a) E ?

b) $x'^T E x = 0$,

a) $E = [T'_x]R = \boxed{\begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & d \\ 0 & -d & 0 \end{bmatrix} = E}$

$R = I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

$T' = \begin{bmatrix} -d \\ 0 \\ 0 \end{bmatrix}$

b) $x = \begin{bmatrix} x_0 \\ y_0 \\ f \end{bmatrix}$ $x' = \begin{bmatrix} x_0' \\ y_0' \\ f \end{bmatrix}$

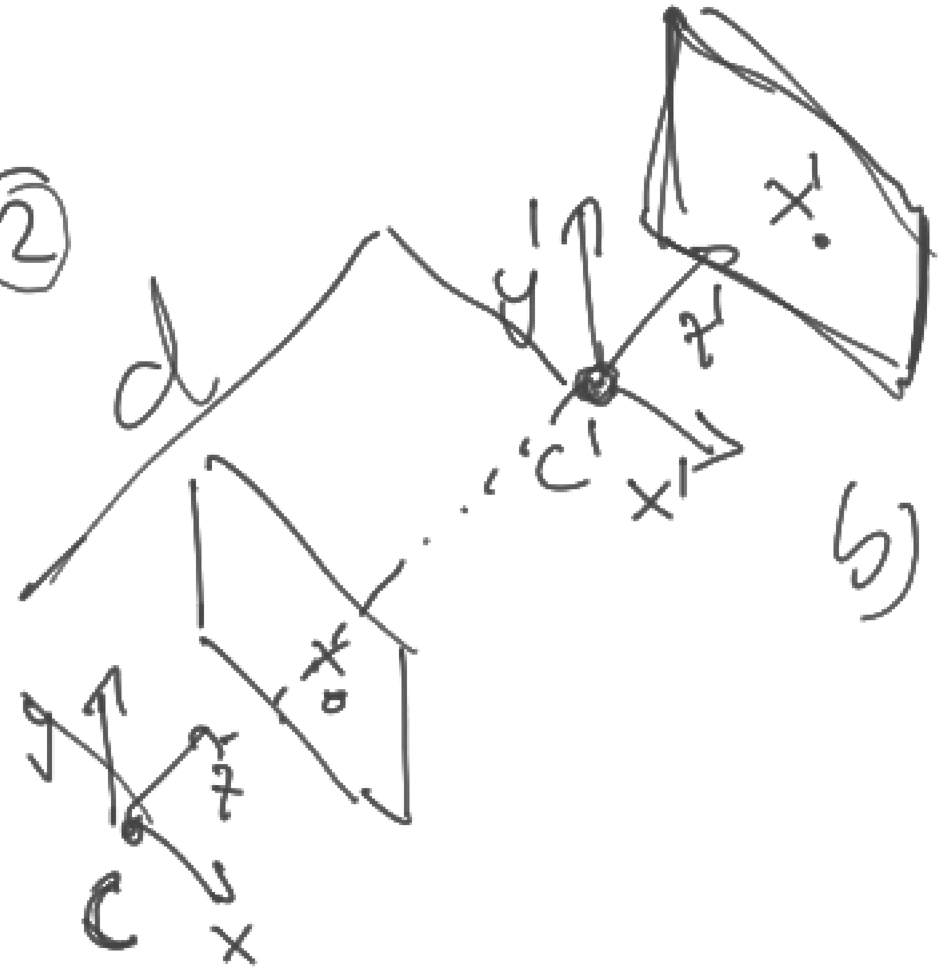
$$[x_0' \; y_0' \; f] \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & d \\ 0 & -d & 0 \end{bmatrix} \begin{bmatrix} x_0 \\ y_0 \\ f \end{bmatrix} =$$

$$= [x_0' \; y_0' \; f] \begin{bmatrix} 0 \\ df \\ -dy_0 \end{bmatrix} = y_0' df - y_0 df = 0$$

$$y_0' \cancel{df} = y_0 \cancel{df}$$

$$\boxed{y_0' = y_0}$$

2



a) E ?

b) $x'^T E x = 0$

$$R = \boxed{\frac{x_0}{y_0} = \frac{x_0'}{y_0'}}$$

PROVE $E = U \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} V^T$, $E = [T_x] \cdot R$ ← orthogonal

skew-symmetric

(1) USE HELPER MATRICES $W = \begin{bmatrix} 0 & -1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ and $Z = \begin{bmatrix} 0 & 1 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$ $Z = -\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} W$

orthogonal skew-symmetric

(2) PROPERTY THAT SKEW-SYMMETRIC MATRIX CAN BE DECOMPOSED AS:

$S = k\, U \cdot Z \cdot U^T$ (up-to-scale and U orthogonal)

$S = (-k)\, U \cdot \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} W\, U^T$

$E = [T_x] R = U \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \underbrace{W U^T R}_{\text{orthogonal}} = \boxed{U \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} V^T = E}$

E is given $\rightarrow$ $\boxed{T' = \pm u_3}$ (last column of U)

we know that $[T'_x] = U \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} W U^T = U \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix} \underbrace{(U W^T)^T}_{V}$

This looks like a singular value decomposition

$[T'_x]\, T' = 0$ $\quad \|T'\| = 1$

$\rightarrow$ solution to this is $SVD([T'_x])$

last column of V of $\rightarrow$ last column of U

For $\underline{R}$

$V^T = W \cdot U^T \cdot R \rightarrow R = U \cdot W^T V^T$.

$\rightarrow R = U \cdot W V^T$.