Sri Chaitanya IIT Academy.,India.

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A right Choice for the Real Aspirant

ICON Central Office - Madhapur - Hyderabad

SEC: Sr.Super60_NUCLEUS-BT | JEE-MAIN | Date: 16-08-2025
Time: 09.00Am to 12.00Pm | RPTM-06 | Max. Marks: 300

KEY SHEET

MATHEMATICS

1	**4**	2	**2**	3	**1**	4	**3**	5	**4**
6	**4**	7	**1**	8	**4**	9	**4**	10	**2**
11	**2**	12	**2**	13	**1**	14	**4**	15	**1**
16	**3**	17	**2**	18	**4**	19	**2**	20	**2**
21	**1200**	22	**252**	23	**4**	24	**2**	25	**2**

PHYSICS

26	**4**	27	**4**	28	**2**	29	**4**	30	**1**
31	**2**	32	**3**	33	**3**	34	**4**	35	**4**
36	**1**	37	**1**	38	**2**	39	**2**	40	**1**
41	**4**	42	**2**	43	**4**	44	**2**	45	**1**
46	**6**	47	**64**	48	**3**	49	**5**	50	**2**

CHEMISTRY

51	**3**	52	**3**	53	**2**	54	**3**	55	**1**
56	**4**	57	**3**	58	**3**	59	**1**	60	**4**
61	**2**	62	**4**	63	**3**	64	**1**	65	**4**
66	**1**	67	**1**	68	**1**	69	**1**	70	**1**
71	**6**	72	**6**	73	**4**	74	**7**	75	**4**

SOLUTION
MATHEMATICS

1. Let $I=\int_0^{\infty}\frac{x^2+ax+1}{1+x^4}.\tan^{-1}\left(\frac{1}{x}\right)dx \quad .....(1)$

Put $x=\frac{1}{t}$, then we get $I=\int\limits_{\infty}^{0}\frac{\left(\frac{1}{t}\right)^2+a\left(\frac{1}{t}\right)+1}{1+\left(\frac{1}{t}\right)^4}.\tan^{-1}(t)\left(-\frac{1}{t^2}\right)dt$

$=\int\limits_0^{\infty}\frac{t^2+at+1}{1+t^4}.\tan^{-1}(t)dt=\int\limits_0^{\infty}\frac{x^2+ax+1}{1+x^4}.\tan^{-1}(x)dx \quad ....(2)$

Adding (1) and (2), we get

(using $\tan^{-1}(1/x)+\tan^{-1}x=\pi/2$ for $x>0$) $I=\frac{\pi}{4}\int\limits_0^{\infty}\frac{(x^2+1)+ax}{1+x^4}dx$

$=\frac{\pi}{4}\left[\int\limits_0^{\infty}\frac{(x^2+1)}{1+x^4}dx+a\int\limits_0^{\infty}\frac{xdx}{1+x^4}\right]=\frac{\pi}{4}\left[\frac{\pi}{2\sqrt{2}}+\frac{a\pi}{4}\right]=\left[\frac{\pi^2}{8\sqrt{2}}+\frac{\pi^2 a}{16}\right]\therefore I=\lim_{a\to\infty}\frac{1}{a}\left[\frac{\pi^2}{8\sqrt{2}}+\frac{\pi^2 a}{16}\right]$

$=\lim_{a\to\infty}\left[\frac{\pi^2}{(8\sqrt{2})a}+\frac{\pi^2}{16}\right]=\frac{\pi^2}{16} \qquad \Rightarrow\frac{k}{2}=8$

2. $f(x)=ax^2+bx+c, f'(x)=2ax+b, f'(2)=4a+b=1 \quad ....(1)$

Now $I=\int\limits_{2-x}^{2+x}f(x).\sin\left(\frac{x-2}{2}\right)dx$

Put $x-2=t\Rightarrow dx=dt$

$I=\int_{-\pi}^{\pi}f(2+t).\sin\left(\frac{t}{2}\right)dt$ ….. (2)

Also, $\int\limits_{-\pi}^{\pi}f(2-t).\sin\left(\frac{t}{2}\right)dt \quad .....(3)$

$\therefore (2)+(3)\, gives$

$2I=\int\limits_{-\pi}^{\pi}\left[f(2+t)-f(2-t)\right]\sin\frac{t}{2}dt.....(4)$

$\therefore f(x)=a(x-2)^2+b(x-2)+c$

$\Rightarrow f'(x)=2a(x-2)+b$

$\Rightarrow f'(2)=b=1$

$\Rightarrow f(x)=a(x-2)^2+(x-2)+c$

Now from (4) we get

$$I=\int_0^{\pi}\left[f(2+t)-f(2-t)\right]\sin\frac{t}{2}dt$$

$$=\int_0^{\pi}\left[\left(at^2+t+c\right)-\left(at^2-t+c\right)\right]\sin\frac{t}{2}dt$$

$$I=2\int_0^{\pi}t\sin\frac{t}{2}dt;\ put\ \frac{t}{2}=y$$

$$I=8\int_0^{\pi/2}y\sin y\,dy;I=8$$

3. Here, $f(x)+f\left(x+\frac{1}{2}\right)=1$

Replace x by $\left(x+\frac{1}{2}\right)$, we get $f\left(x+\frac{1}{2}\right)+f(x+1)=1$

On subtracting, $f(x)=f(x+1)$ ...(1)

Also $g\left(x+1^2\right)=\int_0^{x+1^2}f(t)dt=\int_0^{x}f(t)dt+\int_n^{x+1^2}f(t)dt$

Since, $f(x+1\quad)=f(x)$

$\therefore$ $g\left(x+1^2\right)=\int_0^x f(t)dt+1^2.\int_0^1 f(t)dt$

$$g\left(x+2^2\right)=\int_0^x f(t)dt+2^2.\int_0^1 f(t)dt$$

$$g\left(x+k^2\right)=\int_0^x f(t)dt+k^2.\int_0^1 f(t)dt \qquad .....(ii)$$

And $g(x+k)=\int_0^x f(t)dt+k.\int_0^1 f(t)dt \qquad .....(iii)$

Thus $\sum_{k=1}^{n}\left(g\left(x+k^2\right)-g(x+k)\right)=\sum_{=k1}^{n}\left(k^2-k\right).\int_0^1 f(t)$

$$=\sum_{k=1}^{n}\left(k^2-k\right).g(1),\text{ given } g(x)=\int_0^x f(t)dt$$

$$=\left(\frac{n(n+1)(2n+1)}{6}-\frac{n(n+1)}{2}\right)\times 1$$

$$=\frac{n(n-1)(n+1)}{3}$$

$$\therefore\sum_{n=2}^{\infty}\frac{8}{\sum_{k=2}^{n}\left(g\left(x+k^2\right)-g(x+k)\right)}=\sum_{n=2}^{\infty}\frac{8\times 3}{(n-1)n(n+1)}$$

$$12\sum_{n=2}^{\infty}\left(\frac{(n+1)-(n-1)}{(n-1).n(n+1)}=\frac{1}{(n-1)n}-\frac{1}{n(n+1)}\right)$$

$$=12\left[\left(\frac{1}{1\times 2}-\frac{1}{2\times 3}\right)+\left(\frac{1}{2\times 3}-\frac{1}{3\times 4}\right)+\ldots\ldots+\left(\frac{1}{(n-1)n}-\frac{1}{n(n+1)}\right)\right]$$

$$=12\left(\frac{1}{2}-\frac{1}{n(n+1)}\right)_{n\to\infty}=6$$

4. $$\int \underbrace{x^2}_{I}.\underbrace{\frac{d}{dx}\left(\frac{3x^2+1}{x^7+2x^5+2x^4+x^3+2x^2+5x}\right)}_{II}dx$$

$$x^2.\frac{3x^2+1}{x^7+2x^5+2x^4+x^3+2x^2+5x}-\int\frac{2x(3x^2+1)dx}{x(x^6+2x^4+2x^3+x^2+2x+5)}$$

$$\frac{x(3x^2+1)}{x^6+2x^4+2x^3+x^2+2x+5}-\int\frac{2(3x^2+1)dx}{(x^3)^2+2x^3(x+1)+(x+1)^2+4}$$

$$\frac{x(3x^2+1)}{x^6+2x^4+2x^3+x^2+2x+5}-2\int\frac{(3x^2+1)dx}{(x^3+(x+1))^2+4}$$

$$\frac{x(3x^2+1)}{x^6+2x^4+2x^3+x^2+2x+5}-\tan^{-1}\left(\frac{x^3+x+1}{2}\right)+c$$

$$g(x)=\frac{x^3+x+1}{2}$$

5. Let $J=\int_0^1\frac{f(x).g'(x)-f'(x).g(x)}{f^2(x)g(x)}dx \;=\int_0^1\underbrace{\left(\frac{g(x)}{f(x)}\right)'}_{II}.\underbrace{\frac{1}{g(x)}}_{I}dx$

Now, integrating by parts, $\left.\frac{1}{g(x)}.\frac{g(x)}{f(x)}\right|_0^1+\int_0^1\frac{g^1(x)}{g^2(x)}.\frac{g(x)}{f(x)}dx$

$$j=\left(\frac{1}{f(1)}-\frac{1}{f(0)}\right)+\int_0^1\frac{g'(x)}{g(x).f(x)}dx \quad\ldots(1)$$

Now given, $f^2(x)=1+g^2(x)\Rightarrow f(x).f'(x)=g(x).g'(x)$

$$\Rightarrow g'(x)=\frac{f(x).f'(x)}{g(x)}$$

$$\therefore J=\left(\frac{1}{3}-\frac{1}{2}\right)+\int_0^1 \frac{f(x).f'(x)}{g^2(x).f(x)}dx$$

$$J=\frac{-1}{6}+\int_0^1 \frac{f'(x)}{f^2(x)-1}dx$$

Now put, $f(x)=t$, we get

$$J=\frac{-1}{6}+\int_2^3 \frac{dt}{t^2-1}=\frac{-1}{6}+\frac{1}{2}ln\frac{t-1}{t+1}\Bigg]_2^3$$

$$=\frac{-1}{6}+\frac{1}{2}\left[ln\frac{1}{2}-ln\frac{1}{3}\right]$$

$$J=\frac{-1}{6}+\frac{1}{2}ln\frac{3}{2}\Rightarrow J=\frac{1}{2}ln\frac{3}{2}-\frac{1}{6}$$

$$\Rightarrow 6J+1=ln\frac{27}{8}\Rightarrow a+b=27+8=35$$

6. $$\int_0^x f(t)dt=\int_x^1 t^2 f(t)dt+\frac{x^{16}}{8}+\frac{x^6}{3}+a \quad ....(1)$$

For x = 1, $\int_0^1 f(t)dt=0+\frac{1}{8}+\frac{1}{3}+a=\frac{11}{24}+a$

Differentiating both sides of equation (1) w.r.t. x we get,

$$f(x)=0-x^2f(x)+2x^{15}+2x^5\Rightarrow f(x)=\frac{2\left(x^{15}+x^5\right)}{1+x^2}$$

$$\Rightarrow 2\int_0^1 \frac{x^{15}+x^5}{1+x^2}dx=\frac{11}{24}+a\Rightarrow 2\int_0^1\left(x^{13}-x^{11}+x^9-x^7+x^5\right)dx=\frac{11}{24}+a$$

$$\Rightarrow 2\left(\frac{1}{14}-\frac{1}{12}+\frac{1}{10}-\frac{1}{8}+\frac{1}{6}\right)=\frac{11}{24}+a\Rightarrow a=-\frac{167}{840}$$

7. $$\int_0^{1/2}\tan^{-1}\left(\frac{1}{2}\left(\sqrt{\frac{1+x}{x}}-\sqrt{\frac{x}{1+x}}\right)\right)dx=\int_0^{1/2}\tan^{-1}\left(\frac{1}{2}\left(\frac{1}{\sqrt{x(x+1)}}\right)\right)dx$$

$$\int_0^{1/2}\tan^{-1}\left(\frac{1}{2}\left(\frac{1}{\sqrt{x(x+1)}}\right)\right)dx=\int_0^{1/2}\tan^{-1}\left(\left(\frac{1}{\sqrt{(2x+1)^2-1}}\right)\right)dx$$

$$put\,2x+1=\sec\theta\Rightarrow dx=\frac{\sec\theta\tan\theta}{2}d\theta$$

$$I=\int_0^{\pi/3}\tan^{-1}(\cot\theta)\frac{\sec\theta\tan\theta}{2}d\theta=-\frac{\pi}{12}+\frac{\ln(2+\sqrt{3})}{2}$$

8. $$f'(x)=\lim_{h\to 0}\frac{f(x+h)-f(x)}{h}=\lim_{h\to 0}\frac{f\left(x\left(1+\frac{h}{x}\right)\right)-f\left(\frac{1}{1/x}\right)}{h}=\frac{f\left(\frac{1+h/x}{1/x}\right)-f\left(\frac{1}{1/x}\right)}{h}$$

$$= \lim_{h\to 0}\frac{f\left(1+\frac{h}{x}\right)-f(1)}{x\times\frac{h}{x}\times f\left(\frac{1}{x}\right)} = \frac{f'(1)}{x}\times\frac{f(x)}{f(1)}$$

$\therefore \frac{dy}{dx}=\frac{Ky}{x}$ $\quad\therefore \ln y = k\ln x + \ln c$

$\Rightarrow f(x)=cx^k$ put x = 2; y = 1 in the given equation

$\therefore f(2)=\frac{f(2)}{f(1)} \Rightarrow f(1)=1 \Rightarrow c=1$

$\therefore f(x)=x^k$ now f(2) = 4 $\quad\therefore k=2$ thus $f(x)=x^2$

$$\therefore \lim_{n\to\infty}\sum_{r=1}^{n} e^{\frac{r}{n}} f\left(\frac{\sqrt{r}}{n}\right)=\lim_{n\to\infty}\sum_{r=1}^{n} e^{\frac{r}{n}}\frac{r}{n^2}=\int_0^1 xe^x\,dx=1$$

9. As $\frac{1}{3}<x<\frac{1}{2}$

$\Rightarrow 2<\frac{1}{x}<3 \Rightarrow 4<\frac{2}{x}<6$ $\quad\Rightarrow \left[\frac{2}{x}\right]=4\, or\, 5$

CASE – I: $4<\frac{2}{x},5 \Rightarrow 2<\frac{1}{x}<\frac{5}{2}$ $\quad\Rightarrow \left[\frac{2}{x}\right]=4 \Rightarrow \frac{2}{5}<x<\frac{1}{2} \Rightarrow \frac{8}{5}<4x<2$

CASE –II: $5<\frac{2}{x}<6 \Rightarrow \frac{5}{2}<\frac{1}{x}<3$

$\Rightarrow \left[\frac{2}{x}\right]=5 \Rightarrow \frac{1}{3}<x<\frac{2}{5} \Rightarrow \frac{5}{3}<5x<2$

Now, $I=\int_{\frac{1}{3}}^{\frac{2}{5}}\{5x\}dx+\int_{\frac{2}{5}}^{\frac{1}{2}}\{4x\}dx$

$\{5x\}=5x-[5x]$

$\{5x\}=5x-1$

$\{4x\}=4x-1$

$\therefore I=\int_{\frac{1}{3}}^{\frac{2}{5}}(5x-1)\,dx+\int_{\frac{2}{5}}^{\frac{1}{2}}(4x-1)$

$I=\left(\frac{5x^2}{2}-x\right)\Big|_{\frac{1}{3}}^{\frac{2}{5}}+\left(2x^2-x\right)\Big|_{\frac{2}{5}}^{\frac{1}{2}}$

$$I=\frac{5}{2}\left[\frac{4}{25}-\frac{1}{9}\right]-\left(\frac{2}{5}-\frac{1}{3}\right)+2\left(\frac{1}{4}-\frac{4}{25}\right)-\left(\frac{1}{2}-\frac{2}{5}\right)$$

$$I=\frac{61}{450}=\frac{m}{n}=|m-n|=389$$

10. By solving the above two equations $f(x)=x^2-2x-6$ and $g(x)=x+4$

$$g\left(\tan^2 x\right)-f(\tan x)-8$$

$$=\tan^2 x+4-\tan^2 x+2\tan x+6-8$$

$$=2+2\tan x$$

$$J=\int_0^{\pi/4} ln\left(2(1+\tan x)\right)dx$$

$$=\int_0^{\pi/4} ln\ 2\,dx+\int_0^{\pi/4} ln(1+\tan x)\,dx$$

$$=\frac{\pi}{4}ln\,2+\frac{\pi}{8}ln2=\frac{3\pi}{8}ln\,2$$

$$\Rightarrow \frac{3\pi ln2}{J}=8$$

11. $$I=\int_0^1\left(\underbrace{\frac{\sqrt{1+4x-4x^3}-1}{2x}}_{f(x)}-\frac{\sqrt{x^4-4x+4}}{2}\right)dx$$

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

$$\int_0^1 f(x)\,dx+\int_{f(0)}^{f(1)} f^{-1}(x)\,dx+\int_0^0\frac{x^2}{x}dx$$

$$=1f(1)-0f(0)+\frac{1}{6}(-1)=-\frac{1}{6}$$

12. $$\frac{1}{3n+1}=\int_0^1 t^{3n}dt\ \ and\ \ \frac{1}{3n+2}=\int_0^1 t^{3n+1}dt$$

$$\sum_{n=0}^{\infty}\left(\frac{1}{3n+1}-\frac{1}{3n+2}\right)=\sum_{n=0}^{\infty}\int_0^1\left(t^{3n}-t^{3n+1}\right)dt$$

$$=\sum_{n=0}^{\infty}\int_0^1(1-t)t^{3n}dt=\int_0^1(1-t)\sum_{n=0}^{\infty}t^{3n}=\int_0^1(1-t)\left(1+t^3+t^6+\ldots\infty\right)dt=\int_0^1\frac{1-t}{1-t^3}dt$$

$$=\int_0^1\frac{dt}{t^2+t+1}=\int_0^1\frac{dt}{\left(t+\frac{1}{2}\right)^2+\left(\frac{\sqrt{3}}{2}\right)^2}=\frac{2}{\sqrt{3}}\tan^{-1}\left(\frac{2t+1}{\sqrt{3}}\right)\Big|_0^1$$

$$=\frac{2}{\sqrt{3}}\left(\tan^{-1}\sqrt{3}-\tan^{-1}\frac{1}{\sqrt{3}}\right)=\frac{2}{\sqrt{3}}.\frac{\pi}{6}=\frac{\pi}{3\sqrt{3}}$$

13. $\int_0^{\infty}\frac{x-\sin x}{x^3}$ put $= x=3t\Rightarrow$ $dx=3\,dt$

$$\int_0^{\infty}\frac{3t-\sin 3t}{9t^3}dt=\int_0^{\infty}\frac{3t-\left[3\sin t-4\sin^3 t\right]}{9t^3}dt$$

$$\int_0^{\infty}\frac{(x-\sin x)}{x^3}dx=\int_0^{\infty}\frac{3(t-\sin t)}{9t^3}dt+\int_0^{\infty}\frac{4\sin^3 t}{9t^3}dt$$

$$\int_0^{\infty}\left(\frac{(x-\sin x)}{x^3}\right)dx=\frac{1}{3}\int_0^{\infty}\frac{(x-\sin x)}{x^3}dx+\int_0^{\infty}\frac{4}{9}\frac{\sin^3 t}{t^3}dt$$

$$\frac{2}{3}\int_0^{\infty}\frac{(x-\sin x)}{x^3}=\frac{4}{9}\int_0^{\infty}\frac{\sin^3 t}{t^3}$$

$$\frac{2}{3}.\frac{a}{b}=\frac{4}{9}\qquad\Rightarrow\frac{a}{b}=\frac{2}{3}$$

$$\Rightarrow a+b=5$$

14. $g(x)=\int\frac{b^2-\sin x\left(a^2+2b^2\sin x\right)}{\left(a^2\cos x+b^2\sin x.\cos x\right)^3}dx=\int\frac{b^2\left(1-\sin^2 x\right)-a^2\sin x-b^2\sin^2 x}{\left(a^2+b^2\sin x\right)^3.\cos^3 x}$

$$=\int\frac{\frac{b^2}{\cos x}-\left(\frac{a^2+b^2\sin x}{\cos^3 x}\right)\sin x}{\left(a^2+b^2\sin x\right)^3}dx\qquad\int\frac{b^2\sec x-\left(a^2+b^2\sin x\right)\tan x\sec^2 x}{\left(a^2+b^2\sin x\right)^3}dx$$

$$\int\sec^2 x\frac{b^2\cos x}{\left(a^2+b^2\sin x\right)^3}dx-\int\frac{\tan x\sec^2 x}{\left(a^2+b^2\sin x\right)}dx$$

$$\sec^2 x\left(\frac{-1}{2}\frac{1}{\left(a^2+b^2\sin x\right)^2}\right)-\int\frac{2\sec^2 x\tan x}{2\left(a^2+b^2\sin x\right)^2}dx-\int\frac{\tan x\sec^2 x}{\left(a^2+b^2\sin x\right)^2}$$

$$=\frac{-1}{2}\frac{\sec^2 x}{\left(a^2+b^2\sin x\right)^2}+C$$

15. $=\int_1^e \frac{1+x^2 ln\, x}{x(1+x\, ln\, x)}dx \;=\int_1^e \frac{(1+x\, ln\, x)+(x^2.ln\, x - xln\, x)}{x(1+xln\, x)}dx$

$=\int_1^e \frac{1}{x}dx+\int_1^e \frac{(xln\, x-ln\, x)}{(1+xln\, x)}dx=\int_1^e \frac{1}{x}dx+\int_1^e \frac{1+xln\, x}{1+xln\, x}dx-\int_1^e \frac{1+ln\, x}{1+x\ln x}dx$

$=\log x\Big|_1^e+e-1-ln(xln\, x+1)\Big|_1^e=1+e-1-ln(e+1)=e-ln(e+1)$

16. Given $f(x)+f\left(\frac{x-1}{x}\right)=Tan^{-1}x \quad \rightarrow(1)$

Replace x by $\frac{x-1}{x}$, $\Rightarrow f\left(\frac{x-1}{x}\right)+f\left(1-\frac{1}{\frac{x-1}{x}}\right)=Tan^{-1}\left(\frac{x-1}{x}\right)$

$\Rightarrow f\left(\frac{x-1}{x}\right)+f\left(\frac{1}{1-x}\right)=Tan^{-1}\left(\frac{x-1}{x}\right)\rightarrow(2)$

Replace x by $\frac{1}{1-x}$ $\qquad f\left(\frac{1}{1-x}\right)+f\left(1-\frac{1}{\frac{1}{1-x}}\right)=Tan^{-1}\left(\frac{1}{1-x}\right)$

$f\left(\frac{1}{1-x}\right)+f(x)=Tan^{-1}\left(\frac{1}{1-x}\right) \qquad \rightarrow(3)$

(1) – (2) + (3) gives

$f(x)-f\left(\frac{1}{1-x}\right)+f\left(\frac{1}{1+x}\right)+f(x)=Tan^{-1}x+Tan^{-1}\left(\frac{x-1}{x}\right)+Tan^{-1}\left(\frac{1}{1-x}\right).$

$\Rightarrow 2f(x)=Tan^{-1}x-Tan^{-1}\left(\frac{x-1}{x}\right)+Tan^{-1}\left(\frac{1}{1-x}\right)$

$f(x)=\frac{1}{2}\left[Tan^{-1}-Tan^{-1}\left(\frac{x-1}{x}\right)+Tan^{-1}\left(\frac{1}{1-x}\right)\right]$

$\therefore \int_0^1 f(x)dx=\left(\int_0^1 Tan^{-1}x\,dx+\int_0^1 Tan^{-1}\left(\frac{1}{1-x}\right)dx-\int_0^1 Tan^{-1}\left(\frac{x-1}{x}\right)dx\right)\frac{1}{2}$

$=\left(\int_0^1 Tan^{-1}x+\underset{\substack{\downarrow \\ (a-x) \\ property}}{\int_0^1} Tan^{-1}\frac{1}{x}dx-\int_0^1 Tan^{-1}\left(\frac{x-1}{x}\right)dx\right)\frac{1}{2}$

$=\left(\int_0^1 Tan^{-1}x\,dx+\int_0^1 \cot^{-1}x dx-\int_0^1 Tan^{-1}\left(\frac{x-1}{x}\right)dx\right)\frac{1}{2}=\left(\int_0^1 \frac{\pi}{2}dx-\int_0^1 Tan^{-1}\left(\frac{x-1}{x}\right)dx\right)\frac{1}{2}$

$$=\frac{1}{2}\left[\frac{\pi}{2}-\int_0^1 Tan^{-1}\left(\frac{x-1}{x}\right)dx\right]=\frac{1}{2}\left[\int_0^1\frac{\pi}{2}-Tan^{-1}\left(\frac{x-1}{x}\right)dx\right]$$

Let $I=\frac{1}{2}\int_0^1\cot^{-1}\left(\frac{x-1}{x}\right)dx \Rightarrow I=\frac{1}{2}\int_0^1\cot^{-1}\left(\frac{x}{x-1}\right)dx$

$$2I=\frac{1}{2}\int_0^1\left(\cot^{-1}\left(\frac{x-1}{x}\right)+\cot^{-1}\left(\frac{x}{x-1}\right)\right)dx \qquad \frac{\pi}{2} \quad t>0,\frac{3\pi}{2} \quad t<0$$

$$=\frac{1}{2}\cdot\frac{\pi}{2}=\frac{3\pi}{4} \qquad \because 0<x<1\Rightarrow\frac{x-1}{x}<0 \qquad I=\frac{3\pi}{8}$$

17. $1 \;=\int_{-1}^{1}\frac{\sin x}{\left(\sin^2 x+\cos^2 x-2t\cos x+t^2\right)}dt$

$$=\int_{-1}^{1}\frac{\sin x\,dt}{(t-\cos x)^2+\sin^2 x}$$

$$=\frac{1}{\sin x}.\sin x\;Tan^{-1}\left(\frac{t-\cos x}{\sin x}\right)\Bigg|_{-1}^{1}$$

$$=Tan^{-1}\left(\frac{1-\cos x}{\sin x}\right)-Tan^{-1}(-\cot x/2)$$

$$=Tan^{-1}(\cot x/2)+Tan^{-1}(\tan x/2)$$

$$=Tan^{-1}\left(\tan\left(\frac{\pi}{2}-\frac{x}{2}\right)\right)+Tan^{-1}(\tan x/2)$$

Case-I:

$$=\frac{\pi}{2}-\frac{x}{2}+\frac{x}{2}=\frac{\pi}{2}$$

$$If\;0<\frac{\pi}{2}-\frac{x}{2}<\frac{\pi}{2}$$

18. $f''(t)=\int_{12t}^{t^3+6t^2} ln\left|\frac{x+8}{(t+2)^3-x}\right|dx$ .....(i)

Applying king

$$f''(t)=\int_{12t}^{t^3+6t^2} ln\left|\frac{t^3+6t^2+12t-x+8}{(t+2)^3-\left(t^3+6t^2+12t-x\right)}\right|dx$$

$$f''(t)=\int_{12t}^{t^3+6t^2} ln\left|\frac{(t+2)^3-x}{8+x}\right|dx \quad ....(ii)$$

$$(i)+(ii)$$

$$2f''(t)=0$$

$$\Rightarrow f'(t)=0$$

$$\Rightarrow f'(t)=\lambda$$

$$f(t)=\lambda t+\mu$$

$$\left.\begin{array}{l} f(1)=2\Rightarrow \lambda+\mu=2 \\ f(2)=1\Rightarrow 2\lambda+\mu=1 \end{array}\right\}\Rightarrow \lambda=-1,\ \mu=3$$

$$\therefore \quad \int_{-1}^{1}(-x+3)dx=2\int_{0}^{1}3.dx=6$$

19. $$f(x)=x+\int_{0}^{\pi/2}(\sin x\cos y+\cos x\sin y)f(y)dy$$

$$f(x)=x+\int_{0}^{\pi/2}\left(\left(\cos y\, f(y)dy\right)\sin x+\left(\sin f\ f(y)dy\right)\cos x\right) \qquad .....(i)$$

On comparing with.

$$f(x)=x+\frac{a}{\pi^2-4}\sin x+\frac{b}{\pi^2-4}\cos x,\ x\in R$$

$$\Rightarrow \frac{a}{\pi^2-4}=\int_{0}^{\pi/2}\cos y f(y)dy \qquad ....(2)$$

$$\Rightarrow \frac{b}{\pi^2-4}=\int_{0}^{\pi/2}\sin y\, f(y)dy \qquad ....(3)$$

Add (2) and (3)

$$\frac{a+b}{\pi^2-4}=\int_{0}^{\pi/2}(\sin y+\cos y)f(y)dy \qquad ....(4)$$

$$\frac{a+b}{\pi^2-4}=\int_{0}^{\pi/2}(\sin y+\cos y)\, f\left(\frac{\pi}{2}-y\right)dy \qquad .....(5)$$

Add (4) and (5)

$$\frac{2(a+b)}{\pi^2-4}=\int_{0}^{\pi/2}(\sin y+\cos y)\left(\frac{\pi}{2}+\frac{(a+b)}{\pi^2-4}(\sin y+\cos y)\right)dy \qquad ...(5)$$

$$=\pi+\frac{a+b}{\pi^2-4}\left(\frac{\pi}{2}+1\right)$$

$$(a+b)=-2\pi(\pi+2)$$

20. Nr and Dr is of the form

$$k^4+\frac{1}{4}=k^4+\frac{1}{4}-k^2+k^2=\left(k^2+\frac{1}{2}\right)^2-k^2$$

$$=\left(k^2+\frac{1}{2}+k\right)\left(k^2+\frac{1}{2}-k\right)$$

Where k is odd in Nr and even in Dr

Given expression

$$\prod_{k=1}^{n}\frac{(2k-1)^4+\frac{1}{4}}{(2k)^4+\frac{1}{4}}=\prod_{k=1}^{n}\frac{\left((2k-1)^2+(2k-1)+\frac{1}{2}\right)\left((2k-1)^2-(2k-1)+\frac{1}{2}\right)}{\left((2k^2)+2k+\frac{1}{2}\right)\left((2k)^2-2k+\frac{1}{2}\right)}$$

$$\prod_{k=1}^{n}\frac{\left(4k^2-2k+\frac{1}{2}\right)\left((2k-1)^2-(2k-1)+\frac{1}{2}\right)}{\left((2k)^2+2k+\frac{1}{2}\right)\left(4k^2-2k+\frac{1}{2}\right)} \qquad \prod_{k=1}^{n}\frac{(2k-1)^2-(2k-1)+\frac{1}{2}}{(2k)^2+2k+\frac{1}{2}}$$

21. $I=\int_{-\pi+a}^{3\pi+a}|x-a-\pi|\sin\left(\frac{x}{2}\right)dx$

Put $(x-a-\pi)=t$ $I=\int_{-2\pi}^{2\pi}|t|\sin\left(\frac{\pi}{2}+\frac{a+1}{2}\right)dt=\int_{-2\pi}^{2\pi}|t|\cos\left(\frac{a+t}{2}\right)dt$

$$=\underbrace{\cos\frac{a}{2}\int_{-2\pi}^{2\pi}|t|\cos\left(\frac{t}{2}\right)dt}_{even}-\underbrace{\sin\frac{a}{2}\int_{-2\pi}^{2\pi}(t)\sin\left(\frac{t}{2}\right)dt}_{zero\ beign\ odd}$$

$I=2\cos\frac{a}{2}\int_{0}^{2\pi}t\cos\frac{t}{2}dt$ Put $\frac{t}{2}=y$, we get

$$I=8\cos\frac{a}{2}\int_{0}^{\pi}\underbrace{y}_{I}\ \underbrace{\cos y\,dy}_{II}=8\cos\frac{a}{2}\left[\underbrace{y\sin y\Big|_0^{\pi}-\int_0^{\pi}\sin y\,dy}_{zero}\right]$$

$$\therefore I=-16\cos\frac{a}{2}\Rightarrow-16\cos\frac{a}{2}=-16$$

$$\therefore\cos\frac{a}{2}=1\Rightarrow\frac{a}{2}=2n\pi\Rightarrow a=4n\pi,\ n\in I$$

Sum$==\pi[4+8+12+.....+96]=\pi\left[\frac{24}{2}\times100\right]=\pi[24\times50]\Rightarrow k=1200$

22. $f(\cos x)=\cos 3x=4\cos^3x-3\cos x$ $\cot x=t; t\in[-1,1], f(t)=4t^3-3t;\ t\in[-1,1]$

$\therefore J=\int_0^1(4t^3-3t)^2\sqrt{1-t^2}\,dt$ put $t=\cos\theta$

$$J=\int_0^{\frac{\pi}{2}}\cos^2 3\theta.\sin^2\theta d\theta \qquad ....(1)$$

$$J=\frac{1}{4}\int_0^{\frac{\pi}{2}}\left(2\sin\theta\cos3\theta\right)^2 d\theta=\frac{1}{4}\int_0^{\frac{\pi}{2}}\left(\sin4\theta-\sin2\theta\right)^2 d\theta$$

$$=\frac{1}{4}\int_0^{\frac{\pi}{2}}\left(\sin^2 4\theta+\sin^2\theta-2\sin2\theta\sin4\theta\right)d\theta$$

$$J=\frac{1}{4}\int_0^{\frac{\pi}{2}}\sin^2 4\theta d\theta+\frac{1}{4}\int_0^{\frac{\pi}{2}}\sin^2 2\theta d\theta-\underbrace{\frac{2}{4}\int_0^{\frac{\pi}{2}}\sin2\theta.\sin4\theta d\theta}_{\text{using King and add}\Rightarrow zero}$$

$$J=\frac{1}{4}.\frac{1}{4}\int_0^{2\pi}\sin^2 tdt+\frac{1}{4}.\frac{1}{2}\int_0^{\pi}\sin^2 t\,dt$$

23. $$\lim_{a\to0^+}\frac{\int_0^a x\left(e^x-x-1\right)dx}{a^4}=\lim_{a\to0^+}\frac{e^a-a-1}{4a^2}=\frac{1}{8},\ \lim_{a\to0^+}\frac{\int_0^a\left(\tan x-x\right)dx}{a^4}=\lim_{a\to0^+}\frac{\tan a-a}{4a^3}=\frac{1}{12}$$

$$\lim_{a\to0^+}\frac{\int_0^a\left(\sin x-x\right)dx}{a^4}=\lim_{a\to0^+}\frac{\sin a-a}{4a^3}=\frac{-1}{24}$$

$$\frac{1}{8}t^2+\frac{1}{12}.t-\frac{1}{24}=0,3t^2+2t-1=0,\left(3t-1\right)\left(t+1\right)=0,t=\frac{1}{3},-1$$

$$\lim_{a\to0^+}\left|\frac{1}{\alpha(a)}-\frac{1}{\beta(a)}\right|=|3+1|=4$$

24. $$2I_1=\int_0^{\pi}\frac{2\sin884x\sin1122x}{\sin x}dx=\int_0^{\pi}\frac{\cos238x}{\sin x}dx-\int_0^{\pi}\frac{\cos2006x}{\sin x}dx$$

Let $I_{2m}=\int_0^{\pi}\frac{\cos2mx}{\sin x}dx \quad I_{2m}-I_{2m-2}=\int_0^{\pi}\frac{\cos2mx-\cos\left(2m-2\right)x}{\sin x}dx$

25. $$M=\sum_{k=1}^{\infty}\frac{15^k}{\left(5^k-3^k\right)\left(5^{k+1}-3^{k+1}\right)}$$

$$2\left(\frac{\cos(2m-1)x}{(2m-1)}\right)_0^{\pi}=\frac{-4}{(2m-1)}\Rightarrow I_{2006}-I_2=-4\left(\frac{1}{3}+\frac{1}{5}+.....\frac{1}{2005}\right)$$

$$I_{238}-I_2=-4\left(\frac{1}{3}+\frac{1}{5}+.....\frac{1}{237}\right),2I_1=4\left(\frac{1}{239}+\frac{1}{241}+....\frac{1}{2005}\right)$$

$$I'=\int_0^1\left(x^{238}+x^{240}+....x^{2004}\right)dx,=\left(\frac{1}{239}+\frac{1}{241}.....\frac{1}{2005}\right),\frac{I_1}{I'}=2$$

$$=\sum_{k-1}^{\infty}\frac{3^k.5^k(5-3)}{2\left(5^k-3^k\right)\left(5^{k+1}-3^{k+1}\right)}=\sum_{k=1}^{\infty}\frac{5^{k+1}\left(3^k-5^k\right)+5^k\left(5^{k+1}-3^{k+1}\right)}{2\left(5^k-3^k\right)\left(5^{k+1}-3^{k+1}\right)}$$

$$=\sum_{k=1}^{\infty}\frac{5^{k+1}\left(3^k-5^k\right)+5^k\left(5^{k+1}-3^{k+1}\right)}{2\left(5^k-3^k\right)\left(5^{k+1}-3^{k+1}\right)}=\sum_{k=1}^{\infty}\left(\frac{1}{2\left(1-\frac{3}{5}\right)^k}-\frac{1}{2\left(1-\left(\frac{3}{5}\right)^{k+1}\right)}\right)$$

$$M=\frac{1}{2}\underset{m\to\infty}{Lim}\left(\frac{1}{\left(1-\frac{3}{5}\right)}-\frac{1}{\left(1-\left(\frac{3}{5}\right)^2\right)}+\frac{1}{\left(1-\left(\frac{3}{5}\right)^2\right)}-\frac{1}{\left(1-\left(\frac{3}{5}\right)^3\right)}+....\frac{1}{\left(1-\left(\frac{3}{5}\right)^{m-1}\right)}-\frac{1}{\left(1-\left(\frac{3}{5}\right)^m\right)}\right)$$

$$=\frac{1}{2}\underset{m\to\infty}{Lim}\frac{1}{\frac{2}{5}}-\frac{1}{\left(1-\left(\frac{3}{5}\right)^m\right)}=\frac{5}{4}-\frac{1}{2}\underset{m\to\infty}{Lim}\left(\frac{1}{\left(1-\left(\frac{3}{5}\right)^5\right)}\right),M=\frac{5}{4}-\frac{1}{2}=\frac{3}{4},M=\frac{3}{4}$$

PHYSICS

26. $\frac{4}{3}\pi r^3(\rho - 2\rho)g - 6\pi\eta r v = m\frac{dv}{dt}$

$\frac{dv}{dt} = -\frac{g}{2} - \frac{9}{4}\frac{\eta v}{r^2}, -\int_{v_0}^{0}\frac{dv}{\frac{g}{2}+\frac{9}{4}\frac{\eta v}{r^2}} = \int_0^t dt, t = \frac{4r^2}{9\eta}\ln 2 = \frac{2v_0}{g}\ln 2$

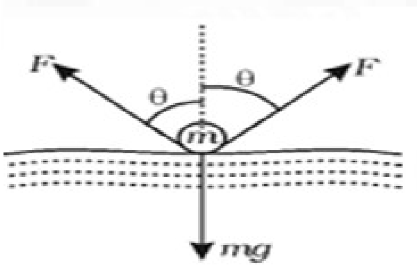
27. Let the mass of the needle be m. As the liquid surface is distorted, the surface tension forces acting on both side of the needle make an angle , θ say, with vertical. Since, the forces acting on the needle are F, F and mg, resolving the forces vertically for its equilibrium, we have

$\sum F_y = F\cos\theta + F\cos\theta - mg = 0$

This gives $m = \frac{2F\cos\theta}{g}$

Where $F = \sigma l$. Then , $\pi r^2 l = \frac{2\sigma l\cos\theta}{g}$

For r to be maximum, $\cos\theta = 1$, Hence, $r_{\max} = \sqrt{\frac{2\sigma}{\pi\rho g}}$



28. $h = \frac{2\sigma\cos\theta}{R\rho g} \Rightarrow \frac{\cos\theta_1}{\cos\theta_2} - \frac{h_1}{h_2} = \frac{16.3}{12} = 13.6\ \theta_2 > \theta_1 \Rightarrow \theta$ will increase to maintain $h = 12\,cm$

29. In a capillary tube water rises to a height h such that the hydrostatic pressure $(h\rho g)$ becomes equal to the excess pressure $p = 2\sigma / R$, where R is the radius of curvature of the meniscus. A satellite in a stable orbit around the earth is in a state of weightlessness, i.e. = $g = 0$. Thus the hydrostatic pressure becomes zero. Consequently, water will rise to the top to the tube.

30. $\triangle P = \frac{\sigma}{r};\ r = \frac{(2-1)}{2} = \frac{1}{2}\,mm;$

$\triangle P = 7\times10^{-2}\left(\frac{1}{0.5\times10^{-3}}\right) = \frac{7\times10^{-2}510^3}{0.5} = \frac{70}{0.5} = 140$

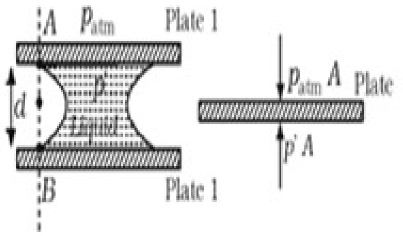
$\triangle P$ must be equal to $pgh \Rightarrow \triangle P = \rho gh \Rightarrow 140 = 10^3\times10\times h,\ \ h = \frac{140}{10^4} = 0.014m$, $Hence\ 1.4\ cm$

31. $\because$ Angle of contact = 0

$\Rightarrow$ Curve AB will be semicircle.

$\Rightarrow p^1 = p_{atm} = \frac{\sigma}{d/2} = P_{atm} - \frac{2\sigma}{d}$

$\Rightarrow Force\ required = \left(p_{atm} - p'\right)A = \dfrac{2\sigma A}{d}$



32. Force due to surface tension balancing the force due to pressure, hence

$1000 \times 10 \times \dfrac{40}{100} = \dfrac{2\sigma}{R} = \dfrac{2\times 7\times 10^{-2}}{R} \Rightarrow 2R = 0.07mm$

33. $I - q,r; II - p,s; III - q,r$

For A AND C, final surface area is greater than the initial surface area. Hence, surface energy increases and this increase is due to decrease in internal energy. Hence, temperature decreases. In B, surface area is decreasing

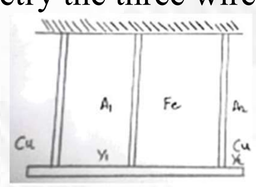
34. $V = K_1 r^2 \quad P = mv; \quad Mass = K_2 r^3 \Rightarrow P \propto r^5$

35. $v_T = \dfrac{2r^2\left(\rho - \rho'\right)g}{9\eta}; \quad x = \dfrac{4}{3}\pi r^3 \times \rho \qquad y = \dfrac{4}{3}\pi r^3 \times \rho'; \qquad v_T \propto \left(\dfrac{x-y}{r}\right)$

36. Radius R of the single tube is given by

$\dfrac{\pi p R^4}{8\eta l} = \dfrac{\pi p r^4}{8\eta l} + \dfrac{\pi p (2r)^4}{8\eta l}$ $or\ R^4 = r^4 + 16r^4\ or\ R - (17)^{1/4} r$ which is choice (A)

37. From symmetry the three wires undergo same extension.



$F = \dfrac{YAe}{l}$, For same tension $\dfrac{Y_1 A_1 e}{l} = \dfrac{Y_2 A_2 e}{l} \Rightarrow \dfrac{A_1}{A_2} = \dfrac{Y_2}{Y_1}$

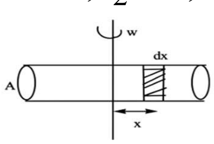
$\dfrac{\pi r_1^2}{\pi r_2^2} = \dfrac{Y_2}{Y_1} \Rightarrow \dfrac{r_1}{r_2} = \sqrt{\dfrac{Y_2}{Y_2}} = \sqrt{\dfrac{10^{11}}{2\times 10^{11}}} = \dfrac{1}{\sqrt{2}} \Rightarrow d_1 : d_2 = 1 : \sqrt{2}$

38. $F = \eta\ A\dfrac{du}{dy}$

$as\ u = C_1 y + C_2, at\ \ y = 0,\ u = 0\ hence\ C_2 = 0, \dfrac{du}{dy} = C_1$

$F = \eta\ \ AC_1, 2 = 10^{-2} \times 1C_1, C_1 = 200, u = c_1 y + c_2, c_1$

$= 200, c_2 = 0, u = 200 \times 2 \times 10^{-2} = 4\ m/\sec$



39.

$dm = \rho A dx, df = dm x \omega^2,\ F = -\rho A\dfrac{\omega^2 x^2}{2} + c$

$At\ x=\frac{1}{2}, F=0, C=\frac{\rho A\omega^2 l^2}{8}$

$x=0, F=\frac{\rho A\omega^2 l^2}{8}\ Stress=\rho=\frac{F}{A}=\frac{\rho\omega^2 l^2}{8}, f=\frac{1}{2\pi}\sqrt{\frac{8\sigma}{\rho l^2}}$

40. $U=8\pi r^2 T,\ p=\frac{dU}{dt}=80\pi T\times 2r\frac{dr}{dt}\Rightarrow p\propto e$

41. (d) force on wire=Load carried

$=m(g+a)=m\left(g+\frac{g}{2}\right)=\frac{3mg}{2}$

Stress $\sigma=\frac{F}{A}\Rightarrow A=\frac{F}{\sigma}$, Hence, $A_{\min}=\frac{F}{\sigma_{\max}}$

$\frac{\pi d_{\min}^2}{4}=\frac{\frac{3}{2}m.g}{\sigma}\Rightarrow d_{\min}^2=\frac{\frac{3}{2}mg\times 4}{\sigma\pi}\quad d_{\min}=\sqrt{\frac{6}{\pi}.\frac{mg}{\sigma}}$

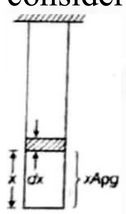
42. Statement – 1 is false, Statement – 2 is true.

43. A is false but R is true.

44. Statement I is incorrect but Statement II is correct

45. Both A and R are correct and R is the correct explanation of A

46. consider an element as shown in the figure



Stress in the element $=\frac{Force}{Area}=\frac{xA\rho g}{A}=x\rho g$

Now, elastic potential energy stored in the wire is

$dU=\frac{1}{2}$(Stress)(Strain)(Volume) $=\frac{1}{2}.\frac{(Stress)^2}{Y}(Volume)$

$dU=\frac{1}{2}.\frac{(x\rho g)^2}{Y}Adx=\frac{1}{2}.\frac{\rho^2 g^2 A}{Y}x^2 dx$

Total energy potential energy $=\frac{1}{2}.\frac{\rho^2 g^2 A}{Y}\int_0^1 x^2 dx \quad =\frac{\rho^2 g^2 AL^3}{6Y}$

47. $V\propto r^2\ \frac{V_1}{V_2}=\left(\frac{r_1}{r_2}\right)^2$

48. Net force $=0$; $mg+6\pi nrv=v4\rho g$; $(6\pi nrv)=F_v=v\times 4\rho\times g-v\times\rho g=(3v\rho g)$. Hence it 3 times of $v\rho g$

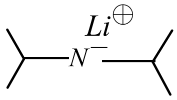
49. Case – I $\quad y_1=y_2=\frac{h}{2},\ \frac{dv}{dx}=\frac{v}{h/2}=\frac{2v}{h}\Rightarrow viscous\ \ force=\eta_0 A\frac{dv}{dx}=\eta_0 A\frac{2v}{h}$

As plates have 2 sides, Total force $=\frac{4\eta_0 vA}{h}$

50. $mg+F_{ST}=B\Rightarrow mg+4at=a^2h\rho_\omega g\Rightarrow 10+4\times\frac{10}{4}=10h$ or $h=2m$

CHEMISTRY

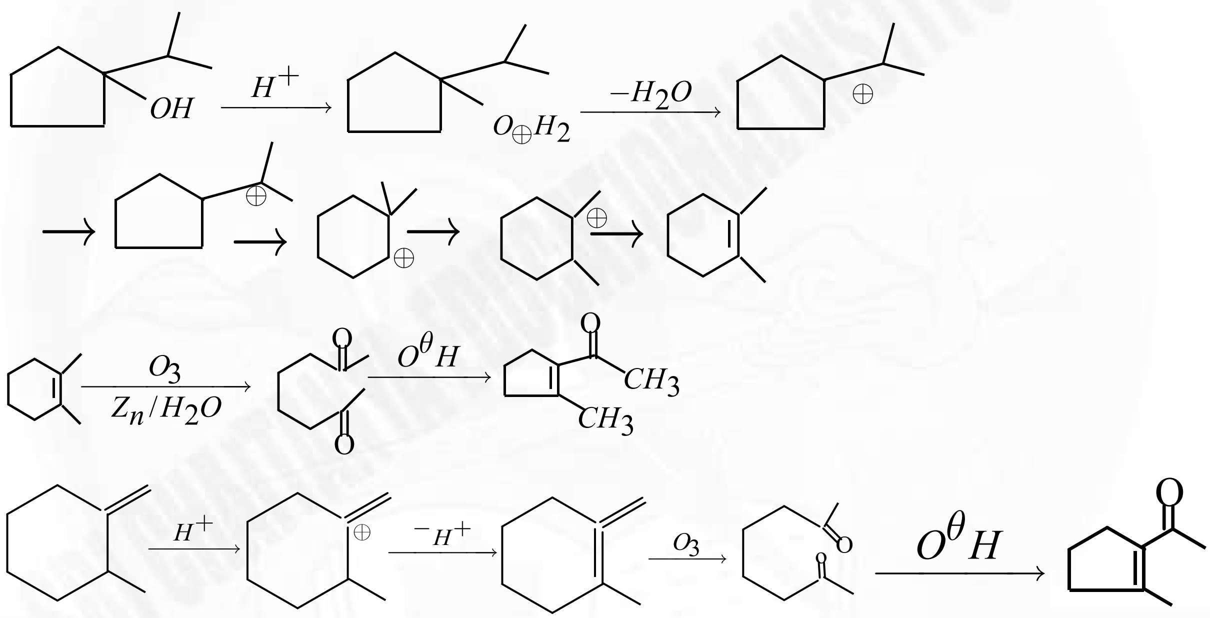
51. $\begin{array}{l}CHO\\ |\\ CHO\end{array} \xrightarrow{OH^{-}} \begin{array}{l}CH_2OH\\ |\\ COO^{\theta}\end{array}$

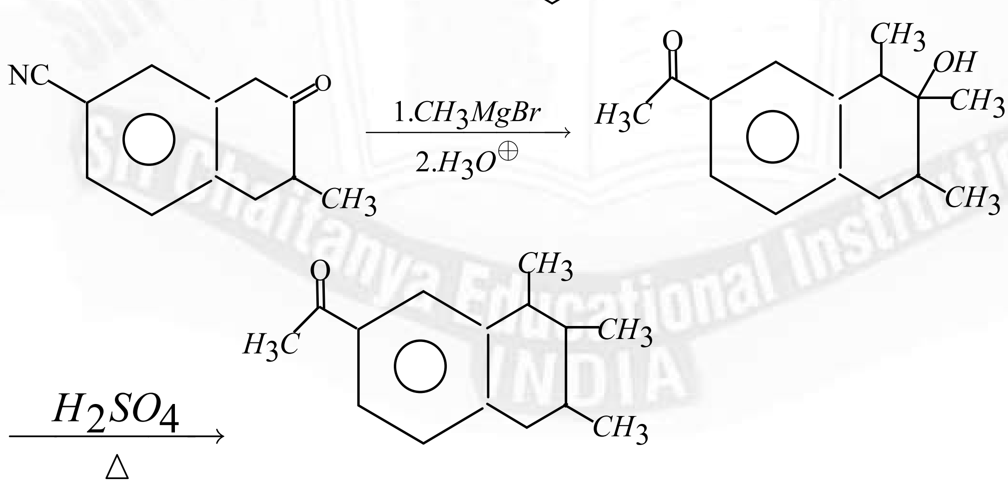
52.  LDA

Bulky base abstract H^+ from less sterically hindered carbon
LDA – Kinetic enolate is formed
NaH – Thermodynamic enolate is formed

53. Higher member aldehydes and ketones are less pungent and more fragrant used in making perfumes and flavouring agents.

54. $C_6H_5CH=CH-CHO$ undergo i, iii and iv only.

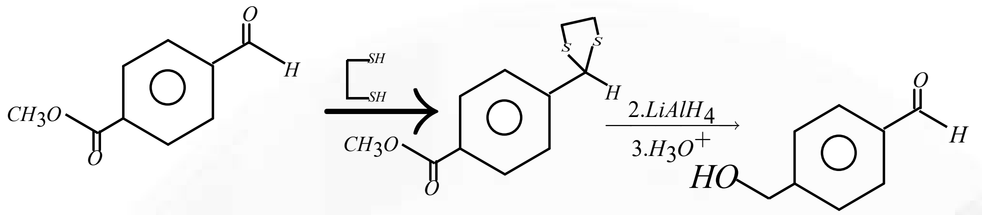
55. 

56. 

57. A = $CH_3-\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-CH=CH_2$ B = $CH_3-\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-CH_2-CH_2-CHO$

C = $CH_3-\underset{CH_3}{\overset{CH_3}{\underset{|}{\overset{|}{C}}}}-CH_2-CD_2-CHO$

58. Conversion of hemi acetal in to acetal takes place through carbocation mechanism

59. 

60. Addition of grigrand reagent is nucleophilic addition
Aldehydes are more reactive than ketones
towards nucleophilic addition
Aliphatic aldehydes are more reactive than aromatic aldehydes

61. $A-C_2H_2$ $B-C_6H_6$ $C-C_6H_5CH_3$ $D-C_6H_5CH\left(OCrOHCl_2\right)_2$ $E-C_6H_5CHO$

62. Aromatic aldehydes donot give positive test with fehling's and Benedicts reagent
Aromatic aldehydes are giving positive tollen's test.

63. Haloform reaction.

64. $A=CHCl_3$ $B=\left(CH_3-CH_2-COO\right)_2 Ca$

$$\left(CH_3-CH_2-COO\right)_2 Ca \xrightarrow{\triangle} \underset{(B)}{CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_2-CH_3} + CaCO_3$$

$$CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_2-CH_3 \xrightarrow{D_2O/D^+} CH_3-CD_2-\overset{O}{\overset{\|}{C}}-CD_2-CH_3$$

65. Claisen condensation (Step – I)
Haloform reaction (Step – II)
Decarboxylation (Step - III)

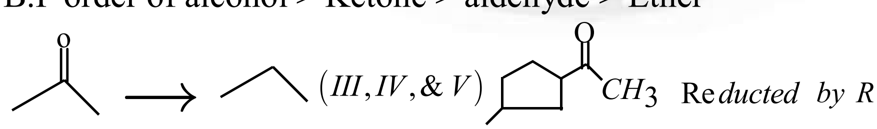
66. Crossed aldol reaction

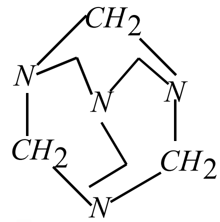
$$C_6H_5CH=CH-\overset{O}{\overset{\|}{C}}-C_6H_5$$

67. $A=C_6H_5COOH$ $B=C_6H_5COC_6H_5$

68. A Nucleophilic addition

69. B.P ordere is
Propan – 1 – ol > Acetone>Protanal>Methoxy ethane
B.P order of alcohol > Ketone > aldehyde > Ether

70. 

71. $6HCHO + 4NH_3 \xrightarrow{-H_2O}$ 

72. Except :- $HCOOH$ and CCl_3CHO

73. $x = 4 \quad y = 1 \quad x - y = 3$

74. Acetophenone and cyclic ketol of acetone

75.