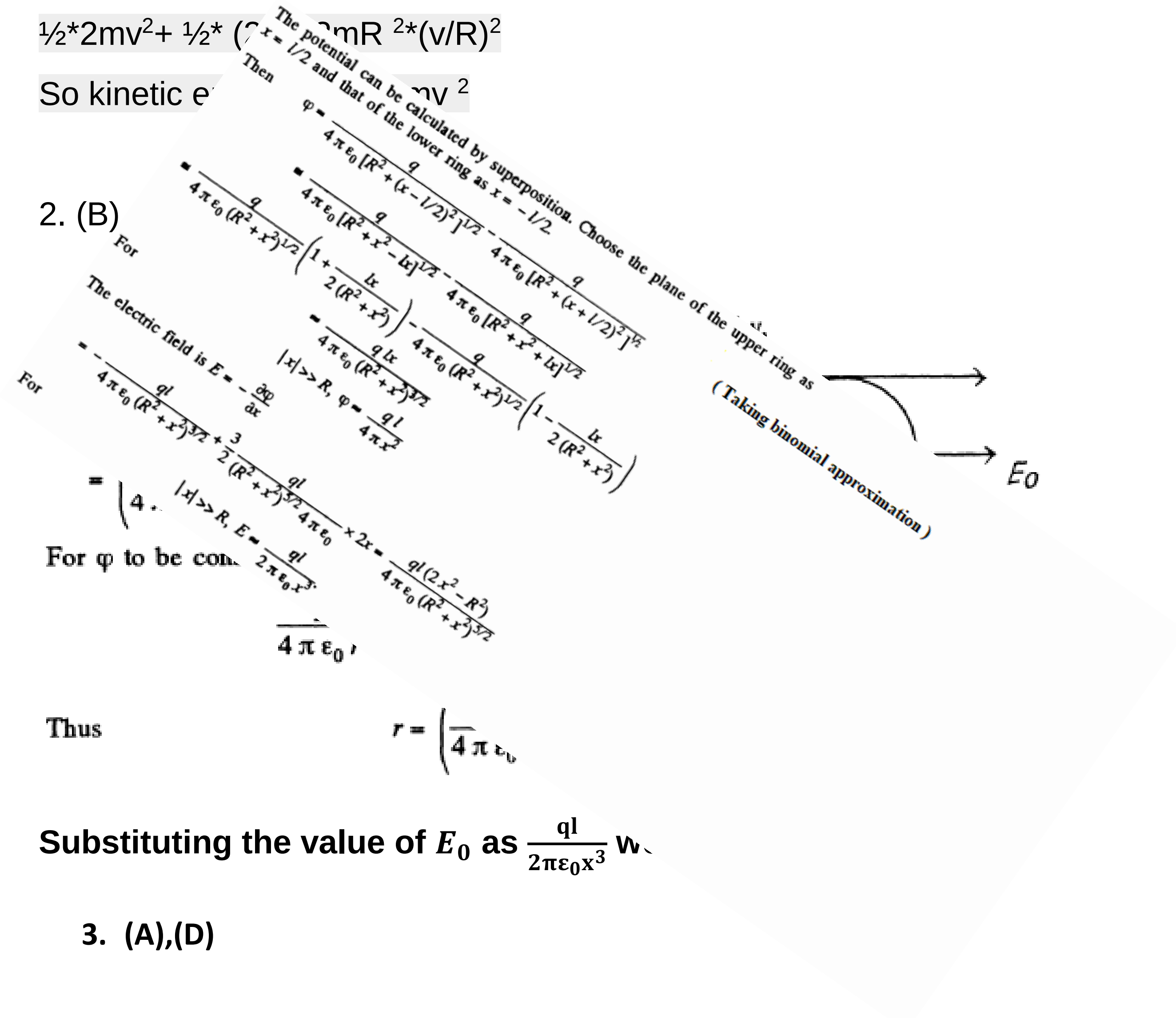
Solving these 2 equations we get $a=(5/7)mR^{2}$

For kinetic energy

½*2mv^2+ ½* (2... mR ^{2}*(v/R)^2

So kinetic e... mv ^{2}

2. (B)


The potential can be calculated by superposition. Choose the plane of the upper ring as $x = l/2$ and that of the lower ring as $x = -l/2$.

Then

$$\varphi = \frac{q}{4\pi\varepsilon_0[R^2+(x-l/2)^2]^{1/2}} - \frac{q}{4\pi\varepsilon_0[R^2+(x+l/2)^2]^{1/2}}$$

$$= \frac{q}{4\pi\varepsilon_0[R^2+x^2-lx]^{1/2}} - \frac{q}{4\pi\varepsilon_0[R^2+x^2+lx]^{1/2}}$$

$$= \frac{q}{4\pi\varepsilon_0(R^2+x^2)^{1/2}}\left(1+\frac{lx}{2(R^2+x^2)}\right) - \frac{q}{4\pi\varepsilon_0(R^2+x^2)^{1/2}}\left(1-\frac{lx}{2(R^2+x^2)}\right)$$ (Taking binomial approximation)

$$= \frac{qlx}{4\pi\varepsilon_0(R^2+x^2)^{3/2}}$$

For $|x|>>R$, $\varphi = \frac{ql}{4\pi x^2}$

The electric field is $E = -\frac{d\varphi}{dx}$

$$= -\frac{ql}{4\pi\varepsilon_0(R^2+x^2)^{3/2}} + \frac{3}{2}\frac{ql}{(R^2+x^2)^{5/2}4\pi\varepsilon_0}\times 2x = \frac{ql(2x^2-R^2)}{4\pi\varepsilon_0(R^2+x^2)^{5/2}}$$

For $|x|>>R$, $E = \frac{ql}{2\pi\varepsilon_0 x^3}$.

= (4...

For φ to be con...

$4\pi\varepsilon_0$...

Thus $r = (4\pi\varepsilon_0$...

Substituting the value of E_0 as $\frac{ql}{2\pi\varepsilon_0 x^3}$ w...

3. **(A),(D)**

A. From the free body diagram of the arrangement ,

(P - P_{atm})A_u = (P - P_{atm})A_l + m_{piston}g.

Rearranging, we get:

P_g = P_{atm} + $\frac{m_{piston}g}{A_u - A_l}$ - - - - (1)

Susbstituting the known values, we get the difference in area of the upper and lower pistons, **A_u – A_l = 10 cm^2**

From equation 1, it is clear that P_g is constant throughout the process.

Work done on the piston is due to the gravitational force.

B. $\mathbf{W_{piston}} = - m_{piston}g(h_2\text{-}h_1) = - (5 \times 10 \times 0.25) = \mathbf{-12.5\ J}$

C. $\mathbf{W_{atm}} = P_{atm}\,\Delta V = -P_{atm}(A_u - A_l)(h_2 - h_1) = \mathbf{-25\ J}$

D. Since the process is infinitesimally slow , $\Delta KE = 0$.

So the total work done on the system is 0.

$W_{gas} + W_{atm} + W_{piston} = 0$

So, $W_{gas} = 37.5$ J

4. (B) (C)

First we have to find z and n for the given atom

Orbital angular momentum in the n^{th} shell is $nh/2\pi$. So comparing we get n=4

Now de-Broglie wavelength =h/p or h/mv

$mvr = nh/2\pi$

$mv=nh/2\pi r$ where $r= a_o n^2/z$

Substituting in λ

$4\pi a_o=2\pi a_o n/z$

Put n=4 we get z=2

For de-excitation

$1/\lambda = Rz^2[1/n_2^2 - 1/n_1^2]$ where $n_1=4$ and $n_2= 3,2,1$

Substituting we get 36/7R for $n_2= 3$

$4/3R$ for $n_2 = 2$ and $4/15R$ $n_2 = 1$

5. (A), (B), (D)

Curvature → $1/r$

When liquid droplets coalesce, the flow is initially controlled by a balance between surface tension and viscosity

6. (A)

$u = -(2f - f/3)$

$= -5f/3$

$1/(-f) = 1/v + 3/(-5f)$

$1/v = 3/5f - 1/f = -2/5f$

$v = -5f/2$

$I = f/2$

SECTION 2

SINGLE DIGIT INTEGER

7) 5

First find g at surface of planet

$g_p' / g_p = R^2/(R+2R)^2$

$9\, g_p' = g_p$

$g_e' = g_e(1-d/r)$ [Put d=r/2]

$g_e' = g_e/2$

$g_e' = g_p'$

$(9/2)g_e = g_p$

$g_p = 9 \times 10/2 = 45$

Now the force acting on rod

$dF = dmg'$ $g' = gx/R$(where x is distance from centre)

$= \mu dxgx/R$

$F = \int_{2R/3}^{R} \mu x dx 45/R$

$= (45\mu[x^2]_{2R/3}^{R})/2R$

$= 45\mu[R^2 - 4R^2/9]/2R$

$= 25\mu R/2$ (Put $\mu=2$)

$= 25R$

$N^2 = 25$

$N = 5$

8) 2

Consider angular momentum of the door about the hinges.

$dL = \tau\, dt$

$L_{final} – L_{initial} = -\int_{ti}^{tf} \tau\, dt$

But $L_{final} = 0$ and $\tau = -F_d\, x$

$I\omega_0 = x \int_{ti}^{tf} F_d\, dt$

Consider the linear momentum of the centre of mass. Just before the collision, momentum is only along the y direction and M**vy** = ML ω0 /2

$P_{Final} – P_{initial} = \int F_y\, dt$

Where **Fy** is the net force in the y direction.

Fy = **F’** + **Fd** and **Pfinal** = 0

So, $ML\omega_0/2 = \int \mathbf{F'}\, dt + \int \mathbf{Fd}\, dt$

$ML\omega_0/2 = \int \mathbf{F'}\, dt + I\omega_0/x$

$\int \mathbf{F'}\, dt = \omega_0(ML/2 - I/x)$

So the impact force at the hinge is zero, if $x = 2I/ML$

For a door hinged at one end, $I = ML^2/3$

So $x = 2L/3$

9) 2

Assume that at time t, only x length remains on the horizontal tube. Then the pulling force on the rest of the chain is given by

$F=M*(h/l)*g$

So $a= (M*(h/l)*g)/(M*(x+h)/l)=hg/(x+h)$

$-v(dv/dx)=hg/(x+h)$

$-\int vdv=\int hgdx/(x+h)$

Here v varies from 0 t*o v and x* varies from l-h to 0

$v^2/2=hg\ln(l/h)$

$v^2=2hg\ln(l/h)$

So kinetic energy=$k=(1/2)*m*v^2$

$k=mhg\ln(l/h)$

substituting values of m,h and l we get k=ln2

so $e^k=2$

10) **8**

In our system, resistance of the medium $R = \frac{\rho}{4\pi}\left[\frac{1}{a}-\frac{1}{b}\right]$,

where ρ is the resistivity of the medium

The current $$i = \frac{\varphi}{R} = \frac{\varphi}{\frac{\rho}{4\pi}\left[\frac{1}{a}-\frac{1}{b}\right]}$$

Also, $i = \frac{-dq}{dt} = -\frac{d(C\varphi)}{dt} = -C\frac{d\varphi}{dt}$, as capacitance is constant.

So, equating (1) and (2) we get,

$$\frac{\varphi}{\frac{\rho}{4\pi}\left[\frac{1}{a}-\frac{1}{b}\right]} = -C\frac{d\varphi}{dt}$$

or,

$$-\int\frac{d\varphi}{\varphi} = \frac{\Delta t}{\frac{C\rho}{4\pi}\left[\frac{1}{a}-\frac{1}{b}\right]}$$

or,

$$\text{in}\ \eta = \frac{\Delta t\, 4\pi ab}{C\rho(b-a)}$$

Hence, resistivity of the medium,

$$\rho = \frac{4\pi\Delta t\, ab}{C(b-a)\ln\eta}$$

11. **7**

P_1=200kPa

P_2=500kPa

$P_1=P_{atm}+k\Delta x_1/A$

$P_2=P_{atm}+k\Delta x_2/A$

$P_2-P_1=300\text{kPa}=3\times10^5\text{Pa}$

$P_2-P_1=k(\Delta x_2-\Delta x_1)/A=k(\Delta V_2-\Delta V_1)/A^2$,

Where $\Delta V_1=V_1-V_0$ and $\Delta V_2=V_2-V_0$, where V_0 is the volume of the system when the spring is uncompressed.

Therefore, $k/A^2=(P_2-P_1)/(\Delta V_2-\Delta V_1) =30000/(V_2-V_1)=3\times10^7\text{N/m}^5$

At any instant, $P=P_{atm}+P_{piston}+k\Delta x/A$, or

$P-P_1=3\times10^7\times(V-V_1)$, where V is the volume at that instant.

Thus, $P=200000+3\times10^7\times(V-0.01)$

Work done by the air during expansion,

$\int PdV=2\times10^5\times0.01+3\times10^7\times(0.02\times0.02/2-0.01\times0.01/2)-(3\times10^7\times0.01\times0.01)$

$=2000+4500-3000=\underline{3500\text{J}}$

Therefore, the answer is 7

12. 8

Since the electric field in the x direction must not depend on the value of the electric flux associated with the two surfaces perpendicular to the x direction cancels out each other. A similar argument follows for the y direction as well.

Hence only the z component of the electric field provides flux.

z component of the electric field is:

$\mathbf{E}_z = E_0\, z\, \check{\mathbf{k}}$

Therefore, flux entering the cube (z=0) is zero, since the field is 0 at that surface.

Flux leaving the cube (z = +a) = $E_0\, a \times a^2\, \check{\mathbf{k}} = E_0\, a^3$

Using Gauss' theorem $\varphi = \frac{q_{net}}{\varepsilon_0}$

Therefore, $q_{net} = \varphi\, \varepsilon_0 = \varepsilon_0\, E_0\, a^3$

So, x = 8

13. 4

Let the intensity of the source be I_o, then intensity at any point with phase difference $\Delta\theta$ will $I=4I_o\cos^2(\Delta\theta/2)$. Hence initial intensity at P is $4I_o$

At P with the glass slabs inserted
$\frac{3}{4}\times 4I_o = 4I_o\cos^2(\Delta\theta/2)$
$\Rightarrow \Delta\theta=2n\pi \pm (\pi/3)$ also $\Delta\theta= (2\pi/\lambda)\, \Delta x$

Hence $\Delta x= \lambda(n \pm (1/6))$, from the data about the 8th maxima and 9th minima we get
$8\lambda < \Delta x < [(2\times 9) - 1]\, \lambda/2$
$\Rightarrow 8\lambda < \lambda(n \pm (1/6)) < [(2\times 9) - 1]\, \lambda/2$
The only value of n satisfying the above condition is n=8 and $\Delta x= \lambda(8 + (1/6))=49\, \lambda/6$

Let μ_2 be the refractive index of the lower glass slab with respect to vacuum then 1.2= $\mu_2/(4/3)$
⇒ $\mu_2=1.6$
Considering the two glass slabs $\Delta x=t(\mu_1-1)-t(\mu_2-1)$
Hence $\Delta x=t(\mu_1-\mu_2)$
49 $\lambda/6 = t\ (2.3-1.6)$

$\Rightarrow t=7\times10^{-6}$

k=7 and so k-3=4

14. 5

An ion of charge q will pick up kinetic energy, $\Delta KE = qV$ in dropping through a P.D of V volts.

In a magnetic induction B perpendicular to its path, the ion of momentum p will describe a circular path of radius r given by

$p = qBr = \sqrt{2M\ \Delta KE} = \sqrt{2MqV}$

$M = qB^2r^2/2V$

For the first ion, $q = 1.6 \times 10^{-19}$ C, B = 0.08 T, r = 0.0883 m and V = 400 V. Substituting these values in we get $m1 = 9.98 \times 10^{-27}$ kg

The mass of this ion is then $\frac{(9.98 \times 10{-}27\ kg)}{1.66 \times 10{-}27\ kg/amu}$ = 6.012 amu, Therefore the mass number is 6.

For the second ion, the only change is the radius of the orbit which is 0.0954 m. The mass of the second ion is $m2 = m1 \times (r_2/r)^2 = 6.012 \times (0.11954/0.08832)^2 = 11.0135$ amu. Therefore, the mass number is 11.

Difference is 11-6=5

SECTION 3- PASSAGE

Passage 1

15) B **16) B** **17) C**

$F = k\Delta x = k\left(\sqrt{l^2 + x^2} - l\right)$

F=2FCosΘ

$F_r = 2k\left(\sqrt{l^2 + x^2} - l\right)$

$x \lll l;$

$F_r = 2kl((1 + x^2/l^2)^{1/2} - 1)\, {}^{x}\!/_{l}$

$F_r = 2kx(1 + x^2/l^2 - 1)$

$F_r = {}^{2kx^3}\!/_{2l^2} = {}^{kx^3}\!/_{l^2}$

$a = {}^{-kx^3}\!/_{ml^2} \Rightarrow w^2 = {}^{k}\!/_{ml^2}$

$w = \left(\sqrt{{}^{k}\!/_{ml^2}}\right)$

To find energy formulation:

$Exte = \left(\sqrt{l^2 + x^2} - x\right)$

$E = 2 \times \frac{1}{2}k\,(\Delta l)^2$ 2 springs

$E = k\left(\sqrt{l^2 + x^2} - l\right)^2$

$E = kl^2((1 + x^2/l^2)^{1/2} - 1)^2$

$E = kl^2(1 + x^2/2l^2 - 1)^2$

$E = {}^{kl^2x^4}\!/_{4l^4} = {}^{kx^4}\!/_{4l^2} = {}^{kA^4}\!/_{4l^2}$

$E_{T/4} = {}^{2kA^4}\!/_{4l^2}$

$E_{(T/4)_n} = {}^{2^n kA^4}\!/_{4l^2}$

$but\ E = {2kA^4}/{4l^2} = {2^n kA^4}/{4l^2}$

$\Rightarrow 2^n = 8 \Rightarrow n = 3$

3 movements to $pos^n \Rightarrow {5T}/{4} \Rightarrow B$

$E_n = {2^n k{A_i}^4}/{4l^2}$

$EA_n = {k{A_o}^4}/{4l^2}$

$E(A) = E_n$

$\Rightarrow {2^n kA^4}/{4l^2} = {k{A_o}^4}/{4l^2}$

$\Rightarrow 2^n {A_i}^4 = {A_i}^4$

$\Rightarrow A_n = A_i 2^{n/4}$

Passage 2

18) C 19) B 20) D

The circuit is inductive when X_L dominates X_c
Therefore it is inductive at point C

R_1=100 Ω X_L= 100
Z=100√2 θ=π/4
I=100 sin 100t

V=IZ
=√2*10^4 sin (100t + π/4)

V across R $=10^4 \sin 100t$
V across L$= 10^4 \sin(100t + \pi/2)$

Since inductors are similar, voltage across the two coils are similar
No of turns in primary coil = No of turns in secondary coil

V in circuit 2$=10^4 \sin(100t + \pi/2 \pm \pi)$
I in circuit 2$=10^4 \sin(100t + \pi/2 \pm \pi)$ [R=1 Ώ]

Chemistry

21. [A,C,D]

$x_A P^0_A + x_B P^0_B = 700$ .....(i)

$x''_A P^0_A + x''_B P^0_B = 0.30 P^0_A + 0.70 P^0_B = 600$ ....(ii)

If moles of A & B initially are x & y then

$x = 0.75 x(2/3)(x+y) + 0.30 x(1/3)(x+y)$

& $x_A = x/(x+y)$ or $x_B = y/(x+y)$

Solving gives

$x_A=0.6$, $x_B=0.4$, $P^0_A = 2500/3$ torr & $P^0_B = 500$ torr.

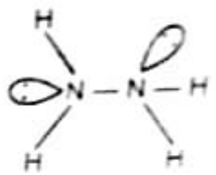
22.[B]

23. [A,B]

$$r_B = \frac{dC_B}{dt} = \frac{1}{V}\frac{dn_B}{dt} = \frac{1}{V}\frac{d(C_B V)}{dt} = \frac{V}{V}\frac{dC_B}{dt} + \frac{C_B}{V} = \frac{dC_B}{dt} + \frac{C_B}{V}\frac{dV}{dt}.$$

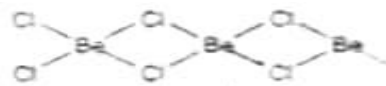
24. [B,C,D]

(A) Structure is similar to ethane. Each N atom is tetrahedrally surrounded by 1 N, 2 H & a lone pair. The two halves of the molecule are rotated 95^0 about N-N bond and occupy a gauche(non eclipsed) conformation.The bond length is 0.145nm .



(B)Has partial double bond character due to $p\pi$-$d\pi$ delocalisation.

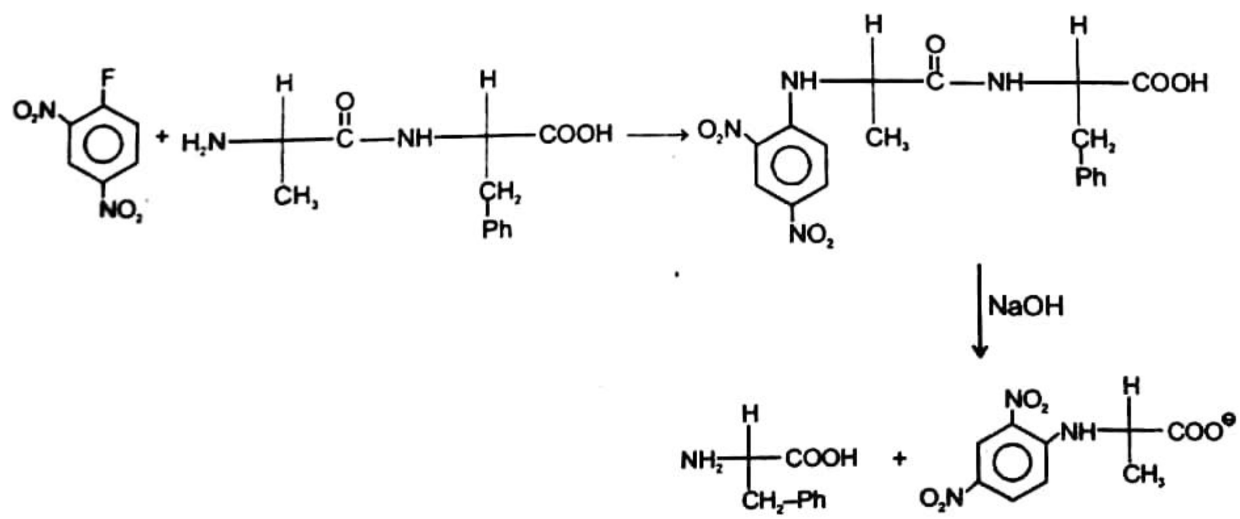
(C)OF_2 =103^0(approx.) and OCl_2 =112^0(approx.).

(D)Exist in polymeric structure as  in solid state.

25. [C]

THF is used as solvent, oxide layer MgO is formed on Mg , so it's not reactive to organic halides. Value of x is 3.

26. [B,D]



27. [1]

Dissolved $[Zn(OH)_2]$ = $[Zn^{+2}]_{aq}$ + $[Zn(OH)_2]^{+}_{aq}$ + $[Zn(OH)_2]_{aq}$ + $[Zn(OH)_3]^{-}$ + $[Zn(OH)_4]^{2-}$.

Now, $[Zn(OH)_2]_{aq} = 10^{-6}$M in saturated solution.

So, $[Zn(OH)]^{+} = 10^{-6} \times 10^{-7}/[OH^{-}] = 10^{-13}/[OH^{-}]$

Similarly, $[Zn^{+2}] = 10^{-17}/[OH^{-}]^2$,

$[Zn(OH)_3]^{-} = 10^{-3}[OH^{-}]$

$[Zn(OH)_4]^{2-} = K_5[Zn(OH)_3]^-$

$[OH^-] \quad = (10^{-2}M^{-1})[OH^-]^2$

Dissolved $Zn(OH)_2 = 10^{-17}/[OH^-]^2 + 10^{-13}/[OH^-] + 10^{-6} + 10^{-3}x[OH^-] + 10^{-2}x[OH^-]^2$

$= 10^{-17}/10^{-16} + 10^{-13}/10^{-8} + 10^{-6} + 10^{-3}x10^{-8} + 10^{-18}$

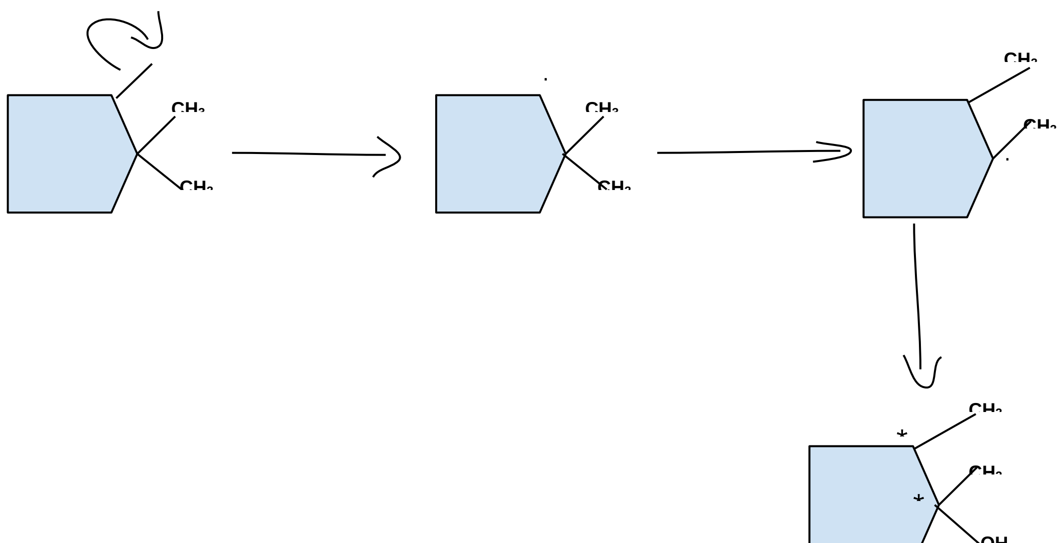
$= 10^{-1} + 10^{-5} + 10^{-6} + 10^{-11} = 10^{-1}$

$= -\log Zn(OH)_2\ (aq) = 1$

28. [5]

Sb_2S_3, SnS_2, As_2S_5, Bi_2S_3, FeS_2 .

29. [4]



S.I $= 2^2 = 4$

30. [6]

$ClO_3^- + 2H_2 + 4e^- \longrightarrow ClO^- + 4OH^-$; ΔG_1^o

$ClO^- + H_2O + e^- \longrightarrow \frac{1}{2} Cl_2 + 2OH^-$; ΔG_2^o

$\frac{1}{2} Cl_2 + e^- \longrightarrow Cl^-$; ΔG_3^o

———————————————————————————

$ClO_3^- + 3H_2O + 3e^- \longrightarrow Cl^- + 6OH^-$; ΔG^o

———————————————————————————

$\therefore \Delta G^o = \Delta G_1^o + \Delta G_2^o + \Delta G_3^o$

$-6FE^o = -4F \times 0.54 - 1F \times 0.45 - 1F \times 1.07$

$\therefore E^o = +3.68/6 = +0.61V$

$\therefore 10xE^o = 6V$

31. [6]

$C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6 + C_6H_{12}O_6$

mol	0.0125	0	0
	0.0125-x	x	x

$\Delta T_b = m_1K_b + m_2K_b + m_3K_b$

$m_1 + m_2 + m_3 = 0.104/0.52 = 0.2$

$((0.125-x+x+x)/(100)) \times 100 = 60$

x=0.0075

mol% = (0.0075/0.0125) x 100 =60

$(1/10)^{th}$ of mol% = 60/10 = 6

32. [6]

H_3PO_2 : P=O $H_2S_4O_6$: S=O XeO_4: Xe=O $XeOF_4$: Xe=O

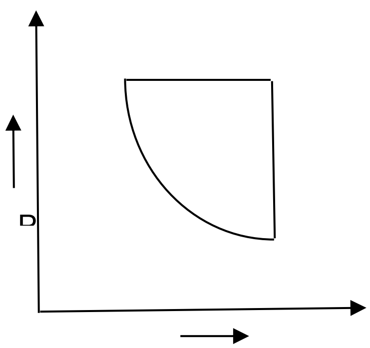
$Fe(CO)_5$: Metal carbonyls have d orbitals of metal in **π** bonding.

ClO_2 : Cl=O

33. [9] a=5 , b=2 , c=2 , d=0

34. [9]

The process can be described on a P-V diagram as



At 1 : P = 10 atm T = 400K $V = V_1$

At 2: P = 10 atm T = 800K $V = V_2 = 2V_1$

At 3: P = ? $T = T_3$ $V = V_3 = V_2 = 2V_1$

Therefore, $W_{12} = -P\Delta V = -nRT = -400R$

$W_{23} = 0$ [Since $\Delta V = 0$]

Between 3 & 1, $TV\gamma - 1$ = Constant

$T_3 \times (2V_1)\gamma - 1 = 400\ (V_1)\gamma - 1$

$T_3 = 400 \times (1/2)^{2/3} = 252K$

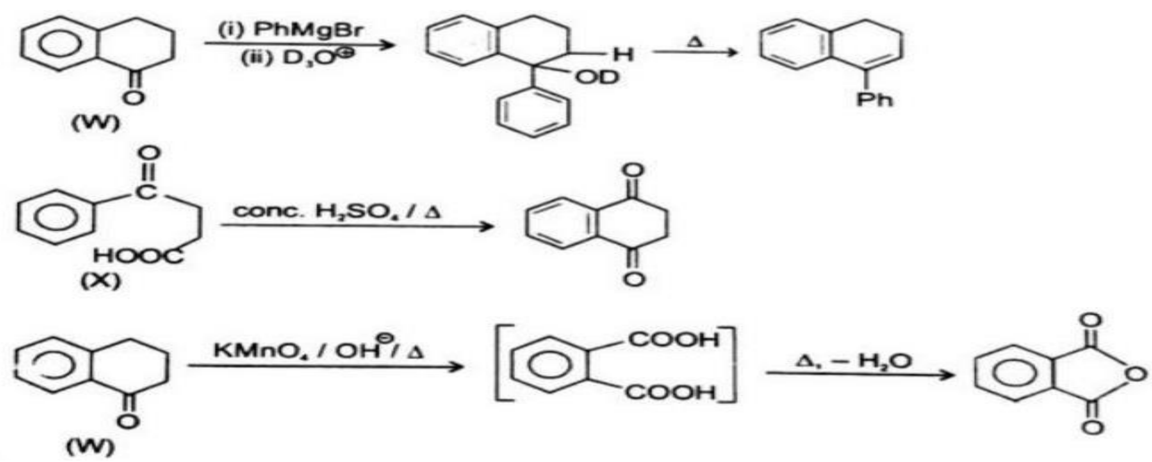
$W_{31} = \Delta U_{31} = nC_v(T_1 - T_3) = 3/2\ R\ (400-252) = 222R$

$W_{12-31} = W_{12} + W_{23} + W_{31} = -178\ R$

35. [C]

36. [C]

37. [D]



38. [A]

$2\ K_2MnF_6 + 4\ SbF_5 \rightarrow 4\ K[SbF_6] + 2\ MnF_3 + F_2$

39. [D]

(A) XeF_2

(B) $24\ XeF_2 + (B)\ S_8 \rightarrow 24\ Xe + 8SF_6$

(C) $XeF_2 + SbF_5 \rightarrow [XeF]^+[SbF_6]^-$

40. [B]

(A) F_2 gives O_2 gas (C) H_2O_2 in acidic medium form CrO_5 not O_3

(B) $KI + 3O_3 \rightarrow KIO_3 + 3O_2$

$XeF_2 \xrightarrow{H_2} Xe + 2HF$

(A) (B) (C)

$XeF_2 + H_2O \xrightarrow{H_2} Xe + HF + O_2$

(B) (C) (D)

$3O_2 \rightleftharpoons 2O_3$; $5O_3 + 2KOH \rightarrow 2KO_3$(orange solid) $+ 5O_2 + H_2O$

(D) (E)

$HF + KF \rightarrow KHF_2$ (molten) $\longrightarrow F_2$

(C) (G)

Mathematics

41.
Sol: A

The solution becomes $x(t) = 5e^{-\frac{\gamma t}{2}}\cos(iw't)$

We know that cos(x)= $\dfrac{e^{ix}+e^{-ix}}{2}$

Hence cos(iw't) = cosh(w't)

42.
Sol: A,B,D

$$I=\int_{-1}^{1}\frac{x^2e^x}{x^4+\cos^2 x}\mathrm{d}x$$

$$I=\int_{-1}^{1}\frac{x^2e^{-x}}{x^4+\cos^2 x}\mathrm{d}x;\ \textit{property of integral}$$

Adding them, we get

$$I=\int_{-1}^{1}\frac{x^2\left(e^x+e^{-x}\right)}{2\left(x^4+\cos^2 x\right)}\mathrm{d}x$$

$$I\geq\int_{-1}^{1}\frac{x^2\cos(x)}{\left(x^2+1\right)}\mathrm{d}x;\ \left(\textit{compare the expansions of } \cos(x)\ \textit{and}\left(e^x+e^{-x}\right)\right)$$

Since $x^2\leq\tan^2 x$, *we have option A*

$$I\geq\int_{-1}^{1}x^2\cos^3(x)\,\mathrm{d}x=2\int_{0}^{1}x^2\cos^3(x)$$

Since $x\geq\sin x$ *in* $(0,1)$, *we have option B*

$$I=\int_{-1}^{1}\frac{x^2e^x}{x^4+\cos^2 x}\mathrm{d}x,\ \textit{implies that}$$

$$I\geq\frac{1}{e}\int_{-1}^{1}\frac{x^2}{\left(x^2+1\right)}\mathrm{d}x=\frac{\left(2-\frac{pi}{2}\right)}{e}$$

hence option D

43.
ANS a,c
Solution :

$x/p + y/q + z/r = 1+i$
On squaring, we get
$(x/p)^2 + (y/p)^2 + (z/r)^2 + 2\ xyz[\ p/x + q/y + r/z\ ]/pqr = 1-1+2i$
$\Rightarrow (x/p)^2 + (y/q)^2 + (z/r)^2 = 2i$

Now let x/p =a and y/q = b and z/r = c

$a^3 - b^3 / a^2 - b^2 = (a - b)(a^2 + b^2 + ab) / (a - b)(a + b)$
$= a^2 + b^2 + ab / a + b$
$= (a + b)^2 - ab / a + b$
$= a + b - ab/(a+b)$ -> (1)

Now 1/a + 1/b+ 1/c = 0 (given)

Therefore c = -ab/(a+b)

Substituting in (1) we get ,

A+b+c which is 1+i given in the question .

44.

ANS : b,c
Solution :
R1 = /(s-a) (radius of excircle)
On substituting the values in the equation we get ,
S - a = 125
S - b = 25
S - c = 5
On adding all three of them we get ,
3s - 2s = 155
s=155
Therefore perimeter = 2s = 310.
We got the value for s . Now using the above relation ,
a=30 b=130 c=150

Next equation of altitude = 2/a

On substituting the values

We get the 3 altitude values .

45.

ANS : a,c

A person can make a number as much as the coefficient of $x + x^2 + x^3 \ldots\ldots + x^{10}$

Therefore 3 can make $(x + x^2 \ldots\ldots +x^{10})^3$

So the required sum will be the coefficient of x^{n-3} in $(1-x^{10})^3(1-x)^{-3}$

46.

Ans:(b),(c)

Since variable x is present at exactly two positions in each of the matrices,the maximum power of x in D(x) is x^2.

Let $D(x)=ax^2+bx+c$

Using any three of the given values of D(x),we get ,

$D(x)=2x^2+5x-2$

Integer type

47. 0.25

Substitute-

n.exp(n)=cos(y)

sin(y)=k

ln(k)=x

48. 6

$y^2 = 4x$ $(t^2 ,2t)$

$2ym = 4$

$m = 1/t$

M(normal) = $-1/m$

$y- 2t = -t (x-t^2)$

=> $t^3+ (-x+2) t - y=0$

Slope $-t_1 = -t_2 = -2$

$t_1 = t_2 = 2$

$t^3 + (-x+2)t - y \div (t^2 - 4t +4.)$

$(-x + 14)t - y - 16$ is the remainder .
But it has to be 0 for the divident to be a perfect multiple of divisor. So on equating $x=14$ $y= -16$

Therefore $3|x+y| = 6$

49. 2

The coordinate of B is of the type (3,k) , as angle A is 900
Also BC perpendicular to DE.
So equation of BC is of the type $3y = x + c$
AS C satisfies the line we get $c = 3$.
Therefore substituting B in equation $3y = x + 3$ gives
$K = 2$.
Now equation of AC is $y = 3$.
So point E is of the form (h,3)
Substituting E in equation $y + 3x = 7$,
We get $h = 4/3$
Since B and E substends 900 on the circumference of the circle , BE is diameter of the circle .
So by using diameter formula ,
$(x-3)(x - 4/3) + (y-2)(y-3) = 0$
$X2 + y2 - 7/3x - 5y + 10 = 0$

50. 9

Property of conics distance from the focus = e times the distance between point and the directrix $x = a/e$.
So distances are $a - ex$ and $a + ex$.
So $a + ex = 2(a - ex)$
$= x = a/3e$
$e = 3/5$.
So $x = 25/9$.
$y = 814/9$
So on differentiating the equation of ellipse and substituting the points we get the corresponding slope . With the slope and points we are able to find the equation of tangent .

M = -2/7

Y- 814/9 = - 2/7(x - 25/9)

Putting y= 0 we get ,

X = 9

51. 3

L=lim1/x0((1+(1/x))/(1-(1/x))1/(1/x)-e2)x2

Replace 1/x with h.

L=limh0 ((1+h)/(1-h))1/h-e2)/h2

Use (1+x)1/x=e(1-x/2 + 11x2/24

L=limh0 (e2(1-h/2+11h2/24-...)(1+h/2+11h2/24+....)-e2) /h2

L=limh0(e2 (1 - h2 /4+22h2 /24)-e2)/h2

L=limh0 e2 (2h2 /3)/h2

L=2e2 /3

52. 1.00

The area is given by the following integral

4 ,0-ln2-,2,e-−x .−1.dx=4(1−ln2) .

- ⇨ A = 4
- ⇨ Therefore A/4 = 1.00

53. 3.46

We have ,|x−1|-1.=,,y−2.-2. = ,|z−3|-3.

,x−1-1.=,y−2-2. = ,z−3-3.

,x−1-−1.=,y−2-2. = ,z−3-3.

,x−2-1.=,y−2-−2. = ,z−3-3.

,x−1-1.=,y−2-2. = ,z−3-−3.

Intersection points with plane x+y+z= 18

Are (3,6,9) , (-2,8,12) , (7,-10,21)

Therefore area S = 36,-3.

Taking ,-3 .=1.73

S/18 = 3.46

54. 5.

Let (a,,a-2.) be any point on the curve,

Slope of tangent =m=,,a-2.+1-a−t.

Slope of tangent at ‘a’ = 2a =m

Two values of a are c&d

c=t−,-1+,t-2..

d=t+,-1+,t-2..

Area enclosed ,c-d-,(x-2.+1).dx – 2,(1+,t-2.)-,3-2.. = ,2-3.,(1+,t-2.)-,3-2..

The given function is minimum at t=,1-,-5..

Comprehension:

I:

(55)d (56)c (57)b

General Property:The circles defined in the above question passes through the foci of the respective ellipses.Therefore T_1 ,T_2 are foci of E_1 and T_3 ,T_4 are foci of E_2 .Then Quadrilateral specified in problem is a rhombus.

(1)Rhombus has area $T_1 T_2$ X $T_3 T_4$ /2.

(3)T_1 =(3,0) T_2 =(0,4)

$T_1 T_2$ =19

Equation of the tangent to the ellipse is:

,x-a.,cos-θ.+ ,y-b.,sin-θ.=1

,x-3.,cos-θ.+ ,y-5.,sin-θ.=1

Slope, m=4=− ,5-3.,cot-θ.

,cot-θ.=−,12-5.

Solving for sin Θ and cos Θ, the equation of the tangent becomes,

4x – y = 13

To find the intersection points R and S, put y = -5 and y = 5,to get

R = (2,-5) and S = (,9-2.,5)

So the length RS = ,-,(2−,9-2.)-2.+,(5+5)-2..= ,5,-17.-2.

II.

58.B 59.C 60.B

6=0(2)+6(1)=1(2)+4(1)=2(2)+2(1)=3(2)+0(1)

No of 2s	No of 1s	No of permutations
0	6	1
1	4	5!4!=5
2	2	4!2!2!=6
3	0	3!3!=1
		Total =13

f(6)=13

Now,
f(f(6))=f(13)

No of 1s	No of 2s	No of permutations
13	0	1
11	1	12
9	2	55
7	3	120
5	4	126
3	5	56
1	6	7
		total=377

sof(f(6))=377
f(1)=1
f(2)=2
f(3)=3
f(4)=5
By taking higher values of n in f(n), we always get more value of f(n).Hence, f(x) is one-one ,clearly f(x) is into.