BANSAL CLASSES
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ANSWER KEY

DATE: 03-12-2018

COURSE
NUCLEUS

JEE-MAIN MOCK TEST-7
XII

TEST CODE				
1	1	2	8	6

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans	2	3	3	2	2	1	3	1	2	3	2	1	2	3	3
Q.No.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans	1	2	1	2	2	2	2	3	3	3	3	4	2	4	3
	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	1	4	4	4	2	2	1	2	2	2	4	3	1	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	2	3	4	1	2	3	2	2	1	4	4	2	4	3	1
Q.No.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Ans	2	3	4	2	3	1	4	3	2	2	3	4	3	3	1
Q.No.	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Ans	1	1	2	2	1	2	3	1	3	2	2	2	2	2	4

HINTS & SOLUTIONS

MATHEMATICS

Q.1

p	q	$\sim q$	$p\rightarrow\sim q$	$p\wedge q$	$(p\rightarrow\sim q)\leftrightarrow(p\wedge q)$
T	T	F	F	T	F
T	F	T	T	F	F
F	T	F	T	F	F
F	F	T	T	F	F

Q.2 $$\overline{x}=\frac{1+2+3+4+5+6+7}{7}=\frac{7\times8}{2\times7}=4$$

$$\therefore\ \sigma=\sqrt{\frac{9+4+1+0+1+4+9}{7}}=\sqrt{\frac{28}{7}}=2$$

Q.3 $$\frac{1}{\sqrt{a_1}+\sqrt{a_2}}+\frac{1}{\sqrt{a_2}+\sqrt{a_3}}+.........+\frac{1}{\sqrt{a_{n-1}}+\sqrt{a_n}}$$

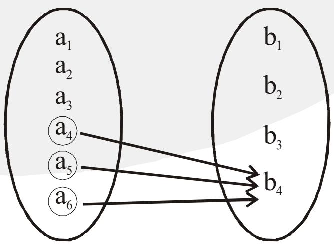
$$=\frac{\sqrt{a_2}-\sqrt{a_1}}{d}+\frac{\sqrt{a_3}-\sqrt{a_2}}{d}+\frac{\sqrt{a_4}-\sqrt{a_3}}{d}+........+\frac{\sqrt{a_n}-\sqrt{a_{n-1}}}{d}$$

$$=\frac{\sqrt{a_n}-\sqrt{a_1}}{d}=\frac{a_n-a_1}{\left(\sqrt{a_n}+\sqrt{a_1}\right)d}=\frac{(n-1)}{\sqrt{a_1}+\sqrt{a_n}}$$

Q.4 $$\frac{\alpha^2+\beta^2+\gamma^2}{(\alpha\beta\gamma)^2}=\frac{(\Sigma\alpha)^2-2\Sigma\alpha\beta}{(\alpha\beta\gamma)^2}$$

$$=\frac{\left(\frac{3}{4}\right)^2-2\cdot\frac{2}{4}}{\left(\frac{1}{4}\right)^2}=\frac{\frac{9}{16}-1}{\frac{1}{16}}=-7$$

Q.5 Let $b_1<b_2<b_3<b_4$



$\therefore\ N={}^6C_3\cdot(3!)=20\times6=120$

Q.6 $P(A)\cdot P\left(\frac{B}{A}\right) = P(B)\cdot P\left(\frac{A}{B}\right)$

$\Rightarrow \frac{1}{4}\times\frac{1}{2} = P(B)\times\frac{1}{4}$

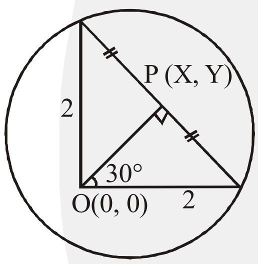
$\therefore P(B) = \frac{1}{2}$; $P(A) = \frac{1}{4}$ and $P(A\cap B) = \frac{1}{8}$

$\therefore\ P\left(\frac{\overline{A}}{\overline{B}}\right) = \frac{P(\overline{A}\cap\overline{B})}{P(\overline{B})}$

$= \frac{1-P(A\cup B)}{1-P(B)} = \frac{1-\left(\frac{1}{2}+\frac{1}{4}-\frac{1}{8}\right)}{1-\frac{1}{2}} = \frac{3}{4}$

Q.7 $T_{r+1} = {}^{100}C_r\, 5^{\frac{100-r}{2}}\cdot 11^{\frac{r}{4}}$,
where $r = 0, 1, 2, \ldots\ldots, 100$
$\therefore$ r must be $0, 4, 8, \ldots\ldots, 100 \to N = 26$ terms

Q.8 $OP = 2\cos 30^\circ = \sqrt{3}$

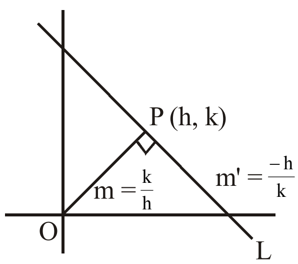


$\therefore OP^2 = 3$
$\therefore X^2 + Y^2 = 3$

Q.9 $\therefore$ Line is $(y-k) = \frac{-h}{k}(x-h)$

$\downarrow\quad P\left(2, \frac{3}{2}\right)$

$\Rightarrow \left(\frac{3}{2}-k\right) = \frac{-h}{k}(2-h)$



$\Rightarrow \frac{3k}{2} - k^2 = -2h + h^2$

$\Rightarrow \frac{3y}{2} + 2x = x^2 + y^2$

$\Rightarrow 2x^2 + 2y^2 - 4x - 3y = 0$

Q.10 $(y-4)^2 = 100t^2 = 100\left(\frac{x-2}{5}\right)$

$\Rightarrow (y-4)^2 = 4\cdot 5\,(x-2)$
$\therefore$ length of $LR = 20$

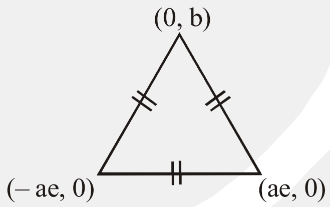
Q.11 $L_1 : y = \sqrt{3}\cdot x - 4\cdot\sqrt{3}\cdot\lambda$
$\Rightarrow (y-\sqrt{3}\,x) = -4\sqrt{3}\ \lambda$
$L_2 : \lambda y = -\sqrt{3}\cdot\lambda\cdot x + 4\cdot\sqrt{3}$

$\Rightarrow y = -\sqrt{3}\cdot x + \frac{4\sqrt{3}}{\lambda} \Rightarrow (y+\sqrt{3}\,x) = \frac{4\sqrt{3}}{\lambda}$

$\Rightarrow (y-\sqrt{3}\,x)\,(y+\sqrt{3}\,x) = -16\cdot 9$
$\Rightarrow y^2 - 3x^2 = -144 \Rightarrow 3x^2 - y^2 = 144$

$\therefore\ e = \sqrt{1+\frac{1}{\left(\frac{1}{3}\right)}} = \sqrt{1+3} = 2$

Q.12 $(2ae)^2 = b^2 + a^2e^2$
$\Rightarrow 3a^2e^2 = b^2$



$\Rightarrow 3e^2 = \frac{b^2}{a^2} = 1 - e^2 \Rightarrow e^2 = \frac{1}{4}$

$\therefore e = \frac{1}{2}$

Q.13 $\frac{1}{e^2}+\frac{1}{e'^2} = 1 \Rightarrow \left(\frac{1}{e'}\right)^2 = 1-\frac{1}{e^2} = \frac{e^2-1}{e^2}$

$\therefore e' = \frac{e}{\sqrt{e^2-1}}$

Q.14 $S_1 : 9(x^2 - 2x + 1) - 16(y^2 + 4y + 4)$
$= 199 + 9 - 64$
$\Rightarrow 9(x-1)^2 - 16(y+2)^2 = 144$

$$\Rightarrow \frac{(x-1)^2}{16} - \frac{(y+2)^2}{9} = 1$$

$$\therefore\ e = \sqrt{1+\frac{9}{16}} = \frac{5}{4}$$

Q.15 L_1 through Point A (1, 1, 1) and dir $<1, 1, 1>$
L_2 through point B (1, – 1, 0) and dir
$<1, -1, -1>$

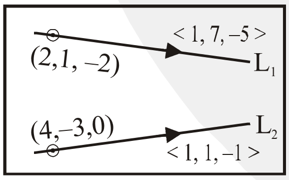
$$\therefore\ S{\cdot}D = \frac{\begin{vmatrix} 0 & 2 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & -1 \end{vmatrix}}{\sqrt{4+4+0}} = \frac{2}{2\sqrt{2}} = \frac{1}{\sqrt{2}}$$

Q.16 Line joins P(3, – 4, 1)
& $Q(2\lambda + 3, -3\lambda - 1, 2 - \lambda)$ and $\overrightarrow{PQ} \cdot \vec{n} = 0$
$\Rightarrow < 2\lambda, -3\lambda + 3, 1 - \lambda > \perp < 2, 1, -1>$
$\Rightarrow 4\lambda - 3\lambda + 3 - 1 + \lambda = 0 \Rightarrow 2\lambda + 2 = 0$
$\therefore\ \lambda = -1$
$\therefore$ P(3, –4, 1) and Q(1,2,3)

$$\therefore\ \frac{x-3}{1-3} = \frac{y+4}{2+4} = \frac{z-1}{3-1} \Rightarrow \frac{x-3}{-2} = \frac{y+4}{6} = \frac{z-1}{2}$$

$$\therefore\ \text{line is } \frac{x-3}{1} = \frac{y+4}{-3} = \frac{z-1}{-1}$$

Q.17 π is $x + 2y + 3z + 2 = 0$



$$\therefore\ P = \left|\frac{2}{\sqrt{1+4+9}}\right| = \frac{2}{\sqrt{14}}$$

Q.18 $|(2x) + i\,(2y+1)|^2 \le |(x) + i\,(y+2)|^2$
$\Rightarrow 4x^2 + 4y^2 + 4y + 1 \le x^2 + y^2 + 4y + 4$
$\Rightarrow 3x^2 + 3y^2 \le 3 \Rightarrow x^2 + y^2 \le 1$ and Area $= \pi$

Q.19 If $x < 0$; then $\cos^{-1}\sqrt{1-x^2} = -\sin^{-1} x$

Q.20 $\lim\limits_{x\to 0} f(x) = 0\ \therefore$ continuous
but LHD = – 1 and RHD = 1

Q.21 $$g'(f(x)) = \frac{1}{f'(x)}$$

$$\Rightarrow g'(\ln x + 2x^3 + 3x^5) = \frac{1}{\frac{1}{x} + 6x^2 + 15x^4}$$

$$\text{put } x = 1 \Rightarrow g'(5) = \frac{1}{1+6+15} = \frac{1}{22}$$

Q.22 $$I = \int_0^{\frac{\pi}{2}} \frac{x \sin 2x}{\sin^4 x + \cos^4 x}\,dx$$

$$\text{and } I = \int_0^{\frac{\pi}{2}} \frac{\left(\frac{\pi}{2} - x\right)\sin 2x}{\cos^4 x + \sin^4 x}\,dx$$

$$\therefore\ 2I = \frac{\pi}{2}\int_0^{\frac{\pi}{2}} \frac{\sin 2x}{1 - \frac{1}{2}\left(1 - \cos^2 2x\right)}\,dx$$

$$= \frac{\pi}{2}\int_0^{\frac{\pi}{2}} \frac{\sin 2x}{\frac{1}{2}\left(1 + \cos^2 2x\right)}\,dx$$

$$\therefore\ I = \frac{\pi^2}{8}$$

Q.23 $$L = \lim_{n\to\infty}\left(\left(1+\frac{1}{n}\right)\left(1+\frac{2}{n}\right).....\left(1+\frac{n}{n}\right)\right)^{\frac{1}{n}}$$

$$\therefore\ \ln L = \lim_{n\to\infty}\frac{1}{n}\sum_{r=1}^{n}\ln\left(1+\frac{r}{n}\right)$$

$$= \int_0^1 \ln(1+x)\,dx$$

$$\therefore\ \ln L = 2\ln 2 - 1 \Rightarrow L = \frac{4}{e}$$

Q.24 $\lambda \geq f(0) \Rightarrow \lambda \geq 5$

Q.25 $ax^3 = y^2 + b \xrightarrow{(2,3)} 8a = 9 + b \qquad$ (i)

and $3ax^2 = 2y \cdot y' \xrightarrow[\text{and } y'=4]{(2,3)} 3a \cdot 4 = 2 \cdot 3 \cdot 4$

$\therefore$ a = 2 and b = 7

Q.26 $\dfrac{f'(c)}{g'(c)} = \dfrac{f(2)-f(0)}{g(2)-g(0)} \Rightarrow 2 = \dfrac{7-3}{g(2)-2}$

$\therefore g(2) - 2 = 2 \Rightarrow g(2) = 4$

Q.27 $A = \int_0^1 \left(x \cdot e^x \cdot - \dfrac{x}{e^x}\right) dx = \dfrac{2}{e}$

Q.28 $\dfrac{dy}{dx} = 2 \cdot \dfrac{y}{x}$

$\Rightarrow \dfrac{dy}{y} = 2\dfrac{dx}{x} \Rightarrow \ln|y| = 2\ln|x| + c$

$\Rightarrow x^2 = \lambda y$

Q.29 $$\alpha + \beta = \frac{\left(\dfrac{\cos 10°}{2} - \dfrac{\sqrt{3}}{2}\sin 10°\right) \times 2}{2\cos 10° \sin 10° \times \dfrac{1}{2}}$$

$\therefore \alpha + \beta = 4 \cdot \dfrac{\cos(60° + 10°)}{\sin 20°} = 4$

and $\alpha \cdot \beta = \dfrac{2\sin 25° \cos 60°}{\cos 65°} = 1$

$\therefore x^2 - 4x + 1 = 0$

$\Delta = 16 - 4 = 12$ (Not perfect square)

Q.30 $P^T \cdot P = \begin{bmatrix} \sin\theta & \cos\theta \\ -\cos\theta & \sin\theta \end{bmatrix} \begin{bmatrix} \sin\theta & -\cos\theta \\ \cos\theta & \sin\theta \end{bmatrix}$

$\therefore P^T \cdot P = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = I$

$\therefore P^T \cdot (Q)^{2018} \cdot P = A^{2018} = \begin{bmatrix} 1 & 2018 \\ 0 & 1 \end{bmatrix}$.

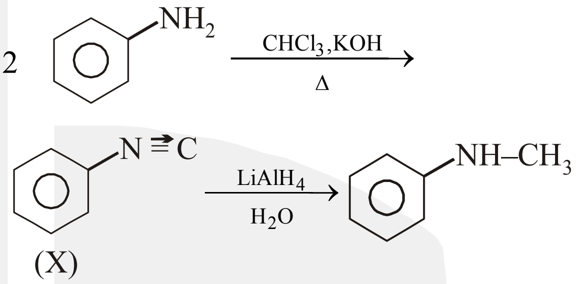
CHEMISTRY

Q.31 $[H_3O^+] = \sqrt{\dfrac{K_w.C}{K_b}} = 10^{-5}$ M ; $n_{H_3O^+}$

$= 10^{-6}$ mol

$\therefore N_{H_3O^+} = 6.020 \times 10^{17}$ **Ans.**

Q.32



Q.33 (1) $[Cu(PPh_3)_4]^+ \rightarrow$ Tetrahedral ; SFL; $\Delta\uparrow$; Intensity $\downarrow$

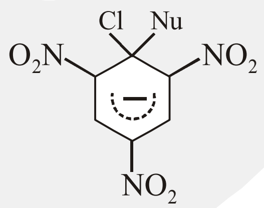
(2) $[Zn(H_2O)_6]^{2+} \rightarrow$ Octahedral complex

(3) $[Cu(NH_3)_4]SO_4 \rightarrow$ Tetrahedral ; $\Delta\uparrow$; Intensity $\downarrow$; SFL

(4) $MnO_4^- \rightarrow d^3s$, Tetrahedral complex ; purple coloured due to LMCT

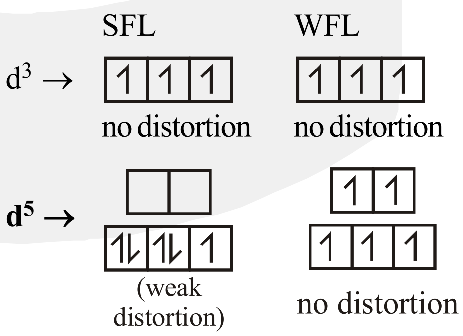
Q.34 Theory based

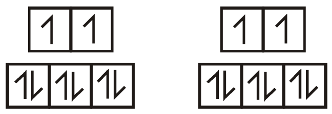
Q.35



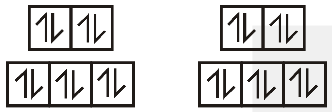
Rate of $S_NAR \propto$ stability of C^-

Q.36



$d^8 \rightarrow$ 

no distortion no distortion

$d^{10} \rightarrow$ 

no distortion no distortion

Q.37 Let, initial volume be V_i.

$\therefore \frac{4}{3}\pi r_i^3 = V_i$

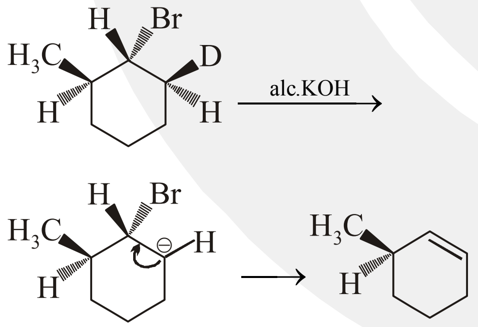
$\therefore A_i = 4\pi r_i^2 = 4\pi\left(\frac{3V_i}{4\pi}\right)^{2/3}$ ....(i)

$V_{avg} = \sqrt{\frac{8RT}{\pi M}} = \sqrt{\frac{8PV}{\pi n M}}$

But, if V_{avg} becomes twice then volume becomes 4-times keeping P and n constant

$\therefore \frac{4}{3}\pi r_f^3 = 4V_i \Rightarrow A_f = 4\pi r_f^2 = 4\pi\left(\frac{3\times 4V_i}{4\pi}\right)^{2/3}$

$\therefore \frac{A_f}{A_i} = 4^{2/3} = 2^{4/3}$ **Ans.**

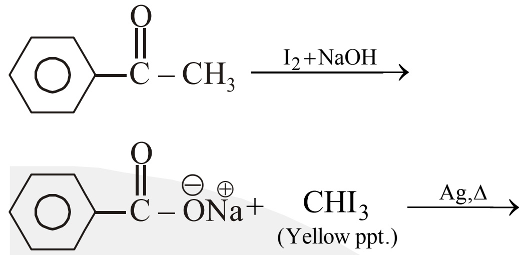
Q.38 

Q.39 (1) Na $\rightarrow$ Golden yellow, Mg $\rightarrow$ does not show colour with flame.
(2) Ba $\rightarrow$ Apple green, Sr $\rightarrow$ Crimson red.
(3) Sr $\rightarrow$ Crison red, Ba $\rightarrow$ Apple green
(4) Ca $\rightarrow$ Brick red, Na $\rightarrow$ Golden yellow

Q.40 $\frac{r_4}{r} = \frac{a_0\times 16/Z}{a_0\times 4/Z} \quad \therefore r_4 = 4r$

and $2\pi r_4 = 4\lambda$

$\therefore \lambda = \frac{2\pi r_4}{4} = 2\pi r$

Q.41 

$HC \equiv CH$

Q.42 $Na + (x+y)\,NH_3(l) \rightarrow [Na^+(NH_3)_x] + [e^-(NH_3)_y]$

Q.43

CH_4	+ Br_2	$\rightarrow$ CH_3Br	+ HBr
n = 0.5 mol	0.25 mol	0	0
	(L.R.)		

$\therefore n_{CH_3Br} = 0.25$ mol.

$\therefore m_{CH_3Br} = \frac{1}{4}\times 95$ g

$= 23.75$ g **Ans.**

Q.45 (1) $\overset{-1}{KO_2} + H_2O \longrightarrow \overset{(+5)}{KOH} + \overset{(-2)}{H_2O_2} + \overset{(0)}{O_2}$

(2) $\overset{+5}{N_2O_5} + H_2O \longrightarrow \overset{(+5)}{HNO_3}$

(3) $\overset{+4}{Xe}F_4 + H_2O \rightarrow \overset{0}{Xe} + \overset{+6}{Xe}O_3 + HF + O_2$

(4) $K_2O_2 + H_2O \xrightarrow{RT} KOH + H_2O + O_2$

Q.46 Theory based

Q.48 $IF_7 + 4H_2O \rightarrow HIO_4 + 7HF$ (complete hydrolysis)

$\underset{(sp^3d^3)}{IF_7} + H_2O \rightarrow 2HF + \underset{(sp^3d^2)}{IOF_5} \xrightarrow{+H_2O}$

$2HF + \underset{(sp^3d)}{IO_2F_3} \xrightarrow{+H_2O} 2HF + \underset{(sp^3)}{IO_3F} \xrightarrow{+H_2O} HF + \underset{(sp^3)}{IOF_4}$

Q.49 F^{-} concentration $= \dfrac{0.1}{500} \times 10^{6}$ ppm

$= 200$ pm **Ans.**

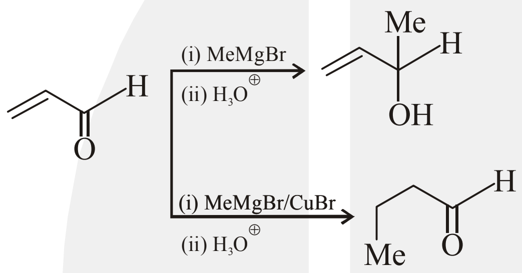
Q.51 No. of monovalent oxygen = no.of divalent oxygen = (2)
Name : Pyroxene (single chain)

Q.52 $\ln\left(\dfrac{k_{32°C}}{k_{27°C}}\right) = \dfrac{E_a}{R}\left(\dfrac{1}{300} - \dfrac{1}{305}\right)$

$\Rightarrow \ln 1.5 = \dfrac{E_a}{R}\left(\dfrac{5}{300 \times 305}\right)$

$\therefore E_a = \left(\dfrac{0.4 \times 8 \times 300 \times 305}{5 \times 1000}\right)$ kJ/mol

$= 58.56$ kJ/mol **Ans.**

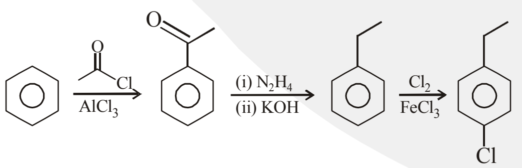
Q.53 

Q.54 $Li + air \rightarrow Li_3N + Li_2O + Li_2O_2$

$\downarrow H_2O$

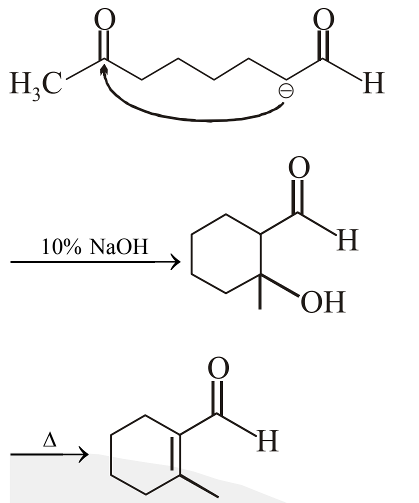
$NH_3 \quad + \quad LiOH$
(Basic-turns
red litmus into blue)

Q.55 Theory based

Q.56 

Q.57 E.A. $\rightarrow$ Cl > F

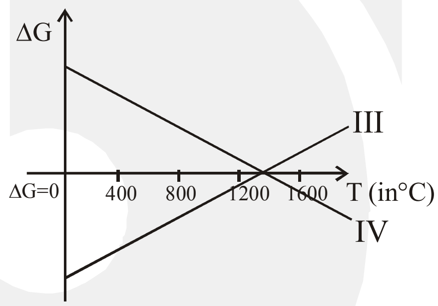
Q.58 Theory based

Q.59 

α,β unsaturated
aldehyde

Q.60

	at T < 1400°C	at T > 1400°C
III $\rightarrow 3Mg + Al_2O_3 \longrightarrow 3MgO + 2Al$	$\Delta G < 0$	$\Delta G > 0$
IV $\rightarrow 3MgO + 2Al \longrightarrow 3Mg + Al_2O_3$	$\Delta G > 0$	$\Delta G < 0$



PHYSICS

Q.61 In the reference frame of infinity, U = 0
$E_1 = -13.6$ eV, $K_1 = 13.6$ eV, $U_1 = -27.2$ eV
$E_2 = -3.4$ eV, $K_2 = 3.4$ eV, $U_2 = -6.8$ eV
Now for U_1 to be zero,
we have to add 27.2 eV to U_1.
Hence $E_2 = -3.4 + 27.2 = 23.8$ eV

Q.62 $F = -\dfrac{dU}{dr} = -2B(r - r_0)$

$\omega^2 = \dfrac{K}{m_{reduced}} = \dfrac{2B}{m_1 m_2}(m_1 + m_2)$

Q.63 $\dfrac{\mu_2}{v} - \dfrac{\mu_1}{u} = \dfrac{\mu_0 - \mu_1}{R_1} + \dfrac{\mu_2 - \mu_0}{R_2}$

When $u = \infty$ $V = f$

$$\frac{1.6}{f} = \frac{1.5-1.2}{+30} + \frac{1.6-1.5}{-30}$$

$f = 240$ cm

Q.64 $$1 = \frac{220\sqrt{2}}{\sqrt{R^2 + X_c^2}}$$

$$R^2 + X_C^2 = 220 \times 220 \times 2$$

$$X_c^2 = \left[2 \times (220)^2\right] - [220]^2$$

$$X_C = (220)$$

$$\tan\phi = \frac{Xc}{R} = \frac{220}{220} = 1$$

$$\phi = 45^0$$

Q.65 Magnetic flux through the loop A;

$$\phi = B\pi r^2 = \frac{\mu_0 I R^2}{2\left(R^2 + x^2\right)^{3/2}}\pi r^2$$

Induced emf in the loop A;

$$\varepsilon = -\frac{d\phi}{dt} = \frac{\mu_0 I R^2 \pi r^2}{2}\left(-\frac{3}{2\left(R^2 + x^2\right)^{5/2}} 2x\frac{dx}{dt}\right)$$

$$= -\frac{3\mu_0 I R^2 \pi r^2 v}{2}\left[\frac{x}{\left(R^2 + x^2\right)^{5/2}}\right]$$

Induced emf is maximum when $\frac{d\varepsilon}{dx} = 0$

$$\left(R^2 + x^2\right) - 5x^2 = 0 \text{ or } x = \frac{R}{2}$$

Q.66 Voltage across rod $= \frac{1}{2}B_0 l_0^2 \omega_0$

Charge on capacitor $= CV_0$

$$v \times q = \frac{1}{2}CV_0^2 + H_{R_1} + H_{R_2}$$

$$CV_0 \times \frac{1}{2}B_0 l_0^2 \omega_0 = \frac{1}{2}CV_0^2 + \frac{R_2}{R_1}H_{R_2} + H_{R_2}$$

$$\frac{1}{2}CV_0 B_0 l_0^2 \omega_0 - \frac{1}{2}CV_0^2 = \frac{H_{R_2}[R_2 + R_1]}{R_1}$$

$$H_{R_2} = \frac{R_1}{R_1 + R_2}\left[\frac{1}{2}CV_0 B_0 l_0^2 \omega_0 - \frac{1}{2}CV_0^2\right]$$

$$= \frac{R_1}{R_1 + R_2} \times \frac{1}{2}CV_0[B_0 l_0^2 \omega_0 - V_0]$$

$$= \frac{1}{2}CV_0^2$$

Q.67 Magnetic moment $M = NIA$

$$M = I_0 \frac{\sqrt{3}}{4}(\sqrt{2}a)^2 = \frac{\sqrt{3}}{2}I_0 a^2$$

Q.68 Resistance between opposite corner is $\frac{R}{2}$ and $\frac{R}{2}$ which is parallely connected.

$\therefore$ Maximum value $= \frac{R}{4}$

For adjacent corner two resistance $\frac{R}{n}$ and $\left(\frac{n-1}{n}\right)R$ are parallel connected

So minimum resistance is $= R\frac{(n-1)}{n^2}$

Q.69 $$E = \pi l = \frac{Vl}{L} = \frac{iR}{L} \times l$$

$$\Rightarrow \quad E = \frac{E}{R + R_h + r} \times \frac{R}{L} \times l$$

$$\Rightarrow \quad E = \frac{10}{5 + 4 + 1} \times \frac{5}{5} \times 3 = 3\text{ V}$$

Q.70 Work done to rotate the ring is equal to work done to return the charge at its initial position.

Q.71 Potential of centre of sphere $= \frac{Kq}{r} + V_i = \frac{Kq}{r}$

where V_i = potential due to induced charge at centre = 0 [$\therefore$ $\Sigma q_i = 0$ and all induced charges are equidistance from centre]

$\therefore$ potential at point P $= \frac{Kq}{r} = \frac{Kq}{r_1} + V_i$

(For conductor all points are equipotential)

$\therefore$ $V_i = K\left(\frac{q}{r} - \frac{q}{r_1}\right)$

Q.72 Slope of potential from x = 0 to x = d is

$-\frac{4Q}{2\varepsilon_0 A} = -\frac{2Q}{\varepsilon_0 A}$

Slope of potential from x = d to x = 2d is

$-\frac{3Q}{\varepsilon_0 A}$

Slope of potential from x = 2d to x = 3d is

$\frac{2Q}{\varepsilon_0 A}$

Q.73 Isotherm of maximum temperature has line AB as tangent on it at $\frac{V_0}{2}$

Q.74 $y(x,t) = 0.02\cos\left(50\pi t + \frac{\pi}{2}\right)\cos(10\pi x)$

$\equiv A\cos\left(\omega t + \frac{\pi}{2}\right)\cos kx$

Node occurs when $kx = \frac{\pi}{2} \Rightarrow 10\pi x = \frac{\pi}{2}$

$\Rightarrow x = 0.05$ m

Antinode occurs when $kx = \pi \Rightarrow 10\pi x = \pi$

$\Rightarrow x = 0.1$ m

Speed of wave (v) $= \frac{\omega}{k} = \frac{50\pi}{10\pi} = 5$ m/s

Wavelength $(\lambda) = \frac{2\pi}{k} = 0.2$ m

Q.75 The relative velocity of sound waves with respect to the walls is $V + v$.

Hence, the apparent frequency of the waves striking the surface of the wall is $\frac{(V+v)}{\lambda}$.

The number of positive crests striking per second is the same as frequency.

In three seconds, the number is $[3(V+v)]/\lambda$.

Q.76 $y = 2A\cos kx \sin \omega t$ (assuming t = 0, y = 0),

$\lambda = \frac{2l}{3}$

as $\Delta P = B\frac{dy}{dx} = B\,2Ak\sin kx\sin\omega t$,

$\Delta P_{max} = B(2A)k$ also $v = \sqrt{\frac{B}{\rho}}$

$\Rightarrow 2A = 2.5$ cm.

Q.77 $f = \frac{3v}{4(L+0.6r)}$

$\frac{df}{dt} = \frac{3v}{4}\left(-\frac{1}{(L+0.6r)^2}\cdot(0.6)\frac{dr}{dt}\right)$

$-2 = -\frac{3v}{4}\left(0.6\frac{dr}{dt}\right)$

$\frac{8}{3v\times 0.6} = \frac{dr}{dt}$

$\frac{dr}{dt} = \frac{1}{72}$ m/s

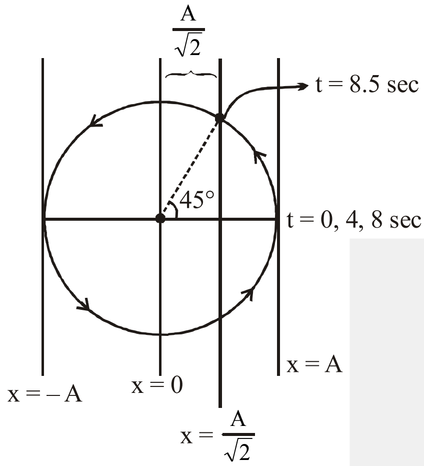
Q.78 Maximum tension in string $= T = mg + m\omega^2 A$

$\mu(3mg) = mg + m\left(\frac{2\pi}{\pi/2}\right)^2$

$\Rightarrow \mu = \frac{13}{15}$

Q.79 In 8.5 sec

$\theta = \omega t = \frac{17\pi}{4} = 4\pi + \frac{\pi}{4}$



$\therefore$ Distance $= 8A + A - \frac{A}{\sqrt{2}}$

$= 9A - \frac{A}{\sqrt{2}} = 27 - \frac{3}{\sqrt{2}}$ cm

Q.80 $\frac{dQ}{dt} = \frac{\pi P r^4}{8\eta L}$

As capillaries are joined in series, so (dQ/dt) will be same for each capillary.

Hence, $\frac{\pi P r^4}{8\eta L} = \frac{\pi P'(r/2)^4}{8\eta(L/2)} = \frac{\pi P''(r/3)^4}{8\eta(L/3)}$

So, pressure difference across the ends of 2nd capillary

$p' = 8P$

and across the ends of 3rd capillary

$p'' = 27P$

Q.81 $\rho h^2 =$ constant

Q.82 Conserving momentum during the explosion

$mv = \frac{m}{2} \times 0 + \frac{m}{2} v'$ or $v' = 2v$

Increase in the mechanical energy $= \Delta K + \Delta U$

$= \Delta K + 0 = \frac{1}{2}\frac{m}{2}(2v)^2 - \frac{1}{2}mv^2 = \frac{1}{2}mv^2$

$= \frac{GMm}{4R} = \frac{mgR}{4}$ $\quad \left[v = \sqrt{\frac{GM}{2R}} \right]$

Q.83 $T(R - r) = \mu mgR$; $2mg - T = 2ma$;

$T - \mu mg = ma$

On solving, we get

$\therefore \quad r = R\left(1 - \frac{3\mu}{2(1+\mu)}\right)$

Q.84 $2M\frac{a^2}{3}\omega - Mv\frac{a}{2} = 0$; $\omega = \frac{3V}{4a}$

Q.85 From Newton's third law, force F will act on the block in forward direction

Acceleration of block $a_1 = \frac{F}{M}$

retardation of bullet $a_2 = \frac{F}{m}$

relative retardation of bullet

$a_r = a_1 + a_2 = \frac{F(M+m)}{Mm}$

Applying $v^2 = u^2 - 2a_r l$

$0 = v_0^2 - \frac{2F(M+m)}{Mm}.l$

or $\quad v_0 = \sqrt{\frac{2Fl(M+m)}{Mm}}$

Therefore, minimum value of v_0 is

$\sqrt{\frac{2Fl(M+m)}{Mm}}$

Q.86 $\frac{\Delta T}{T} \times 100 = \frac{\frac{1}{5}}{25} \times 100 = 0.8\%$

Q.87 The displacement between first stone and aeroplane after t second $(h_1) = \frac{1}{2}(g + f)t^2$

After time t,

Velocity of aeroplane $= u + ft$

Velocity of first stone $= u - gt$

Where u is velocity of aeroplane when first stone is dropped.

The relative speed of second stone with respect to first stone = $(u + ft) - (u - gt)$

$= (g + f)t$

The relative displacement between first and second stone after time $t'(h_2)$

$= (g + f)tt'$

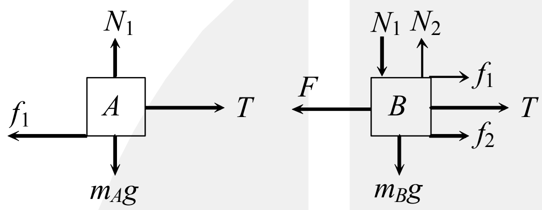
$$h_1 + h_2 = \frac{1}{2}(g + f)t^2 + (g + f)tt'$$

$$= \frac{1}{2}(g + f)(t + 2t')t$$

Q.88 $m_A = 0.5\text{kg}$, $m_B = 1\text{kg}$

From F.B.D. of block A,

$T = f_1 = \mu m_A g = 2N$



From F.B.D. of block B,

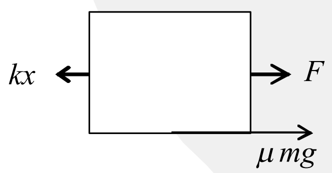
$f_2 = \mu N_2 = 6N$

$F = T + f_1 + f_2 = 2 + 2 + 6 = 10N$

Q.89 Block will return after maximum elongation.

i.e. $F.x_{max} - \frac{1}{2}Kx^2_{max} - \mu g x_{max} = 0$

$$x_{max} = \frac{2(F - \mu mg)}{k} = \frac{8\mu mg}{k}$$



So block will finally comes to rest while returning i.e. $v = 0$ & $a = 0$

By work energy theorem while returning

$$-\left(\frac{1}{2}kx^2 - \frac{1}{2}kx^2_{max}\right) - (F + \mu mg)(x_{max} - x) = 0$$

$$\Rightarrow x = \frac{4\mu mg}{k}$$

Q.90 $mgl + \frac{3mg}{8}\left(l + \frac{l}{3}\right) = \left[m\left(\frac{4l^2}{3}\right) + \frac{3}{8}m\left(\frac{4l}{3}\right)^2\right]\alpha$

$$\alpha = \frac{3g}{4l}$$

$a = g$