KENDRIYA VIDYALAYA SANGATHAN ERNAKULAM REGION

PRE BOARD EXAMINATION (2026-27)

CLASS XII MATHEMATICS –ANSWER KEY SUBJECT CODE :041

DURATION: 3 Hours MAX MARKS :80

SECTION A

1. B. $\{0,2,4\}$
2. C. one –one but not onto
3. B.0
4. A. $\begin{bmatrix}1 & n\\ 0 & 1\end{bmatrix}$
5. A. A^2
6. D. 14^4
7. C. $\frac{1}{2}$
8. A. $[-1,1\,]$
9. D. 2
10. C.$-\frac{\sqrt{3}}{2}$
11. D. no value of x
12. B. $\frac{2^{x+2}}{log2}+C$
13. B. $\frac{\pi}{2}$
14. B. $\hat{\imath}$
15. D. $-\frac{5}{3}$
16. C. $2\overrightarrow{AB}$
17. A . $\frac{\pi}{2}$
18. D. perpendicular to z axis
19. A
20. D

SECTION B

21 A. $\int \frac{sinx-xcosx}{x(x+sinx)}\,dx = \int \frac{(sinx+\ )-x(1+c\quad)}{x(x+sinx)}\,dx$ ½

$= \int \frac{1}{x}dx - \int \frac{1+cosx}{x+sinx}\,dx$ ½

$= \log|x| - \log|x+sinx| + c$ 1

OR

21.B $I = \int \frac{1}{x(x^3+8)}\,dx = \int \frac{x^2}{x^3(x^3+8)}\,dx$

$t = x^3+8 \;\Rightarrow \frac{dt}{3} = x^2dx$ ½

$I = \frac{1}{3}\int \frac{dt}{(t-8)t} = \frac{1}{3}\int \frac{dt}{t^2-8t}$

$= \frac{1}{3}\int \frac{dt}{(t-4)^2-4^2}$ ½

$= \frac{1}{3}\frac{1}{8}\log\left|\frac{t-4-4}{t-4+4}\right| + C$ ½

$= \frac{1}{24}\log\left|\frac{x^3}{x^3+8}\right| + C$ ½

22. $tan^2(\sec^{-1}2) + cot^2(cosec^{-1}3) = sec^2(\sec^{-1}2) - 1 + cosec^2(cosec^{-1}3) - 1$ ½

$= [\sec(sec^{-1}2]^2 + [cosec(cosec^{-1}3]^2 - 2$ ½

$= 4 + 9 - 2 = 11$ 1

23.Given $\overrightarrow{OA} = \vec{a}$, $\overrightarrow{OB} = \vec{b}$, $\overrightarrow{OC} = \vec{c}$

$\overrightarrow{AC} = \overrightarrow{OC} - \overrightarrow{OA} = \vec{c} - \vec{a}$

$\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA} = \vec{b} - \vec{a}$ ½

Given $\overrightarrow{AC} = \frac{5}{4}\overrightarrow{AB}$

$\Rightarrow \vec{c} - \vec{a} = \frac{5}{4}(\vec{b} - \vec{a})$ ½

$\Rightarrow \vec{c} = \frac{1}{4}(5\vec{b} - \vec{a})$ 1

24A.Given equation of the line are $2x - 5 = 3y + 1 = 7 - 5z$.

The given equation can be written in standard form as $\frac{x-\frac{5}{2}}{15} = \frac{y+\frac{1}{3}}{10} = \frac{z-\frac{7}{5}}{-6}$ 1

Direction ratios of line are $(15,10,-6)$

Direction cosines are $\frac{15}{\sqrt{15^2+10^2+-6)^2}}$, $\frac{10}{\sqrt{15^2+10^2+-6)^2}}$, $\frac{-6}{\sqrt{15^2+10^2+-6)^2}}$ ½

ie $\left(\frac{15}{19}, \frac{10}{19}, -\frac{6}{19}\right)$ ½

24B.Let $\vec{b}$ be the vector parallel to the required line

$\Rightarrow \vec{b}$ is perpendicular to both the given lines

$\Rightarrow \vec{b} = \left(2\hat{\imath} - 2\hat{\jmath} + \hat{k}\right) \times (\hat{\imath} + 2\hat{\jmath} + 2\hat{k})$ ½

$= -6\hat{\imath} - 3\hat{\jmath} + 6\hat{k})$ ½

Equation of line in vector form is $\vec{r} = 2\hat{\imath} - \hat{\jmath} + 3\hat{k} + \lambda(-6\hat{\imath} - 3\hat{\jmath} + 6\hat{k})$

$\vec{r} = 2\hat{\imath} - \hat{\jmath} + 3\hat{k} + \mu(2\hat{\imath} + \hat{\jmath} - 2\hat{k})$ $[\mu = -3\lambda]$ 1

25. $i)\ x + 2y \leq 8$ $ii)\ x + y \geq 3$ $iii)\ x \leq 4$ $iv)\ x \geq 0, y \geq 0$ $\frac{1}{2}+\frac{1}{2}+\frac{1}{2}+\frac{1}{2}$

SECTION C

26.AB = $\begin{bmatrix} cos^2x & cosxsinx \\ cosxsinx & sin^2x \end{bmatrix} \begin{bmatrix} cos^2y & cosysiny \\ cosysiny & sin^2y \end{bmatrix}$

$= \begin{bmatrix} cos^2xcos^2y + cosxsinxcosysiny & cos^2xcosysiny + cosxsinxsin^2y \\ cosxsinxcos^2y + sin^2xcosysiny & cosxsinxcosysiny + sin^2xsin^2y \end{bmatrix}$ 1

$= \begin{bmatrix} cosxcosy(cosxcosy + sinxsiny) & cosxsiny(cosxcosy + sinxsiny) \\ sinxcosy(cosxcosy + sinxsiny) & sinxsiny(cosxcosy + sinxsiny) \end{bmatrix}$

½

$= \begin{bmatrix} cosxcosy(\cos(x-y)) & cosxsiny(\cos(x-y)) \\ sinxcosy(\cos(x-y)) & sinxsiny(\cos(x-y)) \end{bmatrix}$ ½

Given $x - y = (2n+1)\frac{\pi}{2}$

Then $\cos(x-y) = \cos(2n+1)\frac{\pi}{2} = 0$ ½

$AB = \begin{bmatrix} cosxcosy(\cos(x-y)) & cosxsiny(\cos(x-y)) \\ sinxcosy(\cos(x-y)) & sinxsiny(\cos(x-y)) \end{bmatrix} = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} = O$ ½

27A. $y = x^{cotx} + \frac{2x^2-3}{x^2+x+2}$

Let $u = x^{cotx}$, $v = \frac{2x^2-3}{x^2+x+2}$

Then $y = u + v$,Differentiating both sides

$\frac{dy}{dx} = \frac{du}{dx} + \frac{dv}{dx}$ ... ... (1) ½

$u = x^{cotx}$,taking logarithm on both sides $logu = cotx\ logx$

Differentiating w.r t x $\frac{1}{u}\frac{du}{dx} = \frac{cotx}{x} - logx\ cosec^2x$

$\frac{du}{dx} = x^{cotx}\ (\frac{cotx}{x} - logx\ cosec^2x\ )$……..(2) 1

$v = \frac{2x^2-3}{x^2+x+2}$

$\frac{dv}{dx} = \frac{(x^2+x+2)4x-(2x^2-3)(2x+1)}{(x^2+x+2)^2} = \frac{2x^2+14x+}{(x^2+x+2)^2}$ …….(3) 1

$\frac{dy}{dx} = x^{cotx}\left(\frac{cotx}{x} - logx\ cosec^2x\right) + \frac{2x^2+14x+3}{(x^2+x+2)^2}$ ½

OR

27B.Given $x + y = t + \frac{1}{t}$

On cubing both sides .$(x+y)^3 = (t+\frac{1}{t})^3$ ½

$\Rightarrow x^3 + y^3 + 3xy(x+y) = t^3 + \frac{1}{t^3} + 3\left(t + \frac{1}{t}\right)$ 1

$\Rightarrow x^3 + y^3 + 3xy(x+y) = x^3 + y^3 + 3(x+y)$ ½

$\Rightarrow 3xy(x+y) = 3(x+y)$

$\Rightarrow \quad xy = 1$

$\Rightarrow \quad y = \frac{1}{x}$ ½

Differentiating $\frac{dy}{dx} = -\frac{1}{x^2}$ ½

28. For correct figure ½

let $DB = x\ m,$ .since the kite is 250m away from the boy , $AC = y = 250\ m$

Speed of the kite, $\frac{dx}{dt} = 10$ m/s

From the figure, $EC = 151.5 - 1.5 = 150m$ ½

In right angled triangle ΔCEA , $AE^2 + EC^2 = AC^2$

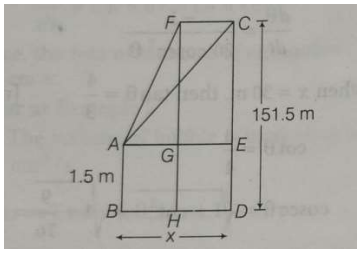
$\Rightarrow x^2 + 22500 = y^2$

Differentiating ,$2x\frac{dx}{dt} = 2y\frac{dy}{dt}$

$\Rightarrow \frac{dy}{dt} = \frac{x}{y}\ \frac{dx}{dt}$ 1

When $y = 250m$, $x = \sqrt{250^2 - 150^2} = 200m$ ½

$\frac{dy}{dt} = \frac{x}{y}\ \frac{dx}{dt} = \frac{200}{250} \times 10 = 8$m/s ½



29A. $x^2dy + (xy + y^2)dx = 0$

$\Rightarrow \frac{dy}{dx} = -\left(\frac{(xy+y^2)}{x^2}\right) \ldots . (1)$, the given equation is a homogeneous differential equation. ½

Put $y = vx$ and $\frac{dy}{dx} = v + x\frac{dv}{dx}$ in (1)

$\Rightarrow\ v + x\frac{dv}{dx} = -\left(\frac{xvx + v^2x^2}{x^2}\right)$

$\Rightarrow\ v + x\frac{dv}{dx} = -v - v^2$

$\Rightarrow\ x\frac{dv}{dx} = -2v - v^2$ ½

Separating variables and integrating, $\int \frac{1}{v(v+2)}dv = -\int \frac{1}{x}dx$

$\Rightarrow \frac{1}{2}\int \frac{2}{v(v+2)}dv = -\int \frac{1}{x}dx$

$\Rightarrow \frac{1}{2}\left(\int \frac{1}{v} - \frac{1}{v+2}\right)dv = -\int \frac{1}{x}\,dx$ 1

$\Rightarrow \frac{1}{2}\log|v| - \frac{1}{2}\log|v+2| = -\log|x| + logC$

$\Rightarrow \frac{v}{v+2} = \left(\frac{c}{x}\right)^2$ ½

The required solution is $\frac{y}{y+2x} = \left(\frac{c}{x}\right)^2$ ½

29B. $(1 + x^2)\frac{dy}{dx} + y = e^{m\tan^{-1}x}$

$\Rightarrow \frac{dy}{dx} + \frac{y}{1+x^2} = \frac{e^{m\tan^{-1}x}}{1+x^2} \ldots\ldots (1)$ ½

$$P = \frac{1}{1+x^2} \quad , Q = \frac{e^{m\tan^{-1}x}}{1+x^2}$$

Integrating factor, $e^{\int p dx} = e^{\int \frac{1}{1+x^2}dx} = e^{\tan^{-1}x}$

Then the solution is , $y.e^{\tan^{-1}x} = \int \frac{e^{m\tan^{-1}x}}{1+x^2}.e^{\tan^{-1}x}\,dx + C$ ½

$$= \int \frac{e^{(m+1)\tan^{-1}x}}{1+x^2}dx + C$$

Put $t = \tan^{-1}x \ \Rightarrow dt = \frac{1}{1+x^2}\ dx$

$y.e^{\tan^{-1}x} = \int e^{(m+1)t}dt + C$

$= \frac{e^{(m+1)t}}{m+1} + C$ ½

$y.e^{\tan^{-1}x} = \frac{e^{(m+1)\tan^{-1}x}}{m+1} + C$ ½

Given when $x = 0$, $y = 1$

$1 = \frac{1}{m+1} + C$

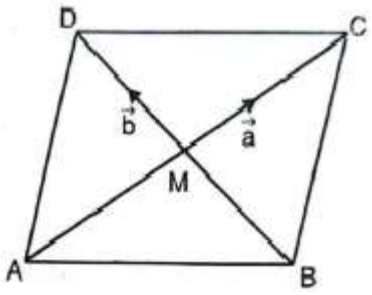
$\Rightarrow C = \frac{m}{m+1}$ ½

Particular solution is $y.e^{\tan^{-1}x} = \frac{e^{(m+1)\tan^{-1}x}}{m+1} + \frac{m}{m+1}$ ½

$\Rightarrow \quad y.(m+1)e^{\tan^{-1}x} = e^{(m+1)\tan^{-1}x} + m$

30.A .Let ABCD be the parallelogram with diagonals $\overrightarrow{AC} = \vec{a}$ and $\overrightarrow{BC} = \vec{b}$ .By applying the rules of vector addition

$\overrightarrow{AB} = \frac{(\overrightarrow{d_1}+\overrightarrow{d_2})}{2} = \frac{\vec{a}+\vec{b}}{2}$ $\quad \overrightarrow{AD} = \frac{(\overrightarrow{d_1}-\overrightarrow{d_2})}{2} = \frac{\vec{a}-\vec{b}}{2}$ ½



Area of ABCD $= \frac{1}{2}\left|\overrightarrow{AB} \times \overrightarrow{AD}\right| = \frac{1}{2}\left|\frac{1}{2}(\vec{a}+\vec{b}) \times \frac{1}{2}(\vec{a}-\vec{b})\right|$

$= \frac{1}{4}\left|(\overrightarrow{a}+\vec{b}) \times (\vec{a}-\vec{b})\right|$ ½

$= \frac{1}{4}\left|\vec{a}\times\vec{a} - \vec{a}\times\vec{b} + \vec{b}\times\vec{a} - \vec{b}\times\vec{b}\right|$ ½

$= \frac{1}{4}\left|2(\vec{a}\times\vec{b})\right|$

$= \frac{1}{2}\left|\vec{a}\times\vec{b}\right|$ ½

Given $\vec{a} = 2\hat{\imath} - \hat{\jmath} + \hat{k}$ and $\vec{b} = \hat{\imath} + 3\hat{\jmath} - \hat{k}$

Area $= \frac{1}{2}\left|(2\hat{\imath} - \hat{\jmath} + \hat{k}) \times (\hat{\imath} + 3\hat{\jmath} - \hat{k})\right|$

$\vec{a}\times\vec{b} = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ 2 & -1 & 1 \\ 1 & 3 & -1 \end{vmatrix} = -2\hat{\imath} + 3\hat{\jmath} + 7\hat{k}$ ½

Area= $\frac{1}{2}\sqrt{62}$ sq units ½

30B. Given A$(2\hat{\imath} - \hat{\jmath} + \hat{k})$, B$(\hat{\imath} - 3\hat{\jmath} - 5\hat{k})$ and C($3\hat{\imath} - 4\hat{\jmath} - 4\hat{k}$

$\overrightarrow{AB} = (\hat{\imath} - 3\hat{\jmath} - 5\hat{k}) - (2\hat{\imath} - \hat{\jmath} + \hat{k}) = (-\hat{\imath} - 2\hat{\jmath} - 6\hat{k})$

$\overrightarrow{BC} = (3\hat{\imath} - 4\hat{\jmath} - 4\hat{k}) - (\hat{\imath} - 3\hat{\jmath} - 5\hat{k}) = (2\hat{\imath} - \hat{\jmath} + \hat{k})$

$\overrightarrow{AC} = (3\hat{\imath} - 4\hat{\jmath} - 4\hat{k}) - (2\hat{\imath} - \hat{\jmath} + \hat{k}) = (\hat{\imath} - 3\hat{\jmath} - 5\hat{k})$

$cos\ A = \frac{\overrightarrow{AB}.\overrightarrow{AC}}{|\overrightarrow{AB}||\overrightarrow{AC}|} = \frac{(-\hat{\imath}-2\hat{\jmath}-6\hat{k}).(\hat{\imath}-3\hat{\jmath}-5\hat{k})}{\sqrt{41}.\sqrt{35}} = \frac{\sqrt{35}}{\sqrt{41}}$ 1

$A = \cos^{-1}\left(\frac{\sqrt{35}}{\sqrt{41}}\right)$

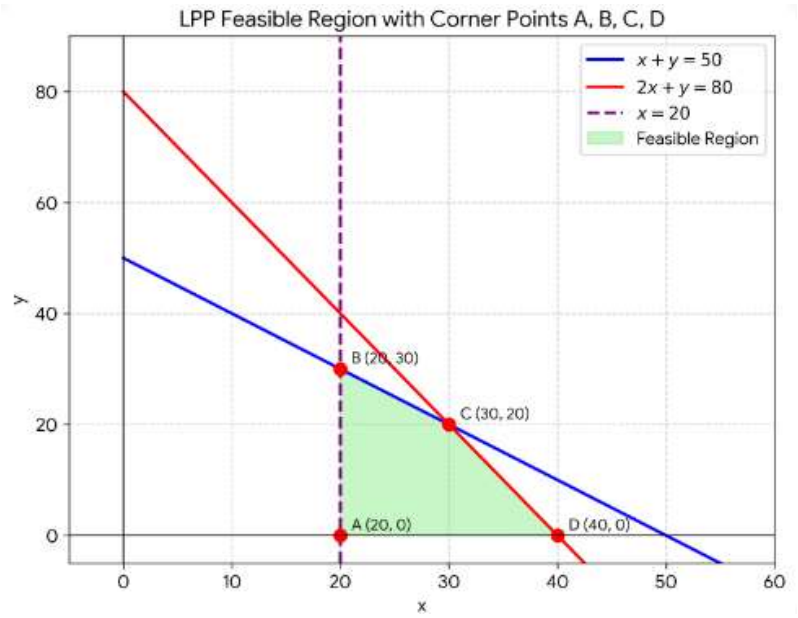
$cos\ B = \frac{\overrightarrow{BA}.\overrightarrow{BC}}{|\overrightarrow{BA}||\overrightarrow{BC}|} = \frac{(\hat{\imath}+2\hat{\jmath}+6\hat{k}).(2\hat{\imath}-\hat{\jmath}+\hat{k})}{\sqrt{41}.\sqrt{6}} = \frac{\sqrt{6}}{\sqrt{41}}$ 1

$B = \cos^{-1}\left(\frac{\sqrt{6}}{\sqrt{41}}\right)$

$cos\ C = \frac{\overrightarrow{CB}.\overrightarrow{CA}}{|\overrightarrow{CB}||\overrightarrow{CA}|} = \frac{(-2\hat{\imath}+\hat{\jmath}-\hat{k}).(-\hat{\imath}+3\hat{\jmath}+5\hat{k})}{\sqrt{6}.\sqrt{35}} = \frac{0}{\sqrt{6}.\sqrt{35}} = 0$ 1

$C = \cos^{-1}(0) = \frac{\pi}{2}$

31.



1 ½

Feasible region is bounded with vertices $A(20,0)$, $B(20,30)$, $C(30,20)$ and $D(40,0)$

$Z_A = 2100$, $Z_B = 4800$, $Z_C = 4950$, $Z_D = 4200$ 1

So maximum value of Z is 4950 at the point $C(30,20)$

SECTION D

32. $I = \int_0^{\pi/2} \frac{x}{sinx+cos}\ dx$ …. …. (1)

$$I = \int_0^{\pi/2} \frac{(\frac{\pi}{2}-x)}{sin(\frac{\pi}{2}-x)+cos(\frac{\pi}{2}-x)}\ dx$$

$I = \int_0^{\pi/2} \frac{(\frac{\pi}{2}-x)}{sinx+cos}\ dx$ …. …. (2) ½

(1) + (2) , $2I = \frac{\pi}{2}\int_0^{\pi/2} \frac{1}{sinx+cosx}\ dx$ ½

$I = \frac{\pi}{4}\int_0^{\pi/2} \frac{1}{sinx+cos}\ dx$ ½

$= \frac{\pi}{4\sqrt{2}}\int_0^{\pi/2} \frac{1}{(\frac{1}{\sqrt{2}}sinx\ \frac{1}{\sqrt{2}}cosx)}\ dx$ ½

$= \frac{\pi}{4\sqrt{2}}\int_0^{\pi/2} \frac{1}{\sin(\frac{\pi}{4}+x)}\ dx$

$= \frac{\pi}{4\sqrt{2}}\int_0^{\pi/2} cosec(\frac{\pi}{4}+x)\ dx$ ½

$= \frac{\pi}{4\sqrt{2}}\left[\log|cosec\left(\frac{\pi}{4}+x\right) - cot(\frac{\pi}{4}+x)\right]_0^{\frac{\pi}{2}}$ 1

$= \frac{\pi}{4\sqrt{2}}\left[(\log\left(cosec\left(\frac{\pi}{4}+\frac{\pi}{2}\right) - cot\left(\frac{\pi}{4}+\frac{\pi}{2}\right)\right) - (\log\left(cosec\left(\frac{\pi}{4}\right) - cot\left(\frac{\pi}{4}\right)\right)\right]$ ½

$= \frac{\pi}{4\sqrt{2}}\log\left|\frac{\sqrt{2}+1}{\sqrt{2}-1}\right|$ 1

33A. Let $f(x) = f(y)$ for some $x, y \in R$

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

$\Rightarrow 2x + 2xy^2 = 2y + 2yx^2$

$\Rightarrow (x-y)(1-xy) = 0$

$\Rightarrow x = y\ or\ xy = 1$.So if $xy = 1$, $x \neq y$ 2

Hence f is not one –one

Let $y = f(x), x \in R$

$\Rightarrow y = \frac{2x}{1+x^2}$ .Here for $x = 0$, $y = 0$

If $y \neq 0$, $y = \frac{2x}{1+x^2}$

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

$\Rightarrow x = \frac{2 \pm \sqrt{4-4y^2}}{2y}$

For x to be real $\sqrt{4-4y^2} \geq 0$

$\Rightarrow -1 \leq y \leq 1$

Range $= [-1,1] \neq$ codomain

Hence f is not on to. 2

For the given function to be on to $A = [-1,1]$ 1

33B.Since $x + x = 2x$, is divisible by 2, $(x,x) \in R$ for every $x \in A$ 1

Therefore R is reflexive

Let $x, y \in A$ be such that $(x,y) \in R$

$\Rightarrow x + y$ *is divisble by* 2

$\Rightarrow y + x$ *is divisible by* 2

$\Rightarrow (y,x) \in R$ 1

Therefore R is Symmetric.

Let $x, y, z \in A$ such that $(x,y) \in R$ and $(y,z) \in R$

$\Rightarrow x + y$ *is divisble by* 2 and $y + z$ *is divisble by* 2

$x + y = 2k$ ... (1) $y + z = 2m$ ..... (2)for some $k, m \in Z$

Adding (1) and (2),$x + 2y + z = 2(k + m)$

$\Rightarrow x + z = 2(k + m - y)$

$x + z$ *is* divisible by 2

Therefore R is transitive.

Hence R is an equivalence relation 2

$[2] = \{-4, -2, 0, 2, 4\}$ 1

34. $(x-a)^2 + (y-b)^2 = c^2$

Differentiating both sides w.r t x

$2(x-a) + 2(y-b)y' = 0$

$\Rightarrow y' = -\frac{x-a}{y-b}$ 1

Differentiating again w r t x

$$y'' = -\left[\frac{(y-b)-(x-a)y'}{(y-b)^2}\right]$$

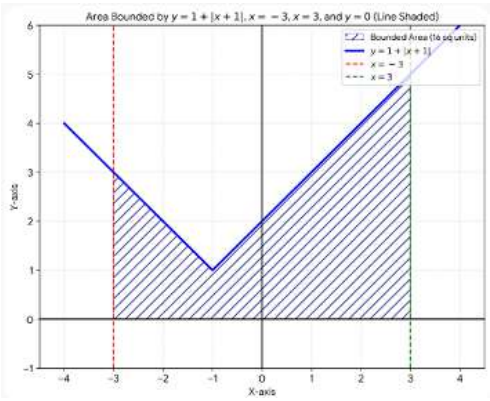
$$= -\left[\frac{(y-b)-(x-a)\left(-\frac{x-a}{y-b}\right)}{(y-b)^2}\right] = -\left[\frac{(x-a)^2+(y-b)^2}{(y-b)^3}\right]$$

$$= -\frac{c^2}{(y-b)^3}$$ 2

$$\frac{\left[1+(y')^2\right]^{\frac{3}{2}}}{y''} = \frac{\left[1+\left(-\frac{x-a}{y-b}\right)^2\right]^{\frac{3}{2}}}{-\frac{c^2}{(y-b)^3}}$$

$$= \frac{\left[\frac{c^2}{(y-b)^2}\right]^{\frac{3}{2}}}{-\frac{c^2}{(y-b)^3}} = -c$$ 2

35A.



For figure 1

Area = $\int_{-3}^{-1}[1-(x+1)]\,dx + \int_{-1}^{3}[1+(x+1)]dx$ 1

$= -\left[\frac{x^2}{2}\right]_{-3}^{-1} + \left[2x+\frac{x^2}{2}\right]_{-1}^{3}$ 1

$= -\left(\frac{1}{2}-\frac{9}{2}\right) + \left(6+\frac{9}{2}\right) - \left(2+\frac{1}{2}\right)$ 1

$= 4+8+4$ 1

$= 16\ sq\ units$

OR

35B. correct figure 1

$x - y + 2 = 0$ ….. (i) and $x = \sqrt{y}$ ….. (ii)

Consider $x = \sqrt{y} \Rightarrow x^2 = y$

The point of intersection of Eqs. (i) and (ii)

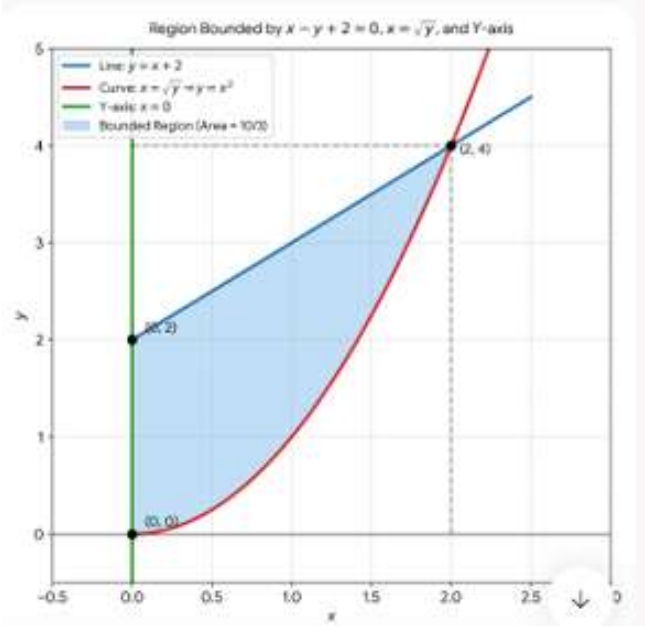
is given by $x^2 = x + 2$

$\Rightarrow x^2 - x + 2 = 0$

$\Rightarrow x = -1, 2$ 1

But x = – 1 does not satisfy the Eq. (ii).

$\therefore x = 2$



putting $x = 2$ in Eq. (ii), we get y = 4
Hence, the point of intersection is (2, 4). ½

Area $= \int_0^2 (x+2)\,dx - \int_0^2 x^2 dx$ 1

$= \left[\frac{x^2}{2} + 2x - \frac{x^3}{3}\right]_0^2$ ½

$= 2 + 4 - \frac{8}{3} = \frac{10}{3}$ sq units. 1

SECTION E

36. I. Equation of line passes through $P(1,4)$ with slope m is $y - 4 = m(x-1)$

$\Rightarrow mx - y = m - 4$ 1

II. $\frac{mx}{m-4} - \frac{y}{m-4} = 1$

$\Rightarrow \frac{x}{\frac{m-4}{m}} + \frac{y}{4-m} = 1$

x −intercept $= \frac{m-4}{m}$ y −intercept$= 4 - m$ 1

III A. $S(m) = \frac{m-4}{m} + 4 - m = 5 - \frac{4}{m} - m$ ½

$S'(m) = \frac{4}{m^2} - 1$, $S''(m) = -\frac{8}{m^3}$

$S'(m) = 0 \Rightarrow m = \pm 2$ 1

For $m = -2$, $S''(m) > 0$.So S is minimum when $m = -2$ ½

OR

IIIB .$S_{min} = 5 - \frac{4}{m} - m = 5 + 2 + 2 = 9$ 2.

37 I. Direction ratios of L_1: $\vec{r} = 3\hat{\imath} + 5\hat{\jmath} + 8\hat{k} + \lambda(2\hat{\imath} + 3\hat{\jmath} + \hat{k})$ are (2,3,1) ½

Direction cosines are $\frac{2}{\sqrt{14}}, \frac{3}{\sqrt{14}}, \frac{1}{\sqrt{14}}$ ½

II. Direction ratios of L_2:

$\vec{r} = \hat{\imath} + 2\hat{\jmath} + 2\hat{k} + \mu(\hat{\imath} + \hat{\jmath} + 2\hat{k})$ are (1,1,2) ½

Direction cosines are $\frac{1}{\sqrt{6}}, \frac{1}{\sqrt{6}}, \frac{2}{\sqrt{6}}$ ½

III A. Shortest distance $= \left|\frac{(\overrightarrow{b_1}\times\overrightarrow{b_2}).(\overrightarrow{a_2}-\overrightarrow{a_1})}{|(\overrightarrow{b_1}\times\overrightarrow{b_2})|}\right|$

$\overrightarrow{a_2} - \overrightarrow{a_1} = (\hat{\imath} + 2\hat{\jmath} + 2\hat{k}) - (\widehat{3\imath} + 5\hat{\jmath} + 8\hat{k}) = \widehat{-2\imath} - 3\hat{\jmath} - 6\hat{k}$ ½

$(\overrightarrow{b_1}\times\overrightarrow{b_2}) = \begin{vmatrix} \hat{\imath} & \hat{\jmath} & \hat{k} \\ 2 & 3 & 1 \\ 1 & 1 & 2 \end{vmatrix} = \widehat{5\imath} - 3\hat{\jmath} - \hat{k}$ ½

$|(\overrightarrow{b_1}\times\overrightarrow{b_2})| = \sqrt{35}$ ½

SD $= \left|\frac{-10+9+}{\sqrt{35}}\right| = \frac{\sqrt{35}}{7}\ m$ ½

OR

III B .Let N be the foot of the perpendicular from $P(1,2,2)$ to

$L_1: \vec{r} = \widehat{3\imath} + 5\hat{\jmath} + 8\hat{k} + \lambda(2\hat{\imath} + 3\hat{\jmath} + \hat{k})$

DRs of $\overrightarrow{PN} = (3 + 2\lambda - 1,\ 5 + 3\lambda - 2\ ,\ 8 + \lambda - 2\ )$

$= (2\lambda + 2\ ,\ 3\lambda + 3\ ,\ \lambda + 6\ )$ ½

Since $\overrightarrow{PN}$ is perpendicular to L_1, $(2\lambda + 2)2 + (\ 3\lambda + 3\ )3 + \ \lambda + 6 = 0$

$\Rightarrow \lambda = -\frac{19}{14}$ ½

$\overrightarrow{PN} = (-\frac{10}{14}, -\frac{15}{14}, \frac{65}{14})$ ½

$\left|\overrightarrow{PN}\right| = \frac{5\sqrt{182}}{14}$ ½

38 I. According to the question we have

$x + y + z = 130$ …….(1)

$60x + 75y + 90z = 10200$

$\Rightarrow 4x + 5y + 6z = 680$…..(2)

$2x - y - z = -20$……..(3)

Matrix form of the equation is $AX = B$

$$\Rightarrow \begin{bmatrix} 1 & 1 & 1 \\ 4 & 5 & 6 \\ 2 & -1 & -1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 130 \\ 680 \\ -40 \end{bmatrix}$$ ½

$$A = \begin{bmatrix} 1 & 1 & 1 \\ 4 & 5 & 6 \\ 2 & -1 & -1 \end{bmatrix}$$

$$adj\ A = \begin{bmatrix} 1 & 0 & 1 \\ 16 & -3 & -2 \\ -14 & 3 & 1 \end{bmatrix}$$ 1 ½

II. $|A| = 3$ ½

$$A^{-1} = \frac{1}{3} \begin{bmatrix} 1 & 0 & 1 \\ 16 & -3 & -2 \\ -14 & 3 & 1 \end{bmatrix}$$ ½

$$\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \frac{1}{3} \begin{bmatrix} 1 & 0 & 1 \\ 16 & -3 & -2 \\ -14 & 3 & 1 \end{bmatrix} \begin{bmatrix} 130 \\ 680 \\ -40 \end{bmatrix}$$

$$= \frac{1}{3} \begin{bmatrix} 130 - 40 \\ 2080 - 2040 + 80 \\ -1820 + 2040 - 40 \end{bmatrix}$$

$$= \frac{1}{3} \begin{bmatrix} 90 \\ 120 \\ 180 \end{bmatrix} = \begin{bmatrix} 30 \\ 40 \\ 60 \end{bmatrix}$$ 1

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