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ANSWER KEY

DATE: 28-11-2018

COURSE
NUCLEUS

JEE-MAIN MOCK TEST-5
XII

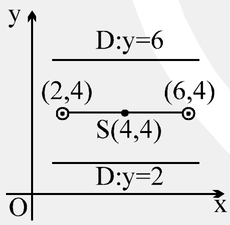
TEST CODE				
1	1	2	7	0

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

HINTS & SOLUTIONS

MATHEMATICS

Q.1 focus is (4, 4) & D can be y = 6 or y = 2



where 'O' is origin and S is the focus and D is directrix

Q.2 Apply $R_3 \to R_3 - R_1$, we get

$$\Delta = \begin{vmatrix} 1 & 3\cos\theta & 1 \\ \sin\theta & 1 & 3\cos\theta \\ 0 & \sin\theta - 3\cos\theta & 0 \end{vmatrix}$$

$= (3\cos\theta - \sin\theta)^2$

So, maximum value of Δ equals 10.

Q.3 We have $|z|^2 + \dfrac{16}{|z|^3} = z^2 - 4z = \bar{z}^2 - 4\bar{z}$

$\Rightarrow (z - \bar{z})\ (z + \bar{z} - 4) = 0$

$\Rightarrow z = \bar{z} = x\ (x \neq 2)$

So, $x^2 = 4x + x^2 + \dfrac{16}{|x|^3} \Rightarrow x = \dfrac{-4}{|x|^3}$

$\Rightarrow x = -\sqrt{2}$

$\therefore z = -\sqrt{2}$

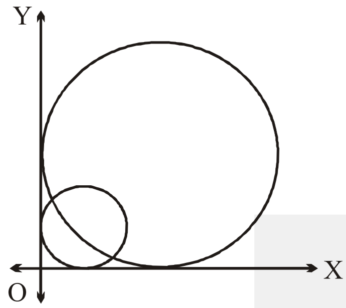
Hence only one z will satisfy above equation.

Q.4 Circle is $(x - r)^2 + (y - r)^2 = r^2$

$\Rightarrow \quad x^2 + y^2 - 2xr - 2yr + r^2 = 0$

Hence the circles are

$x^2 + y^2 - 2xr_1 - 2yr_1 + r_1{}^2 = 0$ ......(1)



$x^2 + y^2 - 2xr_2 - 2yr_2 + r_2^2 = 0$ .....(2)

As (1) and (2) are orthogonal so

$$2r_1r_2 + 2r_1r_2 = r_1^2 + r_2^2$$

$$4\frac{r_1}{r_2} = \left(\frac{r_1}{r_2}\right)^2 + 1$$

$$\Rightarrow \left(\frac{r_1}{r_2}\right)^2 - 4\left(\frac{r_1}{r_2}\right)^2 + 1 = 0$$

$$\Rightarrow \frac{r_1}{r_2} = \frac{4 \pm \sqrt{16-4}}{2} = \frac{2 \pm 2\sqrt{3}}{2}$$

$$= 2 + \sqrt{3} \text{ or } 2 - \sqrt{3} \text{ (rejected)}$$

Q.6 $2x\,dx - 3y\,dy = 0$ gives, on integration,

$x^2 - 3\frac{y^2}{2} = \frac{c}{2}$. The solution represents a family of hyperbolas given by $\frac{x^2}{\frac{c}{2}} - \frac{y^2}{\frac{c}{3}} = 1$

whose eccentricity $= \sqrt{\frac{\frac{c}{2}+\frac{c}{3}}{\frac{c}{2}}} = \sqrt{\frac{5}{3}}$, if $c > 0$

and eccentricity $= \sqrt{\frac{5}{2}}$, if $c < 0$. For $c = 0$, it gives a pair of lines which are the asymptotes of the hyperbolas.

Q.7 $L : (y-4) = \frac{-1}{3}(x-1)$

put $y = 0$, $x = 13$

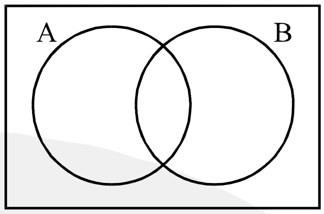
Q.8 $B = AA^T$.

Hence, det.

$B = |AA^T| = |A||A^T| = |A|^2 = 4^2 = 16.$

Q.9 Total $- n(A \cup B)$

$$\frac{6!}{2!2!} - \left(n(A) + n(B) - n(A \cap B)\right)$$



Set A represents number of ways when G's are together
Set B represents number of ways when E's are together

$$\frac{6!}{2!2!} - \left(\frac{5!}{2!} + \frac{5!}{2!} - 4!\right) = 180 - 96 = 84$$

Aliter: GG EE A R

Number of words when

G's are separated $= \frac{4!}{2!} \cdot {}^5C_2 = 120$

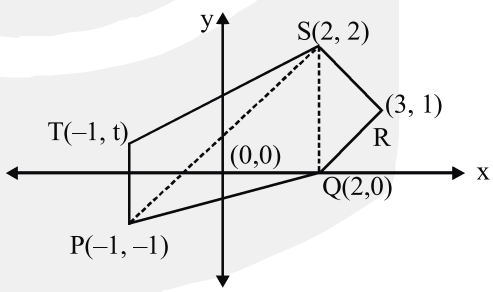
Number of words when G's are separated but E's are together $= 3! \times {}^4C_2 = 36$

$\therefore$ Number of ways when no two alike letters are together $= 120 - 36 = 84$

Q.10 We have $\sin\alpha = \frac{3}{5}$, $\cos\beta = \frac{2+2}{\sqrt{5}\sqrt{5}} = \frac{4}{5}$

So, $(\cos^2\alpha + \sin^2\beta) = \frac{16}{25} + \frac{9}{25} = 1.$

Q.11



Area of pentagon PQRST = 7

$\Rightarrow$ ar.(trapezium PQST) + ar.(ΔQRS) = 7

$$\Rightarrow \frac{1}{2}\left((t+1)+2\right) \times 3 + \frac{1}{2}(2)(1) = 7$$

$\Rightarrow$ $t = 1$ **Ans.**

Q.12 $\begin{vmatrix} 2 & 1 & 1 \\ 3 & 2\lambda & 4 \\ 1 & 1 & -3\lambda \end{vmatrix} = 0$;

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

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

$(3\lambda + 1)(2\lambda + 1) + 3\lambda(2\lambda - 4) = 0$

$\Rightarrow \quad 6\lambda^2 + 5\lambda + 1 + 6\lambda^2 - 12\lambda = 0$

$\Rightarrow \quad 12\lambda^2 - 7\lambda + 1 = 0$

$\Rightarrow \quad (3\lambda - 1)(4\lambda - 1) = 0$

$\Rightarrow \quad \lambda = \frac{1}{3}, \frac{1}{4} \Rightarrow$ Sum $= \frac{7}{12}$ **Ans.**

Q.14 Distance between centre and focus = ae = 10

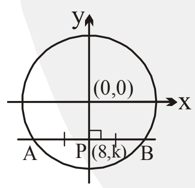
Distance between directrices $= \frac{2a}{e} = 4$

$\therefore \ \frac{ae}{\frac{2a}{e}} = \frac{10}{4} \Rightarrow e^2 = 5 \Rightarrow \frac{4e^2}{5} = 4.$

Q.15 The slope of the chord is $m = -\frac{8}{k}$

$\Rightarrow \quad k = \pm 1, \pm 2, \pm 4, \pm 8$

but (8, k) must also lie inside the circle $x^2 + y^2 = 125$



$\Rightarrow \quad 64 + k^2 - 125 < 0$

$\Rightarrow \quad k^2 < 61$

$\Rightarrow \quad$ k can be equal to $\pm 1, \pm 2, \pm 4$

$\Rightarrow \quad$ 6 values

Q.16 $\big|\,|z-(1+2i)|-|z-(3+4i)|\,\big| = 2$

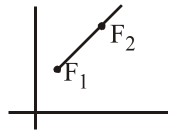
represents a hyperbola with foci (1, 2) and (3, 4) and length of transverse axis = 2.

$\therefore$ 2a = 2 $\Rightarrow$ a = 1

$\because$ Feet of perpendiculars from foci on any tangent lie on auxilliary circle of the hyperbola.

$\therefore$ Locus will be auxilliary circle.

$\therefore$ Centre = mid point of foci = (2, 3)



and radius = semi transverse axis = 1

$\therefore$ Equation of auxilliary circle is $|z-(2+3i)| = 1$

Q.17 $\square\square\square\boxed{0}\square\square\square = \frac{6\,!}{2\,!\,3\,!\,1\,!} = 60$

$\square\square\square\square\square\square\boxed{5} = \frac{6\,!}{2\,!\,3\,!\,1\,!} - \frac{5\,!}{2\,!\,3\,!}$

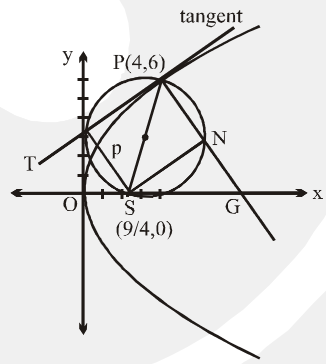
$= 50 \quad \Rightarrow \quad 60 + 50 = 110$]

Q.18 In dual statement $\vee$ replace by $\wedge$ and $\wedge$ replace by $\vee$ so answer is $(p \wedge \sim q) \vee (\sim p)$.

Q.19 Required intercept will be equal to the perpendicular distance from the focus on the tangent at P.

Tangent at P,

$y \cdot 6 = 2 \cdot \frac{9}{4}(x + 4)$



$\Rightarrow 12y = 9x + 36$

$\Rightarrow 9x - 12y + 36 = 0$

$$p = \left|\frac{\frac{81}{4}+36}{\sqrt{81+144}}\right| = \left|\frac{225}{4 \cdot 15}\right| = \frac{15}{4}$$

Q.20 $E: \frac{x^2}{9}+\frac{y^2}{4}=1 \Rightarrow P\,(3\cos\theta, 2\sin\theta)$

and C (0, 0)

$m_{CP}=\frac{2\tan\theta}{3}$; $m_T=\frac{-2\cot\theta}{3}$

$\therefore$ angle between then $=\frac{2}{3}\left|\frac{\tan\theta+\cot\theta}{1-\frac{4}{3}}\right|$

$\therefore$ angle is minimum, when $\theta=45°$

$\Rightarrow \; P\left(\frac{3}{\sqrt{2}}, \sqrt{2}\right)$.

Q.21 $\sum_{i=1}^{20}(x_i-30)=20$

$\sum x_i-\sum 30=20$

$\sum x_i-30\times 20=20$

$\sum x_i=620$

Mean $=\frac{\sum x_i}{20}=\frac{620}{20}=31$.

Q.22 We have $[\hat{a}\;\; \hat{b}\;\; \hat{a}\times\hat{b}]=\frac{1}{4}$

$\Rightarrow (\hat{a}\times\hat{b})\cdot(\hat{a}\times\hat{b})=\frac{1}{4} \;\Rightarrow\; |\hat{a}\times\hat{b}|=\frac{1}{4}$

$\Rightarrow \; \sin^2\theta=\frac{1}{4} \;\Rightarrow\; \sin\theta=\frac{1}{2}$

Hence $\theta=\frac{\pi}{6}$ $\quad(\text{As } |\vec{a}|=1=|\vec{b}|)$

Q.25 We have $z=\frac{2^8(\sqrt{3}+i)^8}{(1-i)^6}+\frac{(1+i)^6}{2^8(\sqrt{3}-i)^8}$

$$=\frac{2^8\left(2e^{\frac{i\pi}{6}}\right)^8}{\left(\sqrt{2}\,e^{\frac{-i\pi}{4}}\right)^6}+\frac{\left(\sqrt{2}\,e^{\frac{i\pi}{4}}\right)^6}{2^8\left(2e^{\frac{-i\pi}{6}}\right)^8}$$

$$=\frac{2^{16}e^{\frac{i4\pi}{3}}}{2^3e^{\frac{-3\pi i}{2}}}+\frac{2^3e^{\frac{3\pi i}{2}}}{2^{16}e^{\frac{-4\pi i}{3}}}$$

$$=2^{13}e^{i\left(\frac{4\pi}{3}+\frac{3\pi}{2}\right)}+\frac{1}{2^{13}}e^{i\left(\frac{3\pi}{2}+\frac{4\pi}{3}\right)}$$

$$=\left(2^{13}+\frac{1}{2^{13}}\right)e^{i\left(\frac{4\pi}{3}+\frac{3\pi}{2}\right)}$$

Hence $|z|=2^{13}+\frac{1}{2^{13}}$ and

amp $z=\frac{4\pi}{3}+\frac{3\pi}{2}-2\pi=\frac{5\pi}{6}$

Q.26 L_1 and L_2 are intersecting lines.

The position vector of their point of intersection is $5\hat{i}-7\hat{j}+6\hat{k}$ (For $\lambda=2$ or $\mu=1$).

Also, angle between L_1 and $L_2=\frac{70}{11\sqrt{42}}$.

Q.27 Since, both the planes are parallel

$P_1: 4x-6y+12z+10=0$

$P_2: 4x-6y+12z+d=0$

$b=-6,\ c=12$

Now, $\left|\frac{d-10}{2\sqrt{4+9+36}}\right|=3$

$|d-10|=42 \;\Rightarrow\; d=52$ or -32

$\therefore$ P_2 is $4x-6y+12z+52=0$

or $\quad 4x-6y+12z-32=0$

$\because$ Point $(-3, 0, -1)$ is lying between planes P_1 and P_2

$\therefore$ On substituting the point in the equation of the planes both expressions must be of opposite sign.

From P_1:

$4\times(-3)-6\times 0+12(-1)+10=-ve$

From P_2:

$4\times(-3)-6\times 0+12(-1)+52=+ve$

$\therefore$ d must be 52

Hence, $(b+c+d)=-6+12+52=58$

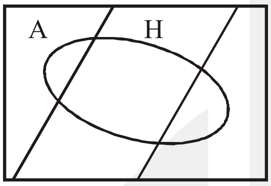
Q.28 H: Victim was hit

A: Event that Mr. A was given the live bullet ; $P(A) = \frac{1}{3}$

B: Mr. B had live bullet ; $P(B) = \frac{1}{3}$

C: Mr. C has live bullet ; $P(C) = \frac{1}{3}$

$$P(C/H) = \frac{P(C \cap H)}{P(H)} = \frac{P(C) \cdot P(H/C)}{P(H)}$$



$$P(H) = P(H \cap C) + P(H \cap B) + P(H \cap A)$$

$$= \frac{1}{3}[P(H/C) + P(H/B) + P(H/A)]$$

$$= \frac{1}{3}[0.8 + 0.7 + 0.6] = \frac{0.21}{3}$$

$$P(C/H) = \frac{0.8}{0.21} = \frac{8}{21}$$

Q.29 $(a, a) \in R$ since $a = 3^0 \cdot a$

$\Rightarrow$ R is reflexive

if $(a, b) \in R \Rightarrow a = 3^k \cdot b,\ k \in I$

$\Rightarrow b = 3^{-k} \cdot a,\ -k \in I \Rightarrow (b, a) \in R$

$\Rightarrow$ R is symmetric

if (a, b) and $(b, c) \in R$

$\Rightarrow a = 3^{k_1} \cdot b,\ b = 3^{k_2} \cdot c,\quad k_1, k_2 \in I$

$\Rightarrow a = 3^{k_1 + k_2} \cdot c,\ -(k_1 + k_2) \in I$

$\Rightarrow (a, c) \in R \Rightarrow$ R is transitive.

$\therefore$ R is an equivalence relation

Q.30 Solving the equation of planes, we get equation of line containing planes

$$\frac{x}{0} = \frac{y}{-10} = \frac{z}{-5} \qquad \text{...........(1)}$$

Any point P on (1) is $(0, -10\lambda, -5\lambda)$.

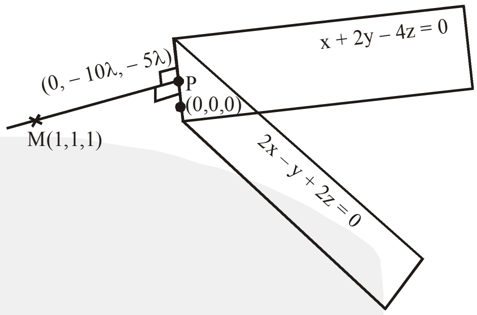
Now, direction ratios of the line joining P and M is $\langle 1, 1+10\lambda, 1+5\lambda \rangle$

As line MP is perpendicular to line (1), so

$0(1) - 10(1 + 10\lambda) - 5(1 + 5\lambda) = 0$

$$\Rightarrow \lambda = \frac{-3}{25} \Rightarrow P\left(0, \frac{6}{5}, \frac{3}{5}\right)$$

So, d.r's of MP are $\left\langle -1, \frac{1}{5}, \frac{-2}{5} \right\rangle$

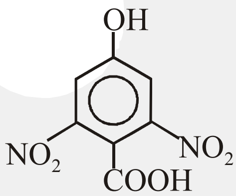


So, equation of required line is $\frac{x-1}{5} = \frac{y-1}{-1} = \frac{z-1}{2}$. **Ans.**

CHEMISTRY

Q.31 Theory based

Q.32



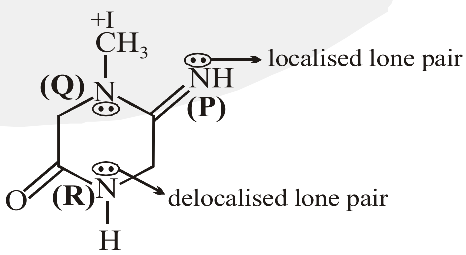
Due to S.I.R. effect

Q.33 As we move left to right metallic character decreases and as we move top to bottom metallic character increases, so correct is

P (group15)	<	Si (group14)	<	Be (group 2 II period)	<	Mg (group 2 III period)	<	Na (group1)

Q.34 Theory based

Q.35



Basicity order of indicated atoms P, Q, R is

$P > Q > R$

Q.36 Theory based

Q.37 $n_{mix} = \left(\dfrac{1 \times 0.0249}{0.083 \times 300}\right) mol = 0.001\ mol$

$\therefore\ n_{O_2} = n_{F_2} = \dfrac{0.001}{2}\ mol$

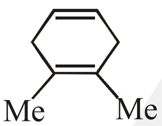
$\therefore\ n_{O_2F_2}\ (\text{decomposed}) = \dfrac{0.001}{2}\ mol.$

$\therefore\ m_{O_2F_2}\ (\text{decomposed}) =$

$\dfrac{0.001}{2} \times 70g = (0.001 \times 35)g$

$\therefore$ % of O_2F_2 decomposed =

$\dfrac{0.001 \times 35}{0.1} \times 100\% = 35\ \%$ **Ans.**

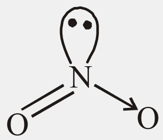
Q.38  Cyclohexene does not show Geometrical Isomerism

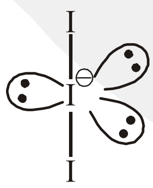
Q.40 $n_{Ba^{2+}} = n_{BaSO_4} = \dfrac{0.233}{233} mol$

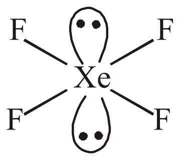
$\therefore\ [Ba^{2+}] = \left(\dfrac{0.233/233}{50/1000}\right) M$

$= \left(\dfrac{1000}{50} \times \dfrac{0.233}{233}\right) M$

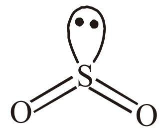
Q.41 Ethers are more volatile than same number of carbon containing alcohol due to absence of H-bonding.

Q.42 (1) NO_2 

(2) I_3^-  (Linear)

(3) XeF_4 

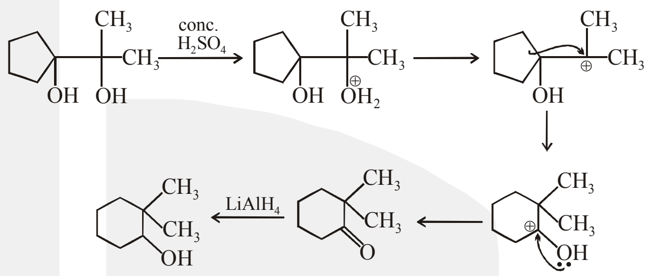
(Square planar)

(4) SO_2 

(Bent, due to lone pair-bond pair repulsion)

Q.43 Theory based

Q.44



Q.45 (1) $H_2 + Cl_2 \longrightarrow$

$2HCl$ → H^+ act as reducing agent; → Cl^-

(2) $2Na + H_2 \longrightarrow$

$2NaH$ → Na^+; → H^- act as oxidising agent

(3) $Cu_2O + H_2 \longrightarrow 2Cu + H_2O$
$\rightarrow$ act as reducing agent

(4) $RCHO + H_2 \longrightarrow R - CH_2 - OH$
$\rightarrow$ act as reducing agent

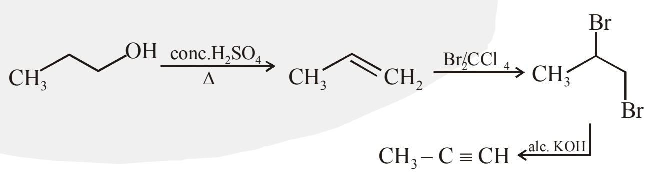
Q.46 Empirical formula of the compound $= Tl_{\frac{89.5}{204}} O_{\frac{10.5}{16}}$

$= Tl_{0.439}\ O_{0.656} = TlO_{1.5}$

i.e. E.F. $= Tl_2O_3$

$\therefore$ O.N. of $Tl = +3$

Q.47



Q.48 (1) $Na + H_2O \longrightarrow 2Na^+ + 2OH^- + H_2$ (redox)

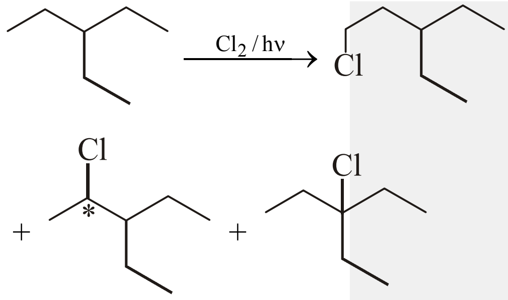
(2) $P_4O_{10} + H_2O \longrightarrow H_3PO_4$ (Hydorlysis)

(3) $CrCl_3 + H_2O \longrightarrow CrCl_3.6H_2O$ (Hydrated formation)

(4) $BaSO_4 + H_2O \longrightarrow$ ppt. formation (Insoluble)

Q.49 Theory based

Q.50



(1) (2) (1)

Total products = 4

Q.51 (1) $Na(s) + NH_3\,(liq.) \longrightarrow Na^+\,(ammoniated) + e^- + NH_2\uparrow$

(2) $Na(s) + O_2\,(excess) \longrightarrow Na_2O_2$

(3) $Na(s) + H_2O \longrightarrow NaOH + H_2$

(4) $Na(s) + H_2 \longrightarrow NaH$

Q.52 $E_{2s} = -13.6 \times \frac{1^2}{2^2}\,eV = -E$

and $E_{3p} = -13.6 \times \frac{1^2}{3^2}\,eV$

$\therefore \frac{E_{3p}}{E_{2s}} = \frac{4}{9}$

$\therefore E_{3p} = -\frac{4}{9}E$

Q.53 $C_2H_5 - Cl \xrightarrow[S_N2]{KCN} C_2H_5 - CN \xrightarrow{Na/C_2H_5OH} C_2H_5 - CH_2 - NH_2$

Q.54 As we move top to bottom basic nature of oxide increases.

Q.55 In 1L hard water equivalent

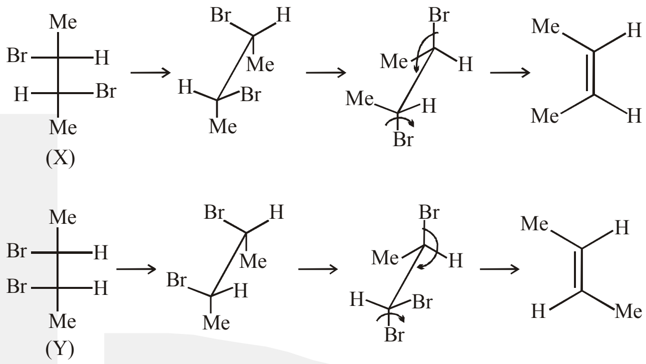
$n_{CaCO_3} = \left(\frac{1.11}{111} + \frac{4.75}{95}\right) \times 5$ mmol.

= 0.3 mmol

$\therefore m_{CaCO_3} = (0.3 \times 100)$ mg = 30 mg

$\therefore$ Hardness of water = 30 mg/L = 30 ppm

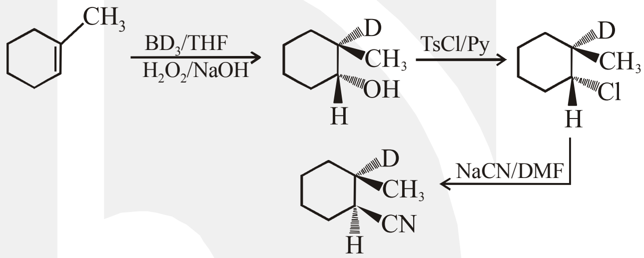
Q.56



Q.57 $Na_2B_4O_7$ (Borax) + $7H_2O \longrightarrow 2NaOH + 4H_3BO_3$ (Ortho boric acid)

Q.58 Theory based

Q.59



Q.60 (i) $2SO_2\,(g) + O_2(g) \xrightarrow{V_2O_5} 2SO_3\,(g)$

$SO_3(g) + H_2SO_4 \longrightarrow H_2S_2O_7$ (oleum)

$H_2S_2O_7 + H_2O \longrightarrow 2H_2SO_4$

(ii) $N_2\,(g) + 3H_2\,(g) \rightleftharpoons 2NH_3\,(g)$

(iii) $C(s) + H_2O\,(g) \xrightarrow{473K-1273K} CO(g) + H_2\,(g)$
water gas

(iv) $4NH_3(g) + 5O_2\,(g) \xrightarrow[500K,\,9bar]{Pt/Rhy\ Gauge\ catalyst} 4NO(g) + 6H_2O(g)$

$2NO\,(g) + O_2\,(g) \rightleftharpoons 2NO_2\,(g)$

$3NO_2\,(g) + H_2O\,(l) \longrightarrow 2HNO_3\,(aq.) + NO\,(g)$

PHYSICS

Q.61 $\frac{L}{M} = \frac{2m}{q} \Rightarrow M = \frac{Lq}{2m} = \frac{I\omega q}{2m} = \frac{ml^2\omega q}{24m}$

Q.62 $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2}$

$= \frac{x}{\varepsilon_0 A} + \frac{a-b-x}{\varepsilon_0 A} \Rightarrow C = \frac{\varepsilon_0 A}{a-b}$

Q.63 Coulombic force between them remains same.

$v_i = \frac{1}{2}\frac{6}{5}CV^2$; $q_i = \frac{6}{5}CV$; $q_f = \frac{11}{5}CV$

$U_f = \left(\frac{1}{2}\frac{6}{5}CV^2 + \frac{1}{2}CV^2\right)$

Charge flown from battery = CV

Work done = CV^2

Heat produced $\Delta H = \Delta U + \Delta W$

$= \left[\left(\frac{1}{2}\frac{6}{5}CV^2 + \frac{1}{2}CV^2\right) - \frac{1}{2}\frac{6}{5}CV^2\right] - CV^2$

$= -\frac{1}{2}CV^2$

Q.64 Potential across capacitor is zero, hence energy stored is zero.

Q.65 $\omega = 0 + 1 \times 10 = 10$ rad/sec^2

$\therefore v = r\omega = 1 \times 10 = 10$ m/s

$\overline{B} = \frac{\mu_0}{4\pi}\frac{q(\vec{V}\times\vec{r})}{r^3} \Rightarrow |\overline{B}| = \frac{\mu_0 qv}{4\pi r^2}$

$B = \frac{10^{-7} \times 0.1 \times 10}{(1)^2} = 10^{-7}T$

Q.66 $i = \sqrt{5}A$

$\frac{q_m^2}{2C} = \frac{q^2}{2C} + \frac{1}{2}Li^2 \Rightarrow q_{max} = 6C$

Q.67 $V_{centre} = \frac{kq}{d} - \frac{kq}{d} + \frac{\Sigma kQ_{in}}{r} = \frac{kQ}{r}$

Q.68 There will be no current any where in the circuit.

Q.69 $\phi = \frac{q}{\varepsilon_0} \times \frac{2\pi(1-\cos\theta)}{4\pi}$

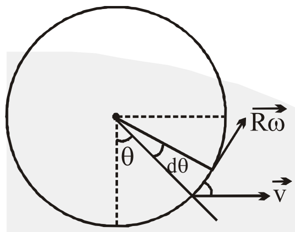
$\phi = \frac{q}{2\varepsilon_0}(1-\cos\theta)$

and $F = qE = q\cdot\frac{\sigma}{2\varepsilon_0}(1-\cos\theta)$

Q.70 Only charge is that capacitor 'C' will get charged.

Hence heat $= \frac{1}{2}CV^2$.

Q.71



$dl = R d\theta$

$dl = (\vec{v}\times\vec{B}).dl$

$= \left[(\vec{v} + \overrightarrow{R\omega})\times B\right].\overrightarrow{dl}$

$= (\vec{v}\times\vec{B}).\overrightarrow{dl} + (\overrightarrow{R\omega}\times\vec{B}).\overrightarrow{dl}$

$= (\vec{v}\times\vec{B}).Rd\theta$

$= vBRd\theta\cos\theta$

$e = vBR\int_0^{\pi/2}\cos\theta\, d\theta$

$|e| = vBR$

Q.72 For image to be coincident, either the rays should retrace or the image due to the lens should formed just at the pole of the mirror in thin case. The image formed due to lens is at 30 cm (2f) be from the lens. Thus either this image should be at centre of curvature of the convex mirror or at the pole of the mirror. Hence 6cm or 30cm should be the separation between the lens and the mirror.

Q.73 Its a wheat stone bridge with equivalent 2R.

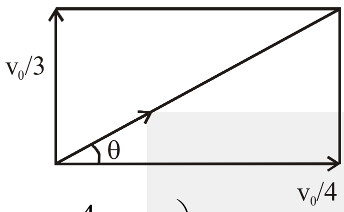
Q.74 Let I_2 be current in capacitor

$I_1 = \frac{v_0}{4}\sin\omega t$

$I_2 = \frac{v_0}{3}\sin(\omega t + \pi/2)$

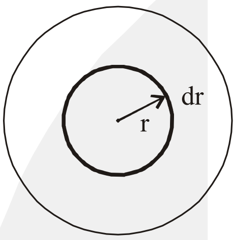
$$I = I_1 + I_2 = \frac{v_0}{4}\sin\omega t + \frac{v_0}{3}\sin(\omega t + \pi/2)$$

$$\tan\theta = \frac{v_0/3}{v_0/4}$$



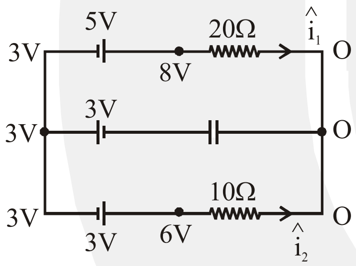
Q.75 $(4\pi r^2)dp = \left(\frac{1}{4\pi\epsilon_0}\frac{\rho\frac{4}{3}\pi R^3}{R^3} r\right)\rho 4\pi r^2 dr$

$$\int_0^P dp = \frac{\rho^2}{3}\int_0^r r\,dr$$



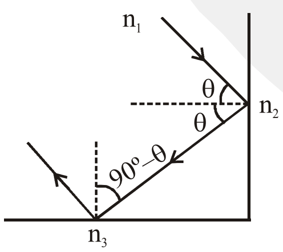
$$p = \frac{\rho^2}{3}\frac{r^2}{2} = \frac{\rho^2}{6} = \left(\frac{R^2}{4}\right) = \frac{\rho^2 R^2}{24}$$

Q.76



$$\frac{i_2}{i_1} = \frac{6/10}{8/20} = \frac{6}{10}\times\frac{20}{8} = \frac{6}{4} = \frac{3}{2}$$

Q.77



At $1-2,\ \theta > i_c \Rightarrow \sin\theta > \frac{n_2}{n_1}$ ...(1)

and at $1-3,\ 90° - \theta > i_c \Rightarrow \cos\theta > \frac{n_3}{n_1}$

$\Rightarrow \sin^2\theta < 1 - \frac{n_3^2}{n_1^2}$ ...(2)

$\therefore$ from (1) and (2), $n_1^2 - n_2^2 > n_3^2$

Q.78 If $n_2 \to n_1$ in H $(z = 1)$ gives λ
then $z\,n_2 \to z\,n_1$ gives λ in H-like ion
for He^+ ion, $z = 2$

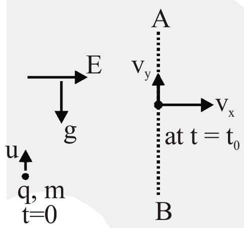
Q.79 No. of field lines $\propto \phi = \frac{q_{in}}{\varepsilon_0}$

Q.80 At $t = 0$, $\frac{A_{0_A}}{A_{0_B}} = \frac{25}{75} = \frac{1}{3}$ ...(1)

at $t = t$, $\frac{A_{t_A}}{A_{t_B}} = \frac{A_{0_A}e^{-\lambda t}}{A_{0_B}e^{-2\lambda t}} = \frac{75}{25} = 3$ ...(2)

$\therefore$ from (1) and (2), $e^{\lambda t} = 9$
$\Rightarrow \lambda t = 2\ln 3 \Rightarrow t = 2.$

Q.81



$t \le t_0 : v_x = \frac{qE}{m} t_0 = g\,t_0$

$v_y = u - gt_0$

just after AB, $\vec{v}$ = constant $\Rightarrow \vec{F}_{net} = 0$

$\Rightarrow q\vec{E} + q(\vec{v}\times\vec{B}) + m\vec{g} = 0$

$\Rightarrow qE\,\vec{i} + qv_x B\,\vec{j} - q\,v_y B\,\vec{i} - mg\,\vec{j} = 0$
$\Rightarrow E = B(u - gt_0)$ and $qB\,t_0 = m$
$\Rightarrow u = 2gt_0 = 3$ m/s.

Q.82 $K = \frac{\theta}{i} = \frac{NAB}{C} \propto NAB$

$\therefore$ To increase K by 25% either N or A or B should be increased by 25%

Q.83 $\frac{dU}{dt} = \frac{d}{dt}\left(\frac{1}{2}Li^2\right) = Li\frac{di}{dt}$

By KVL, $L\frac{di}{dt} + i(10) = 12$

$\Rightarrow L\dfrac{di}{dt} = 8$ when $i = 0.4A$

$\Rightarrow Li\dfrac{di}{dt} = 3.2 = \dfrac{16}{x} \Rightarrow x = 5$

Q.84 $V_{C_1} = 20$ V

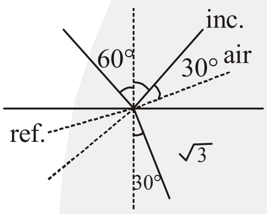
$\Rightarrow V_{C_2} = E - V_{C_1} = 10$ V

$\dfrac{C_1}{C_2} = \dfrac{V_{C_2}}{V_{C_1}} = \dfrac{1}{2} \Rightarrow C_2 = 2C_1$

Q.85 $E_{eq} = 8\varepsilon = 8 \times 1.5 = 12$ V
$r_{eq} = 8r = 8 \times 0.5 = 4\Omega$
$\therefore$ For P_{max}, $R_{ext} = r_{eq} = 4\Omega$

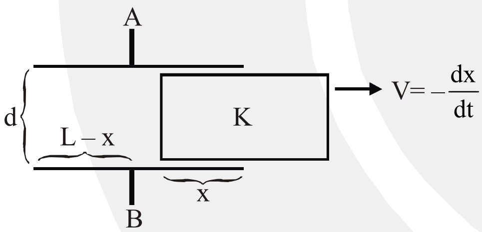
$\Rightarrow P_{max} = \dfrac{\varepsilon_{eq}^2}{4r_{eq}} = 9W$

Q.86 $1 \sin 60° = \sqrt{3}\, \sin\phi$



$\phi = 30°$

Q.87



$C_{AB} = C = C_{air} + C_{slab}$

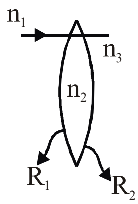
$\Rightarrow C = \dfrac{\epsilon_0 b}{d}\,[L + (K-1)x]$

$\therefore \dfrac{dc}{dt} = -\dfrac{\epsilon_0 b}{d}(K-1)V \Rightarrow$ – ve constant

Q.88 No change in p.d across 'R' = ammeter reads I only

Q.89 By symmetry $\vec{B}_P$ due to left and right conductors cancel each other.

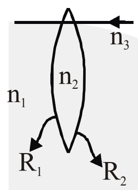
Q.90



$\dfrac{n_2}{v_1} - \dfrac{n_1}{\infty} = \dfrac{n_2 - n_1}{R_1}$

and $\dfrac{n_3}{f_2} - \dfrac{n_2}{v_1} = \dfrac{n_3 - n_2}{-R_2}$

$\Rightarrow \dfrac{n_3}{f_2} = \dfrac{n_2 - n_1}{R_1} + \dfrac{n_2 - n_3}{R_2}$ ....(1)



$\dfrac{n_2}{v_1} - \dfrac{n_3}{\infty} = \dfrac{n_2 - n_3}{R_2}$

and $\dfrac{n_1}{f_1} - \dfrac{n_2}{v_1} = \dfrac{n_1 - n_2}{-R_1}$

$\Rightarrow \dfrac{n_1}{f_1} = \dfrac{n_2 - n_1}{R_1} + \dfrac{n_2 - n_3}{R_2}$ ....(2)

$\therefore$ from (1) and (2), $\dfrac{f_1}{f_2} = \dfrac{n_1}{n_3}$