SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

SR MPC	JeeMain	Date: 29-08-20
Time:3 hrs	GT-18	Max.Marks:360

KEY SHEET

MATHS

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

PHYSICS

26	**4**	27	**4**	28	**1**	29	**1**	30	**1**
31	**2**	32	**3**	33	**2**	34	**4**	35	**2**
36	**3**	37	**2**	38	**3**	39	**2**	40	**4**
41	**1**	42	**2**	43	**1**	44	**2**	45	**4**
46	**4**	47	**1.3**	48	**16**	49	**0.1**	50	**8.2**

CHEMISTRY

51	**4**	52	**4**	53	**2**	54	**3**	55	**1**
56	**1**	57	**1**	58	**3**	59	**2**	60	**3**
61	**2**	62	**3**	63	**4**	64	**2**	65	**3**
66	**2**	67	**1**	68	**1**	69	**3**	70	**3**
71	**82.5**	72	**-0.19**	73	**19**	74	**5**	75	**7**

SOLUTIONS

MATHS

1. We have, $f_1(x)=f_{0+1}(x)=f_0(f_0(x))=\frac{1}{1-\frac{1}{1-x}}=\frac{x-1}{x}$

Similarly, $f_2(x)=f_{1+1}(x)=f_0(f_1(x))=\frac{1}{1-\frac{x-1}{x}}=x$

And $f_3(x)=f_{2+1}(x)=f_0(f_2(x))=f_0(x)=\frac{1}{1-x}$

And $f_4(x)=f_{3+1}(x)=f_0(f_3(x))=f_0(f_0(x))=\frac{x-1}{x}$

$\therefore f_0=f_3=f_6=...=\frac{1}{1-x}$ and $f_1=f_4=f_7=f_{10}=....=\frac{x-1}{x}$

And $f_2=f_5=f_8=.....=x$

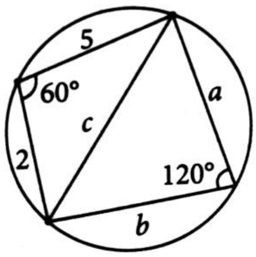
So, $f_{100}(3)=\frac{3-1}{3}=\frac{2}{3}, f_1\left(\frac{2}{3}\right)=\frac{\frac{2}{3}-1}{\frac{2}{3}}=-\frac{1}{2}$ and $f_2\left(\frac{3}{2}\right)=\frac{3}{2}$

$\therefore f_{100}(3)+f_1\left(\frac{2}{3}\right)+f_2\left(\frac{3}{2}\right)=\frac{5}{3}$

2. $f(x)=\min\{x+1,|x|+1\}\Rightarrow f(x)=x+1,\ x\in R$

Hence f(x) is differentiable for all $x\in R$

3. $\cos 60°=\frac{4+25-c^2}{2.2.5}\Rightarrow\frac{1}{2}=\frac{29-c^2}{20}$



$\Rightarrow 10=20-c^2\Rightarrow c^2=19\Rightarrow c=\sqrt{19}$

Now, $\cos 120°=\frac{a^2+b^2-c^2}{2ab}$

$\Rightarrow -\frac{1}{2}=\frac{a^2+b^2-19}{2ab}$

$\Rightarrow a^2+b^2-19=-ab\Rightarrow a^2+b^2+ab=19$

Area of quadrilateral

$=\frac{1}{2}\times 2\times 5\times\sin 60°+\frac{1}{2}ab\sin 120°=4\sqrt{3}$

$\Rightarrow\frac{5\sqrt{3}}{2}+\frac{ab\sqrt{3}}{4}=4\sqrt{3}\Rightarrow\frac{ab}{4}=4-\frac{5}{2}=\frac{3}{2}$

$\Rightarrow ab=6$

$\therefore a^2+b^2=13$

$\therefore a=2, b=3$

4. On rationalizing given polynomial, we get $\left[\frac{2\left(\sqrt{5x^3+1}+\sqrt{5x^3-1}\right)}{2}\right]^8+\left[\frac{2\left(\sqrt{5x^3+1}-\sqrt{5x^3-1}\right)}{2}\right]^8$

$=2[{}^8C_0\left(\sqrt{5x^3+1}\right)^8+{}^8C_2\left(\sqrt{5x^3+1}\right)^6\left(5x^3-1\right)+$

${}^8C_4\left(\sqrt{5x^3+1}\right)^4\left(5x^3-1\right)^2+{}^8C_6\left(\sqrt{5x^3+1}\right)^6\left(5x^3-1\right)+$

${}^8C_4\left(\sqrt{5x^3+1}\right)^4\left(5x^3-1\right)^2+8C_6\left(\sqrt{5x^3+1}\right)^2\left(5x^3-1\right)^3+{}^8C_8\left(5x^3-1\right)^4]$

$=2[\left(5x^3+1\right)^4+28\left(5x^3+1\right)^3\left(5x^3-1\right)+70\left(5x^3+1\right)^2$

$\left(5x^3-1\right)^2+28\left(5x^3+1\right)\left(5x^3-1\right)^3+\left(5x^3-1\right)^4]$

$\therefore n=12 \text{ and } m=2\left(5^4+140.5^3+70.5^4+140.5^3+5^4\right)=1,60,000=\left(20\right)^4$

5. We have $\frac{{}^{15}C_r}{{}^{15}C_{r-1}}=\frac{15!}{r!(15-r)!}\times\frac{(r-1)!(15-r+1)!}{15!}=\frac{16-r}{r}$

$\therefore\sum_{r=1}^{15}r^2\left(\frac{{}^{15}C_r}{{}^{15}C_{r-1}}\right)=\sum_{r=1}^{15}r^2\left(\frac{16-r}{r}\right)=\sum_{r=1}^{15}\left(16r-r^2\right)=16\times\frac{15\times16}{2}-\frac{15\times16\times31}{6}=680$

6. x + y + z = 12

Now, A.M. $\geq$ G.M.

$\Rightarrow\frac{3\left(\frac{x}{3}\right)+4\left(\frac{y}{4}\right)+5\left(\frac{z}{5}\right)}{12}\geq\left[\left(\frac{x}{3}\right)^3\left(\frac{y}{4}\right)^4\left(\frac{z}{5}\right)^5\right]^{\frac{1}{12}}$

$\Rightarrow\frac{x^3y^4z^5}{3^34^45^5}\leq1\Rightarrow x^3y^4z^5\leq3^3.4^4.5^5$

But, given $x^3y^4z^5=(0.1)(600)^3$

$\therefore$ All the numbers are equal

$\therefore\frac{x}{3}=\frac{y}{4}=\frac{z}{5}=k(\text{say})\Rightarrow x=3k,\ y=4k,\ z=5k$

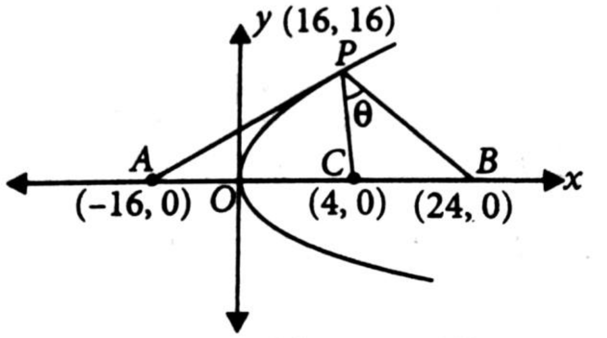
But, $x+y+z=12\Rightarrow3k+4k+5k=12\Rightarrow k=1$

$\therefore x=3;\ y=4;\ z=5$

So, $x^3+y^3+z^3=216$

7. The equation of tangent at P(16, 16) is x – 2y + 16 = 0

The equation of normal at P(16, 16) is 2x + y – 48 = 0



The slope of $PC: m_1 = \frac{16}{12} = \frac{4}{3}$

The slope of PB : $PB: m_2 = \frac{-16}{8} = -2$

$$\tan\theta = \left|\frac{m_1 - m_2}{1 + m_1 m_2}\right| = \left|\frac{\frac{4}{3} + 2}{1 - \frac{4}{3}(2)}\right| = \left|\frac{\frac{10}{3}}{-\frac{5}{3}}\right| = 2$$

8. We have, $4y^2 = x^2 + 1$

The tangent to (i) at (x_1, y_1) is given by $4yy_1 = xx_1 + 1$

According to question, $A \equiv \left(\frac{-1}{x_1}, 0\right)$, $B \equiv \left(0, \frac{1}{4y_1}\right)$

Let mid point of AB be M(h, k)

Then, $\frac{-1}{x_1} = 2h \Rightarrow x_1 = \frac{-1}{2h}$ and $\frac{1}{4y_1} = 2k \Rightarrow y_1 = \frac{1}{8k}$

(x_1, y_1) lies on (i)

$$\therefore 4\left(\frac{1}{8k}\right)^2 = \left(\frac{-1}{2h}\right)^2 + 1 \Rightarrow \frac{4\times1}{64k^2} = \frac{1}{4h^2} + 1$$

$$\Rightarrow \frac{1}{16k^2} = \frac{1}{4h^2} + 1 \Rightarrow h^2 = 4k^2 + 16h^2k^2$$

$\therefore$ Locus of mid point of AB is $x^2 = 4y^2 + 16x^2y^2$ or $x^2 - 4y^2 - 16x^2y^2 = 0$

9. We have, $P(A) = \frac{2}{5}; P(A \cap B) = \frac{3}{20}$

$$P(A' \cup B') = P((A \cap B)') = 1 - P(A \cap B) = 1 - \frac{3}{20} = \frac{17}{20}$$

Now, $A \cap (A' \cup B') = A \cap (A \cap B)' = A - ((A \cap B)')' = A - (A \cap B)$

$$\therefore P(A - (A \cap B)) = \frac{2}{5} - \frac{3}{20} = \frac{1}{4}$$

$$\therefore P\left(A|\left(A'\cup B'\right)\right)=\frac{P\left(A-\left(A\cap B\right)\right)}{P\left(A'\cup B'\right)}=\frac{\frac{1}{4}}{\frac{17}{20}}=\frac{5}{17}$$

10. We have, $\frac{x^2}{12}+\frac{y^2}{16}=1 \;\therefore\; e=\sqrt{1-\frac{12}{16}}=\frac{1}{2}$

$\Rightarrow$ Foci $\equiv(0,2)\&(0.-2)$

So, transverse axis of hyperbola = 2b = 4 $\Rightarrow b=2$

11. We have

$(p\to q)\to\left[(\sim p\to q)\to q\right]$ simplifying as

$(p\to q)\to\left((p\vee q)\to q\right)$

$(p\to q)\left((\sim p\wedge\neg q)\vee q\right)$

$(p\to q)\to\left((\sim p\vee q)\wedge(\sim q\vee q)\right)$

$(p\to q)\to(p\to q)$ which is tautology

12. Let $A=\begin{vmatrix}0 & \cos x & -\sin x\\ \sin x & 0 & \cos x\\ \cos x & \sin x & 0\end{vmatrix}$

$\therefore |A|=0(0-\cos x\sin x)-\cos x\left(0-\cos^2 x\right)-\sin x\left(\sin^2 x-0\right)=0$

$\Rightarrow \cos^3 x-\sin^3 x=0\Rightarrow \tan^3 x=1\Rightarrow \tan x=1$

$\sum_{x\in s}\frac{\sqrt{3}+\tan x}{1-\sqrt{3}\tan x}=\frac{\sqrt{3}+1}{1-\sqrt{3}}\times\frac{1+\sqrt{3}}{1+\sqrt{3}}(\because \tan x=1)$

$=\frac{1+3+2\sqrt{3}}{-2}=\frac{4}{-2}-\frac{2\sqrt{3}}{2}=-2-\sqrt{3}$

13. A + B = 2B'

$\Rightarrow (A+B)'=(2B')'\Rightarrow A'+B'=2B\Rightarrow B=\frac{A'+B'}{2}$

Now, $A+\left(\frac{B'+A'}{2}\right)=2B'\;[\because A+B=2B']$

$\Rightarrow 2A+B'+A'=4B'\Rightarrow 2A+A'=3B'$

$\Rightarrow A=\frac{3B'-A'}{2}$

Also, 3A + 2B = I_3

$\Rightarrow 3\left(\frac{3B'-A'}{2}\right)+2\left(\frac{A'+B'}{2}\right)=I_3$

$\Rightarrow\left(\frac{9B'-2B'}{2}\right)+\left(\frac{2A'-3A'}{2}\right)=I_3$

$\Rightarrow 11B'-A'=2I_3 \Rightarrow (11B'-A')'=(2I_3)' \Rightarrow 11B-A=2I_3$

Multiplying (2) by 3 and then adding (1) and (2), we get $35B=7I_3 \Rightarrow B=\frac{I_3}{5}$

From (2), $11\frac{I_3}{5}-A=2I_3 \Rightarrow 11\frac{I_3}{5}-2I_3=A$

$\Rightarrow A=\frac{I_3}{5}$

$\therefore 5A=5B=I_3 \Rightarrow 10A+5B=3I_3$

14. Let $f(x)=ax^4+bx^3+cx^2+dx+e$ … (i)

Given, $\lim_{x\to 0}\left(\frac{f(x)}{x^2}+1\right)=3$

$\Rightarrow \lim_{x\to 0}\left(ax^2+bx+c+\frac{d}{x}+\frac{e}{x^2}+1\right)=3$

$\Rightarrow c+1=3 \Rightarrow c=2$ [$\because$ limit exists finitely, so d = e = 0]

$\therefore f(x)=ax^4+bx^3+2x^2$

$\Rightarrow f'(x)=4ax^3+3bx^2+4x$

Given that f(x) has extreme values at x = 1 and x = 2

$\therefore f'(1)=0$ and $f'(2)=0$

$\Rightarrow 4a+3b+4=0$ and $32a+12b+8=0$

From (ii) and (iii), we get $a=\frac{1}{2}, b=-2$

Thus, $f(x)=\frac{1}{2}x^4-2x^3+2x^2$

$\therefore f(-1)=\frac{1}{2}+2+2=\frac{9}{2}$

15. We have from hypothesis, $4x+2\pi r=2$

$\therefore r=\frac{1-2x}{\pi}$, Area, $A=x^2+\pi r^2=x^2+\frac{1}{\pi}(2x-1)^2$

For maximum/minimum

$\frac{dA}{dx}=0 \Rightarrow 2x+\frac{4}{\pi}(2x-1)=0 \;\therefore x=\frac{2}{\pi+4}$

Also, $\frac{d^2A}{dx^2}>0$ at this value. Thus there is a minimum

Again, $r = \frac{1}{\pi+4}$, On comparing, x = 2r

16. We have, $\int \frac{\log\left(t+\sqrt{1+r^2}\right)}{\sqrt{1+t^2}}dt = \frac{1}{2}\left(g(t)\right)^2 + C$ ….(i)

Differentiating (i) both sides, we get $\frac{\log\left(t+\sqrt{1+r^2}\right)}{\sqrt{1+t^2}} = g(t)g'(t)$

$\Rightarrow g(t) = \log\left(t+\sqrt{1+t^2}\right)$

$\therefore g(2) = \log\left(2+\sqrt{5}\right)$

17. $\frac{dy}{dx} + \frac{x}{x^2-1}y = \frac{x^4+2x}{\sqrt{1-x^2}}$

The L.F. of this differential equation is

$e^{\int \frac{x}{x^2-1}dx} = e^{-\int \frac{x}{1-x^2}dx} = e^{\frac{1}{2}\ln\left(1-x^2\right)} = \sqrt{1-x^2}$

The solution is given by $y\sqrt{1-x^2} = \int \frac{x\left(x^3+2\right)}{\sqrt{1-x^2}}\sqrt{1-x^2}\ dx + \lambda$

$= \int\left(x^4+2x\right)dx + \lambda = \frac{x^5}{5} + x^2 + \lambda$

As y(0) = 0 $\Rightarrow \lambda = 0$

$\Rightarrow y\sqrt{1-x^2} = \frac{x^5}{5} + x^2$

$\int_{-\sqrt{3}/2}^{\sqrt{3}/2} \frac{\frac{x^5}{5}+x^2}{\sqrt{1-x^2}}dx = \int_{-\sqrt{3}/2}^{\sqrt{3}/2} \frac{x^2}{\sqrt{1-x^2}}dx$ (The other part is odd)

$= 2\int_0^{\sqrt{3}/2} \frac{x^2}{\sqrt{1-x^2}}dx$

Let x = $\sin\theta$, we get

$I = 2\int_0^{\pi/3} \frac{\sin^2\theta}{\cos\theta}\cos\theta d\theta = 2\int_\theta^{\pi/3} \sin^2\theta d\theta$

$= \int_0^{\pi/3}\left(1-\cos 2\theta\right)d\theta = \theta - \frac{\sin 2\theta}{2}\Big|_0^{\pi/3} = \frac{\pi}{3} - \frac{\sqrt{3}}{4}$

18. $\vec{a} = 2\hat{i} + \hat{j} - 2\hat{k} \Rightarrow |\vec{a}| = 3$ and $\vec{b} = \hat{i} + \hat{j}$

Now, $\vec{a}\times\vec{b}=\begin{vmatrix}\hat{i} & \hat{j} & \hat{k}\\ 2 & 1 & -2\\ 1 & 1 & 0\end{vmatrix}=2\hat{i}-2\hat{j}+\hat{k}$

$\therefore \left|\vec{a}\times\vec{b}\right|=3$

We also have, $\left|\left(\vec{a}\times\vec{b}\right)\times\vec{c}\right|=\left|\vec{a}\times\vec{b}\right|\left|\vec{c}\right|\left|\sin 30°\right|\left|\hat{n}\right|=3\left|\vec{c}\right|.\frac{1}{2}$

$\Rightarrow 3=3\left|\vec{c}\right|.\frac{1}{2}\Rightarrow\left|\vec{c}\right|=2$

Since, $\left|\vec{c}-\vec{a}\right|=3\ldots$(i)

On squaring (i), we get $c^2+a^2-2\vec{c}.\vec{a}=9$

$\Rightarrow 4+9-2\vec{a}.\vec{c}=9\Rightarrow\vec{a}.\vec{c}=2$

19. Lines are coplanar

$\therefore\begin{vmatrix}3-1 & 2-2 & 1-(-3)\\ 1 & 2 & \lambda^2\\ 1 & \lambda^2 & 2\end{vmatrix}=0\Rightarrow\begin{vmatrix}2 & 0 & 4\\ 1 & 2 & \lambda^2\\ 1 & \lambda^2 & 2\end{vmatrix}=0$

$\Rightarrow 2\left(4-\lambda^4\right)+4\left(\lambda^2-2\right)=0$

$\Rightarrow 4-\lambda^4+2\lambda^2-4=0\Rightarrow\lambda^2\left(\lambda^2-2\right)=0$

$\Rightarrow\lambda=0,\ \sqrt{2},\ -\sqrt{2}$

20. Given lines can be written as $\frac{x-b}{a}=\frac{y-0}{1}=\frac{z-d}{c}$ and $\frac{x-b'}{a'}=\frac{y-0}{1}=\frac{z-d}{c'}$

$\therefore$ Required condition of perpendicularity is $aa'+cc'+1=0$

21. $\sin^{-1}\left(\frac{x}{5}\right)+\sin^{-1}\left(\frac{4}{5}\right)=\frac{\pi}{2}$

$\Rightarrow\sin^{-1}\left(\frac{x}{5}\right)=\frac{\pi}{2}-\sin^{-1}\left(\frac{4}{5}\right)$

$\frac{x}{5}=\sin\left(\frac{\pi}{2}-\sin^{-1}\left(\frac{4}{5}\right)\right)$

$\frac{x}{5}=\cos\left(\sin^{-1}\frac{4}{5}\right)=\cos\left(\cos^{-1}\frac{3}{5}\right)=\frac{3}{5}\Rightarrow x=3$

22. Let $I=\int_4^{10}\frac{\left[x^2\right]}{\left[x^2-28x+196\right]+\left[x^2\right]}dx$

Use $\int_a^b f\left(a+b-x\right)dx=\int_a^b f\left(x\right)dx$

$$\therefore I=\int_4^{10}\frac{\left[(x-14)^2\right]}{\left[x^2\right]+\left[(x-14)^2\right]}dx$$

Adding (i) & (ii), we get

$$2I=\int_4^{10}\frac{\left[(x-14)^2\right]+\left[x^2\right]}{\left[x^2\right]+\left[(x-14)^2\right]}dx\Rightarrow 2I=\int_4^{10}dx$$

$$\Rightarrow 2I=6\Rightarrow I=3$$

23. We have, $3x^2-10x-25=0$ … (i)

Since tan A and tan B are roots of (i)

$$\therefore \tan A+\tan B=\frac{10}{3} \text{ and } \tan A\tan B=\frac{-25}{3}$$

$$\text{Now, } \tan(A+B)=\frac{\tan A+\tan B}{1-\tan A\tan B}=\frac{\frac{10}{3}}{1+\frac{25}{3}}=\frac{5}{14}$$

$$\therefore \sin(A+B)=\frac{5}{\sqrt{221}} \text{ and } \cos(A+B)=\frac{14}{\sqrt{221}}$$

Now, $3\sin^2(A+B)-10\sin(A+B)\cos(A+B)-25\cos^2(A+B)$

$$=\frac{3\times25}{221}-\left(\frac{10\times5\times14}{221}\right)-\left(\frac{25\times14\times14}{221}\right)=\frac{2}{221}(3-28-196)=-25$$

24. α is a root of $x^2-6x-2=0$

Then $\alpha^2-6\alpha-2=0$

Multiplying by $\alpha^{n+2}-6\alpha^{n+1}-2\alpha^n=0$

Similarly, $\beta^{n+2}-6\beta^{n+1}-2\beta^n=0$

Subtracting, we get

$$\left(\alpha^{n+2}-\beta^{n+2}\right)-6\left(\alpha^{n+1}-\beta^{n+1}\right)-2\left(\alpha^n-\beta^n\right)=0$$

i.e., $a_{n+2}-6a_{n+1}-2a_n=0$

Thus, $\dfrac{a_{n+2}-2a_n}{2a_{n+1}}=3$

Set n = 8 to obtain the desired value $\dfrac{a_{10}-2a_8}{2a_9}=3$

25. Incorrect $\sum_{i=1}^{100}x_i^2=400$ and incorrect $\sum_{i=1}^{100}x_i^2=2475$

Now incorrect observations 3, 4 and 5 are omitted.

$\therefore$ Correct $\sum_{i=1}^{97} x_i = 400 - 3 - 4 - 5 = 388$

PHYSICS

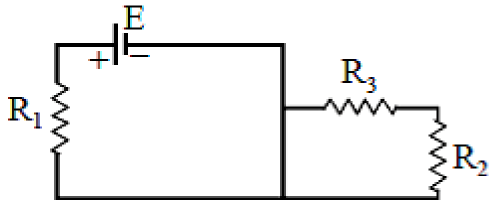
26. Conceptual

27. Conceptual

28. $\frac{dA}{dt} = \frac{L}{2m}$

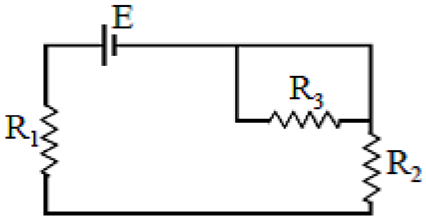
29. Just after switch is closed, L is open circuit and C is short circuit

Just after

$\Rightarrow$ 

$\Rightarrow i = 0$

Long time



$i = 0$

30. Conceptual

31. Conceptual

32. AT the top

$T + mg = \frac{mv^2}{L}$

$T < 10mg$

$V < \sqrt{11gL}$

$\sqrt{3gL} < u < \sqrt{13gL}$

33.

$d \sin\theta = n\lambda$

$0.320 \times 10^{-3}.\sin 30^0 = n.500 \times 10^{-9}$

$n = \frac{320 \times 10^{-6}}{500 \times 10^{-9}} \frac{1}{2} \frac{16 \times 1000}{50} = 320$

$So, total\ no\ of\ bright\ fringes = 2.(320) + 1$

$= 641$

34. Conceptual

35. Let the elongation in spring are $x_1 \& x_2$

$$x_1 + x_2 = 2x$$

$$3kx_1 = kx_2$$

$$3kx_1 + kx_2 = k_{eq}x$$

$$T = 2\pi\sqrt{\frac{m}{k_{eq}}}$$

36. From momentum conservation

$$\overrightarrow{p_i} = \overrightarrow{p_f}$$

$$a\hat{i} + b\hat{j} + c\hat{i} + d\hat{j} = p\hat{i} + q\hat{j} + r\hat{i} + s\hat{j}$$

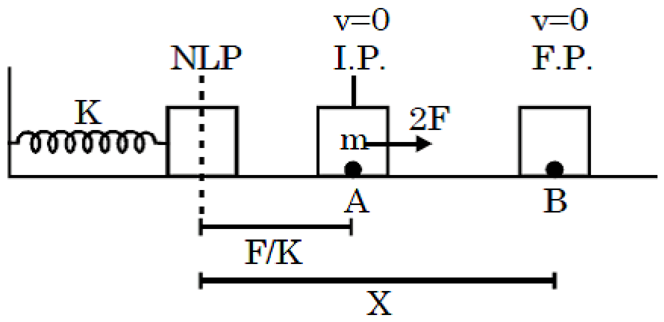
a + c = p + r

37. F = pressure at centroid $\times$ area

$$F = \left(P_0 + \frac{h+h+a+h+a}{3}\rho g\right)\frac{1}{2}ab$$

$$= \left(P_0 + \left(h + \frac{2a}{3}\right)\rho g\right)\frac{1}{2}ab$$

38. Replacing it with string block system



Let at initial position 2F force is applied then W.E.T. from A to B

$$W_S + W_F = 0$$

$$X = \frac{3F}{K}$$

Net elongation in spring = $\frac{3F}{K} \Rightarrow 3CE$

39. Conceptual

40. Charge is conserved. In order to fully convert an electron into energy, a positron (the electron's antiparticle must be involved). That is, electron + positron – > energy, NOT electron – > positron + energy.

41. Conceptual

42. Using Gauss theorem

43. $P_t = P_c\left(1+k^2/2\right)$

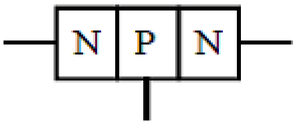
P_t is total transmitted power (sidebands and carrier)

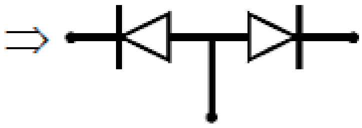
P_c is carrier powder

k is modulation index

Maximum sideband power occurs when k = 1

44.



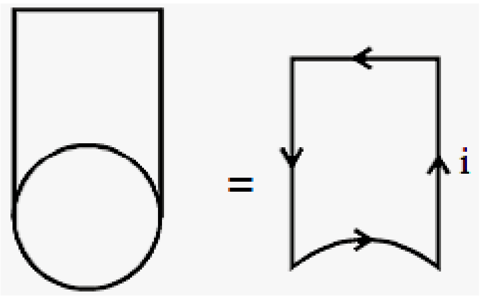


45. A = 2

$V_{max} = 6$

$$\begin{cases} v_{max} = A\omega \\ \Rightarrow \omega = 3 \\ \& T = \dfrac{2\pi}{\omega} \end{cases}$$

46.



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

47. $\dfrac{dN}{dt}\times\dfrac{hC}{\lambda}=P$

$$F=\frac{dN}{dt}\frac{h}{\lambda}=ma$$

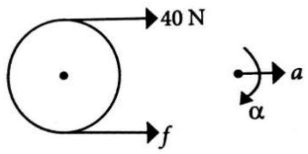
$$S=\frac{1}{2}at^2$$

$$S=\frac{1}{2}\times\frac{P}{mc}\times t^2$$

$$=\frac{1}{2}\times\frac{3\times10^{-3}}{50\times10^{-3}\times3\times10^{8}}\times(3600)^2$$

$$=\frac{36\times36\times10^4}{10^{10}}\times10^{-6}=1.3\text{mm}$$

48. $40 f = ma = m(R\alpha)$



$40\times R - f\times R = mR^2\alpha$

From eqn (i) and (ii)

$80 = 2mR\alpha$

$\alpha=\frac{40}{mR}=\frac{40}{5\times0.5}$

$=16\,\text{rad/s}^2$

49. For string, $\frac{\text{Mass}}{\text{Length}}=m=\frac{10^{-2}}{0.4}=2.5\times10^{-2}kg/m$

$\therefore$ Velocity $v=\sqrt{\frac{T}{m}}=\sqrt{\frac{16}{2.5\times10^{-2}}}=8m/s$

For constructive interference between successive pulses.

$\Delta t_{\min}=\frac{2l}{v}=\frac{2(0.4)}{8}=0.1\text{sec}$

(After two reflections, the wave pulse is in same phase as it was produced since in one reflection it's phase changes by π, and If at this moment next identical pulse is produced, then constructive interference will be obtained.

50. $\frac{\Delta u}{u}\times100=\left(\frac{2\Delta d}{d}+\frac{\Delta v}{v}+\frac{\Delta\ell}{\ell}\right)\times100$

$\frac{\Delta\ell}{\ell}=\frac{30}{1800}=\left[2\times\frac{0.04}{1-6}+\left(\frac{30}{1800}\right)\right]\times100=8.166\%\approx8.2\%$

CHEMISTRY

51. NO $\Rightarrow$ Bond order 2.5 paramagnetic $\qquad$ $\overset{+}{NO}\Rightarrow$ Bond order '3' diamagnetic

52. Conceptual

53. $A(g)\rightarrow 2B(g)+C(g)$

Let initial pressure P_0 $\quad 0 \quad 0$

After 10 min. $(P_0 - x)$ $2x$ x

After long time $(t \to \infty)$ 0 $2P_0$ P_0

As per given $(P_0 - x) + 2x + x +$ vapour pressure of $H_2O = 188$

$P_0 + 2x = 160$ and $3P_0 + 28 = 388$

So, $P_0 = 120$ and $x = 20$ torr

$$k = \frac{1}{t}\ln\left(\frac{P_0}{P_0 - x}\right)$$

$$\Rightarrow \frac{1}{10}\ln\left(\frac{120}{100}\right) = \frac{1}{10}\times(\ln 4 + \ln 3 - \ln 10) = 0.02\,\text{min}^{-1} = 1.2\,\text{hr}^{-1}$$

54. $\wedge_m^\infty(BaSO_4) = 2\wedge_{eq}^\infty(BaSO_4)$

$\wedge_{eq}^\infty(BaSO_4) = \wedge_{eq}^\infty(Ba^{2+}) + \wedge_{eq}^\infty(SO_4^{2-})$

$= \wedge_{eq}^\infty(BaCl_2) = \wedge_{eq}^\infty(H_2SO_4) - \wedge_{eq}^\infty(HCl)$

$\wedge_{eq}^\infty(BaSO_4) = x_1 + x_2 - x_3$

$\wedge_m^\infty = 2(x_1 + x_2 - x_3)$

For sparingly soluble salt $\wedge_m^\infty = \frac{k}{M}\times 1000 \Rightarrow \frac{500x}{(x_1 + x_2 - x_3)}$

$$K_{sp} = M^2 \Rightarrow \frac{2.5\times 10^5 x^2}{(x_1 + x_2 - x_3)^2}$$

55. In excess of air

$Li + O_2 \to Li_2O$ (*Monoxide*)

$Na + O_2 \to Na_2O_2$ (*Peroxide*)

$K + O_2 \to KO_2$ (*Superoxide*)

56. Inert pair effect ,relectunce of ns orbitals e^- in bond formation

57. Conceptual

58. Ppts. of Ag_2CrO_4, Ag_2CO_3 are soluble in NH_4OH due to formation of $[Ag(NH_3)_2]^+$

Green ppt. of $Ni(OH)_2$ is soluble in NH_4OH due to formation of $[Ni(NH_3)_6]^{2+}$

$$Ag_2CrO_4 \uparrow + 4NH_4OH \to 2[Ag(NH_3)_2]^+ + CrO_4^{2-} + 4H_2O$$

$$Ag_2CrO_3 \uparrow + 4NH_4OH \to 2[Ag(NH_3)_2]^+ + CO_3^{2-} + 4H_2O$$

$$Ni(OH)_2 \uparrow + 8NH_4OH \to [Ni(NH_3)_6]^{2+} + 2OH^- + 6H_2O$$

Green ppt.

$Fe(OH)_3$ is insoluble in NH_4OH

$Al(OH)_3$ is insoluble in NH_4OH

59. Conceptual

60. $\Delta_t = \frac{4}{9}\Delta_0$

$\therefore \Delta_t \text{ for} [CoCl_4]^{2-} = \frac{4}{9} \times 18000\,cm^{-1} = 8000\,cm^{-1}$

61. (I) IUPAC name is Pentaamminenitrito – N-chromium (III) tetrachlorozincate (II)

(II) It does not exhibit geometrical isomerism

(III) It shows linkage isomerism due to presence of ambidentate ligand NO_2^-

(IV) Its coordination isomers are :

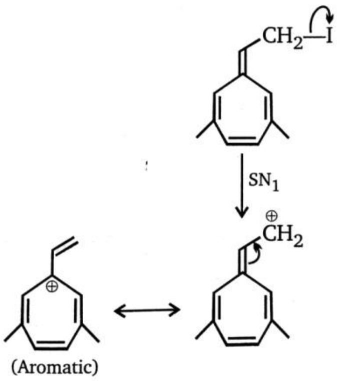
$$[CrCl(NH_3)_5][ZnCl_3(NO_2)]$$

$$[CrCl_2(NH_3)_4][ZnCl_2(NO_2)NH_3]$$

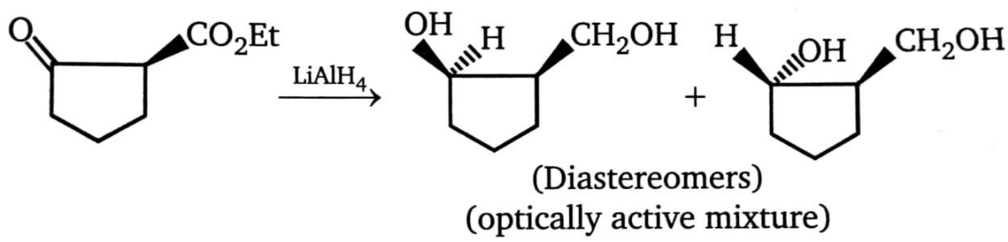
$$[Zn(NO_2)(NH_3)_3][CrCl_4(NH_3)_2]$$

62. Conceptual

63.

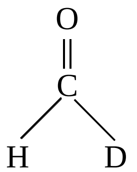


64.



Mechanism of reaction is nucleophilic addition

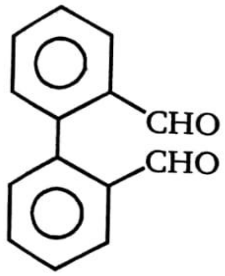
65.



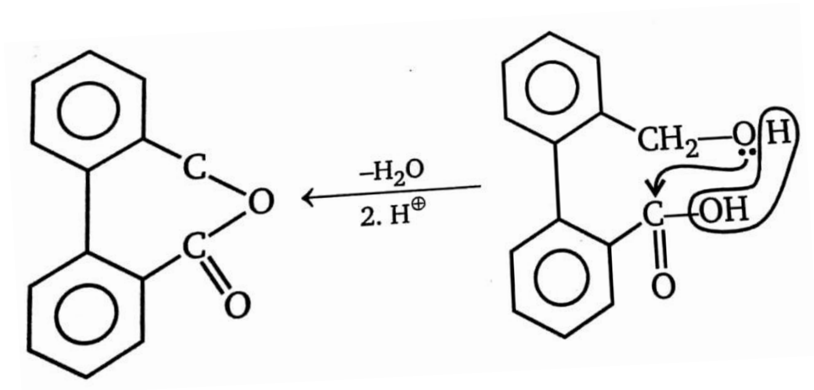
$\xrightarrow{HO^{\ominus}} DCOO^{\ominus} + CH_2DOH$

Disproportionation (Salt of acid + alcohol)

66. Conceptual

67. 

$\xrightarrow[\Delta]{\text{Conc.KOH}}$ No $\alpha-H$ hence no aldol. Only cannizzaro



68. Conceptual

69. Alkene (A) must be symmetrical alkene. Which give racemic mixture an anti-addition and meso-compound is syn-addition.

$\therefore$ cis-4-octene is the answer.

70. Conceptual

71. Total m-eq. of NaOH taken = 20

m-eq. of $H_2SO_4 = m-eq.\text{ of}NaOH$ reacted = $\frac{5\times0.2}{25}\times250=10$

m-eq. of NaOH reacted = 20 – 10 = 10

$(NH_4)_2SO_4 + 2NaOH$

$\Rightarrow Na_2SO_4 + 2NH_3 + 2H_2O$

m-moles of $(NH_4)_2SO_4$ reacted = 5

wt. of $(NH_4)_2SO_4 \Rightarrow 5\times10^{-3}\times132=0.66$

Percentage of $(NH_4)_2SO_4$ in sample = $\frac{0.66}{0.80}\times100=82.5$

72. Conceptual

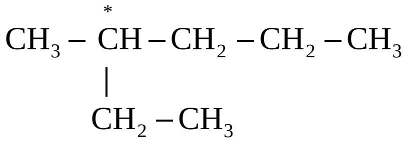
73. $CO + H_2O \rightleftharpoons CO_2 + H_2$

Initial conc.	3	3	x	0
At eqm.	2	2	(x + 1)	1

$$5 = \frac{(x+1)}{4} = 20 = x + 1 \Rightarrow x = 19$$

74. Conceptual

75.



(or)