BANSAL CLASSES PRIVATE LIMITED
Ideal for Scholars

ANSWER KEY

DATE: 12-12-2018

COURSE
NUCLEUS

JEE-MAIN MOCK TEST-10
XII

TEST CODE				
1	1	2	9	7

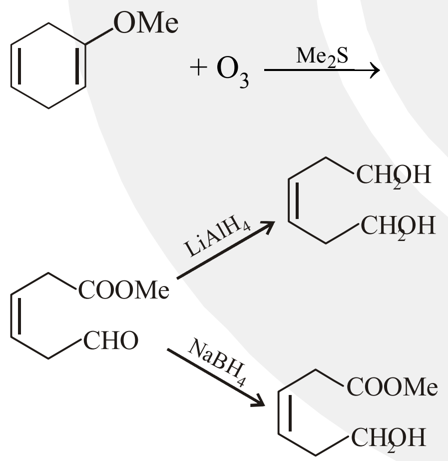
	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC
Q.No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Ans	2	3	4	1	4	2	1	4	2	1	2	4	1	4	3
	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC	IOC	OC	PC
Q.No.	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**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

HINTS & SOLUTIONS

CHEMISTRY

Q.1 $M(s) \xrightarrow{(a)} M(g) \xrightarrow{(c)} M^{+}(g)$

Q.2



Q.3 $\left(\dfrac{V_n}{2\pi r_n}\right) \propto \dfrac{Z^2}{n^3}$

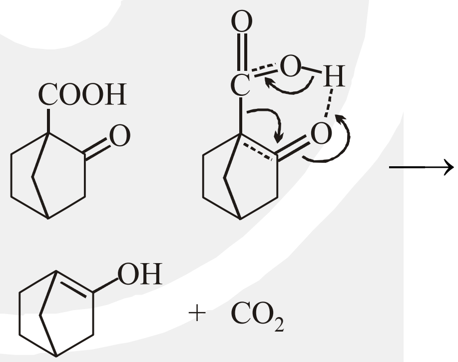
$\Rightarrow \quad \dfrac{Z^2}{4^3} = 2.\dfrac{1^2}{2^3}$

$\Rightarrow \quad Z^2 = 16$

$Z = 4$

Q.4 $Zn(\text{amphoteric}) + 2NaOH \rightarrow Na_2ZnO_2 + H_2\uparrow$

Q.5



unstable structure double bond is at bridge head C

Q.6 $(Eq)_{KMnO_4} = (Eq)_{H_2O_2} + (Eq)_{H_2C_2O_4}$

$0.2 \times 200 \times 5 = (M \times 50 \times 2) + (0.5 \times 100 \times 2)$

$[H_2O_2] = 1M$

$\therefore$ volume strength $= 11.2 \times 1$ V

$= 11.2$ V

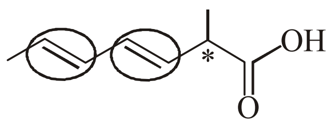
Q.7 $\underset{\text{(quick lime)}}{CaO(s)} \longrightarrow \underset{\text{(slaked lime)}}{Ca(OH)_2(s)}$

$\downarrow H_2O$

$\underset{\text{(white turbidity)(milk of lime)}}{Ca(OH)_2}$

$\downarrow H_2O$

$\underset{\text{(lime water)}}{Ca(OH)_2(aq)}$

Q.8 

n = 3

$2^n = 2^3 = 8$

Q.9 Process is isochoric

$q = q_v = n.C_{v,m}\,\Delta T$

$= 2 \times \frac{3R}{2}\,(200 - 400)$

$= -1200$ Cal

Q.10 $C_2^+ \quad \rightarrow \quad C_2$

B.O. = 1.5 (para) $\quad$ B.O.=2(dia)

$C_2^+ = \sigma_{1s^2}\ \sigma^*_{1s^2}\ \sigma_{2s^2}\sigma^*_{2s^2}\ \pi_{2p_x}{}^2 = \pi_{2p_y}{}^1$

Bond order $= \frac{N_b - N_a}{2}$

$= \frac{7-4}{2} = 1.5$ (Paramagnetic)

$C_2 = \sigma_{1s^2}\sigma^*_{1s^2}\sigma_{2s^2}\sigma^*_{2s^2}\ \pi_{2p_y^2} = \pi_{2p_y^2}$

Bond order $= \frac{N_b - N_a}{2}$

$= \frac{8-4}{2} = 2$ (diamagnetic)

Q.11 Order of basicity

$(C_2H_5)_2NH > (C_2H_5)_3N > C_2H_5NH_2 > NH_3$

Q.12 $2NO + 2SO_3 \rightleftharpoons 2NO_2 + 2SO_2$;$K_C = (3)^2$

$2SO_2 + O_2 \rightleftharpoons 2SO_3$; $K_C = 16$

$2NO + O_2 \rightleftharpoons 2NO_2$; $K_C = 9 \times 16$

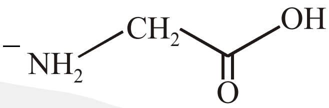
So, $2NO_2 \rightleftharpoons 2NO + O_2$; $K_C = \frac{1}{144}$

Q.13 $[Mn(CO)_5]$

EAN $= 25 + 5 \times 2$

$= 25 + 10 = 35$

$[Mn(CO)_5]$ requires 1 more electron to achieve 36 e^- so it act as oxidizing agent.

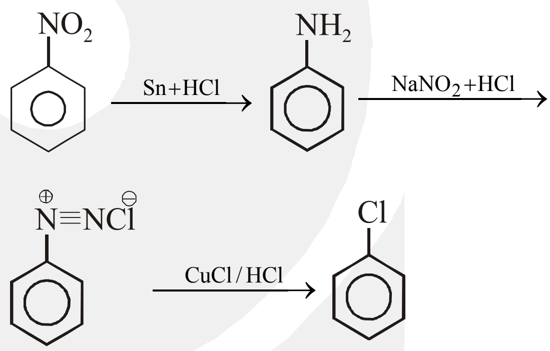
Q.14 Glycine – 

No chiral carbon is present here therefore optically inactive

Q.15 $\frac{r_{Cs^+}}{r_{Cl^-}} = 0.732$

Q.16 $XeF_2 + H_2O \rightarrow Xe + \frac{1}{2}O_2 + 2HF$

$2XeF_4 + 4H_2O \rightarrow Xe + \frac{1}{2}O_2 + 8HF + XeO_3$

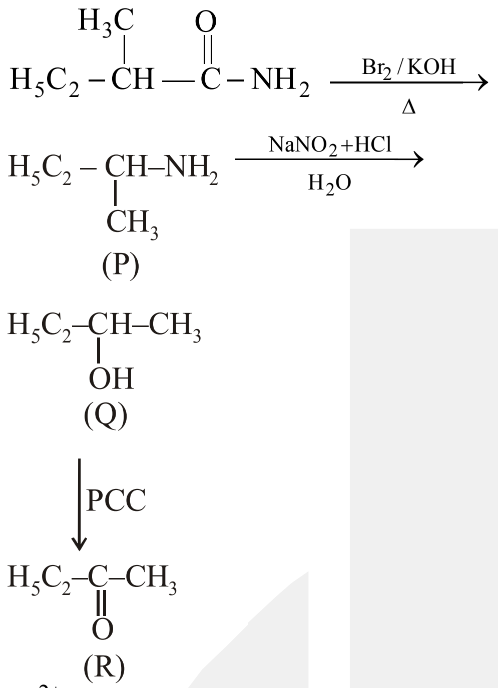
Q.17 

Q.18 Theory based

Q.19 $\underset{(sp^3)}{PH_4^+} > \underset{(sp^3)}{OF_2} > \underset{(sp^3)}{SF_2} > SbH_3$

No hybridisation (Bond angle ≈ 90°)

BA α EN of CA

Q.20 

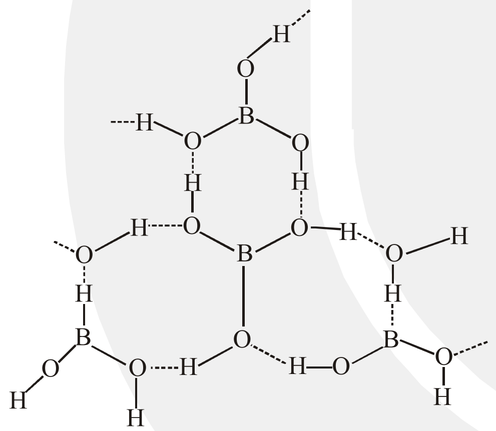
Q.21 $Sn^{2+} + 2e^- \rightarrow Sn$; $\Delta G° = (-2.F.x)$

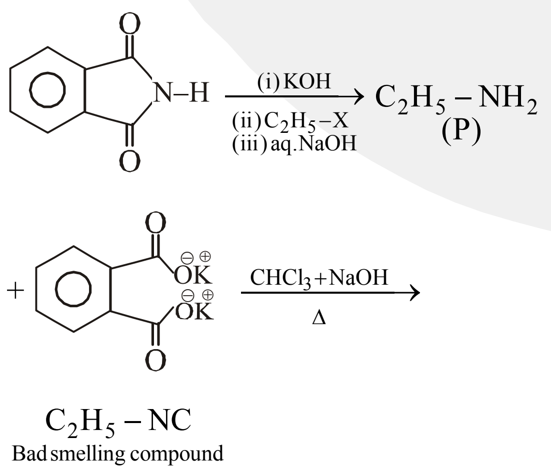
$Sn^{4+} + 4e^- \rightarrow Sn$; $\Delta G° = (-4.F.y)$

$Sn^{2+} \rightarrow Sn^{4+} + 2e^-$; $\Delta G° = (-2.F.E°)$

So, $(-2.F.E°) = (-2.F.x) - (-4.F.y)$

$\Rightarrow E° = (x - 2y)$

Q.22 

Q.23 

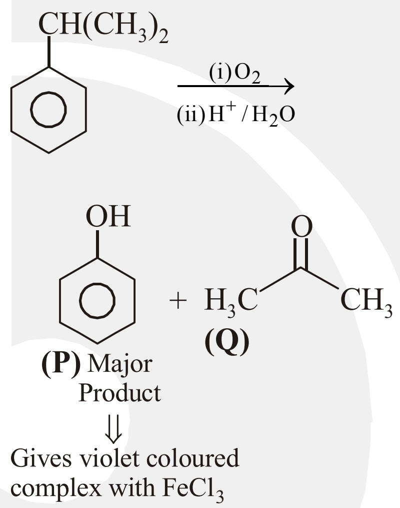
Q.24 AT 373K, $P^0_{H_2O} = 760$ torr

$\because P = P^0 . X_{H_2O}$

$570 = 760 . X_{H_2O}$

$\Rightarrow X_{solute} = \frac{1}{4}$

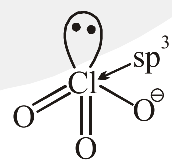
Q.25 Smelting - An oxidation process.
Smelting is a process of applying heat to ore in order to extract out a base metal. It is a form of extractive metallurgy. Smelting uses heat and a chemical reducing agent to decompose the ore, driving off other element as gases or slag leaving the metal base behind.

Q.26 

Q.27 $\frac{[A]_t}{[A]_0} = \frac{1}{2^n} = \frac{1}{2^3} = \frac{1}{8}$

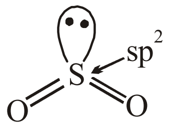
Number of Half lives (n) $= \frac{300}{100} = 3$

Fraction reacted $= 1 - \frac{1}{8} = \frac{7}{8}$

Q.28 (1) ClO_3^{-1} 

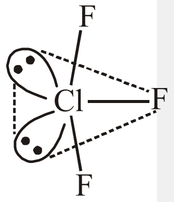
2 pπ - dπ
0 pπ - pπ

(2) SO_2



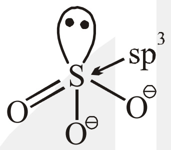
1 $p\pi$ - $d\pi$
1 $p\pi$ - $p\pi$

(3) ClF_3



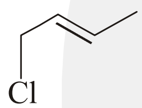
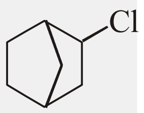
0 $p\pi$ - $d\pi$
0 $p\pi$ - $p\pi$

(4) SO_3^{2-}



1 $p\pi$ - $d\pi$
0 $p\pi$ - $p\pi$

Q.29 $\underset{\substack{\| \\ O}}{Me-C}-CH_2-Cl > Me-O-CH_2-Cl >$

 > 

Q.30 For AB $= K_{sp} = s_1^2$

$MB_2 \quad K_{sp} = 4\ s_2^3$

$N_3C_2 \quad K_{sp} = 108\ s_3^5$

$A_3C \quad K_{sp} = 27\ s_4^4$

All have same K_{sp}, So maximum solubility will be of $N_3C_2(s)$.

MATHEMATICS

Q.31 $y = \dfrac{ax^2 - 3x + 5}{5x^2 - 3x + a}$

Range is R $\Rightarrow a \in (-8, -2)$
$a = -7, -6, -5, -4, -3.$

Q.32 a^2, b^2, c^2 AP

$\Rightarrow a^2 + 1, b^2 + 1, c^2 + 1$ AP

$\Rightarrow a^2 + ab + bc + ca,\ b^2 + ab + bc + ca,\ c^2 + ab + bc + ca$ AP

$\Rightarrow (a + b)(a + c), (a + b)(b + c), (b + c)(c + a)$ AP

$\Rightarrow \dfrac{1}{b+c}, \dfrac{1}{c+a}, \dfrac{1}{a+b}$ AP.

Q.33 $\dfrac{\sin 20° + \cos 20° + \sin 50°}{\cos 10° \cdot \sin 35° \cdot \cos 25°}$

$= \dfrac{\sin 160° + \sin 70° + \sin 130°}{\sin 80° \cdot \sin 35° \cdot \sin 65°} = 4$

Q.34 $f(x) = [x] + \sqrt{\{x\}} + 1$

$\Rightarrow f^{-1}(x) = g(x) = [x] + \{x\}^2 - 1$

$f(0) = 1$ and $f(2) = 3$ then

$\int_0^2 f(x)dx + \int_1^3 g(x)dx = 6$

Q.35 $(z^n - 1) = (z - \alpha_0)(z - \alpha_1) \ldots\ldots (z - \alpha_{n-1})$

$ln(z^n - 1) = ln(z - \alpha_0) + ln(z - \alpha_1) \ldots\ldots + ln(z - \alpha_{n-1})$

$\dfrac{n \cdot z^{n-1}}{z^n - 1} = \sum_{r=0}^{n-1} \dfrac{1}{z - \alpha_r}$

$\Rightarrow \dfrac{n \cdot 3^{n-1}}{3^n - 1} = \sum_{r=0}^{n-1} \dfrac{1}{3^n - \alpha_r}$

Now,

$\sum_{r=0}^{n-1} \dfrac{\alpha_r}{3 - \alpha_r} = \sum_{r=0}^{n-1} \left(\dfrac{3}{3 - \alpha_r} - 1 \right) = \dfrac{n \cdot 3^n}{3^n - 1} - n = \dfrac{n}{3^n - 1}.$

Q.36 $y = \sqrt{7 + \sqrt{7 - \sqrt{7 + \sqrt{7 - \ldots\ldots \infty}}}}$

$\Rightarrow y^2 = 7 + \sqrt{7 - y} \Rightarrow y = 3$

Q.37 $f_n^2(3) + 2f_n(1) = 9f_n^2(1) + 2f_n(1)$

$= 9\left(\dfrac{10^n - 1}{9}\right)^2 + \dfrac{2(10^n - 1)}{9}$

$= \dfrac{10^{2n} - 1}{10 - 1} = f_{2n}(1).$

Q.38 $2^a + 3^b + 5^c = 2^a + (4 - 1)^b + (4 + 1)^c$
$= 2^a + 4k + (-1)^b + 1$

Case-1: $a = 1 \Rightarrow b \in$ even and c is any number
number of ways = 10.
Case-2: $a \neq 1 \Rightarrow b \in$ odd and c is any number
number of ways $= 4 \times 3 \times 5 = 60$.

Q.39 In multinomial, by beggar's method
Total number of distinct terms $= {}^{n+r-1}C_{r-1}$.
So, ${}^{n+4-1}C_{4-1} = {}^{n+3}C_3 = {}^{n+3}C_n$.

Q.40 $f(x) = \begin{vmatrix} x^2+3x & x-1 & x-3 \\ x+1 & 2-x & x-3 \\ x-3 & x+4 & 3x \end{vmatrix}$

$f'(0) =$

$$\begin{vmatrix} 3 & -1 & -3 \\ 1 & 2 & -3 \\ 1 & 4 & 0 \end{vmatrix} + \begin{vmatrix} 0 & 1 & -3 \\ 1 & -1 & -3 \\ -3 & 1 & 0 \end{vmatrix} + \begin{vmatrix} 0 & -1 & 1 \\ 1 & 2 & 1 \\ -3 & 4 & 3 \end{vmatrix}$$

$= 36 + 3 - 6 + 9 + 6 + 6 + 10 = 60$.

Q.41

$$PP^T = \begin{bmatrix} \frac{\sqrt{3}}{2} & \frac{1}{2} \\ \frac{-1}{2} & \frac{\sqrt{3}}{2} \end{bmatrix} \begin{bmatrix} \frac{\sqrt{3}}{2} & \frac{-1}{2} \\ \frac{1}{2} & \frac{\sqrt{3}}{2} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = I$$

$\Rightarrow Q^2 = PAP^TPAP^T = PA^2P^T$

$\Rightarrow P^TQ^{2019}P = A^{2019} = \begin{bmatrix} 1 & 2019 \\ 0 & 1 \end{bmatrix}$.

Q.42 $n(A \times B) = n(S) = 20$.
$a + b = 9 \Rightarrow \{(1, 8), (3, 6), (5, 4), (7, 2)\}$
$n(E) = 4$

$P(E) = \frac{1}{5}$.

Q.43 $f(x) = x^3 - x^2 + 4x + 2\sin^{-1}x$

$f'(x) = 3x^2 - 2x + 4 + \frac{2}{\sqrt{1-x^2}} > 0$

$\forall x \in (0, 1)$
$\Rightarrow$ Range is $[0, 4 + \pi]$.

Q.44 Put $\sin x = 1 + t \Rightarrow$ if $x \to \frac{\pi}{2} \Rightarrow t \to 0$

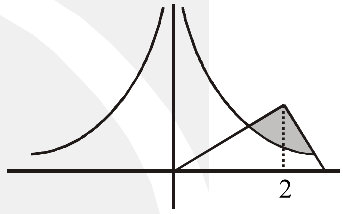
$$\lim_{t\to 0} \frac{(1+t)-(1+t)^{(1+t)}}{-t+ln(1+t)} = \lim_{t\to 0} \frac{(1+t)^t - 1}{t - ln(1+t)}$$

$$= \lim_{t\to 0} \frac{1+t^2+\frac{t(t+1)t^2}{2!}+\ldots\ldots-1}{t-\left(t-\frac{t^2}{2}+\frac{t^3}{3}+\ldots\ldots\right)} = 2.$$

Q.45 $f'(x) = 3x^2 + 2ax + b - 5\sin 2x > 0 \ \forall x \in R$
$\Rightarrow a^2 - 3(b - 5) < 0 \Rightarrow a^2 - 3b + 15 < 0$.

Q.46 Let the point be $(2t^2, 4t)$
Equation of normal is $tx + y = 4t + 2t^3$
$\Rightarrow 2t^3 + 4t + 6 = 0 \Rightarrow t^3 + 2t + 3 = 0$
$\Rightarrow (t + 1)(t^2 - t + 3) = 0 \Rightarrow t = -1$
point be $(2, -4)$.

Q.47 $y = \begin{cases} x, & x < 2 \\ 4-x, & x \geq 2 \end{cases}$; $y = \begin{cases} \frac{3}{x}, & x > 0 \\ \frac{-3}{x}, & x < 0 \end{cases}$



Hence, required area

$$= \left| \int_{\sqrt{3}}^{2} \left(x - \frac{3}{x}\right) dx \right| + \left| \int_{2}^{3} \left((4-x) - \frac{3}{x}\right) dx \right|$$

$= \frac{5 - 3ln3}{2}$.

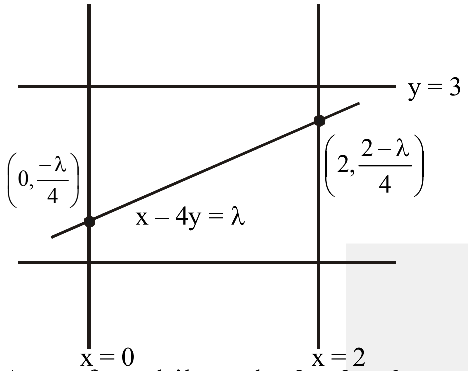
Q.48 Put $x + y = t \Rightarrow 1 + \frac{dy}{dx} = \frac{dt}{dx}$

$$\left(\frac{t-1}{t-2}\right)\left(\frac{dt}{dx} - 1\right) = \frac{t+1}{t+2}$$

$$\Rightarrow \frac{(t^2+t-2)\,dt}{(t^2+2)} = 2dx$$

$$\Rightarrow t + \frac{ln|t^2-2|}{2} = 2x + C$$

$$\Rightarrow (y - x) + \frac{ln|(x+y)^2 - 2|}{2} = C.$$

Q.49 

Area of quadrilateral = 2 × 3 = 6

$\Rightarrow 3 = \frac{1}{2}\left(\frac{2-2\lambda}{4}\right) \times 2 \Rightarrow \lambda = -5.$

Q.50 $\frac{\sin^4\theta}{5} + \frac{\cos^4\theta}{1} = \frac{(\sin^2\theta + \cos^2\theta)^2}{5+1}$

$\Rightarrow \frac{\sin^4\theta}{5} = \frac{\cos^4\theta}{1} \Rightarrow \tan^2\theta = 5.$

Q.51 Let the circle be
$x^2 + y^2 - a^2 + \lambda\,(x\cos\alpha + y\sin\alpha - P) = 0$

Centre is $\left(\frac{-\lambda\cos\alpha}{2}, \frac{-\lambda\sin\alpha}{2}\right)$.

$\Rightarrow \lambda = -2P.$

Q.52 Let P(h, k), then

$ky = 4b\left(\frac{2ax}{k} + \frac{2ah}{k}\right) = 0 \Rightarrow D = 0$

$\left(\frac{8ab}{k}\right)^2 = \frac{8ah}{k} \Rightarrow xy = \text{constant}.$

Q.53 Centre is point of intersection of
$2x - y + 1 = 0$ and $x + 2y - 3 = 0$.

Q.54 Let the tangent be $y = mx + \frac{2}{m}$

$x\left(mx + \frac{2}{m}\right) = -1 \Rightarrow mx^2 + \frac{2x}{m} + 1 = 0$

$D = \frac{4}{m^2} - 4m = 0 \Rightarrow m = 1.$

Q.55 $R = \sqrt{3}\,a$

$|\vec{a}| = |\vec{b}| = |\vec{c}| = \frac{a}{\sqrt{3}} = |\vec{p}|$

where $\overrightarrow{OA} = \vec{a}$; $\overrightarrow{OB} = \vec{b}$; $\overrightarrow{OC} = \vec{c}$; $\overrightarrow{OP} = \vec{p}$

$\left|\overrightarrow{PA}\right|^2 + \left|\overrightarrow{PB}\right|^2 + \left|\overrightarrow{PC}\right|^2$

$= |\vec{a} - \vec{p}|^2 + |\vec{b} - \vec{p}|^2 + |\vec{c} - \vec{p}|^2 = 6\left(\frac{a}{\sqrt{3}}\right)^2 = 2a^2$

Q.56 From theory.

Q.57 $\lim_{n\to\infty} \sum_{r=1}^{n} \frac{\pi}{n}\sin\left(\frac{\pi r}{n}\right) = \int_0^1 \pi\sin\pi x\,dx$

$= -\cos\pi x\Big|_0^1 = 2.$

Q.58 $f(x) = [3 + 11\sin x] = 3 + [11\sin x]$
Number of points at which y = f(x) is not differentiable is 21.

Q.59 $f(x) = (\sin^{-1}x)^4 + (\cos^{-1}x)^4$

$\Rightarrow f'(x) = \frac{4\left((\sin^{-1}x)^3 - (\cos^{-1}x)^3\right)}{\sqrt{1-x^2}}$

$\Rightarrow$ f(x) is decreasing in $\left(-1, \frac{1}{\sqrt{2}}\right)$

and increasing in $\left(\frac{1}{\sqrt{2}}, 1\right)$.

$f_{max.} = f(-1) = \frac{17\pi^4}{16}$; $f_{min} = f\left(\frac{1}{\sqrt{2}}\right) = \frac{\pi^4}{128}$.

Q.60 $f(x) = \int\sqrt{\frac{\cos x - \cos^3 x}{1 - \cos^3 x}}\,dx = \frac{2}{3}\int\frac{dt}{\sqrt{1-t^2}}$

$f(x) = \frac{2}{3}\left(\sin^{-1}(\cos x)^{\frac{3}{2}}\right).$

PHYSICS

Q.61 For W to be maximum ; $\frac{dW}{dx} = 0$;
i.e. $F(x) = 0 \quad \Rightarrow x = \ell, x = 0$
Clearly for d = 1, the work done is maximum.
Alternate Solution :
External force and displacement are in the same direction

$\therefore$ Work will be positive continuosly so it will be maximum when displacement is maximum.

Q.62 At equilibrium

$mg = 6\pi\eta rv$ or $\rho\frac{4\pi}{3}r^3g = 6\pi\eta rv$

$\therefore \frac{v_r}{v_{2r}} = \frac{(r)^2}{(2r)^2}$ or $v_{2r} = (v_r) \times 4$

$= 4$ cm/s.

Q.63 At maximum depth the ray graze the surface (i.e. the angle made by the ray with normal will become 90°)
Applying Snell's law

$$1 \times \sin 45^0 = \left(\sqrt{2} - \frac{1}{\sqrt{2}}x\right)\sin 90^0$$

$$\Rightarrow \sqrt{2} - \frac{1}{\sqrt{2}}x = \frac{1}{\sqrt{2}} \text{ or } x = 1 \text{ m}$$

Q.64 (2) $dB = 10\log\left(\frac{I}{I_0}\right) = 10\log\left(\frac{K/r^2}{I_0}\right) = 10$
$[\log(K^1) - 2\log r]$
$dB_1 = 10(\log K' - 2\log r_1)$
$dB_2 = 10(\log K' - 2\log r_2)$

$$3 = dB_1 - dB_2 = 20\log\left(\frac{r_2}{r_1}\right)$$

$$(0.3) = \log\left(\frac{r_2}{r_1}\right)^2 \Rightarrow \left(\frac{r_1}{r_2}\right) = \frac{1}{\sqrt{2}}$$

Q.65 Induced emf in the rod $\varepsilon = Blv$
Current in the circuit

$$I = \frac{\varepsilon}{R}e^{-t/RC} = \frac{Blv}{R}e^{-t/RC}$$

Since the net force on the rod should be zero, the external force will be equal in magnitude but opposite to the magnetic force.

$$\Rightarrow F = I\,l\,B = \frac{B^2l^2v}{R}e^{-t/RC}$$

Q.67 $n = \lambda N = \lambda = \frac{n}{N}$

$$\therefore t_{1/2} = \frac{0.69}{\lambda} = \frac{0.69\ N}{n}$$

Q.68 Energy released $= (80 \times 7 + 120 \times 8 - 200 \times 6.5) = 220$ MeV.

Q.69 Angular momentum $= \frac{nh}{2\pi} = \frac{h}{2\pi}$

$(\because n = 1)$

Q.70 $C = \frac{\varepsilon_0 A}{L}$

$$\therefore \log C = \log\varepsilon_0 + \log A - \log L$$

$$\frac{dC}{C} = \frac{dA}{A} - \frac{dL}{L}$$

$$\frac{dC}{C} = 2\alpha_1\,dT - \alpha_2 dT = 0$$

$$\therefore 2\alpha_1 = \alpha_2$$

Q.71 Since elasticity of balloon is negligible, pressure inside ballon $\simeq$ pressure outside baloon $= P_{atm}$.
$\therefore W = P_{atm}\Delta V$
$V_{in} = 10$ litre.

$$\frac{V_{in}}{T_{in}} = \frac{V_{fin}}{T_{fin}} \Rightarrow V_{final} = \left(\frac{V_{in}T_{final}}{T_{in}}\right) \text{litre.}$$

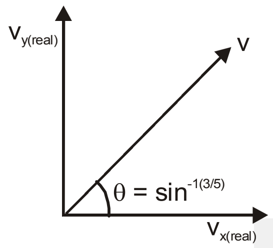
$$\Rightarrow W = P_{atm}V_{in}\left(\frac{T_{final}}{T_{in}} - 1\right)$$

$$\Rightarrow 10^5 \times 10^{-2}\left(\frac{58}{290}\right) = 200 \text{ J}$$

Q.72 Let y-axis be vertically upwards and x-axis be horizontal.

$$V_y\,(\text{app.}) = \frac{V_y(\text{real})}{\left(\frac{1}{\mu}\right)}$$

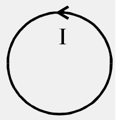
$$V_x\,(\text{app.}) = V_x\,(\text{real})$$



$$\tan\phi = \frac{V_y(\text{app})}{V_x(\text{app})} = \frac{4}{3}\tan\theta = \frac{4}{3}\times\frac{3}{4} = 1$$

Q.73 $E = \pi \times 10^{-9}\,\omega\sin\omega t$
Also $E = i \times 2$.
$\Rightarrow i = \dfrac{\pi\omega}{2} \times 10^{-9}\sin\omega t$.

Q.74 As soon as the field changes, there will be an induced current (anticlockwise) in the ring. As there is always a electromagnetic force acting on a current carrying element. Hence, there will be a torque on the ring about its axis. Hence (2).

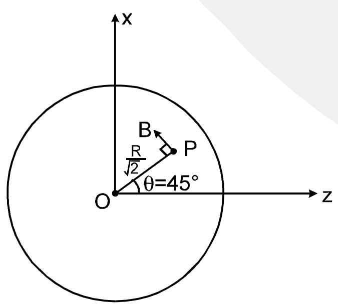


Q.75 The magnitude of magnetic field at $P\left(\frac{R}{2}, y, \frac{R}{2}\right)$ is

$$B = \frac{\mu_0 Jr}{2} = \frac{\mu_0 i}{2\pi R^2} \times \frac{R}{\sqrt{2}} = \frac{\mu_0 i}{2\sqrt{2}\pi R}$$

unit vector in direction of magnetic field is

$$\hat{B} = \frac{\hat{i}-\hat{k}}{\sqrt{2}}$$



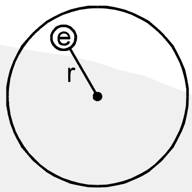
$\therefore \quad \vec{B} = B\hat{B} = \dfrac{\mu_0 i}{4\pi R}(\hat{i}-\hat{k})$

Alternate solution

$$\vec{B} = \frac{\mu_0}{2}\vec{J}\times\vec{r} = \frac{\mu_0}{2}\frac{i}{\pi R^2}\hat{j} \times \left(\frac{R}{2}\hat{i} + \frac{R}{2}\hat{k}\right) = \frac{\mu_0 i}{4\pi R}(\hat{i}-\hat{k})$$

Q.76 $eE = m_e\,\omega^2 r$

$$\Rightarrow \quad \int E\,dr = \frac{m_e\omega^2}{e}\int_0^R r\,dr$$



$$\Rightarrow \quad V = \frac{m_e\omega^2 R^2}{2e}$$

Q.77 As field is uniform

Acceleration 'a' $= \dfrac{qE}{m}$. $E = \dfrac{\sigma}{2\epsilon_0}$

Using $s = \dfrac{1}{2}at^2 \Rightarrow t = \dfrac{2s}{a}$

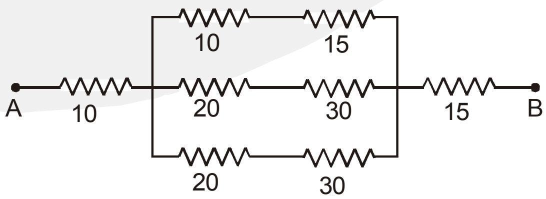
on putting values $t = 4\sqrt{2}\mu s$

Q.78 Strain $(\varepsilon) = \dfrac{\Delta\ell}{\ell} = \propto \Delta T = (10^{-5})(200)$
$= 2 \times 10^{-3}$
Stress = Y (strain)
Stress $= 10^{11} \times 2 \times 10^{-3} = 2 \times 10^{8}$ N/m^2
$\Rightarrow$ Required force = stress × Area = $(2 \times 10^{8})(2 \times 10^{-6}) = 4 \times 10^{2} = 400$ N

$\therefore$ Mass to be attached $= \dfrac{400}{g} = 40$ kg

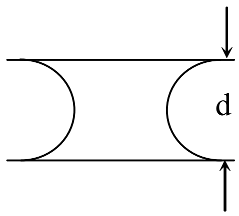
Ans.

Q.79 Equivalent circuit is



$= 37.5\ \Omega$

Q.80 The shape of water layer between the two plates is shown in the figure.
Thickness d of the film
= 0.12 mm = 0.012 cm.



Radius R of cylindrical face $= \frac{d}{2}$.

Pressure difference across the surface

$= \frac{T}{R} = \frac{2T}{d}$.

Area of each plate wetted by water = A.
Force F required to separate the two plates is given by

F = pressure difference × area $= \frac{2T}{d}A$

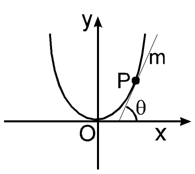
$= \frac{2 \times 75 \times 8}{0.012} = 10^5$ dynes

Q.81 Momentum of the system remains conserved as no external force is acting on the system in horizontal direction.
∴ (50 + 100) 10 = 50 × V + 100 × 0
⇒ V = 30 m/s towards right, as boat is at rest.
$V_{P_{boat}} = 30$ m/s

Q.82 $mg = m\omega^2 R$, $\omega = \sqrt{\frac{g}{R}}$

Q.83 $x^2 = 4ay$
Differentiating w.r.t. y, we get

$$\frac{dy}{dx} = \frac{x}{2a}$$



∴ At (2a, a), $\frac{dy}{dx} = 1$

⇒ hence θ = 45°

the component of weight along tangential direction is mg sin θ.

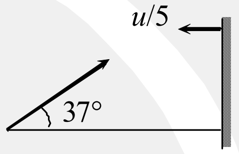
hence tangential acceleration is $g \sin\theta = \frac{g}{\sqrt{2}}$

Q.84 When connected in parallel
Potential difference across each capacitor = v
P.D. when connected in series = N.V.

Q.85 Let the ball collides with the wall after time t.
Let velocity of ball after collision is v.

$$\frac{-v-\left(-\frac{u}{5}\right)}{-\frac{u}{5}-u\cos 37} = \frac{1}{4}\ ;\ -v+\frac{u}{5} = -\frac{u}{4}\ ;$$

$$v = \frac{u}{5}+\frac{u}{4} = \frac{9u}{20}$$



Also, $(u\cos 37)\,t = \frac{9u}{20}(T-t)$

$$\frac{4ut}{5} = \frac{9u}{20}\left(\frac{2u}{g}\frac{3}{5}-t\right) \Rightarrow t = \frac{54u}{125g}$$

Q.86 The current lags the EMF by π/2, so the circuit should contain only an inductor.

Q.87 $x = A\sin\frac{2\pi}{T}t$; for $x = \frac{A}{2}$

$\Rightarrow \frac{A}{2} = A\sin\frac{2\pi}{T}t$

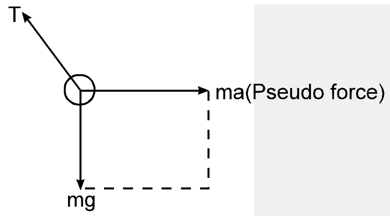
Solving $t = \frac{T}{6}$.

Q.88 $\omega_{rod} = \omega_{point} = \left(\frac{v_{rel.}}{r}\right)$; $v_{rel.}$ being the velocity of one point w.r.t. other.

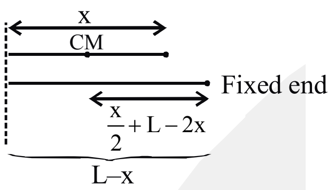
$= \frac{3v-v}{r}$ and 'r' being the distance between them. $= \frac{2v}{r}$

Q.89 Acceleration of box = 10 m/s^2
Inside the box forces acting on bob are shown in the figure

$$T = \sqrt{(mg)^2 + (ma)^2} = 10\sqrt{2}\ \text{N}$$



Q.90



$$\frac{d}{dt}(L - 2x) = 1\ \text{m/s}$$

$$\therefore -\frac{dx}{dt} = \frac{1}{2}\ \text{m/s}$$

$$\therefore r_{CM} = \frac{2L - 3x}{2}$$

$$\frac{dr_{CM}}{dt} = v_{CM} = \frac{-3}{2}\frac{dx}{dt} = \frac{3}{4}\ \text{m/s}$$