① a) $A=(5,4,1)$ $B=(-2,3,2)$

$\vec{AB}=(-2,3,2)-(5,4,1) = (-7,-1,1)$ $X = A + \alpha(-7,-1,1)$

Forma Paramétrica { Forma simétrica

$$\begin{cases} X = 5 + (-7\alpha) \\ Y = 4 - \alpha \\ Z = 1 + \alpha \end{cases} \qquad \begin{cases} X = 5 - 7\alpha \\ Y = 4 - \alpha \\ Z = 1 + \alpha \end{cases} \qquad \frac{X-5}{-7} = -Y+4 = Z-1$$

b) $A=(0,-1,0)$ $B=(1,0,0)$

$\vec{AB}=(1,0,0)-(0,-1,0)=(1,1,0)$ $X=(0,-1,0)+\alpha(1,1,0)$

Forma Paramétrica

$$\begin{cases} X = \alpha \\ Y = -1+\alpha \\ Z = 0 \end{cases}$$

Forma Simétrica $\nexists$

c) $A=(0,1,-1)$ $B=(0,0,0)$

$\vec{AB}=(0,-1,1)$ $X=(0,0,0)+\alpha(0,-1,1)$

Forma Paramétrica

$$\begin{cases} X = 0 \\ Y = -\alpha \\ Z = \alpha \end{cases}$$

Forma Simétrica $\nexists$

d) $A=(0,1,-1)$ $B=(6,1,-4)$

$\vec{AB}=(6,1,-4)-(0,1,-1) = (6,0,-3)$ $X=(0,1,-1)+\alpha(6,0,-3)$

Forma Simétrica

$$\begin{cases} X = 0 + 6\alpha \\ Y = 1 + 0 \\ Z = -1 + (-3\alpha) \end{cases} \qquad \begin{cases} X = 6\alpha \\ Y = 1 \\ Z = -1 - 3\alpha \end{cases}$$

Forma Simétrica $\nexists$

② a) $\begin{cases} x = 1 - \lambda \\ y = \lambda \\ z = 4 + 2\lambda \end{cases}$, $\lambda \in \mathbb{R}$

Pontos: P $\Rightarrow$ $\lambda = 0$ $\quad P = (1, 0, 4)$
Q $\qquad \lambda = 1$ $\quad Q = (0, 1, 6)$

Vetores diretores possíveis: $\vec{PQ} = (-1, 1, 2)$
$\vec{QP} = (1, -1, -2)$

b) $P = (1, 3, -3)$ $\quad Q = (-3, 4, 12)$

P:
$\begin{cases} 1 = 1 - \lambda \\ 3 = \lambda \\ -3 = 4 + 2\lambda \end{cases}$ $\quad P \notin r$

Q:
$\begin{cases} -3 = 1 - \lambda \checkmark \\ 4 = \lambda \\ 12 = 4 + 2\lambda \Rightarrow 12 = 4 + 8 \checkmark \end{cases}$ $\quad Q \in r$

c) reta s $\Rightarrow$ paralela a r e contém o ponto $(1, 4, -7)$

• vetor diretor de s e $(1, -1, -2)$ precisam ser L.D. logo...

• $X = (1, 4, -7) + (1, -1, -2)\alpha$

Equação paramétrica

$\begin{cases} x = 1 + \alpha \\ y = 4 + (-\alpha) \\ z = -7 + (-2\alpha) \end{cases}$ $\qquad \begin{cases} x = 1 + \alpha \\ y = 4 - \alpha \\ z = -7 - 2\alpha \end{cases}$

③ a) $A = (3, 6, -7)$ $\quad B = (-5, 2, 3)$ $\quad C = (4, -7, -6)$

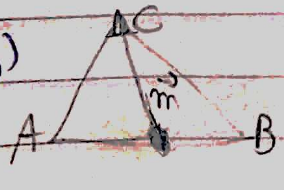
A, B, C serão vértices de um triângulo se, e somente se, $\vec{AB}$ e $\vec{AC}$ forem L.I.

$\vec{AB} = (-8, -4, 10)$ $\qquad \dfrac{-8}{1} \neq \dfrac{10}{1}$

A → B $\quad$ A → C $\quad \vec{AC} = (1, -13, 1)$

$\therefore \nexists \lambda \in \mathbb{R}$ que satisfaça $(-8, -4, 10) = \lambda(1, -13, 1)$

b)



$\vec{m} = C - \left(\dfrac{A+B}{2}\right)$ $\Leftrightarrow$ $\vec{m} = C - \dfrac{(-2, 8, -4)}{2}$

$\vec{m} = (4, -7, -6) - (-1, 4, -2)$

$\vec{m} = (5, -11, -4)$ $\qquad X = (4, -7, -6) + \alpha(5, -11, -4)$

$\alpha \in \mathbb{R}$

tilibra

4) a) $A=(0,1,8)$ $B=(-3,0,9)$ $r=(1,2,0)+\lambda(1,1,-3)$

$C \in \mathbb{R}$, ABC é triângulo retângulo

$\vec{CA}\cdot\vec{AB}=0$

$C=(1,2,0)+\lambda(1,1,-3)$ $\quad C(\lambda)=(1+\lambda,\ 2+\lambda,\ -3\lambda)$

$\vec{CA}=(0-X_c,\ 1-Y_c,\ 8-Z_c)$ $\quad \vec{AB}=(-3,-1,1)$

$-3\cdot(-X_c)+(-1)(1-Y_c)+8-Z_c=0$

$3X_c+(-1+Y_c)+8-Z_c=0 \iff 3X_c+Y_c-Z_c+7=0$

$3(1+\lambda)+2+\lambda+3\lambda+7=0$

$3\lambda+\lambda+3\lambda+3+2+7=0$

$\lambda=-12/7$

$C=\left(\frac{7}{7}+\left(\frac{-12}{7}\right),\ \frac{14}{7}+\left(\frac{12}{7}\right),\ -3\left(\frac{-12}{7}\right)\right)$

$C=\left(\frac{-5}{7},\ \frac{2}{7},\ \frac{36}{7}\right)$

b) $A=(1,1,1)$ $B=(0,0,1)$ $r: X=(1,0,0)+(\lambda,\lambda,\lambda)$

$\to X=(1+\lambda,\lambda,\lambda)$

$d(X,A)=d(X,B)$

$\left[(1-1-\lambda)^2+(1-\lambda)^2+(1-\lambda)^2\right]^{1/2}=\left[(1+\lambda)^2+\lambda^2+(1-\lambda)^2\right]^{1/2}$

$\cancel{\lambda^2}+(1-\lambda)^2+(1-\lambda)^2=(1+\lambda)^2+\cancel{\lambda^2}+(1-\lambda)^2$

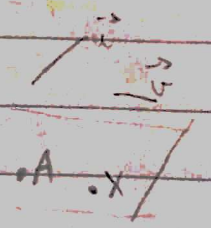
$(1-\lambda)^2=(1+\lambda)^2$

$1-\lambda=1+\lambda$ $\quad \lambda=0$

O único ponto de r equidistante a A e B é (1,0,0).

(5) a) $A=(1,2,0)$, $\pi \parallel \vec{u}=(1,1,0)$ e $\vec{v}=(2,3,-1)$

$\pi: X=(1,2,0)+\alpha(1,1,0)+\beta(2,3,-1)$

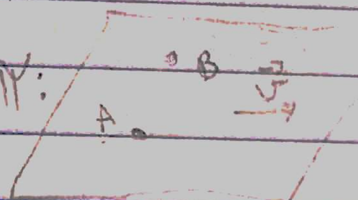


$\vec{u}$ e $\vec{v}$ são L.I $\Rightarrow \frac{1}{2} \neq \frac{1}{3} \Rightarrow$ $\vec{u}$ e $\vec{v}$ $\Rightarrow$ formam o plano

Paramétrica:

$$\pi: \begin{cases} x=1+\alpha+2\beta \\ y=2+\alpha+3\beta \\ z=0+0+-\beta \end{cases} = \pi: \begin{cases} x=1+\alpha+2\beta \\ y=2+\alpha+3\beta, \ \alpha,\beta \in \mathbb{R} \\ z=-\beta \end{cases}$$

b) $A=(1,1,0)$ $B=(1,-1,-1)$ $\parallel \vec{v}=(2,1,0)$



$\pi: X=A+\vec{AB}\cdot\alpha+\vec{v}\cdot\beta$, $\Leftrightarrow$ $\vec{AB}$ e $\vec{v}$ forem L.I.

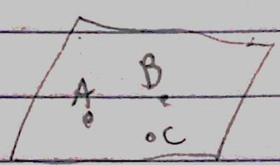
$\vec{AB}=B-A=(1,-1,-1)-(1,1,0)=(0,-2,-1)$ $\frac{0}{2} \neq \frac{-2}{1}$ L.I.

Equação Vetorial $\Rightarrow$ $\pi: X=(1,1,0)+(0,-2,-1)\alpha+(2,1,0)\beta$; $\alpha,\beta \in \mathbb{R}$

Equações Paramétricas.

$$\begin{cases} x=1+0\alpha+2\beta \\ y=1+(-2\alpha)+1\beta \\ z=0+(-\alpha)+0\beta \end{cases} \quad \pi: \begin{cases} x=1+2\beta \\ y=1-2\alpha+\beta \\ z=-\alpha \end{cases}$$

c) $A=(1,0,1)$, $B=(2,1,-2)$, $C=(1,-1,0)$



Se $\vec{AB}$ e $\vec{AC}$ forem L.I., formam um plano

$\vec{AB}=(2,1,-2)-(1,0,1)=(1,1,-3)$ $\Rightarrow$ claramente L.I.

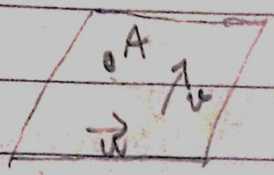
$\vec{AC}=(1,-1,0)-(1,0,1)=(0,-1,-1)$

Forma Paramétrica:

$$\pi: \begin{cases} x=1+1\alpha+0\beta \\ y=0+1\alpha+(-1)\beta \\ z=1+(-3\alpha)+(-1)\beta \end{cases} \quad \pi: \begin{cases} x=1+\alpha \\ y=\alpha-\beta \\ z=1-3\alpha-\beta \end{cases} \rightarrow \alpha,\beta \in \mathbb{R}$$

Forma Vetorial $\Rightarrow$ $\pi: X=(1,0,1)+\alpha(1,1,-3)+\beta(0,-1,-1)$

6) a) $A=(9,-1,0)$ $\quad \vec{u}=(0,1,0)$ $\quad \vec{v}=(1,1,1)$



$$\pi: \begin{cases} x = 9 + 0\alpha + \beta \\ y = -1 + 1\alpha + \beta \\ z = 0 + 0\alpha + \beta \end{cases} \qquad \pi: \begin{cases} x = 9 + \beta \\ y = -1 + \alpha + \beta \\ z = \beta \end{cases}$$

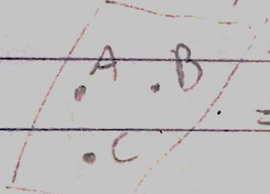
→ eixo y é paralelo ao plano

$$\begin{vmatrix} x-9 & y-(-1) & z-0 \\ 0 & 1 & 0 \\ 1 & 1 & 1 \end{vmatrix} = \begin{vmatrix} x-9 & 0 & z \\ 0 & 1 & 0 \\ 1 & 0 & 1 \end{vmatrix} \quad (x-9)\cdot 1 + z(-1) = 0$$

$$= x-9-z=0$$

$$\boxed{x-z-9=0} \; //$$

b) $A=(1,0,1)$ $\quad B=(-1,0,1)$ $\quad C=(2,1,2)$



$\Rightarrow \vec{AB} = (-1,0,1)-(1,0,1) = (-2,0,0) \Rightarrow X-A$

$\Rightarrow \vec{AC} = (2,1,2)-(1,0,1) = (1,1,1)$

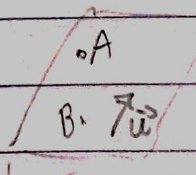
$$\begin{vmatrix} x-1 & y & z-1 \\ -2 & 0 & 0 \\ 1 & 1 & 1 \end{vmatrix} = \begin{vmatrix} 0 & y & z-1 \\ 1 & 0 & 0 \\ 0 & 1 & 1 \end{vmatrix} = y\begin{vmatrix} 0 & 1 \\ 1 & 0 \end{vmatrix} + (z-1)\begin{vmatrix} 1 & 0 \\ 0 & 1 \end{vmatrix} = -y+(z-1)\cdot 1$$

$$\boxed{-y+z-1=0} \; //$$

c) $A=(1,1,0)$ $\quad B=(1,-1,-1)$ $\quad // \vec{u}=(2,1,0)$

$\Rightarrow \vec{AB} = (1,-1,-1)-(1,1,0) = (0,-2,-1)$

$\Rightarrow \vec{u}$ $\quad \Rightarrow X-A$



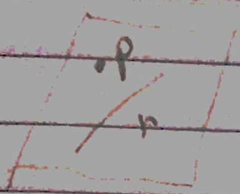
$$\begin{vmatrix} x-1 & y-1 & z \\ 0 & -2 & -1 \\ 2 & 1 & 0 \end{vmatrix}$$

$$\begin{vmatrix} x-1 & y-1 & z \\ 0 & 2 & 1 \\ 2 & 1 & 0 \end{vmatrix} = (x-1)\begin{vmatrix} 2 & 1 \\ 1 & 0 \end{vmatrix} + (y-1)\begin{vmatrix} 1 & 0 \\ 0 & 2 \end{vmatrix} + z\begin{vmatrix} 0 & 2 \\ 2 & 1 \end{vmatrix} = (x-1)(-1)+(y-1)2 + z(-4) = 0$$

$$-x+1+2y-2-4z=0 \iff \boxed{x-2y+4z+1=0}$$

d) $P = (1,-1,1)$ $r: X = (0,2,2) + \lambda\underbrace{(1,1,-1)}_{\vec{u}}$ $\lambda = 0 \Rightarrow X = (0,2,2)$

$\vec{PX} = (0,2,2) - (1,-1,1) = (-1,3,1)$



$P \notin r$

$\Rightarrow \vec{u}$; $\vec{PX}$; $W_{(x,y,z)} - (0,2,2)$

$$\begin{vmatrix} x & y-2 & z-2 \\ 1 & 1 & -1 \\ -1 & 3 & 1 \end{vmatrix} = x\begin{vmatrix} 1 & -1 \\ 3 & 1 \end{vmatrix} + (y-2)\cancel{\begin{vmatrix} -1 & 1 \\ 1 & -1 \end{vmatrix}} + (z-2)\begin{vmatrix} 1 & 1 \\ -1 & 3 \end{vmatrix} = x(1+3) + (z-2)(3+1) = 0$$

$4x + 4z - 8 = 0$

E paralelo a $\leftarrow$ $\boxed{x + z - 2 = 0}$ //

7) a) $4x + 2y - z + 5 = 0 \Leftrightarrow z = 4x + 2y + 5$ $x = \alpha$; $y = \beta$

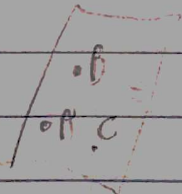
$$\pi: \begin{cases} x = \alpha \\ y = \beta \\ z = 4\alpha + 2\beta + 5 \end{cases} \qquad \pi: \begin{cases} x = \alpha \\ y = \beta \\ z = 5 + 4\alpha + 2\beta \end{cases} //$$

b) $5x - y - 1 = 0$

$A = (0,-1,0) \Rightarrow x = 0$

$B = (0,-1,1) \Rightarrow z =$ LIVRE

$C = (\frac{1}{5}, 0, 0) \Rightarrow y = 0$



$\vec{AB} = (0,0,1)$, $\vec{AC} = (\frac{1}{5}, 1, 0)$ } L.I.

$$\pi: \begin{cases} x = 0 + 0\lambda_1 + \frac{1}{5}\lambda_2 \\ y = -1 + 0\lambda_1 + 1\lambda_2 \\ z = 1 + 1\lambda_1 + 0\lambda_2 \end{cases} //$$

c) $z - 3 = 0$ $\Rightarrow z = 3$, x e y livres

$A = (0\ 0\ 3)$ $\vec{AB} = (1,0,0)$

$B = (1\ 0\ 3)$ $\vec{AC} = (0,1,0)$

$C = (0\ 1\ 3)$

$$\pi: \begin{cases} x = 0 + 1\lambda_1 + 0\lambda_2 \\ y = 0 + 0\lambda_1 + 1\lambda_2 \\ z = 3 + 0\lambda_1 + 0\lambda_2 \end{cases}$$

$$\pi: \begin{cases} x = \lambda_1 \\ y = \lambda_2 \\ z = 3 \end{cases} //$$

d) $y - z - 2 = 0$ $\quad x = \alpha \rightarrow$ livre

$y = z + 2$ $\quad z = \beta$

$y = \beta + 2$

$$\begin{cases} x = \alpha \\ y = \beta + 2 \\ z = \beta \end{cases}$$

8 a) $\begin{cases} x = 1 + \lambda - \mu \\ y = 2\lambda + \mu \\ z = 3 - \mu \end{cases}$

$$\begin{vmatrix} x-1 & y & z-3 \\ 1 & 2 & 0 \\ -1 & 1 & -1 \end{vmatrix} = (x-1)\begin{vmatrix} 2 & 0 \\ 1 & -1 \end{vmatrix} + y\begin{vmatrix} 0 & 1 \\ -1 & -1 \end{vmatrix} + (z-3)\begin{vmatrix} 1 & 2 \\ -1 & 1 \end{vmatrix}$$

$(x-1)(-2) + y \cdot 1 + (z-3)(1 - -2) = -2x + 2 + y + 3z - 9 = 0$

$-2x + y + 3z + 2 - 9 = 0 \iff 2x - y - 3z + 7 = 0$ //

b) $\begin{cases} x = 1 + \lambda \\ y = 2 \\ z = 3 - \lambda + \mu \end{cases}$

$$\begin{vmatrix} x-1 & y-2 & z-3 \\ 1 & 0 & -1 \\ 0 & 0 & 1 \end{vmatrix} = \begin{vmatrix} 0 & y-2 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{vmatrix} = (y-2)\begin{vmatrix} 0 & 1 \\ 1 & 0 \end{vmatrix} = -y + 2$$

$-y + 2 = 0$ //

c) $\begin{cases} x = -2 + \lambda - \mu \\ y = 0 + 2\lambda + 2\mu \\ z = 0 + \lambda + \mu \end{cases}$

$$\begin{vmatrix} x+2 & y & z \\ 1 & 2 & 1 \\ -1 & 2 & 1 \end{vmatrix} = \cancel{(x+2)\begin{vmatrix} 2 & 1 \\ 2 & 1 \end{vmatrix}} + y\begin{vmatrix} 1 & 1 \\ 1 & -1 \end{vmatrix} + z\begin{vmatrix} 1 & 2 \\ -1 & 2 \end{vmatrix}$$

$y(-2) + z(4) = -2y + 4z = 0$

$y - 2z = 0$ //

9) a) $r: \begin{cases} x = 1 + 2\lambda \\ y = \lambda \\ z = 1 + 3\lambda \end{cases}$ $s: \begin{cases} x = -1 + 4\mu \\ y = -1 + 2\mu \\ z = -2 + 6\mu \end{cases}$ $(2,1,3) = \frac{1}{2}(4,2,6)$ NÃO CONCORRENTES

$X = (1,0,1) + (2,1,3)\lambda$ $X = (-1,-1,-2) + (4,2,6)\mu$

$\begin{cases} 1 = -1 + 4\mu \\ 0 = -1 + 2\mu \\ 1 = -2 + 6\mu \end{cases}$ $\begin{cases} \mu = \frac{1}{2} \\ \mu = \frac{1}{2} \\ \mu = \frac{1}{2} \end{cases}$ Coincidentes! $r = s$ $\Rightarrow$ Não formam um plano

b) $r: X = (1,1,0) + \lambda(1,2,3)$ $s: X = (2,3,3) + \mu(3,2,1)$

Vetores diretores são L.I., não são paralelas

$\overrightarrow{X_1X_2} = (2,3,3) - (1,1,0) = (1,2,3)$

$\begin{vmatrix} 1 & 2 & 3 \\ 1 & 2 & 3 \\ 3 & 2 & 1 \end{vmatrix} \Rightarrow \begin{vmatrix} 0 & 0 & 0 \\ 1 & 2 & 3 \\ 3 & 2 & 1 \end{vmatrix} = 0$ Formam um plano

Concorrentes

$\begin{cases} 1 + \lambda \cdot 1 = 2 + \mu \cdot 3 \\ 1 + \lambda \cdot 2 = 3 + \mu \cdot 2 \\ 0 + \lambda \cdot 3 = 3 + \mu \cdot 1 \end{cases}$ $\begin{cases} 1 + \lambda = 2 + 3\mu \\ 1 + 2\lambda = 3 + 2\mu \\ 3\lambda = 3 + \mu \end{cases}$ $\begin{cases} \lambda - 3\mu = 1 \\ 2\lambda - 2\mu = 2 \\ 3\lambda - \mu = 3 \end{cases}$

$\begin{cases} \lambda - \mu = 1 \\ 3\lambda - \mu = 3 \end{cases}$ $-$ $-2\lambda = -2$ $\lambda = 1$ $\mu = 0$ Intersecção no ponto $(2,3,3)$

$\begin{vmatrix} x-1 & y-1 & z \\ 1 & 2 & 3 \\ 3 & 2 & 1 \end{vmatrix} = \begin{vmatrix} x-1 & y-1 & z \\ -2 & 0 & 2 \\ 3 & 2 & 1 \end{vmatrix} = (x-1)\begin{vmatrix} 0 & 2 \\ 2 & 1 \end{vmatrix} + (y-1)\begin{vmatrix} 2 & -2 \\ 1 & 3 \end{vmatrix} + z\begin{vmatrix} -2 & 0 \\ 3 & 2 \end{vmatrix}$

$(x-1)(-4) + (y-1)(6+2) + z(-4) = 0$

$-4x + 4 + 8y - 8 - 4z = 0$

$-4x + 8y - 4z + 4 - 8 = 0$

$4x - 8y + 4z - 4 = 0$

Equação do plano: $x - 2y - 4z = 0$ //

/ /

c) $r: \begin{cases} x = 2 - 4\lambda \\ y = 4 + 5\lambda \\ z = 11 \end{cases}$ $s: \frac{x}{2} = \frac{y-1}{-2} = z = \alpha$

$(-4, 5, 0) = \beta(2, -2, 1)$ $\begin{cases} x = 2\alpha \\ y = -2\alpha + 1 \\ z = \alpha \end{cases}$

L.I. // ⇒ não paralelos

$\overrightarrow{X_1X_2} = (0, 1, 0) - (2, 4, 11) = (-2, -3, -11)$

$\begin{vmatrix} 2 & 3 & 11 \\ -4 & 5 & 0 \\ 2 & -2 & 1 \end{vmatrix} = 2 \cdot 5 + 3 \cdot 4 + 11 \cdot \begin{vmatrix} -4 & 5 \\ 2 & -2 \end{vmatrix}$

$10 + 12 + 11 \cdot (8 - 10) = 22 - 22 = 0$ → Formam um plano: concorrentes

Intersecção:

$\begin{cases} 2 - 4\lambda = 2\alpha \\ 4 + 5\lambda = -2\alpha + 1 \\ 11 = \alpha \end{cases}$ $\begin{cases} -4\lambda - 2\alpha = -2 \\ 5\lambda + 2\alpha = -3 \\ \alpha = 11 \end{cases}$ $\lambda + 22 = 2 \Rightarrow \lambda = -5$ $5 \cdot (-5) + 22 = -3$

Ponto de intersecção: $(22, 21, 11)$

d) $r = \frac{x-2}{3} = \frac{y+2}{4} = z$ $s: \frac{x}{4} = \frac{y}{2} = \frac{z-3}{2}$

$(3, 4, 1)$ $(4, 2, 2)$ ⇒ L.I.

$\overrightarrow{X_1X_2} = (0, 0, 3) - (2, -2, 0) = (-2, 2, 3)$

$\begin{vmatrix} -2 & 2 & 3 \\ 3 & 4 & 1 \\ 4 & 2 & 2 \end{vmatrix}$ $-2\begin{vmatrix} 4 & 1 \\ 2 & 2 \end{vmatrix} + 2\begin{vmatrix} 1 & 3 \\ 2 & 4 \end{vmatrix} + 3\begin{vmatrix} 3 & 4 \\ 4 & 2 \end{vmatrix}$

$-2(8-2) + 2(4-6) + 3(6-16)$

$-12 + (-4) - 30 = -46 \neq 0$ → Formam um espaço

↳ Retas Reversas

↳ Não formam um plano

$\begin{cases} 4\alpha = 3\beta + 2 \\ 2\alpha = 4\beta - 2 \\ 2\alpha + 3 = \beta \end{cases}$ $2\alpha = -\beta + 4$ $2\alpha + 3 = \beta$ $4\alpha = 1$ $\alpha = \frac{1}{4}$ $\beta = -\frac{1}{3}$

$\Rightarrow \frac{1}{2} + 3 \neq -\frac{1}{3}$ → Sem intersecção

/ /

10 a) $\begin{cases} x+2y+3z-1=0 \\ x-y+2z=0 \end{cases}$ $\vec{n}_1=(1,2,3)$
$\vec{n}_2=(1,-1,2)$

$\vec{d}=\begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 1 & 2 & 3 \\ 1 & -1 & 2 \end{vmatrix} = \vec{i}\begin{vmatrix} 2 & 3 \\ -1 & 2 \end{vmatrix} + \vec{j}\begin{vmatrix} 3 & 1 \\ 2 & 1 \end{vmatrix} + \vec{k}\begin{vmatrix} 1 & 2 \\ 1 & -1 \end{vmatrix}$

$7\vec{i} + 1\vec{j} + (-3)\vec{k} = 7i+j-3k = (7,1,-3)$ vetor diretor

fixar $z=0$ $\begin{cases} x+2y=1 \\ x-y=0 \end{cases} \Leftrightarrow 3y=1$
$y=\frac{1}{3}$ $x=\frac{1}{3}$

$r: X=(\frac{1}{3},\frac{1}{3},0)+(7,1,-3)\alpha$, $\alpha \in \mathbb{R}$ //

b) $r: \begin{cases} x+y+z-1=0 \\ x+y-z=0 \end{cases}$ $\vec{n}=(1,1,1)$
$\vec{n}=(1,1,-1)$

$\vec{d}=\begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 1 & 1 & 1 \\ 1 & 1 & -1 \end{vmatrix} = \dots = \vec{i}\begin{vmatrix} 0 & 1 \\ 1 & 0 \end{vmatrix} + \vec{j}\begin{vmatrix} 1 & 0 \\ 0 & 1 \end{vmatrix}$

$\vec{i}(-1)+\vec{j}(1) = -\vec{i}+\vec{j}=(-1,1,0)$

fixar $x=0$
$\begin{cases} y+z=1 \\ y-z=0 \end{cases}$ $y=z=\frac{1}{2}$

$r: X=(0,\frac{1}{2},\frac{1}{2})+(-1,1,0)\alpha$, $\alpha \in \mathbb{R}$

c) $r: \begin{cases} x=3 \\ 2x-z+1=0 \end{cases}$ $\vec{n}_1=(1,0,0)$
$\vec{n}_2(2,0,-1)$

$\vec{d}=\begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 1 & 0 & 0 \\ 2 & 0 & -1 \end{vmatrix} = \begin{vmatrix} 0 & \vec{j} & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{vmatrix} = \vec{j}\begin{vmatrix} 0 & 1 \\ 1 & 0 \end{vmatrix} = -\vec{j} = (0,-1,0)$

fixar $y=0$
$\begin{cases} x=3 \\ 6-z=-1 \end{cases}$
$z=7$

$r: X=(3,0,7)+(0,-1,0)\alpha$, $\alpha \in \mathbb{R}$

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d) $r: \begin{cases} y = 2 \\ z = 0 \end{cases}$ $\quad \begin{pmatrix} 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 1 \end{pmatrix}$ $\quad \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{vmatrix} = \vec{i} \cdot 1 = (1,0,0)$ (ok)

$x = 0$

$r: X = (0,2,0) + (1,0,0)\alpha \;,\; \alpha \in \mathbb{R}$

11) a) $r: X = (1,-1,1) + \lambda \underbrace{(-2,1,-1)}_{\vec{v_1}}$ $\quad s: \begin{cases} y + z = 3 \\ x + y - z = 6 \end{cases}$

$\begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 0 & 1 & 1 \\ 1 & 1 & -1 \end{vmatrix} = \vec{i} \begin{vmatrix} 1 & 1 \\ 1 & -1 \end{vmatrix} + \vec{j} \begin{vmatrix} 1 & 0 \\ -1 & 1 \end{vmatrix} + \vec{k} \begin{vmatrix} 0 & 1 \\ 1 & 1 \end{vmatrix} = \vec{i}(-1-1) + \vec{j}(1) + k(-1)$

$= \vec{i} \cdot (-2) + \vec{j} - k = (-2,1,-1)$

$\vec{v_1} = \vec{v_2}$

$s \Rightarrow \boxed{y = 0}$ $\quad \begin{cases} z = 3 \\ x - z = 6 \;,\; x = 9 \end{cases} \Rightarrow (9,0,3)$ $\quad \begin{cases} 9 = 1 + \lambda \cdot (-2) \\ 0 = -1 + \lambda \cdot 1 & \lambda = 1 \\ 3 = 1 + \lambda \cdot -1 & \lambda = -2 \end{cases}$

⇒ São retas paralelas distintas.

b) $r: \frac{x+1}{2} = \frac{y}{3} = \frac{z+1}{2}$ $\quad S: X_2 = (0,0,0) + \lambda(1,2,0)$

São LI.

$X_1 = (-1,0,-1) + (2,3,2)\lambda$

$\overrightarrow{X_1X_2} = (1,0,1)$

$\begin{vmatrix} 1 & 0 & 1 \\ 2 & 3 & 2 \\ 1 & 2 & 0 \end{vmatrix} = \begin{vmatrix} 1 & 0 & 1 \\ 0 & 3 & 0 \\ 1 & 2 & 0 \end{vmatrix} = \begin{vmatrix} 0 & 0 & 1 \\ 0 & 1 & 0 \\ 1 & 0 & 0 \end{vmatrix} = \begin{vmatrix} 0 & 1 \\ 1 & 0 \end{vmatrix} = -1$ ⇒ não formam um plano

⇒ São retas reversas

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c) $r: X = (8, 1, 9) + \lambda(2, -1, 3)$ $\quad s: X = (3, -4, 4) + \mu(1, -2, 2)$

$\vec{v}_1$ $\quad \vec{v}_2$

$\vec{v}_1$ e $\vec{v}_2$ são LI

$\vec{X_1X_2} = (3, -4, 4) - (8, 1, 9) = (-5, -5, -5)$ — São concorrentes

$$\begin{vmatrix} -5 & -5 & -5 \\ 2 & -1 & 3 \\ 1 & -2 & 2 \end{vmatrix} = \begin{vmatrix} 1 & 1 & 1 \\ 0 & -3 & 1 \\ 0 & -3 & 1 \end{vmatrix} = 0$$

$$\begin{cases} x: & 8 + 2\lambda = 3 + \mu \\ y: & 1 + (-\lambda) = -4 + -2\mu \\ z: & 9 + 3\lambda = 4 + 2\mu \end{cases} \Rightarrow \quad 10 + 2\lambda = 0 \quad \lambda = -5$$

$\Rightarrow 8 - 10 = 3 + \mu$ $\quad \mu = -5$

$8 - 10 = 3 - 5$ ✓

$1 + 5 = -4 + 10$ ✓

$9 - 15 = 4 - 10$ ✓

$\Rightarrow$ São retas concorrentes que se intersectam no ponto $(-2, 6, -6)$

d) $r: \dfrac{x+1}{2} = y = z$ $\quad s: \begin{cases} x + y - 3z = 1 \\ 2x - y - 2z = 0 \end{cases}$ $\quad (1, 1, -3)$ $\quad (2, -1, -2)$

$$\begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 1 & 1 & -3 \\ 2 & -1 & -2 \end{vmatrix} \quad \vec{i}\begin{vmatrix} 1 & -3 \\ -1 & -2 \end{vmatrix} + \vec{j}\begin{vmatrix} -3 & 1 \\ -2 & 2 \end{vmatrix} + \vec{k}\begin{vmatrix} 1 & 1 \\ 2 & -1 \end{vmatrix} \quad \vec{r}\ (-5, -4, -3)$$

$\vec{i}(-2 - 3) + \vec{j}(-6 + 2) + \vec{k}(-1 - 2) = -5\vec{i} - 4\vec{j} - 3\vec{k}$

$(2\ 1\ 1) = \lambda(5\ 4\ 3)$ $\quad \nexists\, \lambda \in \mathbb{R}$, não são paralelas

fixar $z = 0$ $\quad \begin{cases} x + y = 1 \\ 2x - y = 0 \end{cases}$ $\quad 3x = 1$ $\quad x = \frac{1}{3}$ $\quad y = \frac{2}{3}$ $\quad (1/3, 2/3, 0)$

$\vec{X_1X_2} = (-1, 0, 0) - (\frac{1}{3}, \frac{2}{3}, 0) = (-\frac{4}{3}, -\frac{2}{3}, 0)$

$$\begin{vmatrix} 4 & 2 & 0 \\ 2 & 1 & 1 \\ 5 & 4 & 3 \end{vmatrix} = \begin{vmatrix} 2 & 1 & 0 \\ 0 & 0 & 1 \\ 5 & 4 & 0 \end{vmatrix} = 2\begin{vmatrix} 0 & 1 \\ 4 & 0 \end{vmatrix} + 1\begin{vmatrix} 1 & 0 \\ 0 & 5 \end{vmatrix} = 2(-4) + 5$$

$5 - 8 = -3$ $\quad$ } não há um plano

$\Rightarrow$ São retas reversas

12) a) $r: X = (1,1,0) + \lambda(\underbrace{0,1,1}_{\vec{v}})$ $\pi: x - y - z = 2$

$\vec{n} = (1, -1, -1)$

$\vec{n} \cdot \vec{v} = 0 + (-1) \cdot 1 + (-1) \cdot 1 = -2$ $\Rightarrow$ Transversais não perpendiculares

$P_{(x,y,z)} = (1, 0, -1)$

$$\begin{cases} 1 = x \\ 1 + \lambda = y \\ \lambda = z \end{cases}$$

$(1, z+1, z)$

$x - (z+1) - z = 2 \rightarrow 1 - z - 1 - z = 2$

$-2z = 2 \quad z = -1 \quad y = 0$

$\lambda = -1$

$\Rightarrow$ São transversais não perpendiculares e $P = (1, 0, -1)$

b) $r: \frac{x-1}{2} = y = z$ $\pi: X = (3,0,1) + \lambda(1,0,1) + \mu(2,2,0)$

$$\vec{d} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 1 & 0 & 1 \\ 2 & 2 & 0 \end{vmatrix} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{vmatrix} = \vec{i}\begin{vmatrix} 0 & 1 \\ 1 & 0 \end{vmatrix} + \vec{j}\begin{vmatrix} 1 & 1 \\ 0 & 1 \end{vmatrix} + \vec{k}\begin{vmatrix} 1 & 0 \\ 1 & 1 \end{vmatrix}$$

$\vec{i}(-1) + \vec{j} \cdot 1 + \vec{k} = (-1, 1, 1) \rightarrow$ normal ao plano π

Seja $\vec{v}$ o vetor diretor de r:

$\vec{v} \cdot \vec{d} = 2 \cdot (-1) + 1 \cdot 1 + 1 \cdot 1 = -2 + 2 = 0$ $\Rightarrow$ NÃO transversais

c) $r: \begin{cases} x - y = 1 \\ x - 2y = 0 \end{cases}$ $\pi: x + y = 2 \rightarrow \vec{n}(1,1,0)$

$$\begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 1 & -1 & 0 \\ 1 & -2 & 0 \end{vmatrix} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 1 & -1 & 0 \\ 0 & -3 & 0 \end{vmatrix} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 1 & -1 & 0 \\ 0 & 1 & 0 \end{vmatrix} = \vec{i} \cdot 0 + \vec{j} \cdot 0 + \vec{k} \cdot 1 = (0,0,1)$$

$\vec{v} = (0,0,1)$

$\vec{n} \cdot \vec{v} = 0 + 0 + 0 = 0$

NÃO TRANSVERSAIS

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d) $r: x-2y = 3-2z+y = 2x-z$, $\pi: X = (1,4,0) + \lambda(1,1,1) + \mu(2,1,0)$

$x-2y+z = 3-z+y = 2x$

$-x-2y+z = -2x+y-z+3 = 0$

$$\begin{cases} x+2y-z=0 \\ 2x-y+z=3 \end{cases}$$

$$\begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 1 & 2 & -1 \\ 2 & -1 & 1 \end{vmatrix} = \vec{i}\begin{vmatrix} 2 & -1 \\ -1 & 1 \end{vmatrix} + \vec{j}\begin{vmatrix} -1 & 1 \\ 1 & 2 \end{vmatrix} + \vec{k}\begin{vmatrix} 1 & 2 \\ 2 & -1 \end{vmatrix}$$

$\vec{i}(2-1) + \vec{j}(-2-1) + \vec{k}(1-4) = \vec{i} - 3\vec{j} - 5\vec{k} = (1,-3,-5)$

Achando um ponto em r: fixar $y=0$

$$\begin{cases} x-z=0 \\ 2x+z=3 \end{cases} \quad 3x=3 \quad x=1 \quad z=1$$

$r: X = (1,0,1) + \alpha(1,-3,-5)$ $\vec{v}$

Achando o vetor normal a π:

$$\begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 1 & 1 & 1 \\ 2 & 1 & 0 \end{vmatrix} = \vec{i}\begin{vmatrix} 1 & 1 \\ 1 & 0 \end{vmatrix} + \vec{j}\begin{vmatrix} 1 & 1 \\ 0 & 2 \end{vmatrix} + \vec{k}\begin{vmatrix} 1 & 1 \\ 2 & 1 \end{vmatrix} = \vec{i}(-1) + \vec{j}\cdot 2 + \vec{k}(1-2)$$

$-\vec{i} + 2\vec{j} - \vec{k} = (-1,2,-1)$ $\vec{n}$

$\vec{v}\cdot\vec{n} = -1 + (-3)(2) + 5 = 4 - 6 = -2 \Rightarrow$ Transversais

$(-1\ 2\ -1) = (1\ -3\ -5)\alpha$, $\nexists\, \alpha \in \mathbb{R} \Rightarrow$ Não Perpendiculares

$$\begin{cases} 1+\alpha = 1+\lambda+2\mu \\ -3\alpha = 4+\lambda+\mu \\ 1-5\alpha = \lambda \end{cases} \qquad \begin{cases} \alpha-\lambda-2\mu = 0 \\ 3\alpha+\lambda+\mu = -4 \\ 5\alpha+\lambda = 1 \end{cases}$$

$\alpha - \lambda - 2\mu = 0$

$\Rightarrow 6\alpha + 2\lambda + 2\mu = -8$

$-\ 7\alpha + \lambda = -8$

$5\alpha + \lambda = 1$

$2\alpha = -9$ $\quad \alpha = -9/2$

$x = 1 - \frac{9}{2} = -\frac{7}{2}$

$y = -3\cdot\left(-\frac{9}{2}\right) = \frac{27}{2}$

$z = 1 - 5\left(-\frac{9}{2}\right) = 1 - \left(\frac{45}{2}\right) = \frac{47}{2}$

$P = \left(-\frac{7}{2}, \frac{27}{2}, \frac{47}{2}\right)$

$\vec{v}$

(13) a) $r \parallel \pi$ $\quad r: X=(1,1,1)+\lambda(2,m,1) \quad \pi: X=(0,0,0)+\alpha(1,2,0)+\beta(1,0,1)$

$$\vec{n}=\begin{vmatrix}\vec{i} & \vec{j} & \vec{k}\\ 1 & 2 & 0\\ 1 & 0 & 1\end{vmatrix}=\vec{i}\begin{vmatrix}2 & 0\\ 0 & 1\end{vmatrix}+\vec{j}\begin{vmatrix}0 & 1\\ 1 & 1\end{vmatrix}+\vec{k}\begin{vmatrix}1 & 2\\ 1 & 0\end{vmatrix}$$

$$\vec{i}\cdot 2+\vec{j}(-1)+\vec{k}\cdot(-2)=(2,-1,-2)$$

$\vec{n}\cdot\vec{v}=2\cdot 2-m-2=0 \iff m=2$ //

b) $r \subseteq \pi$ $\quad r: X=(n,2,0)+\lambda(2,m,n) \quad \pi: x-3y+z=1$

$\vec{v}$ $\quad \vec{n}=(1,-3,1)$

$\vec{n}\cdot\vec{v}=\begin{cases}2-3m+n=0 & \dots (1)\\ n-3\cdot 2=1 & \dots (2)\end{cases}$ $\rightarrow 2-3m+7=0 \quad m=3$ //

$n=7$ //

c) $r: \dfrac{x-1}{m}=\dfrac{y}{2}=\dfrac{z}{m}$ transversal a $\pi: x+my+z=0$

$\vec{n}=(1,m,1)$

$\vec{v}=(m,2,m)$ $\quad \vec{v}\cdot\vec{n}=m+2m+m\neq 0 \quad ; m\neq 0$

Será transversal $\forall\, m \mid m\neq 0$.

(14) a) $\pi_1: x=(4,2,4)+\lambda(1,1,2)+\mu(3,3,1)$

$\pi_2: x=(3,0,0)+\lambda(1,1,0)+\mu(0,1,4)$

$$\vec{n}_1=\begin{vmatrix}\vec{i} & \vec{j} & \vec{k}\\ 1 & 1 & 2\\ 3 & 3 & 1\end{vmatrix}=\begin{vmatrix}\vec{i} & \vec{j} & 0\\ 1 & 1 & 0\\ 0 & 0 & 1\end{vmatrix}=\vec{i}\begin{vmatrix}1 & 0\\ 0 & 1\end{vmatrix}+\vec{j}\begin{vmatrix}0 & 1\\ 1 & 0\end{vmatrix}=\vec{i}-\vec{j}=(1,-1,0)$$

$$\vec{n}_2=\begin{vmatrix}\vec{i} & \vec{j} & \vec{k}\\ 1 & 1 & 0\\ 0 & 1 & 4\end{vmatrix}=\vec{i}\begin{vmatrix}1 & 0\\ 1 & 4\end{vmatrix}+\vec{j}\begin{vmatrix}0 & 1\\ 4 & 0\end{vmatrix}+\vec{k}\begin{vmatrix}1 & 1\\ 0 & 1\end{vmatrix}$$

$$\vec{i}(4)+\vec{j}(-4)+\vec{k}=(4,-4,1)$$

LI $\rightarrow$ São TRANSVERSAIS.

$$\vec{n}_1\times\vec{n}_2=\begin{vmatrix}\vec{i} & \vec{j} & \vec{k}\\ 1 & -1 & 0\\ 4 & -4 & 1\end{vmatrix}=\begin{vmatrix}\vec{i} & \vec{j} & \vec{k}\\ 1 & -1 & 0\\ 0 & 0 & 1\end{vmatrix}=\vec{i}\begin{vmatrix}-1 & 0\\ 0 & 1\end{vmatrix}+\vec{j}\begin{vmatrix}0 & 1\\ 1 & 0\end{vmatrix}+\vec{k}\cancel{\begin{vmatrix}1 & -1\\ 0 & 0\end{vmatrix}}$$

$$\vec{i}\cdot(-1)+\vec{j}(-1)=(1\ 1\ 0)$$

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Equação geral $\pi_1 = (x-4)(-1) + (y-2) = -x+4+y-2 = x-y-2=0$

$\pi_2 = (x-3)4 + (y)-4 + z(1) = 4x-4y+z-12=0$

$x=0$ $\begin{cases} y=-2 \\ 4y-z=-12 \end{cases}$ $z=4$

Intersecção: $X = (0,-2,4) + (1\ 1\ 0)\alpha \quad , \alpha \in \mathbb{R}$

b) $\pi_1 : x-y+2z-2=0$ $\qquad \pi_2 : X=(0,0,1) + \lambda(1,0,3) + \mu(-1,1,1)$

$\vec{n}_2 = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 1 & 0 & 3 \\ -1 & 1 & 1 \end{vmatrix} = \vec{i}\begin{vmatrix} 0 & 3 \\ 1 & 1 \end{vmatrix} + \vec{j}\begin{vmatrix} 3 & 1 \\ 1 & -1 \end{vmatrix} + \vec{k}\begin{vmatrix} 1 & 0 \\ -1 & 1 \end{vmatrix}$

$\vec{i}(-3) + \vec{j}(-3-1) + \vec{k}(1) = (-3,-4,1) \rightarrow$ LI

$(1,-1,2)$

Equação Geral $\pi_2 : x(-3) + y(-4) + (z-1) = -3x-4y+z-1=0$

$\begin{cases} x-y+2z-2=0 \\ -3x-4y+z-1=0 \end{cases}$ $y=0$ $\begin{cases} x+2z=2 \\ 3x-z=-1 \end{cases}$ $\begin{matrix} x+2z=2 \\ 6x-2z=-2 \end{matrix}$ $7x=0$ $z=1$

Intersecção: $X = (0,0,1) + (1,-1,-1)\alpha$

$\begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 1 & -1 & 2 \\ -3 & -4 & 1 \end{vmatrix} = \vec{i}\begin{vmatrix} -1 & 2 \\ -4 & 1 \end{vmatrix} + \vec{j}\begin{vmatrix} 2 & 1 \\ 1 & -3 \end{vmatrix} + \vec{k}\begin{vmatrix} 1 & -1 \\ -3 & -4 \end{vmatrix}$

$\vec{i}(-1+8) + \vec{j}(-6-1) + \vec{k}(-4-3) = (7,-7,-7)$ $(1\ -1\ -1)$

c) $\pi_1 : 2x-y+z-1=0$ $\qquad \pi_2 : 4x-2y+2z-9=0$

$\begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 2 & -1 & 1 \\ 4 & -2 & 2 \end{vmatrix} = 0 \rightarrow$ São paralelos DISTINTOS

$(2x-y+z-1)k = (4x-2y+2z-9)$

$k \nexists$

d) π_1: $A=(0,1,6)$ $B=(5,0,1)$ $C=(4,0,0)$ $\pi_2: 4x+40y-4z-16=0$

$\vec{AB}=(5,0,1)-(0,1,6)=(5,-1,-5)$ $\qquad \pi_2 = x+10y-z-4=0$

$\vec{AC}=(4,0,0)-(0,1,6)=(4,-1,-6)$

$$\begin{vmatrix}\vec{i}&\vec{j}&\vec{k}\\5&-1&-5\\4&-1&-6\end{vmatrix} = \begin{vmatrix}\vec{i}&\vec{j}&\vec{k}\\1&0&1\\4&-1&-6\end{vmatrix} = \begin{vmatrix}\vec{i}&\vec{j}&\vec{k}\\1&0&1\\0&-1&-10\end{vmatrix} = \vec{i}\begin{vmatrix}0&1\\-1&-10\end{vmatrix}+\vec{j}\begin{vmatrix}1&1\\-10&0\end{vmatrix}+\vec{k}\begin{vmatrix}1&0\\0&-1\end{vmatrix}$$

$i+10j-k=(1,10,-1)$ $\Big\rangle$ LD
$(1,10,-1)$

Equação Geral $\pi_1: (x-4)+10y-z = x+10y-z-4=0$

$\Rightarrow$ São planos paralelos COINCIDENTES.

(15) a) $\pi_1: \begin{cases} x=-\lambda_1+2\mu_1\\ y=m\lambda_1\\ z=\lambda_1+\mu_1\end{cases}$ $\qquad \pi_2: \begin{cases} x=1+m\lambda_2+\mu_2\\ y=2+\lambda_2\\ z=3+m\mu_2\end{cases}$

$\pi_1: X=(0,0,0)+\lambda_1(-1,m,1)+\mu_1(2,0,1)$

$\pi_2: X=(1,2,3)+\lambda_2(m,1,0)+\mu_2(1,0,m)$

$$\begin{vmatrix}\vec{i}&\vec{j}&\vec{k}\\-1&m&1\\2&0&1\end{vmatrix} = \vec{i}\begin{vmatrix}m&1\\0&1\end{vmatrix}+\vec{j}\begin{vmatrix}1&-1\\1&2\end{vmatrix}+\vec{k}\begin{vmatrix}-1&m\\2&0\end{vmatrix}$$

$\vec{i}\cdot m+\vec{j}(2+1)+k(-2m) = (m,3,-2m)=\vec{n_1}$

$$\begin{vmatrix}\vec{i}&\vec{j}&\vec{k}\\m&1&0\\1&0&m\end{vmatrix} = \vec{i}\begin{vmatrix}1&0\\0&m\end{vmatrix}+\vec{j}\begin{vmatrix}0&m\\m&1\end{vmatrix}+\vec{k}\begin{vmatrix}m&1\\1&0\end{vmatrix}$$

$\vec{i}\cdot m+\vec{j}(-m^2)+\vec{k}\cdot 1 = (m,-m^2,-1)=\vec{n_2}$

$\vec{n_1}=\vec{n_2}\cdot\lambda \iff (m,3,-2m)=(m,-m^2,-1)\lambda$

$\begin{cases} m=m\lambda & \lambda=1\\ 3=-m^2\cdot\lambda & m=\pm\sqrt{-3}\ \times\\ -2m=-\lambda\end{cases}$ $\qquad \nexists\ \lambda\in\mathbb{R}\ |\ \vec{n_1}=\vec{n_2}\cdot\lambda$

$\therefore$ π_1 e π_2 serão transversais $\forall m,\ m\in\mathbb{R}$

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b) $\pi_1 : X = (1, 1, 0) + \lambda(m, 1, 1) + \mu(1, 1, m)$

$\pi_2 : 2x + 3y + 2z + n = 0$

$\pi_1 \parallel \pi_2 \quad | \quad \pi_1 \cap \pi_2 =$

$\vec{n}_1 \parallel \vec{n}_2$

$$\vec{n}_1 = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ m & 1 & 1 \\ 1 & 1 & m \end{vmatrix} = \vec{i}\begin{vmatrix} 1 & 1 \\ 1 & m \end{vmatrix} + \vec{j}\begin{vmatrix} 1 & m \\ m & 1 \end{vmatrix} + \vec{k}\begin{vmatrix} m & 1 \\ 1 & 1 \end{vmatrix}$$

$\vec{i}(m-1) + \vec{j}(1-m^2) + \vec{k}(m-1) = (m-1, 1-m^2, m-1)$

$(m-1, 1-m^2, m-1) = (2, 3, 2)k$

$\begin{cases} m-1 = 2k \\ 1-m^2 = 3k \end{cases} \quad \begin{cases} m-1 = 2k \\ (1-m)(1+m) = 3k \end{cases} \quad \begin{cases} m-1 = 2k \\ -2k(1+m) = 3k \end{cases}$

$-2(1+m) = 3 \Leftrightarrow -2 - 2m = 3 \quad m = -5/2$

$(x-1)(-5/2 - 1) + (y-1)(1 - (-5/2)^2) + z(-5/2 - 1) = 0$

$(x-1)(-7/2) + (y-1)(1 - 25/4) + -7/2 \cdot z = 0$

$-\frac{7}{2}x + \frac{7}{2} + (y-1)(-21/4) + -7/2 \cdot z = 0$

$-(7/2) \cdot x + 7/2 - (21/4)y + 21/4 - (7/2) \cdot z = 0$

$-14x + 14 - 21y + 21 - 14z = 0 \Leftrightarrow -14x - 21y - 14z + 35 = 0$

$2x + 3y + 2z + (-5) = 0$

Serão paralelos distintos se $m = -\frac{5}{2}$ e $n = -5$.