SECOND YEAR HIGHER SECONDARY SECOND TERMINAL EVALUATION DECEMBER 2019

ANSWER KEY

1. $fog = f\left[g\left(x\right)\right] = f\left(3x-5\right) = \left(3x-5\right)^2 + 3 = 9x^2 - 30x + 25 + 3 = 9x^2 - 30x + 28$

   $gof = g\left[f\left(x\right)\right] = g\left(x^2+3\right) = 3\left(x^2+3\right) - 5 = 3x^2 + 9 - 5 = 3x^2 + 4$

2. a) ii) $\int_a^b y\,dx$

   b) $A = 4\int_0^2 \sqrt{2^2 - x^2}\,dx = 4\left[\frac{x}{2}\sqrt{4-x^2} + 2\sin^{-1}\left(\frac{x}{2}\right)\right]_0^2$

   $= 4\left[0 + 2\sin^{-1}\left(1\right) - \left(0+0\right)\right] = 4 \times 2 \times \frac{\pi}{2} = 4\pi$ sq.units

3. a) $f\left(x\right) = x^2 - 4x - 3$

   Since $f\left(x\right)$ is a polynomial, it is continuous in [1,4],

   $f'\left(x\right) = 2x - 4$

   $\therefore$ it is differentiable at (1,4),

   $\therefore$ there exists a constant 'c' such that

   $f'\left(c\right) = \frac{f\left(b\right) - f\left(a\right)}{b-a} \Rightarrow 2c - 4 = \frac{-3-\left(-6\right)}{4-1} \Rightarrow 2c - 4 = 1 \Rightarrow 2c = 5 \Rightarrow c = \frac{5}{2} \in \left(1,4\right)$

   Hence verified Mean value theorm.

4. Let A be the enclosed area of the circular wave with radius r.

   $A = \pi r^2 \Rightarrow \frac{dA}{dt} = 2\pi r \times \frac{dr}{dt} = 2\pi \times 10 \times 4 = 80\pi$

   Thus, the enclosed area is increasing at the rate of $80\pi\, cm^2 / s$

5. a) ii) $y = Cx$

   b) i) $y = x^2 + C$

   c) iv) $y^2 = Cx$

6. The enclosed area $= \left|\int_{-1}^0 x\,dx\right| + \int_{-1}^0 \left(x^2+1\right)dx + \int_0^2 \left(x^2 + 1 - x\right)dx$

   $= \left|\left[\frac{x^2}{2}\right]_{-1}^0\right| + \left[\frac{x^3}{3} + x\right]_{-1}^0 + \left[\frac{x^3}{3} + x - \frac{x^2}{2}\right]_0^2$

$$=\left|\left[0-\frac{(-1)^2}{2}\right]\right|+\left[0-\left\{\frac{(-1)^3}{3}+(-1)\right\}\right]+\left[\frac{2^3}{3}+2-\frac{2^2}{2}-(0)\right]$$

$$=\left|-\frac{1}{2}\right|+\left[-\left(-\frac{1}{3}-1\right)\right]+\left[\frac{8}{3}+2-2\right]=\frac{1}{2}+\frac{1}{3}+1+\frac{8}{3}$$

$$=1+\frac{1}{2}+\frac{9}{3}=4+\frac{1}{2}=\frac{9}{2}\text{ sq.units.}$$

7. a) $\frac{dy}{dx}+\frac{2}{x}y=x$ $\qquad \| \div ing\ by\ x$

$P=\frac{2}{x},\ \ Q=x$

$\int pdx=2\int\frac{1}{x}dx=2\log x=\log x^2$

$\therefore$ Integrating factor $=e^{\log x^2}=x^2$

b) $\int Qe^{\int pdx}dx=\int x.x^2dx=\int x^3dx=\frac{x^4}{4}+C$

$\therefore$ solution is $ye^{\int pdx}=\int Qe^{\int pdx}dx+C$

$yx^2=\frac{x^4}{4}+C\Rightarrow y=\frac{1}{4}x^2+Cx^{-2}$

8. a) $a_{ij}=i-j$

$a_{11}=1-1=0, a_{12}=1-2=-1, a_{13}=1-3=-2$
$a_{21}=2-1=1, a_{22}=2-2=0, a_{23}=2-3=-1$
$a_{31}=3-1=2, a_{32}=3-2=1, a_{33}=3-3=0$

$$\therefore A=\begin{bmatrix}0 & -1 & -2\\ 1 & 0 & -1\\ 2 & 1 & 0\end{bmatrix}$$

b) $|A|=0$ (since the diagonal elements are zeroes, then the det. of a skew-symmetric matrix is 0)

9. a) dr's are 1,1,–2

b) Let a vector $\perp r$ to $\hat{i}+\hat{j}-2\hat{k}$ is $\hat{i}+\hat{j}+\hat{k}\left(=\vec{b}\right)$

$\therefore$dc of $\vec{b}$ are $\frac{1}{\sqrt{3}},\frac{1}{\sqrt{3}},\frac{1}{3}$.

10. a) i) R is not reflexive

If $a\in R\Rightarrow a\le a^2$, which is false $\forall(a,a)\in R$

ii) Let $a,b\in R$ and $(a,b)\in R\Rightarrow a\le b^2\ and\ b\le a^2$, which is false. $\therefore$ R is not symmetric

iii) If $(a,b)\in R\Rightarrow a\le b^2$

if $(b,c)\in R \Rightarrow b \le c^2 \Rightarrow a \le (c^2)^2 \Rightarrow a \le c^4$, which is false .

$\therefore$ R is not transitive .Hence R is not reflexive, not symmetric and not transitive.

b)

*	1	2	3
1	1	1	1
2	1	2	1
3	1	1	3

11. a) $A^2 = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}\begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$

$= \begin{bmatrix} 8 & 5 \\ -5 & 3 \end{bmatrix}$

$5A = \begin{bmatrix} 15 & 5 \\ -5 & 10 \end{bmatrix}$

$7I = \begin{bmatrix} 7 & 0 \\ 0 & 7 \end{bmatrix}$

$LHS = A^2 - 5A + 7I = \begin{bmatrix} 8 & 5 \\ -5 & 3 \end{bmatrix} - \begin{bmatrix} 15 & 5 \\ -5 & 10 \end{bmatrix} + \begin{bmatrix} 7 & 0 \\ 0 & 7 \end{bmatrix}$

$= \begin{bmatrix} -7 & 0 \\ 0 & -7 \end{bmatrix} + \begin{bmatrix} 7 & 0 \\ 0 & 7 \end{bmatrix} = 0$

$= RHS$

b) $A^2 - 5A + 7I = 0$

$A^2.A^{-1} - 5AA^{-1} + 7IA^{-1} = 0$ $\qquad \| \, Xing \ by \ A^{-1}$

$A - 5I + 7A^{-1} = 0$

$7A^{-1} = 5I - A = \begin{bmatrix} 5 & 0 \\ 0 & 5 \end{bmatrix} - \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix} = \begin{bmatrix} 2 & -1 \\ 1 & 3 \end{bmatrix}$

$\therefore A^{-1} = \frac{1}{7}\begin{bmatrix} 2 & -1 \\ 1 & 3 \end{bmatrix}$

12. a) $\sin^{-1}\left(\sin\frac{2\pi}{3}\right) = \sin^{-1}\sin\left(\pi - \frac{\pi}{3}\right)$

$= \sin^{-1}\sin\frac{\pi}{3} = \frac{\pi}{3} \in \left[\frac{-\pi}{2}, \frac{\pi}{2}\right]$

b) $\tan^{-1}\left(\frac{\sqrt{1+x^2}-1}{x}\right) = \tan^{-1}\left(\frac{\sqrt{1+\tan^2\theta}-1}{\tan\theta}\right)$ $\qquad$ put $x = \tan\theta$

$$= \tan^{-1}\left[\frac{\sec\theta-1}{\tan\theta}\right] = \tan^{-1}\left[\frac{1-\cos\theta}{\sin\theta}\right]$$

$$= \tan^{-1}\tan\frac{\theta}{2} = \frac{\theta}{2}$$

$$= \frac{1}{2}\tan^{-1}x$$

13. $LHL = \lim_{x\to5^-}(kx+1) = 5k+1$

$RHL = \lim_{x\to5^+}(3x-5) = 3\times5-5 = 0$

$\because f$ is continuous at $x=5$,

$LHL = RHL$

$5k+1 = 10$

$5k = 10-1 = 9$

$\therefore k = \frac{9}{5}$

14. $f(x) = 3x^4 + 4x^3 - 12x^2 + 12$

$f'(x) = 12x^3 + 12x^2 - 24x$

$f''(x) = 36x^2 + 24x - 24$

For max. or min $f'(x) = 0$

$12x^3 + 12x^2 - 24x = 0$

$12x(x^2 + x - 2) = 0$

$(x+2)(x-1) = 0 \ (or)\ x = 0$

$\therefore x = 0, x = -2$ or $x = 1$

When $x=-2$, $f''(-2) = 36(-2)^2 + 24(-2) - 24$
$= 36(4) - 48 - 24$
$= 72 > 0$

$\therefore f(x)$ is minimum.

Minimum value of $f(x) = f(-2) = 3(-2)^4 + 4(-2)^3 - 12(-2)^2 + 12 = -20$

When $x=1$, $f''(1) = 36(1^2) + 24(1) - 24 = 36 > 0$

$\therefore$Min. value of $f(x) = f(1) = 3(1^4) + 4(1^3) - 12(1) + 12$

$= 3 + 4 - 12 + 12 = 7$

When $x=0$, $f''(0) = 36(0) + 24(0) - 24 = -24 < 0$

$\therefore f(x)$ is maximum.

$\therefore$ the max. value of $f(x) = f(0) = 0 + 0 - 0 + 12 = 12$

$\therefore$ the local maximum value of $f(x)=12$ *at* $x=0$ and the local minimum values of $f(x)$ are 7 at $x=1$ and -20 at $x=-2$.

15. Here $a=2, b=3, nh=3-2=1$

$$f(x)=x^2$$
$$f(2)=2^2$$
$$f(2+h)=(2+h)^2$$
$$f(2+2h)=(2+2h)^2$$
$$\ldots \quad \ldots. \quad \ldots..$$
$$\ldots. \quad \ldots \quad \ldots.$$
$$f(2+\overline{n-1}h)=(2+\overline{n-1}h)^2$$

$$\int_2^3 x^2dx=\lim_{h\to 0} h\left[2^2+(2+h)^2+(2+2h)^2+\ldots.+(2+\overline{n-1}h)^2\right]$$

$$=\lim_{h\to 0} h\left[(2^2+2^2+\ldots to\ n\ times)+(4h+8h+12h+\ldots+4\overline{n-1}h)+(h^2+(2h)^2+(3h)^2+\ldots+(\overline{n-1}h)^2)\right]$$

$$=\lim_{h\to 0} h\left[2^2\times n+4h(1+2+3+\ldots+\overline{n-1})+h^2(1^2+2^2+\ldots+\overline{n-1}^2)\right]$$

$$=\lim_{h\to 0} h\left[4n+4h.\frac{n(n-1)}{2}+h^2.\frac{n(n-1)(2n-1)}{6}\right]$$

$$=\lim_{h\to 0} h\left[4n+\frac{4\times 1(n-1)}{2}+\frac{1(1-h)(2n-1)}{6}\right]$$

$$=\lim_{h\to 0} h\left[4n+2(n-1)+\frac{(1-h)(2n-1)}{6}\right]$$

$$=\lim_{h\to 0}\left[4nh+2(nh-h)+\frac{(1-h)(2nh-h)}{6}\right]$$

$$=\lim_{h\to 0}\left[4\times 1+2(1-h)+\frac{(1-h)(2\times 1-h)}{6}\right]$$

$$=\left[4+2(1-0)+\frac{(1-0)(2-0)}{6}\right]$$

$$=4+2+\frac{1}{3}=6+\frac{1}{3}=\frac{19}{3}$$

16. $I=\int_0^{\pi}\frac{x\sin x}{1+\cos^2 x}dx \quad \ldots\ldots..(1)$

$$\int_0^a f(x)dx = \int_0^a f(a-x)dx$$

$$\therefore I = \int_0^a \frac{(\pi - x).\sin x}{1+\cos^2(\pi - x)}dx$$

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

$$= \int_0^\pi \frac{\pi \sin x}{1+\cos^2 x}dx - \int_0^\pi \frac{x \sin x}{1+\cos^2 x}dx \qquad ....(2)$$

$(1)+(2) \Rightarrow$

$$2I = \pi \int_0^\pi \frac{\sin x}{1+\cos^2 x}dx$$

put $\cos x = t \Rightarrow -\sin x dx = dt \ \Rightarrow \sin x dx = -dt$

when $x = 0, t = \cos 0 = 1$

when $x = \pi, t = \cos \pi = -1$

$$\therefore 2I = \pi \int_1^{-1} \frac{-dt}{1+t^2}$$

$$= \pi \int_{-1}^{1} \frac{dt}{1+t^2} \qquad \| P_1$$

$$= \pi \left[\tan^{-1} t\right]_{-1}^{1}$$

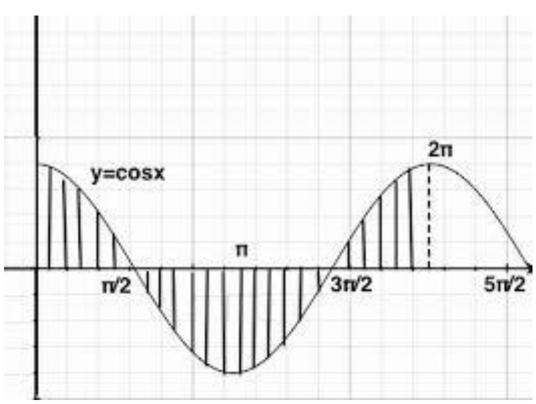
$$\tan^{-1}(1) \quad \tan^{-1}(\quad 1)$$

$$= \pi \left[\frac{}{4} - - \frac{}{4}\right]$$

$$2I = \pi . \frac{\pi}{2}$$

$$\therefore I = \frac{\pi^2}{4}$$

17. a)



b) $A = \int_0^{\frac{\pi}{2}} \cos x dx + \left| \int_{\frac{\pi}{2}}^{\frac{3\pi}{2}} \cos x dx \right| + \int_{\frac{3\pi}{2}}^{2\pi} \cos x dx$

$= (\sin x)_0^{\frac{\pi}{2}} + \left| (\sin x)_{\frac{\pi}{2}}^{\frac{3\pi}{2}} \right| + (\sin x)_{\frac{3\pi}{2}}^{2\pi}$

$= \left[\sin\frac{\pi}{2} - \sin 0 \right] + \left| \sin\frac{3\pi}{2} - \sin\frac{\pi}{2} \right| + \left(\sin 2\pi - \sin\frac{3\pi}{2} \right)$

$= (1-0) + \left| -\sin\frac{\pi}{2} - 1 \right| + \left(0 - -\sin\frac{\pi}{2} \right)$

$= 1 + |-1-1| + (1)$

$= 1 + |-2| + 1 = 1 + 2 + 1 = 4 sq.units$

18. a) CE is $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{6}$

b) (1,2,3)

c) Let P(x,y,z) be a general point on this line. Then P is $(2\lambda+1, 3\lambda+2, 6\lambda+3)$.

$\therefore (2\lambda+1-1)^2 + (3\lambda+2-2)^2 + (6\lambda+3-3)^2 = 7^2$

$4\lambda^2 + 9\lambda^2 + 36\lambda^2 = 49 \Rightarrow 49\lambda^2 = 49 \Rightarrow \lambda^2 = 1 \Rightarrow \lambda = \pm 1$

$\therefore$ another point on the line is (3,5,9) , when $\lambda = 1$ and (–1,–1,–3), when $\lambda = -1$

19. $AX = B$ where

$A = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 3 \\ 1 & -2 & 1 \end{bmatrix} = -1(1 - -6) - 1(0-3) + 1(0-1)$

$= 1(7) - 1(-3) + 1(-1)$

$= 7 + 3 - 1 = 9$

$A_{11} = 7 = 7$; $A_{21} = 3 = -3$; $A_{31} = 2 = 2$

$A_{12} = -3 = 3$; $A_{22} = 0 = 0$; $A_{32} = 3 = -3$

$A_{13} = -1 = -1$; $A_{23} = -3 = 3$; $A_{33} = 1 = 1$

$adj = \begin{bmatrix} 7 & -3 & 2 \\ 3 & 0 & -3 \\ -1 & 3 & 1 \end{bmatrix}$

$$A^{-1} = \frac{1}{|A|}.adjA = \frac{1}{9}\begin{bmatrix} 7 & -3 & 2 \\ 3 & 0 & -3 \\ -1 & 3 & 1 \end{bmatrix}$$

$$X = A^{-1}B = \frac{1}{9}\begin{bmatrix} 7 & -3 & 2 \\ 3 & 0 & -3 \\ -1 & 3 & 1 \end{bmatrix}\begin{bmatrix} 6 \\ 11 \\ 0 \end{bmatrix}$$

$$= \frac{1}{9}\begin{bmatrix} 42-33+0 \\ 18+0+0 \\ -6+33+0 \end{bmatrix} \quad = \frac{1}{9}\begin{bmatrix} 9 \\ 18 \\ 27 \end{bmatrix} \quad = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$$

$\therefore\ x = 1\ ;\ y = 2\ and\ z = 3$

20. a) $x = a\left(t - \sin t\right)$

$$\frac{dx}{dt} = a\left(1 - \cos t\right)$$

$$y = a\left(1 + \cos t\right)$$

$$\frac{dy}{dt} = a\left(0 + -\sin t\right) = -a\sin t$$

$$\frac{dy}{dx} = \frac{\frac{dy}{dt}}{\frac{dx}{dt}} = \frac{-a\sin t}{a\left(1-\cos t\right)} = \frac{-2\sin\frac{t}{2}\cos\frac{t}{2}}{2\sin^2\frac{t}{2}}$$

$$= -\cot\left(\frac{t}{2}\right)$$

b) $y = \left(\tan^{-1} x\right)^2$

$$\frac{dy}{dx} = 2\tan^{-1}x.\frac{1}{1+x^2}$$

$$\left(1 \quad x^2\right)\frac{dy}{dx} \quad 2\tan^{-1}x$$

$$\left(1+x^2\right)\frac{d^2y}{dx^2} + \frac{dy}{dx}\left(0+2x\right) = 2.\frac{1}{1+x^2}$$

$$\left(1+x^2\right)\frac{d^2y}{dx^2} + 2x\frac{dy}{dx} = \frac{2}{\left(1+x^2\right)}$$

$$\left(1+x^2\right)^2\frac{d^2y}{dx^2} + 2x\left(1+x^2\right)\frac{dy}{dx} = 2$$

Hence proved.

21. a) $f\left(x\right)=x^3-3x^2+3x-100$

$f'\left(x\right)=3x^2-6x+3$

$=3\left(x^2-2x+1\right)=3\left(x-1\right)^2>0$

$\therefore f\left(x\right)$ is increasing on R.

b) $y=3x^2-4x$

$\frac{dy}{dx}=6x-4$

Slope of tangent $=\frac{dy}{dx}_{\left(at\,x=2\right)}=6\left(2\right)-4=8$

c) Let $y=\sqrt{x}$ ....$\left(1\right)$

$\sqrt{x+\Delta x}=y+\Delta y$ $\quad \| x=25,\ \Delta x=0.3$

$\sqrt{25+0.3}=\sqrt{x}+\Delta y$

$\sqrt{25.3}=5+\Delta y$............$\left(2\right)$

Diff. (1) wrt x

$\frac{dy}{dx}=\frac{1}{2\sqrt{x}}$

$\Delta y=\frac{1}{2\sqrt{25}}\Delta x$

$=\frac{1}{2\times 5}\times 0.3=\frac{0.3}{10}=0.03$

$in\left(2\right)$

$\sqrt{25.3}=5+0.03$

$=5.03\left(nearly\right)$

22. a) $I=\int\frac{\sin\left(\tan^{-1}x\right)}{1+x^2}dx$

$=\sin\left(\tan^{-1}x\right).\frac{1}{1+x^2}dx$

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

$\therefore I=\int\sin t.dt=-\cos t+C=-\cos\left(\tan^{-1}x\right)+C$

b) $\frac{dy}{dx} = \frac{x^2+y^2}{2xy}$, is a homogeneous D.E.

$Put \quad y = vx \Rightarrow \frac{dy}{dx} = v + x\frac{dv}{dx}$

$v + x\frac{dv}{dx} = \frac{x^2+v^2x^2}{2x.vx}$

$x\frac{dv}{dx} = \frac{1+v^2}{2v} - v$

$= \frac{1+v^2-2v^2}{2v} = \frac{1-v^2}{2v}$

$x\,dv \times 2v = \left(1-v^2\right)dx$

$\frac{2v}{1-v^2}dv = \frac{1}{x}dx$ is in variable separable form.

$\int \frac{2v}{1-v^2}dv = \int \frac{1}{x}dx$

$\int \frac{-2v}{1-v^2}dv = -\int \frac{1}{x}dx$

$\log|1-v^2| = -\log|x| + \log|C|$

$\log|1-v^2| + \log|x| = \log|C|$

$\log|\left(1-v^2\right)x| = \log|C|$

$\left(1-v^2\right)x = C$

$\left(1-\frac{y^2}{x^2}\right)x = C \Rightarrow \frac{x^2-y^2}{x^2}.x = C$

$x^2 - y^2 = Cx$ is the required solution.

24. a) $\left|\bar{a}\times\bar{b}\right| = \left|\bar{a} - b\right|$

$\left|ab\sin\theta\left(\hat{n}\right)\right| = \left|ab\cos\theta\right|$

$\left|\bar{a}\right|\left|\bar{b}\right|\sin\theta(1) = \left|\bar{a}\right|\left|\bar{b}\right|\cos\theta$

$\Rightarrow \sin\theta = \cos\theta$

$\therefore \theta = \frac{\pi}{4}$

b) Let $\bar{c} = x\hat{i} + y\hat{j} + z\hat{k}$

If $\bar{c} \perp \bar{a} \Leftarrow 2x - y + 3z = 0$ ....(1)

If $\bar{c} \perp \bar{a} \Leftarrow x + y + z = 0$ ....(2)

Solving (1) and (2)

$$\begin{matrix} & x & y & z \\ -1 & 3 & 2 & -1 \\ 1 & 1 & 1 & 1 \end{matrix}$$

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

$\therefore \vec{c} = -4\hat{i} + \hat{j} + 3\hat{k}$

c) $\vec{a} \times \vec{b} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -1 & 3 \\ 1 & 1 & 1 \end{vmatrix} = \hat{i}(-1-3) - \hat{j}(2-3) + \hat{k}(2--1) = -4\hat{i} + \hat{j} + 3\hat{k}$

Area of the parallelogram $= \left|\vec{a} \times \vec{b}\right| = \sqrt{16+1+9} = \sqrt{26}$ sq.units

d) Volume of the parallelepiped $= [\vec{a}\ \vec{b}\ \vec{c}] = (\vec{a} \times \vec{b}).\vec{c} = (-4\hat{i} + \hat{j} + 3\hat{k}).(\hat{i} + 2\hat{j} - \hat{k})$

$$= -4 + 2 + -3 = -5$$

$\therefore$ volume = 5 cubic units.

25 a) Let P(x,y,x) be a general point in the given line $\vec{r} = (\hat{i} + \hat{j}) + \lambda(\hat{i} + 2\hat{j})$.

Then $\frac{x-1}{1} = \frac{y-1}{2} = \frac{z-0}{0} = \lambda$

$x = \lambda + 1,\ y = 2\lambda + 1,\ z = 0$

$But\ (\lambda + 1 - 1)^2 + (2\lambda + 1 - 1)^2 + 0^2 = 25$

$\Rightarrow \lambda^2 + 4\lambda^2 = 25 \Rightarrow 5\lambda^2 = 25 \Rightarrow \lambda^2 = 5 \Rightarrow \lambda = \pm\sqrt{5}$

$When\ x = \sqrt{5}$

$\therefore x = \sqrt{5} + 1, y = 2\sqrt{5} + 1, z = 0$

$\vec{a} = (\sqrt{5} + 1)\hat{i} + (2\sqrt{5} + 1)\hat{j}$

$\therefore$ Required equation of the line is $\vec{r} = \vec{a} + \mu\vec{b} = \left[(\sqrt{5}+1)\hat{i} + (2\sqrt{5}+1)\hat{j}\right] + \mu(\hat{i} + 2\hat{j})$.

b) $\vec{a}_1 = \hat{i} + 2\hat{j} + \hat{k},\ \vec{b}_1 = \hat{i} - \hat{j} + \hat{k}, \vec{a}_2 = 2\hat{i} - \hat{j} - \hat{k},\ \vec{b}_2 = 2\hat{i} + \hat{j} + 2\hat{k}$

$\vec{a}_1 = \hat{i} + 2\hat{j} + \hat{k},\ \vec{b}_1 = \hat{i} - \hat{j} + \hat{k}, \vec{a}_2 = 2\hat{i} - \hat{j} - \hat{k},\ \vec{b}_2 = 2\hat{i} + \hat{j} + 2\hat{k}$

$\vec{a}_2 - \vec{a}_1 = \hat{i} - 3\hat{j} - 2\hat{k}$

$$\vec{b}_1 \times \vec{b}_2 = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & -1 & 1 \\ 2 & 1 & 2 \end{vmatrix} = \hat{i}(-3) - \hat{j}(0) + \hat{k}(3) = -3\hat{i} + 3\hat{k}$$

$\left|\vec{b}_1 \times \vec{b}_2\right| = \sqrt{9+9} = \sqrt{9 \times 2} = 3\sqrt{2}$

$\left(\vec{b}_1 \times \vec{b}_2\right).\left(\vec{a}_2 - \vec{a}_1\right) = -3 + 0 - 6 = -9$

$$\therefore d = \left| \frac{\left(\vec{b}_1 \times \vec{b}_2\right).\left(\vec{a}_2 - \vec{a}_1\right)}{\left|\vec{b}_1 \times \vec{b}_2\right|} \right| = \left| \frac{-9}{3\sqrt{2}} \right| = \frac{3}{\sqrt{2}} = \frac{3\sqrt{2}}{2} \text{ units.}$$

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