SRIGAYATRI EDUCATIONAL INSTITUTIONS

INDIA

SR MPC | **GT-4** | **Date: 14-09-20**

Time: 02:00 PM to 05:00 PM | **2014_P2 Model** | **Max.Marks:180**

KEY SHEET

PHYSICS

1	**B**	2	**B**	3	**B**	4	**A**	5	**A**
6	**A**	7	**D**	8	**B**	9	**C**	10	**C**
11	**D**	12	**C**	13	**A**	14	**C**	15	**A**
16	**B**	17	**D**	18	**A**	19	**B**	20	**C**

CHEMISTRY

21	**D**	22	**B**	23	**A**	24	**C**	25	**A**
26	**D**	27	**A**	28	**A**	29	**D**	30	**B**
31	**D**	32	**A**	33	**B**	34	**A**	35	**B**
36	**A**	37	**A**	38	**A**	39	**C**	40	**B**

MATHS

41	**C**	42	**B**	43	**C**	44	**D**	45	**B**
46	**B**	47	**B**	48	**B**	49	**C**	50	**A**
51	**B**	52	**D**	53	**B**	54	**B**	55	**D**
56	**B**	57	**A**	58	**C**	59	**B**	60	**D**

SOLUTIONS
PHYSICS

1. Let velocity of the aeroplane be $\vec{v}_p = u\cos 30^0\hat{i} + u\sin 30^0\hat{j}$ and velocity of the wind be v,

then $u\dfrac{\sqrt{3}}{2}t\hat{i} + \left(\dfrac{u}{t}t - 5t^2\right)\hat{j} + vt\hat{k} = 400\sqrt{3\hat{i}} + 80\hat{j} + 200\hat{k}$

$\Rightarrow u\dfrac{\sqrt{3}}{2}t = 400\sqrt{3}.\dfrac{u}{2}t - 5t^2 = 80,\ vt = 200$

$ut = 800\ and\ \dfrac{u}{2}t - 5t^2 = 80$

$\Rightarrow 400 - 5t^2 = 80 \qquad \Rightarrow t^2 = 64 \qquad \Rightarrow t = 8\sec$

2. $\tau = F_{\perp} r = (\Delta PA)r$ as rod is light $\tau = 4\times 10^5\times 20\times 10^{-4}\times(0.2)$

$= 40\times 4\ Nm$

3. The F.B.D. of wire PQ is

The force due to surface tension = F_{ST} = $2T\times 2AD\tan\theta$

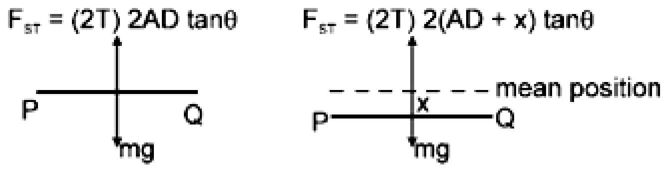


Figure (a) Figure (b)

For wire to be in equilibrium (Figure (a))

$AT\ AD\tan\theta = mg$ ....(1)

If the wire PQ is at a distance x below the mean position, the restoring force on the wire is (Figure (b))

$-ma = 4T\tan\theta(AD + x) - mg = 4t\tan\theta\, x$

Hence the wire PQ executes SHM

$a = -\dfrac{4T}{m}\tan\theta\, x$

Comparing with $a = -\omega^2 x$ we get

$\omega^2 = \dfrac{4T}{m}\tan\theta$ Or $T = 2\pi\sqrt{\dfrac{m}{4T\tan\theta}} = 2\pi\sqrt{\dfrac{1\times 10^{-3}}{4\times 25\times 10^{-3}}} = \dfrac{\pi}{5}s$

4. By using conservation of energy,

Loss of gravitational P.E of mass = gain in K.E of mass + P.E of spring.

5. Conceptual

6. Magnetic flux through conducting loop = $\frac{\mu_0 I}{2\pi} a \ln\left(\frac{R+b}{R}\right)$

Emf = $\frac{\mu_0 I_0 a\omega}{2\pi}\ln\left(\frac{5}{4}\right)\cos 1000t$

Maximum emf = $\frac{\mu_0}{2\pi}(I_0\omega)\left(\ln\frac{5}{4}\right)a$

$= 2\times 10^{-7}\times 10\times 1000\left(\ln\frac{5}{4}\right)a$

$= 2\times 10^{-3}\ln\left(\frac{5}{4}\right)a$

7. At any height 'h'

$$\frac{P_0V_0}{T_0} = \frac{P_0(1-\alpha h)}{T_0\sqrt{1-\alpha h}} \Rightarrow V = \frac{V_0}{\sqrt{1-\alpha h}}$$

$$dv = \frac{-1}{2}V_0(-\alpha)\frac{1}{1-\alpha h^{3/2}}dh$$

$$\int dw = \int_0^h P\,dv = \int_0^h P_0(1-\alpha h)\frac{v_0\alpha}{2}\frac{1}{(1-\alpha h)^{3/2}}dh$$

$$= \frac{P_0V_0\alpha}{2}\int\frac{1}{(1-\alpha h)^{1/2}}dh = \frac{P_0V_0\alpha}{2}\left[\frac{(1-\alpha h)^{1/2}}{1/2(-\alpha)}\right]_0^h$$

$$= P_0V_0\left(\sqrt{1-\alpha h}\right)$$

8. Graph follows $y^2 = 4ax$

$T_0^2 = 4a\left(\frac{1}{V_0}\right)$

$\Rightarrow$ $T_0^2V_0 =$ constant

$\Rightarrow$ $T_0V_0^{1/2} =$ constant $\left(\therefore\ TV^{\gamma-1} = \text{constant}\right)$

$\therefore$ $\gamma = 3/2$

$\Rightarrow$ $\frac{V_{rms}}{V_{sound}} = \sqrt{\frac{3}{\gamma}} = \sqrt{2}$

9. $\phi = BA$

$e = \frac{d\phi}{dt} = A\frac{dB}{dt} = \frac{1}{2} \times 2 \times \sqrt{3} \times \sqrt{3}$

$I = \frac{3}{5} Amp,\ V_{AB} = I - \frac{3}{5}$

10. $\sqrt{V_R^2 + V_L^2} = 100\ \ V_C - V_L = 120\ \ 130^2 = 120^2 + V_R^2$

11. $T = 2\pi\sqrt{\frac{m}{K}} = 2\pi\sqrt{\frac{2}{800}} = \frac{2\pi}{20}; T = \frac{\pi}{10}\text{sec}$ $\quad \therefore \Delta t = \frac{T}{4} = \frac{\pi}{40}\text{sec}$

12. Let the distance of the lens from the object is l when a real image is formed on the screen.

$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}; \frac{1}{(100-l)} = \frac{1}{-l} = \frac{1}{23}$

$\Rightarrow l = \left(50 \pm 10\sqrt{2}\right)cm$

$y = A\sin\omega t$

$10\sqrt{2} = A\sin\frac{2\pi}{T}\left(\frac{T}{8}\right)$

$10\sqrt{2} = A\sin\frac{\pi}{4}$

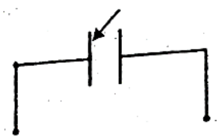
$A = 20cm$

13&14

Force applied on slab by insect = force applied on slab by capacitor, F

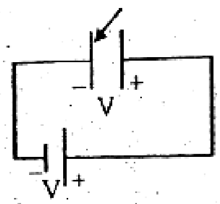
$\frac{1}{2}at^2 = l \Rightarrow \frac{1}{2}\frac{F}{m}t^2 = l$, time of flight is $t = \frac{1}{v}$.

15&16

[Graph-1] 

$hf = KE_{max} + \phi$

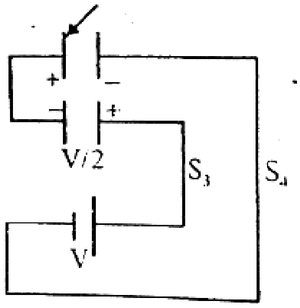
$\Rightarrow 0 = (-E) + \phi \Rightarrow (\phi = E)$

[Graph-2] 

$hf + eV = KE_{\max} + f$

$0 + eV = 0 + f \quad Or$

$eV = f = E$



$hf - \dfrac{e}{2} = KE_{\max} + (f)$

$\Rightarrow \; hf = 0 + \dfrac{3e}{2} \quad or$

$E_1 = \dfrac{3e}{2}$

17. Conceptual

18. Conceptual

19. Conceptual

20. Conceptual

CHEMISTRY

21. according to VSEPR

3 bond pairs + 2 Lone pairs = T-shape

2 bond pairs + 3 Lone pairs = Linear

22. $n_{air} = \dfrac{PV}{RT} \; n_{O_2} = n_{air} \times \dfrac{20}{100} = 0.8 \; C + \dfrac{1}{2}O_2 \rightarrow CO \; CO + \dfrac{1}{2}O_2 \rightarrow CO_2$

23. $t_{1/2} \propto \dfrac{1}{a^{n-1}}$ if n = 0 $t_{1/2} \propto a \log \; t_{1/2} \propto \log a$

24. $\propto_{(spe)} = \dfrac{\propto_{(obs)}}{l(dm) \times c\left(\dfrac{g}{ml}\right)}$

25. From I to III Anglestrain increases

26. $XeF_6 + RbF \rightarrow Rb^{\oplus} + XeF_7^-$

$XeF_6 + 3H_2O \rightarrow XeO_3 + 6HF$

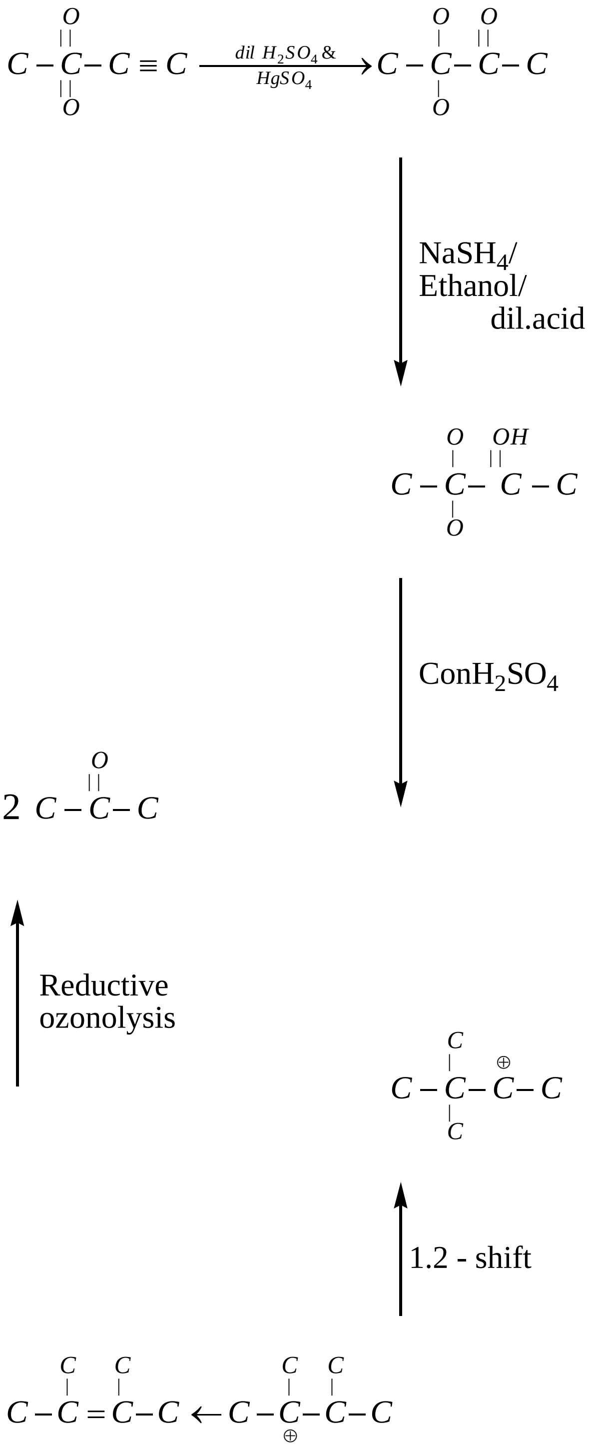
$2XeF_6 + SiO_2 \rightarrow 2XeOF_4 + SiF_4$

$eF_6 + 6HCl \rightarrow 6HF + Xe + 3Cl_2$

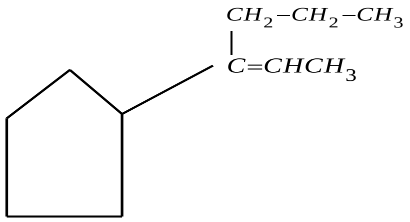
27. Conceptual

28. Conceptual

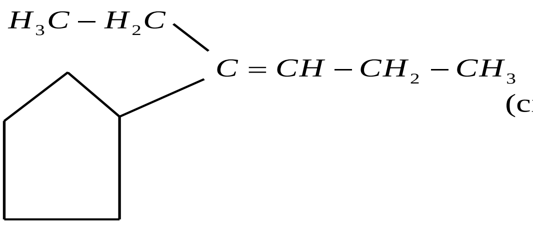
29.



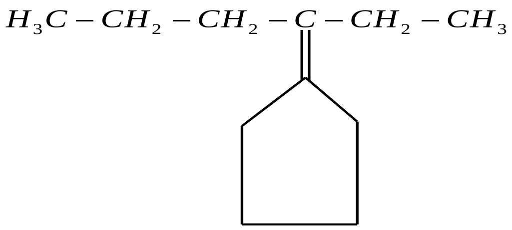
30.



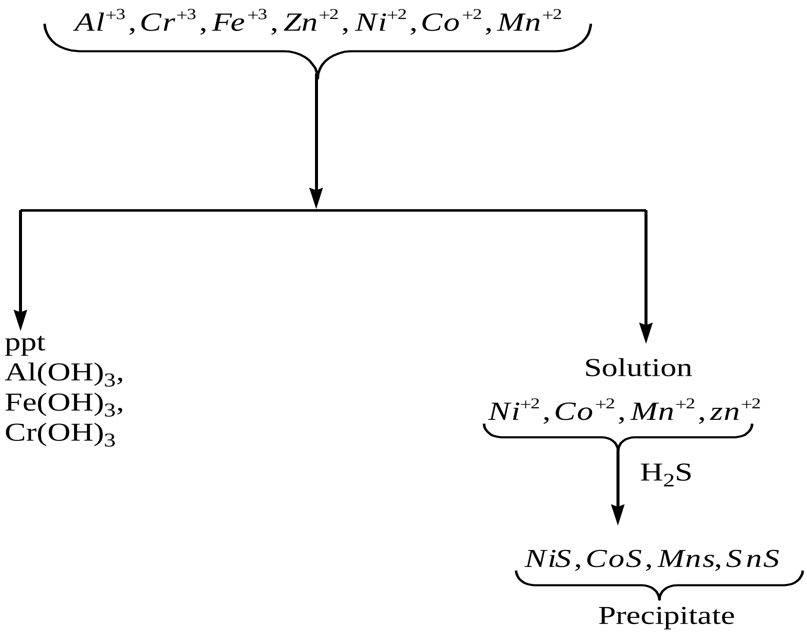
(cis. trans)



(cis. trans)



31& 32



. Al^{+3} does not form Al_2S_3 in aq. Sol^n.

. $Cr^{+3} \xrightarrow[H_2O_2/OH^-]{Na_2O_2} \underset{yellow}{CrO_4^{-2}}$

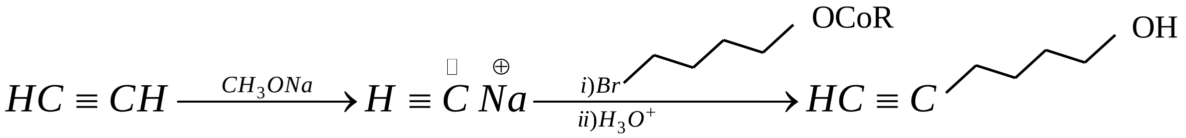
33. $V_{balloon} = \frac{4}{3}\pi(300)^3 = 113142\ Lit\ {}^nH_2 = 4.62 \times 10^3 mole$

34. wt air = 138 kg

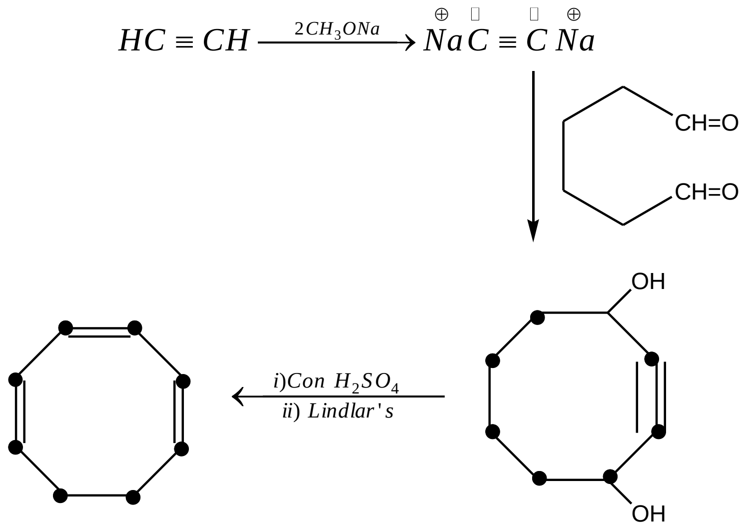
wt (H_2) = 9.62 kg

payload = 138- 9.62= 128.7 kg

35.



36.



37. Conceptual

38. Conceptual

39. Conceptual

40. Conceptual

MATHS

41. $2.\frac{1}{2}C_1 = 1 + \frac{1}{2^2}C_2$

$\Rightarrow n = 8,\ n = 1\ (\text{Re ject})$

$T_{r+1} = {}^{8}C_r \left(\frac{1}{2}\right)^r x^{\frac{16-3r}{4}}, r = 0,1,2....8$

$\frac{4}{(16-3r)}$, r can take values 0, 4, 8

42. $\frac{d^2}{dx^2}\ln\left(x+\sqrt{1+x^2}\right) = \left(\frac{-x}{\left(1+x^2\right)^{\frac{3}{2}}}\right)^2$

$I = \int_0^1 \frac{\left(x^3+x^5\right)x^2}{\left(1+x^2\right)^3}dx = \int_0^1 \frac{x^5 dx}{\left(1+x^2\right)^2}$

$1+x^2 = t \Rightarrow 2xdx = dt$

$$\int_1^2 \frac{(t-1)^2}{2t^2} = \frac{1}{2}\int_1^2 \left(1-\frac{2}{t}+\frac{1}{t^2}\right)dt$$

$$= \frac{1}{2}\left(t-2\ln t-\frac{1}{t}\right)_1^2 = 1-\ln 2-\frac{1}{4} = \frac{3}{4}-\ln 2$$

$$\frac{3}{4}\ln e-\ln 2 = \ln\left(\frac{e^{\frac{3}{4}}}{2}\right)$$

43. $\int_0^{\frac{\pi}{4}} \left\{(\sec x+\tan x)+(\sec x-\tan x)\right\}^{2019} dx$

$\sec x+\tan x = t \Rightarrow \sec x.t\,dx = dt$

$$= \int_1^{1+\sqrt{2}} 2^{2019}\sec^{2019} x.\frac{dt}{\sec x.t}$$

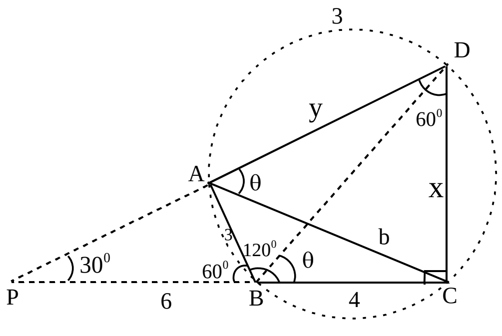
$$= \int_1^{1+\sqrt{2}} 2^{2019}\sec^{2018} x\frac{dt}{t}$$

$$= \int_1^{1+\sqrt{2}} 2^{2019}.\sec^{2018} x\frac{dt}{t}$$

$$= \int_1^{\sqrt{2}+1} 2^{2019}\left(t-\frac{1}{t}\right)^{2018}\frac{1}{2^{2018}}\frac{dt}{t}$$

$$= \int_1^{\sqrt{2}+1} 2.\left(t-\frac{1}{t}\right)^{2018}\frac{dt}{t}$$

44.



Extended CB and DA to meet at P

Note that D PCD is right angle as shown

$$\therefore\ x = \frac{10}{\sqrt{3}} = \frac{10\sqrt{3}}{3}$$

47. No. of ways $= {}^{10}C_1\,{}^{4}C_2 9\times 8-\left[\,{}^{9}C_1\,{}^{3}C_2\,{}^{8}C_1+{}^{9}C_2\times 31\right]$

48. $x, y > 0$

$$1 \le \frac{|3x-4y|}{5} + \frac{|4x+3y|}{5} \le 3$$

$$5 \le |3x-4y| + |4x+3y| \le 15$$

Case-1: $3x-4y>0$

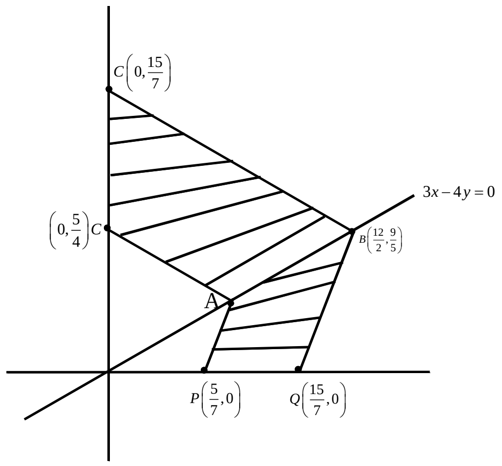
$$5 \le 3x-4y+4x \le 15 \Rightarrow 15 \le 7x-y \le 15$$

Case-2: $3x-4y<0$

$$5 \le 4y-3x+4x+3y \le 15 \;\; \Rightarrow 5 \le x+7y \le 15$$

$$A = [ABCD]+[ABPD]$$

$$= \; = \frac{16}{7}+\frac{12}{7} = 4$$



B

50. For any $m \in R$, $M \cap N \ne \phi$, which means point (0,b) is on or in ellipsoid

$$\frac{x^2}{3}+\frac{2y^2}{3}=1 \therefore \frac{2b^2}{3} \le 1 \; or \; -\frac{\sqrt{6}}{2} \le b \le \frac{\sqrt{6}}{2}$$

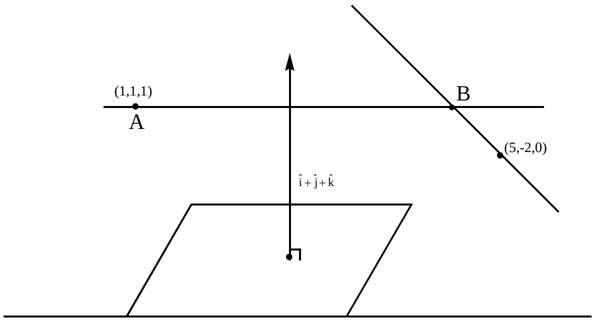
51. Obviously line is parallel to $\bar{n}_1 \times \bar{n}_2$

$$\bar{n}_1 = \hat{i}+2\hat{j}+k \;\; ; \;\; \bar{n}_2 = \hat{i}+\hat{j}+2k \;\Rightarrow\; \bar{n}_1 \times \bar{n}_2 = \begin{vmatrix} i & j & k \\ 1 & 2 & 1 \\ 1 & 1 & 2 \end{vmatrix}$$

$$\bar{n}_1 \times \bar{n}_2 = 3\hat{i} - \hat{j} + k(-1) = 3\hat{i}-\hat{j}-k$$

equation of line is $\frac{x-1}{3}=\frac{y-1}{-1}=\frac{z-1}{-1}$ or $\frac{x-1}{-3}=\frac{y-1}{1}=\frac{z-1}{1}$

52.



$L_2: x+2y+z=1$

$x+y+2z=3$

D. R of L_2 $\begin{vmatrix} \hat{i} & \hat{j} & k \\ 1 & 2 & 1 \\ 1 & 1 & 2 \end{vmatrix} = \hat{i}(4-1)-\hat{j}(2-1)+k(-1)=3\hat{i}-\hat{j}-k$

Put z = 0

$x+2y=1$

$x+y=3$

$y=-2;\ \ x=5\ \ (5,-2,0)$

$L_2:\ \frac{x-5}{3}=\frac{y+2}{-1}=\frac{z-0}{-1}=\lambda$

Let $B(+\lambda+5, -\lambda-2, -\lambda) \Rightarrow \overrightarrow{AB}=(3\lambda+y)\hat{i}+(-\lambda-3)\hat{j}+(-\lambda-1)k$

A.T.O $3\lambda+4-\lambda-3-\lambda-1=0$

$\Rightarrow \lambda=0$

$\Rightarrow B(5,-2,0)$

equation of AB is

i e L= $\frac{x-1}{-4}=\frac{y-1}{3}=\frac{z-1}{1}$

53&54: $p(0)=1;\ p(1)=\frac{1}{6}(p(0)) \Rightarrow p_1=\frac{1}{6}$

$p(2)=\frac{1}{6}[p(0)+p(1)]=\frac{1}{6}\left[1+\frac{1}{6}\right]=\frac{7}{36}$

$p(3)=\frac{1}{6}[p(0)+p(1)+p(2)]=\frac{1}{6}\left[1+\frac{1}{6}+\frac{7}{36}\right]=\frac{49}{6^3}$

$p(4)=\frac{1}{6^4}[216+36+42+49]=\frac{7^3}{6^4}$

$p(n)=\frac{1}{6}\left[p(n-1)+p(n-2)+.........+p(n-6)\right],\ n\geq 6$ add all the equations

$p_{(n)}+\frac{5}{6}p(n-1)+\frac{4}{6}p(n-2)+\frac{3}{6}p(n-3).......+\frac{1}{6}p(n-5)=1$

If $n\to\infty\Rightarrow p(n)+\frac{5}{6}p(n)+\frac{4}{6}p(n)+\frac{3}{6}p(n)+\frac{2}{6}p(x(n))+\frac{2}{6}p(n)=1$

$p_n=\frac{6}{21}=\frac{2}{7}$

55. $PQ=kI\ \Rightarrow\frac{Q}{k}=P^{-1}\Rightarrow\frac{q_{23}}{k}=\frac{(C_{32})}{|P|}-\frac{k}{8}.\frac{1}{k}=\frac{-(3\alpha+4)}{20+12\alpha}\Rightarrow\alpha=-1$

56. $\frac{Q}{k}=P^{-1}\Rightarrow\frac{q_{23}}{k}=\frac{C_{32}}{|P|}\Rightarrow-\frac{1}{3}=\frac{-(3\alpha+4)}{26+12\alpha}$

$26+12\alpha=9\alpha+12\ 3\alpha=-14\ \alpha=-\frac{14}{3}$

$|P|=\begin{vmatrix}3 & -1 & -2\\ 2 & 1 & \alpha\\ 3 & -5 & 0\end{vmatrix}=20-3\alpha-\left(-6-\Delta^{-2}\right)=26+12\alpha$

57. P. $y^2=\sin^2\left(\frac{1}{2}\tan^{-1}\frac{4}{3}\right)=\frac{1-\cos\left(\tan^{-1}\frac{4}{3}\right)}{2}$

$y^2=\frac{1-\cos\cos^{-1}\frac{3}{5}}{2}\Rightarrow y^2=\frac{1}{5}$.................... 1

Q. Point of intersection of two curves are

$A\left(-\frac{1}{2},\frac{\sqrt{3}}{2}\right),\ B\left(-\frac{1}{2},-\frac{\sqrt{3}}{2}\right)$; common chord length $AB=\sqrt{3}$ 2

R. $\bar{b}\times\bar{c}=\bar{a}\Rightarrow\left[\bar{a}\ \bar{b}\bar{c}\right]=|\bar{d}|^2$ parallel $\left[\bar{a}\ \bar{b}\bar{c}\right]=|\bar{b}|^2=|\bar{c}|^2$ $\left[\bar{a}\ \bar{b}\bar{c}\right]=\left[\bar{a}\ \bar{b}\bar{c}\right]^2\Rightarrow\left[\bar{a}\ \bar{b}\bar{c}\right]=1$ 3

S. $(1+x^2)\frac{dy}{dx}+2xy=1\Rightarrow\frac{d}{dx}(1+x^2)y=1\ y=\frac{x}{(1+x^2)}$

58. $|z-1|^2+|z+1|^2=4\Rightarrow$ Locus of z is $x^2+y^2=1$ Now verify options

59. P) Angle bisector of $\overline{OX}\,\&\,\overline{OY}$ is along y =x, and its distance from $(\beta,1-\beta)$ is

$\left|\frac{\beta-(1-\beta)}{\sqrt{2}}\right|=\frac{3}{\sqrt{2}}\Rightarrow\frac{2}{3}-1=\pm 3$

Q) ans. 1 equality holds only for $x=0$

R) $A^{-1}+B^{-1}=2I;\ I+AB^{-1}=2A\ B+A=2AB\ \Rightarrow 2AB=I$ 2

S) If $\tan^{-1}\alpha=\tan^{-1}(\alpha+K)+\frac{\pi}{4}$

$K=1-\frac{2}{\alpha+1}-\alpha^2 \Rightarrow K=-1$

60. P) Let $f(x)=ax^3+bx^2+cx$

$\int_0^1 f(x)dx=1 \Rightarrow \frac{a}{4}+\frac{b}{3}+\frac{c}{2}=1$

$\Rightarrow 3a+4b+6c=12$

A, b, c

4, 0, 0

2, 0, 1

0, 3, 0

0, 0, 2

Q) No solution .... ans: zero

R) (x_1,y_1) and (x_2,y_2) are two points on both curves

$\Rightarrow y_1-2x_1^3-4x_1+2$

$2y_1=2x_1^3+4x_1-2$

$y_1=8x_1-4$

& $y_2=8x_2-4 \Rightarrow \frac{y_2-y_1}{x_1-x_1}=8$

S) $\frac{2ab}{a+b}=4,\ 2(5-a)=b-5 \Rightarrow b=15-2a$

$2a(15-2a)=4(15-a) \Rightarrow 15a-2a^2=30-2a$

$\Rightarrow 2a^2-17a+30=0 \Rightarrow a=\frac{5}{2},6$

$|q-a|=|10-2a|=5\ or\ 2$ ....