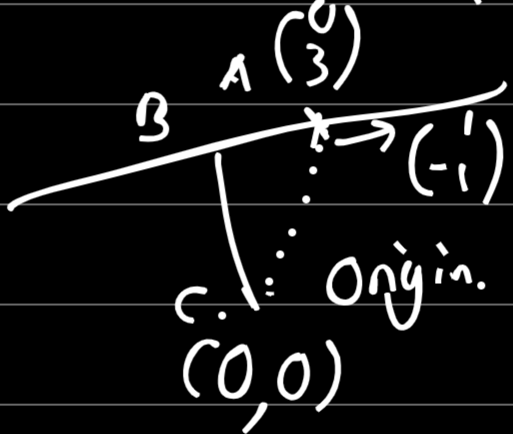
E4.1) $l : \left\{ \begin{pmatrix} 0 \\ 3 \end{pmatrix} + t\begin{pmatrix} 1 \\ -1 \end{pmatrix}, t \in \mathbb{R} \right\}$.

BA.

From origin.

$$d = \left\| \begin{pmatrix} 0 \\ 3 \end{pmatrix} - \frac{\begin{pmatrix} 0 \\ 3 \end{pmatrix} \cdot \begin{pmatrix} 1 \\ -1 \end{pmatrix}}{\left\| \begin{pmatrix} 1 \\ -1 \end{pmatrix} \right\|^2} \begin{pmatrix} 1 \\ -1 \end{pmatrix} \right\|$$



$$\left\| \begin{pmatrix} 1 \\ -1 \end{pmatrix} \right\|^2 = 1+1 = 2.$$

CB+BA = CA.

CB = CA - BA.

$$= \left\| \begin{pmatrix} 0 \\ 3 \end{pmatrix} - \frac{-3}{2} \begin{pmatrix} 1 \\ -1 \end{pmatrix} \right\|$$

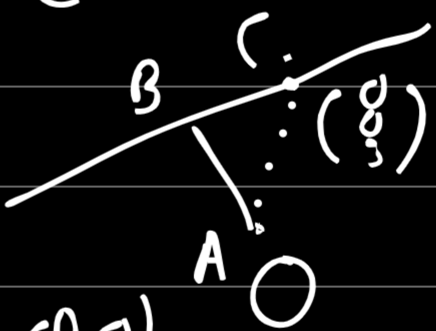
$$= \left\| \begin{pmatrix} 0 \\ 3 \end{pmatrix} - \begin{pmatrix} -\frac{3}{2} \\ \frac{3}{2} \end{pmatrix} \right\|$$

$$= \left\| \begin{pmatrix} \frac{3}{2} \\ \frac{3}{2} \end{pmatrix} \right\| = \sqrt{\left(\frac{3}{2}\right)^2 + \left(\frac{3}{2}\right)^2}.$$

≈ 2.121 units.

E4.2

$$l: \left\{ \begin{pmatrix}0\\0\\3\end{pmatrix} + t\begin{pmatrix}1\\1\\0\end{pmatrix}, \; t\in\mathbb{R} \right\}.$$



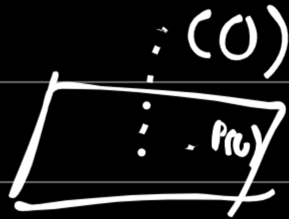
$AB + BC = AC.$

$AB = AC - BC.$

$$d_{(l,O)} = \left\| \begin{pmatrix}0\\0\\3\end{pmatrix} - \frac{\begin{pmatrix}0\\0\\3\end{pmatrix}\cdot\begin{pmatrix}1\\1\\0\end{pmatrix}}{\left\|\begin{pmatrix}1\\1\\0\end{pmatrix}\right\|^2} \cdot \begin{pmatrix}1\\1\\0\end{pmatrix} \right\|.$$

$$\therefore \left\| \begin{pmatrix}0\\0\\3\end{pmatrix} - 0 \right\| = 3 \text{ units}^2.$$

E4.3) $P: \left\{ \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} \cdot \left[\begin{pmatrix} x \\ y \\ z \end{pmatrix} - \begin{pmatrix} 4 \\ 5 \\ 6 \end{pmatrix} \right] = 0. \right.$



$$d(P, O) = \frac{|\vec{n} \cdot P_0|}{|\vec{n}|^2} = \frac{\left| \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} \cdot \begin{pmatrix} 4 \\ 5 \\ 6 \end{pmatrix} \right|}{\left\| \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} \right\|^2}$$

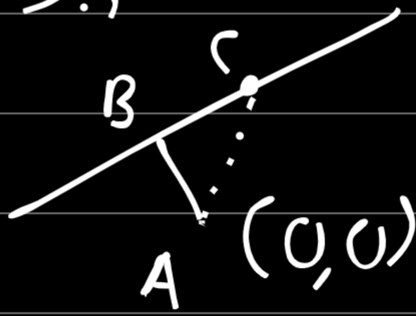
$$= \frac{4+5+6}{\sqrt{1+1+1}}$$

$$= \frac{15}{\sqrt{3}} = \frac{3 \times 5}{\sqrt{3}} = \underline{\underline{5\sqrt{3}}}.$$

E4.4) $l: \left\{ \begin{pmatrix} 0 \\ 5 \end{pmatrix} + t \begin{pmatrix} 6 \\ -7 \end{pmatrix},\ t \in \mathbb{R} \right\}.$

E4.5) $r = (1,3,0)$

$$l: \left\{ \begin{pmatrix} 0 \\ 0 \\ 2 \end{pmatrix} + t \begin{pmatrix} 1 \\ -1 \\ 0 \end{pmatrix} \right\},\ t \in \mathbb{R}.$$



$$P: x + y + z = 1.$$

a) $d(r, 0) = \sqrt{1^2 + 3^2 + 0^2} = \sqrt{10}.$

$AB + BC = AC \cdot BC$

$AB = AC - AB$

b) $$d(l, 0) = \left\| \begin{pmatrix} 0 \\ 0 \\ 2 \end{pmatrix} - \frac{\begin{pmatrix} 0 \\ 0 \\ 2 \end{pmatrix} \cdot \begin{pmatrix} 1 \\ -1 \\ 0 \end{pmatrix}}{\left\| \begin{pmatrix} 1 \\ -1 \\ 0 \end{pmatrix} \right\|^2} \begin{pmatrix} 1 \\ -1 \\ 0 \end{pmatrix} \right\|$$

$$= \left\| \begin{pmatrix} 0 \\ 0 \\ 2 \end{pmatrix} - 0 \right\| = 2.$$

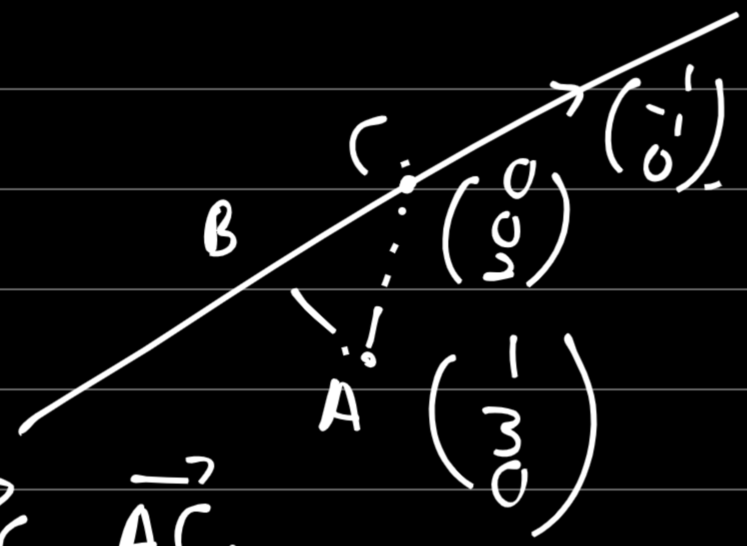
$x_1 = 1 - y - z.$

c) $P: x + y + z = 1.$

$$\frac{1}{\left\| \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} \right\|} = \underline{\underline{\frac{1}{\sqrt{3}}}}.$$

d).

$d(r, l)$.



$$\vec{AB} + \vec{BC} = \vec{AC}.$$

$$\vec{AB} = \vec{AC} - \vec{BC}$$

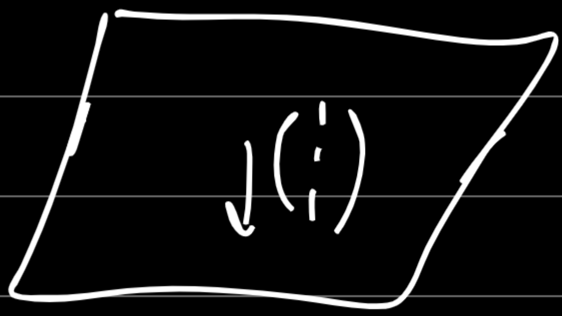
$$\vec{AC} = \begin{pmatrix}0\\0\\2\end{pmatrix} - \begin{pmatrix}1\\3\\0\end{pmatrix} = \begin{pmatrix}-1\\-3\\2\end{pmatrix}.$$

$$d(r, l) = \left\| \begin{pmatrix}-1\\-3\\2\end{pmatrix} - \frac{\begin{pmatrix}-1\\-3\\2\end{pmatrix} \cdot \begin{pmatrix}1\\-1\\0\end{pmatrix}}{\left\|\begin{pmatrix}1\\-1\\0\end{pmatrix}\right\|^2} \begin{pmatrix}1\\-1\\0\end{pmatrix} \right\|.$$

$$= \left\| \begin{pmatrix}-1\\-3\\2\end{pmatrix} - \frac{2}{\sqrt{2}} \begin{pmatrix}1\\-1\\0\end{pmatrix} \right\|.$$

$$= \left\| \begin{pmatrix}-1\\-3\\2\end{pmatrix} - \begin{pmatrix}1\\-1\\0\end{pmatrix} \right\| = \left\| \begin{pmatrix}-2\\-2\\2\end{pmatrix} \right\|$$

e). $d(r, P)$. $r = (1,3,0)$.



P.

Let $y = \lambda_1$

$z = \lambda_2$.

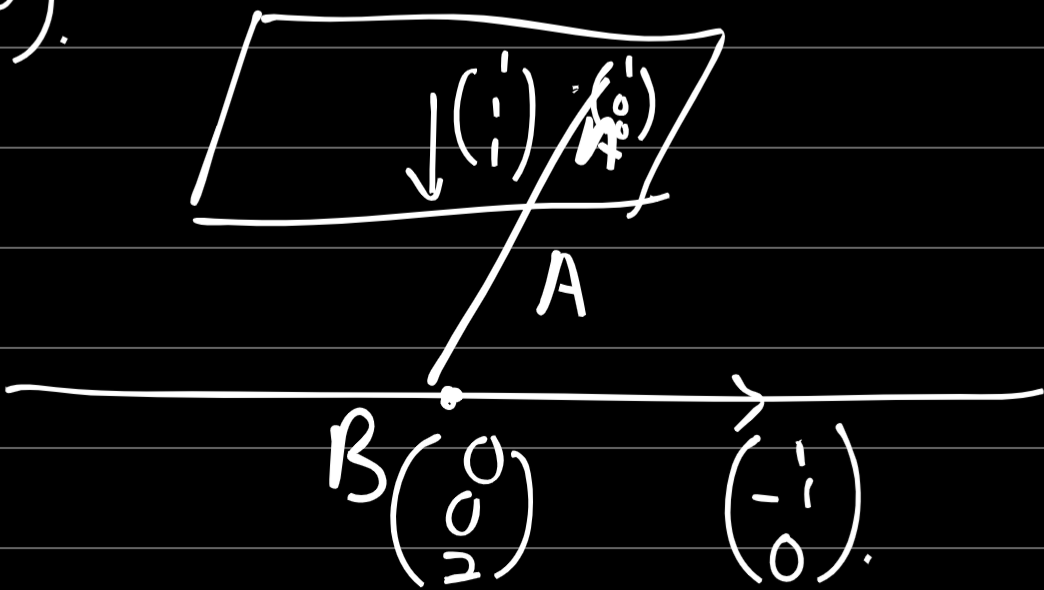
$x + y + z = 1$.

$$p = \begin{pmatrix} 1-y-z \\ y \\ z \end{pmatrix}.$$

$$\frac{\begin{pmatrix} 0 \\ 3 \\ 0 \end{pmatrix} \cdot \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}}{\sqrt{3}} \qquad = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} + \lambda_1 \begin{pmatrix} -1 \\ 1 \\ 0 \end{pmatrix} + \lambda_2 \begin{pmatrix} -1 \\ 0 \\ 1 \end{pmatrix}.$$

$$= \underline{\underline{\sqrt{3}}}.$$

f) $d(l, P)$.



Since $\begin{pmatrix}1\\1\\1\end{pmatrix}\cdot\begin{pmatrix}1\\-1\\0\end{pmatrix}=0$,

P and l are parallel.

$$\vec{AB}=\begin{pmatrix}0\\0\\2\end{pmatrix}-\begin{pmatrix}1\\0\\0\end{pmatrix}$$

$$=\begin{pmatrix}-1\\0\\2\end{pmatrix}.$$

$$\frac{\begin{pmatrix}-1\\0\\2\end{pmatrix}\cdot\begin{pmatrix}1\\1\\1\end{pmatrix}}{\sqrt{3}}=\frac{1}{\sqrt{3}}.$$

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