SOLUTIONS PAPER-1(PCM) CODE AA (UPSEE 2017)

PHYSICS

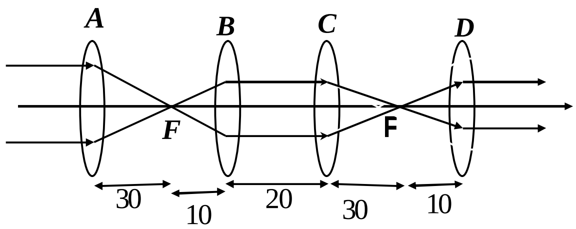
Sol.1. (C) ***ray will be still totally internally reflected at interface.***

As n_2 decreases , $i_C = sin^{-1}\left(\frac{n_2}{n_1}\right)$ also decreases, so condition $i > i_C$ is still satisfied and there will be still total internal reflection at interface. If angle of incidence is increased then ray will be still totally internally reflected at interface because $i > i_C$.

Sol.2. (B) $2eV$

$KE_{max} = h\nu_{max} - \phi = 3 - 1 = 2eV$

Sol.3. (C) ***100 cm***

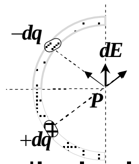


AD=30+10+20+30+10=100cm

Sol.4. (B) ***conduction***

As atoms in the spoon vibrates about their equilibrium positions and transfer energy from one end to other end. This process is conduction.

Sol.5. (B) ***along +y axis***



Consider any two symmetric dipole elements, net contribution due to these elements at point P is along +y axis . Similarly by principle of superposition we can say that net electric field at P is directed along +y axis.

Sol.6. (D) $8\,kR^2$

$KE_i + PE_i = KE_f + PE_f$

$\Rightarrow 0 + \frac{1}{2}k\left[OA - R\right]^2 = KE_f + \frac{1}{2}k\left[OB - R\right]^2$

$\Rightarrow \frac{1}{2}k\left[5R - R\right]^2 = KE_f + \frac{1}{2}k\left[R - R\right]^2$

$\Rightarrow KE_f = 8kR^2$

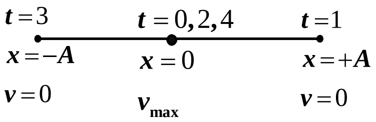
Sol.7. (B) $9\mu\,J$

$U = \frac{1}{2}C_{eq}V^2 = \frac{1}{2}\frac{(3\mu)(6\mu)}{(3\mu + 6\mu)}(-3)^2 = 9\mu J$

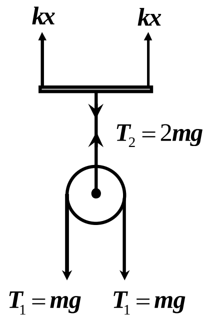
Sol.8. (A) ***experiences a force directed along the radial direction only.***

Circular motion is a special case in gravitational field. There may be straight line,elliptical paths, but force will be always directed toward the centre of the sphere.

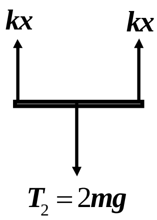
Sol.9. (C) ***speed is maximum at t=4s.***



Sol.10. (A) $\frac{mg}{k}$



F.B.D. of lower rod

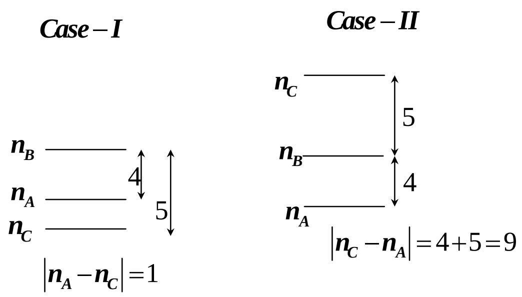


$$kx+kx=2mg$$

$$\Rightarrow x=\frac{mg}{k}$$

Sol.11. (C) 9

We consider two possible cases:



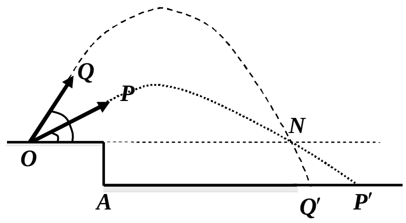
Sol.12. (A) $0.6\,m/s$

By momentum conservation

$$(10\times10^{-3})1000=(10\times10^{-3})\times400+10v$$

$$\Rightarrow v=0.6m/s$$

Sol.13. (B) $AP'>AQ'$



For complimentary angles range ON is same for P and Q as points O and N are on same horizontal plane. From figure $AP'>AQ'$

Sol.14. (D) 60 Hz

Second overtone n=3 $\therefore f_3=3f_0=60Hz$

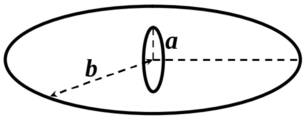
Sol.15. (B) $4m/s^2$

$$x=\text{slope}(t^2)=2t^2\Rightarrow\frac{d^2x}{dt^2}=4$$

Sol.16. (C) $1s$

In one time constant 63% change occurs in the value of current .The 63% of maximum current is 1.26 A .It is obvious from graph that current 1.26A corresponds to time which is slightly greater than 0.9sec. Hence option having 1s is most appropriate.

Sol.17. (C) zero



At the position of smaller loop, Magnetic field due to larger loop is parallel to plane of smaller loop. Due to larger loop, magnetic flux linked with smaller loop is zero. Hence mutual induction is zero.

$\phi_1 = Mi_2 \Rightarrow 0 = Mi_2 \Rightarrow M = 0$

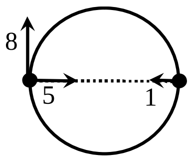
Sol.18. (D) $3m/s$

Impulse during t=2 to t=4 is $\frac{1}{2}(3-2)(5)+\frac{1}{2}(4-3)(-5)=0$

Impulse =change in momentum

$mv_f - mv_i = 0 \Rightarrow v_f = v_i = -3 \Rightarrow speed = 3$

Sol.19. (D) 10



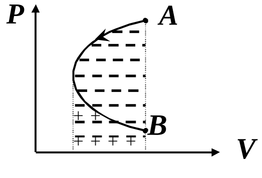
$\vec{a}_Q = -\hat{i}\ ,\vec{a}_P = 5\hat{i} + 8\hat{j} \Rightarrow \vec{a}_{rel} = \vec{a}_P - \vec{a}_Q = 6\hat{i} + 8\hat{j}, \Rightarrow \left|\vec{a}_{rel}\right| = 10$

Sol.20. (A) ***pressure of 85cm of Hg***

$P_{gas} = P_{atm} + P' = 76cm\,of\ Hg + 9cm\,of\ Hg = 85cm\,of\ Hg$

Sol.21. (C) ***work done by gas is negative***

Volume does not remain constant throughout the process AB . As $T = \frac{PV}{nRT}$,temperature decreases initially as both P and V decreases .By area under curve ,net work done is negative.



Sol.22. (A) $20kgm^2s^{-3}$

$\frac{dKE}{dt} = P_{all} = \vec{F}.\vec{v} = m\vec{a}.\vec{v} = \left(100\times10^{-3}\right)\left(20\hat{i}+10\hat{j}\right).10\hat{i} = 20$

Sol.23. (C) ***It remains stationary***

Maximum possible friction force $F_{friction\,Max.} = (0.5)2g = 10N$

Maximum applied force $F_{applied\,Max.} = 8(1) = 8N$

$\because F_{applied\,Max.} < F_{friction\,Max.}$ so the block will remain stationary

Sol.24. (A) $84\,kPa$

$$\Delta p = B\left(\frac{-\Delta V}{V}\right) = 2100\times10^6\times\frac{0.004}{100} = 84\,kPa$$

Sol.25. (D) $m_1R^2 + \frac{m_2R^2}{3}$

$$I = I_{ABC} + I_{AOC} = \sum m_i R^2 + m_2\frac{(AC)^2}{12} = R^2\sum m_i + m_2\frac{(2R)^2}{12} = m_1R^2 + m_2\frac{R^2}{3}$$

Sol.26. (A) ***dark***

Path difference $\Delta = 13.5\lambda = \left(13+\frac{1}{2}\right)\lambda = \left(n+\frac{1}{2}\right)\lambda$

So there will be minima.

Sol.27. (A) ***It will be clockwise***

As collision is elastic ,so after collision ball moves towards left with speed v .As walls and ground are smooth ,there is no tangential torque on the ball. Only normal forces and mg force pass through the centre of the ball ,so their torques about the centre are zero. Torques on the ball about its centre is zero . By $\tau = I\alpha$,angular acceleration is zero hence angular velocity does not change.

Sol.28. (A) ***electron***

$R = \frac{mv}{qB}$ v ,q and B are same so $R \propto m$

Mass of electron is minimum for given options.

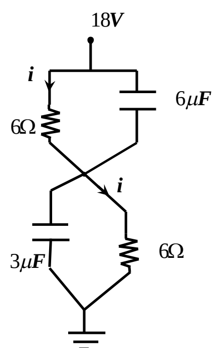
Sol.29. (C) $8\,Nm$

$$\tau = iAB\sin 90^o = 2\times\frac{1}{2}\times2\times2\times2 = 8Nm$$

Sol.30. (A) $84\,m^2$

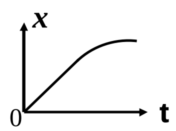
Result should have only two significant numbers (same as 12m).

Sol.31. (C) $27\,\mu C$



$$i = \frac{18}{6+6} = 1.5A \;\; and \;\; V_2 = R_2 i = 6\times1.5 = 9V\,;\, q_2 = (3)9 = 27\mu C$$

Sol.32. (B)

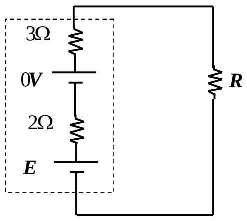


Initially velocity is constant ,so slope of x-t graph is constant and finite .Finally velocity becomes zero hence slope of x-t graph becomes zero.

Sol.33(C) $20m^3$

$mg = \rho_{air} Vg \Rightarrow 26g = 1.3Vg \Rightarrow V = 20m^3$

Sol.34. (D) 5Ω



Since equivalent internal resistance of equivalent cell across the external resistor R is $2+3=5\Omega$,Hence power delivered to R will be maximum if $R = 5\Omega$

Sol.35. (A) $\frac{1}{4}$

$R_A = \frac{\rho l}{\pi(2R)^2}, R_B = \frac{\rho l}{\pi(R)^2} \Rightarrow \frac{R_A}{R_B} = \frac{1}{4} \Rightarrow \frac{V_A}{V_B} = \frac{R_A I}{R_B I} = \frac{1}{4}$

Sol.36. (A) ***Al***

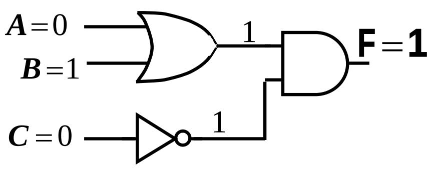
Sol.37. (A) $7\ \text{kgm}^2\text{s}^{-1}$

$L = 2\times2\times2\sin90^o + 3\times3\times3\sin0^o - 1\times1\times1\sin90^o = 8-1=7$

Sol.38. (A) $\frac{2V^2}{3R}$

$P = \frac{V^2}{R_{eq}} = \frac{V^2}{R+\frac{R}{2}} = \frac{V^2}{\frac{3R}{2}} = \frac{2V^2}{3R}$

Sol.39. (C) $A=0, B=1, C=0$



Sol.40. (D) ***remains same***

Intensity after passing through polaroid A is $I_A = \frac{I_0}{2} = \frac{\text{Intensity of unpolarised light}}{2}$

Intensity after passing through polaroid B is $I_B = I_A \cos^2\theta$

Here θ is the angle between pass axes of A and B .Here their pass(transmission) axes always remain parallel to each other i.e. $\theta = 0$. $\therefore I_B = I_A = \frac{I_0}{2} = \text{constant.}$ Hence during the rotation, intensity of transmitted light through polaroid B remains same.

Sol.41. (B) ***4 days***

$8000 \xrightarrow{\text{4days}} 4000 \xrightarrow{\text{4days}} 2000 \xrightarrow{\text{4days}} 1000$

$T_{1/2} = 4\text{days}$

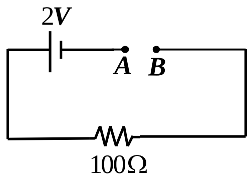
Sol.42. (B) $1035\ A^o$

$$\lambda \cong \frac{12420}{\Delta E} = \frac{12420}{\left|E_2 - E_1\right|} = \frac{12420}{\left|-4-(-16)\right|} = 1035\ A^o$$

Sol.43. (D) ***2V***

In reverse bias ,it is equivalent to open circuit condition. From figure given below

$\left|V_{AB}\right| = 2V$



Sol.44. (B) ***greater than P but less than 16P***

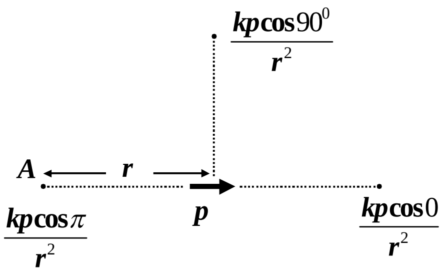
$$P \propto T^4, P' \propto T'^4 \ \text{Here}\, T = 273+50\ , T' = 273+100\ \therefore T < T' < 2T$$

$$\frac{P'}{P} = \left(\frac{273+100}{273+50}\right)^4 \quad \therefore 1 < \frac{P'}{P} < 2^4$$

Sol.45. (D) ***It is not possible***

It is not possible, because it will violate the second law of thermodynamics (Clausius statement) .If we consider imaginary case in which temperature of sample becomes more than 600K then it will radiated power is more than absorbed power. Hence it will correspond to decreasing temperature situation. So it is not possible to heat the sample to 900K.

Sol.46. (C) $\frac{-kp}{r^2}$



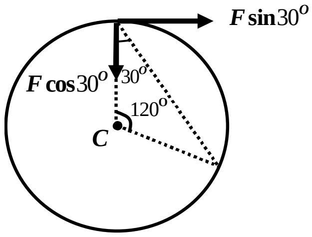
$$V_A = \frac{kp\cos\pi}{r^2} = \frac{-kp}{r^2}$$

Sol.47. (C) $\frac{\left(b^2 - a^2\right)\gamma}{R}$

$$\phi = \vec{B}_1.\vec{A}_1 + \vec{B}_2.\vec{A}_2 = Bb^2 \cos 0^o + Ba^2 \cos 180^o = B\left(b^2 - a^2\right) = \left(b^2 - a^2\right)\gamma t$$

$$i = \frac{|\varepsilon|}{R} = \frac{\left|\frac{d\phi}{dt}\right|}{R} = \frac{\left(b^2 - a^2\right)\gamma}{R}$$

Sol.48. (C) $\frac{F}{MR}$



$$\tau = I\alpha \Rightarrow F\,sin30^0 R = \frac{MR^2}{2}\alpha \Rightarrow \alpha = \frac{F}{MR}$$

Sol.49. (C) *acceleration may be zero at t=2*

Let us consider an example in which particle is projected vertically upward from ground at t=0 and it reaches highest point at t=2.

Then at that instant(t=2) velocity v=0 but acceleration$=-g$. Here displacement is non zero for the duration t=0 to t=2. For t>2 the ball again acquires velocity. In this example options(A),(B) and (D) are incorrect.

Let us consider another example in which a particle is moving on horizontal plane and it comes to rest permanently at t=1 ,then this is the one of the special case in which acceleration of particle is zero at t=2.

Sol.50. (C) $\left(4\hat{i}+2\hat{j}\right)m/s$

$$e = \left[\frac{v_{separation}}{v_{approach}}\right]_y \Rightarrow \frac{1}{2} = \frac{v_y - 0}{4-0} \Rightarrow v_y = 2$$

v_x remains same,Hence $\vec{v}_{final} = 4\hat{i} + 2\hat{j}$

CHEMISTRY

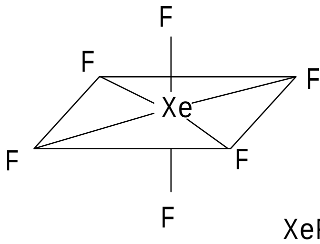
Sol.51. (A) $[Co(CO)_4]^-$ **and** $Ni(CO)_4$

$[Co(CO)_4]^-$ has total electrons =3+2×4+1=12,

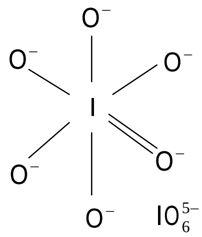
$Ni(CO)_4$ has total electrons =4+2×4=12 ;Thus isoelectronic

Sol.52(B) (i), (ii) & (iv)

XeF_6 has distortion and become Pentagonal bipyramid with one lone pair.



XeF_6



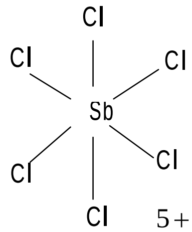
IO_6^{5-}

Orthoperiiodate(5^-)

Octahedral

$7+6(6)+5=48$ electrons

Octahedral



$5+6(7)+1=48$

Octahedral

$SnCl_6^{2-} - \quad 4+6(7)+2=48$

$6 \; set \; of \; electrons - octahedral$

Sol.53. (B) ***$H_2S < NH_3 < H_2O < HF$***

Sol.54. (D) BF_3

BF_3 can form π bond also in addition to σ bond. As F is more electronegative and octate in B is not complete.

Sol.55. (D) H_2O

H_2O will act as Brönsted acid as provided H^+ ion.

Sol.56. (B) 0.354 gm

$$pOH = pK_b + \log\frac{[NH_4Cl]}{[NH_3]} \Rightarrow pOH = -\log K_b + \log\frac{[NH_4Cl]}{[NH_3]} \Rightarrow pOH = \log\frac{[NH_4Cl]}{[NH_3]K_b}$$

$$\Rightarrow 14-9.45 = \log\frac{[NH_4Cl]}{[NH_3]K_b} \qquad \Rightarrow \because \log 3 \approx 0.47$$

$$\Rightarrow \log 10^{14} - (\log 10^9 + \log 3) \approx \log\frac{[NH_4Cl]}{[NH_3]K_b} \Rightarrow \log\frac{10^{14}}{10^9\times 3} \approx \log\frac{[NH_4Cl]}{[NH_3]K_b} \Rightarrow \frac{10^{14}}{10^9\times 3} \approx \frac{[NH_4Cl]}{[NH_3]K_b}$$

$$\Rightarrow \frac{10^{14}}{10^9\times 3}[NH_3]K_b \approx [NH_4Cl] \Rightarrow \frac{10^{14}}{10^9\times 3}\times 0.01\times 1.85\times 10^{-5} \approx [NH_4Cl] \approx 0.35$$

Sol.57. (D) $\dfrac{2\sqrt{K_p}}{1+2\sqrt{K_p}}$

$$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$$

$At \; eq. \; 2(1-x) \qquad x \qquad x$

Total moles at equilibrium =2-2x+x+x=2 ,here x= degree of dissociation

$$K_p = \frac{\left(\frac{x}{2}\right)\left(\frac{x}{2}\right)P^2}{\frac{4(1-x)^2 P^2}{4}} = \frac{x^2}{4(1-x)^2} \Rightarrow 2\sqrt{K_p} = \frac{x}{1-x} \Rightarrow x = \frac{2\sqrt{K_p}}{1+2\sqrt{K_p}}$$

Sol.58. (C) 171

A 6% solution of sucrose $C_{22}H_{22}O_{11}$ conc.= $\frac{6g}{100ml} = 0.06ml^{-1} = \frac{60}{342} mole\,l^{-1}$

For unknown solution conc.= $3g\ per\,100cc = 30\ gl^{-1} = \frac{30}{m} mole\,l^{-1}$

For isotropic solution $\frac{60}{342} = \frac{30}{m} \Rightarrow m = \frac{30\times 342}{60} = 171$

Sol.59. (D) 491 kJ

$CH_3COOH + 2O_2 \rightarrow 2CO_2 + 2H_2O$

$-869 = 2\times(-395) + 2\times(-285) - \Delta_f H_{(CH_3COOH)}$

Simplification gives

$-2\times 434.5 = 2\times(-395) + 2\times(-285) - \Delta_S H_{(CH_3COOH)}$

$or\ -434.5 = (-395) + (-285) - \frac{1}{2}\Delta_f H \quad \Rightarrow 491 = \Delta_f H$

Sol.60. (B) Sulphur

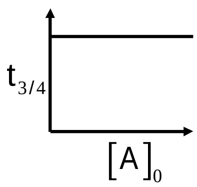
Sol.61. (A) Cathode is Lead dioxide (PbO_2) and anode is Lead (Pb)

Sol.62. (D) (ΔS_{system}+ $\Delta S_{surrounding}$) > 0

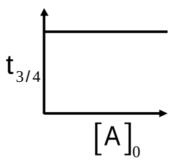
Sol.63. (A) PV_m=RT

At low pressure & high pressure V is very high ,thus $\frac{a}{V_m^2}$ and b are negligible, finally reduced eq. PV_m=RT

Sol.64. (D)



If $t_{1/2}\ vs.[A]^0$ is constant ,it is radioactive decay hence is not of zero order. Thus answer will be



Sol.65. (C) Hexane

Sol.66. (A) 5×10^{-10} **gm**

Let W be the weight of Ra^{238} in equilibrium as

$\frac{Th^{232}}{Ra^{238}} = \frac{t_{1/2Th}}{t_{1/2Ra}} \Rightarrow \frac{1\times N_0/232}{W\times N_0/238} = \frac{1.4\times 10^{10}}{7}$ **;** N_0 = AvagardoNo

$W = \frac{238}{232\times 2\times 10^9} = 5\times 10^{-10} gm$

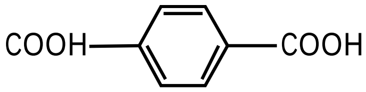
Sol.67. (B) $n=4,\quad l=0,\quad m=0,\quad s=+\frac{1}{2}$

For option (A) electron is in 3d
For option (B) electron is in 4s
For option (C) electron is in 4p
For option (D) electron is in 5s

According to Aufbau principle 4s<3d<4p<5s. Hence Answer will be $n=4, l=0, m=0, s=+\frac{1}{2}$

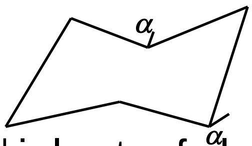
Sol.68. (A) 4, 6

Sol.69. (C)



Terlhalic acid.

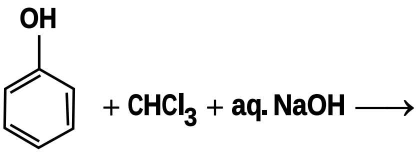
Sol.70. (B) cis-1, 3-dimethylcyclohexane



Two chiral centre of plane of symmetry so it is meso compound.

Sol.71. (C) 2 ethyl-3 methyl pentanal

Sol.72. (A)



In Reimer-Tieman ,phenol reacts with $CHCl_3$ & aq. KOH/NaOH to give Selicil Aldehyde.

Sol.73. (B) B < S < P < F

I.P. in period increases↑ left to right.
I.P. in group up to down↓ decreases.

Sol.74. (B) $H_3C-CH_2-\overset{\oplus}{C}H-CH_3$ and $H_2C-CH_2-CH-\overset{\oplus}{C}H_2$

2^0 Carbocation will be more stable than 1^0

Substituted carbocation will more stable than simple.

Sol.75. (A) Be_3N_2

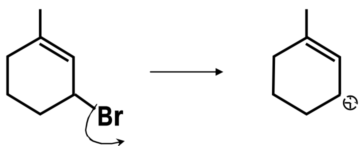
Sol.76. (C) Cannizzaro reaction

Sol.77. (C) BN

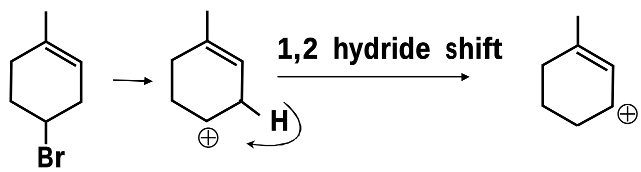
Sol.78. (C) i > iv > ii > iii

Acidity $\propto \frac{1}{basicty}$

Sol.79. (C) (i),(ii)



(i)



(ii)

Sol.80. (A) iii < i < iv < ii

Acidic strength ∝ electron withdrawing group strength.

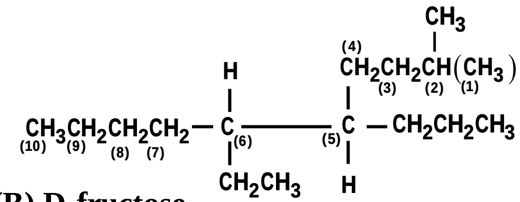
$$-R < -H - I < \frac{1}{+I} < \frac{1}{+H} < \frac{1}{+R}$$

Sol.81. (A) Only –I effect

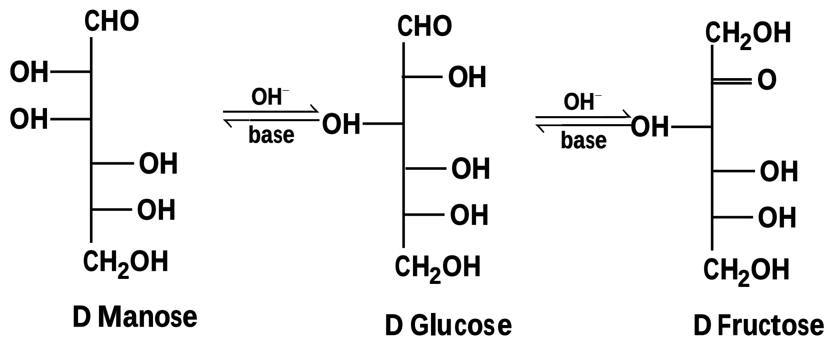
Due to SIR effect $-NO_2$ group goes out of plane of the paper (-I).

Sol.82. (C) $AgNO_3$

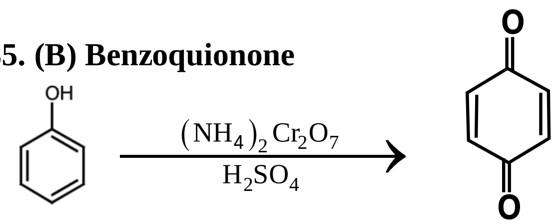
Sol.83. (A) 6-ethyl-2-methyl-5-propyldecane



Sol.84. (B) D-fructose



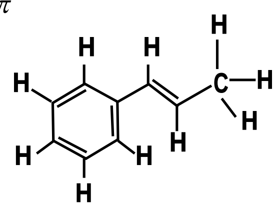
Sol.85. (B) Benzoquionone



Benzoquinone

Conjugated diketones

Sol.86. **(C)** $19\sigma, 4\pi$



19σ *and* 4π

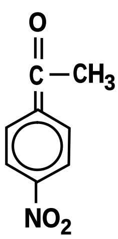
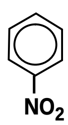
Sol.87. (B) (i) and (iii)

As a plane of symmetry exist in compound(ii),there is no chirality in it. Hence (i) &(iii) will be optically active.

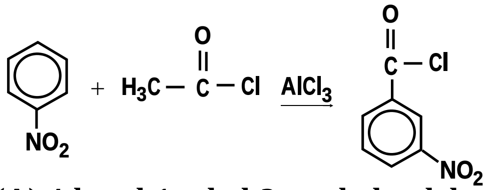
Sol.88. (A) BCl_3 and $AlCl_3$ are both Lewis acids and BCl_3 is stronger than $AlCl_3$

BCl_3 and $AlCl_3$ both are Lewis acids but BCl_3 is more electron deficient than $AlCl_3$ so BCl_3 s stronger Lewis acid than $AlCl_3$ due to high electron negativity.(E.N. B-2.0,*Al* 1.5)

Sol.89. (C) I, II, IV

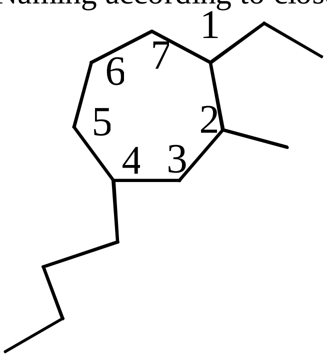
Compound  cannot be obtained by Friedel Craft acylation, In  ,NO_2

Group has -M or –R effect so it cannot be used in Friedel Craft acylation ,this is deactivating & metadirecting group in ESR.

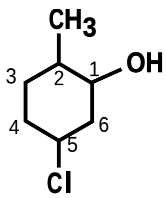


Sol.90. (A) 4-butyl-1-ethyl-2-methylcycloheptane

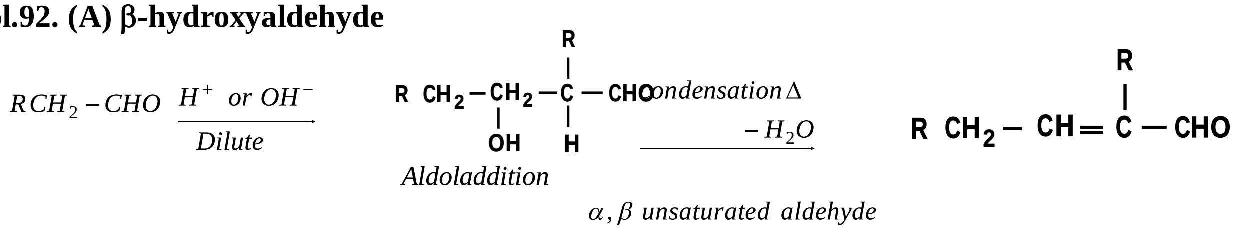
Naming according to closest set of locant rule



Sol.91. (D) 5-chloro-2-methylcyclohexanol

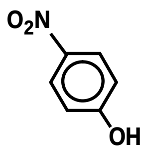


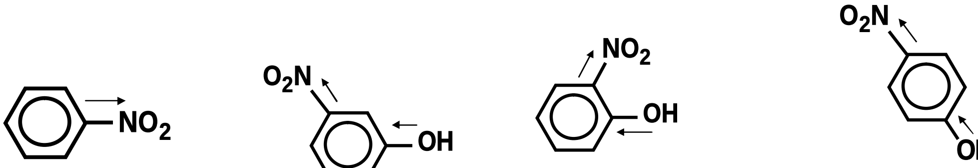
Sol.92. (A) β-hydroxyaldehyde



In aldol addition it is β hydroxyl aldehyde(aldol both alcohol and aldehyde group) But in aldol condensation the product is α,β unsaturated aldehyde

Sol.93. (D)

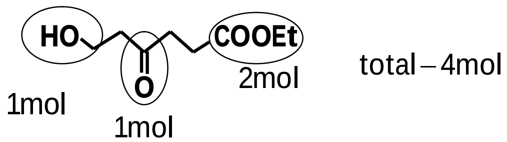




Highest dipole moment

Sol.94. (A) 4

Grignard reagent will react on CO bond there are four C-O bond .These will be addition of Grignard reagent at four positions.



Sol.95. (A) KO_2

$KO_2 \rightarrow K^+ + O_2^- \quad \equiv 17e^-$ in valance cell so unpaired electron present & show paramagmetism

$SiO_2 \rightarrow Si^{+4} \quad + \quad 2O^{2-} \equiv$ Diamagnetic

$\qquad 2s^2 2p^6 \qquad 2s^2 2p^6$

$TiO_2 \rightarrow Ti^{+4} \quad + \quad 2O^{2-} \equiv$ Diamagnetic

$\qquad 3d^0 \qquad 2s^2 2p^6$

$BaO_2 \rightarrow \quad Ba^{+2} \quad + \quad 2O^{2-} \quad \equiv$ Diamagnetic

Xe Configuration   Ne Configuration

Sol.96. (C) CH_3^-

Nucleophilicity order

$CH_3^- > NH_2^- > OH^- > F^-$

Sol.97. (D) For lead +2, for tin +4

$$PbO_2 + Pb \rightarrow 2PbO, \quad \Delta G^0 < 0$$

i.e. ΔG^0 is negative so reaction is fisiable i.e. for Pb,+2 Oxidation state is more stable.

$$SnO_2 + Sn \rightarrow 2SnO, \quad \Delta G^0 > 0$$

i.e. ΔG^0 is positive so reaction is nonfisiable i.e. for Sn,+4 Oxidation state is more stable.

Correct answer is (D) For lead +2, for tin +4

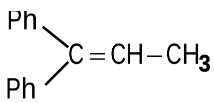
For lead +2, for tin +4 Oxidation State are more characteristics.

Sol.98. (A) 1-Phenyl-2-butane

(i) $Ph-CH_2-CH=CH-CH_3$ Geometrical isomerism.

(ii) $CH_2=CH-\underset{|}{\underset{Ph}{CH}}-CH_3$ No Geometrical isomerism

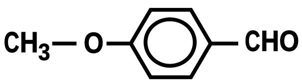
(iii) $CH_2=\underset{|}{\underset{Ph}{C}}-CH_2-CH_3$ No Geometrical isomerism

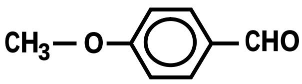
(iv) 

No Geometrical isomerism

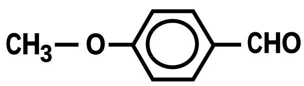
Sol.99. (C) associate

At CMC they associate.

Sol.100. (B) 



will be most reactive.

Hence most appropriate option is 

MATHEMATICS

Sol.101. (A) $x=\log_2 \dfrac{y}{1-y}$

$y=\dfrac{2^x}{1+2^x}$ which gives $x\log_2 2=\log_2 \dfrac{y}{1-y}$

Sol.102. (D) $-2\le x<0$

y is well defined when $\log_{10}(1-x)\ne 0$ & $x+2\ge 0$, Hence $-2\le x<0$

Sol.103. (B) A = – 1 , B = 1

For continuity of f(x) at $x=-\frac{\pi}{2}$ & $\frac{\pi}{2}$, we have

$$\lim_{x\to -\frac{\pi}{2}-} f(x)=2=\lim_{x\to -\frac{\pi}{2}+} f(x)=-A+B=f\left(-\frac{\pi}{2}\right)=2$$

$$\& \lim_{x\to \frac{\pi}{2}-} f(x)=2=\lim_{x\to \frac{\pi}{2}+} f(x)=0=f\left(\frac{\pi}{2}\right)=2$$

$\Rightarrow -A+B=2$ & $A+B=0$ $\therefore A=-1, B=1$

Sol.104. (B) $\dfrac{2}{\pi\, x}$

$\lim_{x\to 0} f(x)=f(0)$ for continuity of f(x) at x=0. $\Rightarrow \alpha=\dfrac{2}{\pi\, x}$

Sol.105. (D) $-\dfrac{a}{\pi}$

$\lim_{y\to a}\left\{\left(\sin\dfrac{y-a}{2}\right)\Big/\left(\cot\dfrac{\pi y}{2a}\right)\right\}$ is of the form $\dfrac{0}{0}$.

Using L'Hospital rule $\lim_{y\to a}\left\{\left(\sin\dfrac{y-a}{2}\right).\left(\tan\dfrac{\pi y}{2a}\right)\right\}=-\dfrac{a}{\pi}$

Sol.106. (C) $\lim_{n\to\infty} \ell_n$ **does not exist but** $\lim_{n\to\infty} L_n$ **exists**

$\lim_{n\to\infty} \ell_n=\begin{cases}0 & \text{when n is odd}\\ 2 & \text{when n is even}\end{cases}$ so $\lim_{n\to\infty} \ell_n$ does not exist

$\lim_{n\to\infty} L_n=0$ exists

Sol.107. (B) $-\infty<x\le 0$

Since $\cos^{-1}\dfrac{1-x^2}{1+x^2}=2\tan^{-1}x$ is valid for $0\le x<\infty$,so negative times shows the answer $-\infty<x\le 0$

Sol.108. (A) (1 , 0) , (- 1 ,- 4)

Slope of tangent to curve at point (α,β) is $\left.\dfrac{dy}{dx}\right|_{(\alpha,\beta)}$ i.e. $3\alpha^2+1$ which is parallel to line having slope 4.

So $3\alpha^2+1=4$ which gives $\alpha=\pm 1$.The point (α,β) lies on the curve so $\beta=0,-4$ .Points are $(1,0)$ & $(-1,-4)$.

Sol.109. (C) 25

$$\left[\vec a\times\vec b\ ,\ \vec b\times\vec c\ ,\ \vec c\times\vec a\right]=\left\{\left(\vec a\times\vec b.\vec c\right)\vec b-\left(\vec a\times\vec b.\vec b\right)\vec c\right\}.(\vec c\times\vec a)$$

$$=\left[\vec a\,\vec b\,\vec c\right]\vec b.(\vec c\times\vec a)=\left[\vec a\,\vec b\,\vec c\right]^2=25$$

Sol.110. (C) 2x - y + 1 = 0

Equation of chord joining the points P(1,4) & (3,8) on the parabola is $2x-y+2=0$. Tangent parallel to this chord will have the slope i.e. $\frac{dy}{dx}=2$ ∴Equation of tangent at (α,β) on the curve with slope 2 is 2x - y + 1 = 0

Sol.111. (B) $\left(\frac{3}{2},\frac{3}{4}\right)$

Given $y=\int_0^x\left(t^2-3t+2\right)dt$. Differentiating w.r.to x, we have $\frac{dy}{dx}=x^2-3x+2$ & $\frac{d^2y}{dx^2}=2x-3$. At the point of inflection $\frac{d^2y}{dx^2}=0$ & second derivative changes sign while passing through the point of inflection. Clearly $P\left(\frac{3}{2},\frac{3}{4}\right)$.

Sol.112. (C) - 2

$$\lim_{x\to\frac{\pi}{2}}\left\{2x\ \tan x-\frac{\pi}{\cos x}\right\}=\lim_{x\to\frac{\pi}{2}}\left\{\frac{2x\sin x-\pi}{\cos x}\right\} is\frac{0}{0}\ form.$$

Use L' Hospital Rule, we get result -2.

Sol.113. (D) 2x - y - 1 = 0

The point of intersection of the curve $y=-\sqrt{x}+2$ with the bisector of the first quadrant i.e. y=x is (1,1) {Neglect the point (4,0) as it does not satisfy y=x}. Equation of normal to the curve at (1,1) is $2x-y=1$.

Sol.114. (D) $\frac{-2\left(1+y^2\right)}{y^5}$

Write $y=\tan(x+y)$ as $(x+y)=\tan^{-1}y$,then differentiating directly implicitly ,we get $\frac{dy}{dx}=-2\frac{\left(1+y^2\right)}{y^5}$

Sol.115. (D) $60^0\ or\ 120^0$

Let sides AB, BC & AC be c,a,b respectively in ΔABC.

Area of triangle $=\frac{1}{2}bc\sin A\Rightarrow 10\sqrt{3}=\frac{1}{2}5.8\sin A\Rightarrow\sin A=\frac{\sqrt{3}}{2}\therefore a=60^0\ \text{or}\ 120^0$

Sol.116. (C) $\tan^{-1}\frac{41}{2}$

Equation of curves $c_1:y=x^2$ & $c_2:9x^2+16y^2=25$.Let $m_1\,\&\,m_2$ be the slope of the tangents to these curve at the point of intersection (1,1)$\Rightarrow m_1=2\ \&\ m_2=-\frac{9}{16}$,So $\theta_1=\tan^{-1}\left|\frac{m_1-m_2}{1+m_1m_2}\right|\Rightarrow\theta_1=\tan^{-1}\frac{41}{2}$

Similarly at the point of intersection (-1,1) $\theta_2=\tan^{-1}\left|\frac{-2-\frac{9}{16}}{1-\frac{18}{16}}\right|=\tan^{-1}\frac{41}{2}$

Sol.117. (C) 1

For maxima –minima $\frac{dy}{dx}=0\Rightarrow 2\sec^2x\left(1-\tan x\right)=0\Rightarrow x=\frac{\pi}{4}\ \&\ \left[\frac{d^2y}{dx^2}\right]_{x=\frac{\pi}{4}}<0$

So $x=\frac{\pi}{4}$ is the point where function $y=2\tan x-\tan^2x$ has maximum value.

$\therefore$Maximum value $[y]_{at\ x=\frac{\pi}{4}} = 1$

Sol.118. (B) $(a^2 + b^2) - 4\,ab = 138$

Let M be the middle point of the segment AB. So $M\left(\frac{a+b}{2}, 24\right)$. Since $\overrightarrow{OM} \perp \overrightarrow{MA}$ and Length $\overrightarrow{OM} = \sqrt{3}\, length\, \overrightarrow{MA}$, but $\overrightarrow{MA} = \left(\frac{a-b}{2}, -13\right)$. So using $|\overrightarrow{OM}| = \sqrt{3}|\overrightarrow{MA}|$. We get

$(a^2 + b^2) - 4\,ab = 138$

Sol.119. (A) 3 sin x — 4 cos x

$Let\ x < 0\ So - x > 0. Hence\ f(-x) = 3\sin(-x) + 4\cos(-x) given$,But f is odd, so

$f(-x) = -f(x)\ where\ x < 0\ \Rightarrow\ f(x) = 3\sin x - 4\cos x$

Sol.120. (A) continuous at x = 0 but not differentiable at x = 0

Since $-\frac{\pi}{2}x \le x\tan^{-1}\frac{1}{x} \le \frac{\pi}{2}x$,So $\lim_{x\to 0} f(x) = 0 = f(0) \Rightarrow$ f is continuous, but

$\lim_{x\to 0}\frac{f(x) - f(0)}{x - 0} = \lim_{x\to 0}\tan^{-1}\frac{1}{x}$ does not exit, so not differentiable at x=0.

Sol.121. (B) 48

According to question $\sqrt{\alpha\beta} = \alpha + 2$ & $\frac{\alpha+\beta}{2} + 24 = \beta$. Solving $\alpha = 6, \beta = 54 \therefore \beta - \alpha = 48$

Sol.122. (C) $a = -\frac{2}{3}$, $b = -\frac{1}{6}$

At the point of Maxima or Minima $\frac{dy}{dx} = 0$ i.e. at $x = 1$ & $x = 2$,we have $\frac{dy}{dx} = \frac{a}{x} + 2bx + 1$ which is 0 at x=1 &2 . $\Rightarrow a = -\frac{2}{3}, b = -\frac{1}{6}$, Clearly $\left[\frac{d^2y}{dx^2}\right]_{at\ x=1} > 0$, so minimum & $\left[\frac{d^2y}{dx^2}\right]_{at\ x=2} < 0$,so maximum.

Sol.123. (C) $\frac{1}{4}$

Let P be a point inside the circle $|z - z_0| \le r$. Probability of the point P which lies within the circle of radius $\frac{r}{2}$ is $|z - z_0| = \frac{r}{2}$ is $\frac{\left(\frac{\pi r^2}{4}\right)}{\pi r^2} = \frac{1}{4}$

Sol.124. (A) $\frac{1}{3}$

Required chance $= \frac{5!}{\left(\frac{6!}{2!}\right)} = \frac{1}{3}$

Sol.125. (A) 30^0

Given $L: 3\sin A + 4\cos B = 6$ & $M: 4\sin B + 3\cos A = 1$ in ΔABC ,So $L^2 + M^2$ implies $\sin(A + B) = \frac{1}{2}$

$\therefore \sin C = \sin(180^0 - \overline{A + B}) = \frac{1}{2}$ $\therefore C = 30^0$ or 150^0. Discard $C = 150^0$ because for this value of C, A will be less than 30^0. Hence $3\sin A + 4\cos B < \frac{3}{2} + 4 < 6$ a contradiction.$\therefore$ $C = 30^0$

Sol.126. (B) $c - \frac{1}{a}\sin^{-1}\frac{a}{|x|}$

Put $x = \frac{1}{t}$ so $I = \int\frac{dx}{x\sqrt{x^2 - a^2}}$ reduces to $-\frac{1}{a}\int\frac{dt}{\sqrt{\left(\frac{1}{a}\right)^2 - t^2}}$ .Hence $I = c - \frac{1}{a}\sin^{-1}\frac{a}{|x|}$

Sol.127. (A) $e^y\left(\frac{d^2y}{dx^2}+\left(\frac{dy}{dx}\right)^2\right)=\sin x$

Differentiating the given relation w.r.to x, we get $e^y\frac{dy}{dx}+\cos x=0$,Again d.w.r.to x

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

Sol.128. (C) $\frac{\sqrt{3}}{2}$

Given $L:\sin a+\sin b=\frac{1}{\sqrt{2}}$ & $M:\ \cos a+\cos b=\frac{\sqrt{6}}{2}$,So L^2+M^2 implies $\cos(a-b)=0$

While LM (using $\cos(a-b)=0$) gives $\sin(a+b)=\frac{\sqrt{3}}{2}$

Sol.129. (C) $e^b-\sqrt{3}\,e^a$

Given $\left[\frac{dy}{dx}\right]_{x=a}=\tan\frac{\pi}{3}$ & $\left[\frac{dy}{dx}\right]_{x=b}=\tan\frac{\pi}{4}$ So, $f'(a)=\sqrt{3}$, $f'(b)=1$ $\therefore$

$$I=\int_a^b e^x\{f'(x)+f''(x)\}dx=\int_a^b\frac{d}{dx}\{e^xf'(x)\}dx=\left[e^xf'(x)\right]_a^b=e^bf'(b)-e^af'(a)=e^b-\sqrt{3}e^a$$

Sol.130. (B) $a=-5,b\neq 5$

$$\left[A|\bar{b}\right]=\begin{pmatrix}1&-1&2:3\\3&5&-3:b\\2&6&a:2\end{pmatrix}$$

$$R_2-3R_1,R_3-2R_1\sim\begin{pmatrix}1&-1&2:3\\0&8&-9:b-9\\0&8&a-4:-4\end{pmatrix}\sim R_3-R_2\begin{pmatrix}1&-1&2:3\\0&8&-9:b-9\\0&0&a+5:5-b\end{pmatrix}$$

For no solution rankA≠rank$\left[A|\bar{b}\right]$, So $a=-5,b\neq 5$

Sol.131. (A) $5x^2-3x+1=0$

Required equation $x^2-\left(-\frac{1}{\alpha}-\frac{1}{\beta}\right)x+\left(-\frac{1}{\alpha}\right)\left(-\frac{1}{\beta}\right)=0$

Where $\alpha+\beta=-3$ & $\alpha\beta=5$ as α,β are roots of $x^2+3x+5=0$

$\Rightarrow 5x^2-3x+1=0$

Sol.132. (D) $\frac{\pi h^2}{3}(3a+h)$

Volume of the solid of revolution $V=\pi\int_a^{a+h}y^2dx$ (The figure is bounded by x=a,x=a+h,y=0)

$$V=\pi\int_a^{a+h}\left(x^2-a^2\right)dx=\frac{\pi h^2}{3}[3a+h]$$

Sol.133. (A) $y^2=(1+x)\log\frac{c}{1+x}-1$

Given diff. Eq. can be written as

$y\frac{dy}{dx}-\frac{1}{2(x+1)}y^2=-\frac{x}{2(x+1)}$,Let $y^2=t$ so $2y\frac{dy}{dx}=\frac{dt}{dx}$ .Hence eq. reduces to

$\frac{dt}{dx}-\frac{1}{(x+1)}t=-\frac{x}{(x+1)}$ where $I.F.=e^{-\int\frac{1}{1+x}dx}=\frac{1}{(x+1)}$

Hence solution $t.IF. = \int Q.IF.dx + c \Rightarrow y^2 = (1+x)\log\frac{c}{1+x} - 1$

Sol.134. (D) $10m/\sec^2$

$x(t) = 5t^2 - 7t + 3$, $v = \frac{dx}{dt} = 10t - 7 \Rightarrow 5 = 10t - 7 \Rightarrow t = \frac{12}{10}$; $a = \left[\frac{d^2x}{dt^2}\right]_{t=\frac{12}{10}} = 10m/s^2$

Sol.135. (C) $5x^2 - 7x - 439$ **= 0**

Obviously p,q satisfy the equation $5x^2 - 7x - 3 = 0$ .Hence $p + q = \frac{7}{5}, pq = -\frac{3}{5}$

Given $\alpha = 5p - 4q \;\&\; \beta = 5q - 4p.$

The required equation $x^2 - (\alpha + \beta)x + \alpha\beta = 0 \Rightarrow \quad 5x^2 - 7x - 439 = 0$

Sol.136. (B) $-\frac{1}{2} \le x \le \frac{1}{2}$

Let $sin^{-1}x = \theta$, given $3\,sin^{-1}x = sin^{-1}\left[x\left(3 - 4x^2\right)\right] \Rightarrow 3\theta = sin^{-1}\left[sin\theta\left(3 - 4\,sin^2\theta\right)\right]$

$-\frac{\pi}{2} \le 3\theta \le \frac{\pi}{2}$,Hence $-\frac{\pi}{6} \le \theta \le \frac{\pi}{6}$ $\therefore -\frac{1}{2} \le sin\theta \le \frac{1}{2}$ i.e $-\frac{1}{2} \le x \le \frac{1}{2}$

Sol.137. (B) $(x+1)^2 + (y-1)^2 = \frac{1}{8}(x - y + 3)^2$

Required ellipse $\sqrt{(x+1)^2 + (y-1)^2} = e\left(\frac{x - y + 3}{\sqrt{2}}\right)$ where $e = \frac{1}{2}$

Sol.138. (C) $2 + \ell og_e\left(\frac{2}{e^2 + 1}\right)$

Mean value $M = \frac{1}{2-0}\int_0^2 \frac{2}{1+e^x}dx \Rightarrow M = \int_0^2 \frac{e^{-x}}{1+e^{-x}}dx$ Put $1 + e^{-x} = t$,We get $M = 2 + \ell og_e\left(\frac{2}{e^2 + 1}\right)$

Sol.139. (A) $\ell og_e\left|\tan\frac{y}{4}\right| = -2\sin\frac{x}{2} + c$

$\frac{dy}{dx} = -\sin\left(\frac{x+y}{2}\right) + \sin\left(\frac{x-y}{2}\right) = -2\cos\left(\frac{x}{2}\right)\sin\left(\frac{y}{2}\right)$.

So separating the variables and integrating $\ell og_e\left|\tan\frac{y}{4}\right| = -2\sin\frac{x}{2} + c$

Sol.140. (C) - 9/2

$R_1 + (R_2 + R_3) \sim \begin{vmatrix} 2x+9 & 2x+9 & 2x+9 \\ 2 & 2x & 2 \\ 7 & 6 & 2x \end{vmatrix} = 0 \Rightarrow x = 1, \frac{7}{2}, -\frac{9}{2}$

Sol.141. (D) ***a =1 , b = 0***

$a + ib = cos\left(log\, i^{4i}\right) = cos\left[4i\left\{log|i| + i\frac{\pi}{2}\right\}\right] = 1 \quad \therefore a = 1, b = 0$

Sol.142. (B) increases in (0 , 1) but decreases in (1 , 2)

$y = \sqrt{2x - x^2}$ so $\frac{dy}{dx} = \frac{1-x}{\sqrt{1-(x-1)^2}} \begin{cases} > 0 & for\ 0 < x < 1 \\ < 0 & for\ x \in (1,2) \end{cases}$

So f increases in (0,1) & decreases in (1,2).

Sol.143. (B) $|\alpha| < \frac{5}{3}$

$|\alpha| < \frac{5}{3}$ as the line y=x intersect lines $|2x+5| = 5$ at points $\left(\frac{5}{3}, \frac{5}{3}\right)$ & $\left(-\frac{5}{3}, -\frac{5}{3}\right)$.

Sol.144. (A) $|z-2| > 7$

$log_{sin\frac{\pi}{6}} \left\{\frac{|z-2|+3}{3|z-2|-1}\right\} > 1$,since $sin\left(\frac{\pi}{6}\right) = \frac{1}{2} < 1$ So $\left\{\frac{|z-2|+3}{3|z-2|-1}\right\} < \frac{1}{2} \Rightarrow |z-2| > 7$

Sol.145. (C) $\frac{1}{2}\left(3^n - 1\right)$

Let $S_n = 1 + 4 + 13 + 40 + 121 + 364 + ... \ T_{n-1} + T_n$

Rewrite $S_n = 1 + 4 + 13 + 40 + 121 + 364 + ... + T_{n-2} + T_{n-1} + T_n$

& $S_n - S_n = 1 + 3 + 3^2 + 3^3 + ...(T_n - T_{n-1}) - T_n$

$\Rightarrow T_n = 1.\frac{3^n - 1}{3 - 1}$ & $T_n = \frac{3^n - 1}{2}$

Alternative: put options directly.

Sol.146. (D) $\left(\frac{\pi}{3}, \frac{5\pi}{3}\right)$

$y = x - 2\,sin\,x$ has tangent parallel to x axis at the points $\frac{\pi}{3}, \frac{5\pi}{3}$ and

$\frac{dy}{dx} < 0 \ \ for\ x \in \left(0, \frac{\pi}{3}\right) U \left(\frac{5\pi}{3}, 2\pi\right)$

$\frac{dy}{dx} > 0 \ \ for\ x \in \left(\frac{\pi}{3}, \frac{5\pi}{3}\right)$

Sol.147. (D) 9

$$\frac{{}^xC_6\left(2^{1/3}\right)^{x-6}\left(3^{-1/3}\right)^6}{{}^xC_{x-6}\left(2^{1/3}\right)^6\left(3^{-1/3}\right)^{x-6}} = \frac{1}{6} \Rightarrow x = 9$$

Sol.148. (B) 256

If cardinality of A=m & Cardinality of B is n ,then total no. of relations from A to B is 2^{mn}.

Here m=4,n=2 $\therefore 2^8 = 256$

Sol.149. (A) $0 < \delta < 0.00025$

Using $|x-2| < \delta$,we get $|y-4| < \delta(\delta+4)$ which is less than ε,

So $\delta < \sqrt{\varepsilon + 4} - 2$ For $\varepsilon = 0.001$, the $\delta < 0.00025$

Sol.150. (D) $f'(0)$

$$f'(0) = \lim_{x \to 0} \frac{f(x) - f(0)}{x - 0} \text{ where } f(0) = 0 \text{(given)}, \text{So } L = f'(0)$$