

1) Let $R = \{O; B = \{\vec{e}_1, \vec{e}_2\}\}$ be an orthonormal reference frame on a Euclidean plane A .

a) Let $\vec{f} : \vec{A} \rightarrow \vec{A}$ be a linear map such that

$\vec{f}(\vec{e}_1) = -2\vec{e}_1 + \vec{e}_2$, $\vec{f}(\vec{e}_2) = \vec{e}_1 - 2\vec{e}_2$. Is \vec{f} a symmetric tensor? Explain your answer..

b) If f is an affine transformation on A with \vec{f} as its associated linear map and such that f carries the point $(P)_R = (1, 1)$ to $(P')_R = (4, 2)$, is f isometry? If so, identify which kind of isometry is and find its defining geometric objects.

c)

d) If g is given in the frame R by $\begin{cases} x' = -\frac{5}{13}x - \frac{12}{13}y + 3 \\ y' = -\frac{12}{13}x + \frac{5}{13}y - 2 \end{cases}$, is g isometry? If so, classify it

and find its characteristic elements.

2) Let A be a Euclidean plane and consider the reference frame $R = \{O; B = \{\vec{e}_1, \vec{e}_2\}\}$ such that

$m(\cdot, B) = \begin{pmatrix} 5 & -3 \\ -3 & 2 \end{pmatrix}$. Is the affine map with equations in $R \begin{cases} x' = x - \frac{6}{5}y - 6 \\ y' = -y + 2 \end{cases}$ an isometry? If

so, classify it and find its characteristic elements.

3) Let $R = \{O; B = \{\vec{e}_1, \vec{e}_2\}\}$ be a reference frame on a Euclidean plane A such that

$\begin{cases} \vec{e}_1 \cdot \vec{e}_1 = 2 \\ (\vec{e}_1 + \vec{e}_2) \cdot \vec{e}_2 = 1 \\ (2\vec{e}_1 + \vec{e}_2)(\vec{e}_1 + \vec{e}_2) = 1 \end{cases}$. Is

the affine map with equations in $R \begin{cases} x_1' = -x_1 - x_2 + 4 \\ x_2' = 2x_1 + x_2 + 1 \end{cases}$ an isometry? If so, identify which

isometry is and find its defining geometric objects.

4) Let A be a Euclidean plane and consider the reference frame $R = \{O; B = \{\vec{e}_1, \vec{e}_2\}\}$ such that

$m(\cdot, B) = \begin{pmatrix} 1 & -1 \\ -1 & 2 \end{pmatrix}$. Is the affine map with equations in $R \begin{cases} x' = -x + 2y + 5 \\ y' = -x + y - 1 \end{cases}$ an isometry? If

so, classify it and find its defining geometric elements.

5) Let $R = \{O; B = \{\vec{e}_1, \vec{e}_2\}\}$ be an orthonormal reference frame on a Euclidean plane A If g is

$$\begin{cases} x' = -3x + 4y + 2 \\ y' = \dots \end{cases}$$

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- 6) Let $R = \{O; B = \{\vec{e}_1, \vec{e}_2\}\}$ be a reference frame on a Euclidean plane A such that
- $$\begin{cases} (\vec{e}_1 - \vec{e}_2)(\vec{e}_1 + \vec{e}_2) = -1 \\ (\vec{e}_1 + \vec{e}_2) \cdot 2\vec{e}_1 = 2 \\ \vec{e}_2 \cdot \vec{e}_2 = 3 \end{cases} .$$

Is the affine transformation f given in R by $\begin{cases} x_1' = \frac{17}{13}x_1 - \frac{12}{13}x_2 + 2 \\ x_2' = \frac{10}{13}x_1 - \frac{17}{13}x_2 + 5 \end{cases}$ an isometry? If so, classify

it and find its characteristic elements.

- 7) Let $R = \{O; B = \{\vec{e}_1, \vec{e}_2\}\}$ be an orthonormal reference frame on a Euclidean plane A and let g

be an affine transformation given (in the frame R) by $\begin{cases} x' = \frac{-4}{5}x - \frac{3}{5}y + 3 \\ y' = \frac{3}{5}x - \frac{4}{5}y - 1 \end{cases}$

- Is g isometry? In the affirmative case, determine its type and its defining elements.
 - Sketch the image under g of the circle $x^2 + y^2 = 9$. Justify your answer.
 - Find the equations of the glide (reflection) symmetry, f , with axis the line that goes through $P = (3, 1)$ and $Q = (1, 3)$ and satisfying $f(P) = Q$.
- 8) Consider an orthonormal reference frame on a Euclidean plane A and the line $r: 2x - y = 5$
- If f is the (reflection) symmetry with respect to the line r , find the image $P' = f(P)$ under of $P = (2, 1)$.
 - Let g be the (affine) rotation of centre $P = (2, 1)$ and angle $\frac{3\pi}{2}$. Find the equations of the composition $h = g \circ f$. Is h an isometry?
- 9) Consider an orthonormal reference frame on a Euclidean plane A . Find the equations of the glide (reflection) symmetry with axis the line that goes through $P = (3, 1)$ and $Q = (1, 3)$ that carries P to Q .
- 10) Let A be a Euclidean plane and consider the reference frame $R = \{O; B = \{\vec{e}_1, \vec{e}_2\}\}$ such that $m(\cdot, B) = \begin{pmatrix} 3 & 1 \\ 1 & 2 \end{pmatrix}$ and consider the line $r: x - y = 2$. Find the equations of the glide (reflection) symmetry with axis r and translation vector $\vec{u} = (-2, -2)$.
- 11) Let $R = \{O; B = \{\vec{e}_1, \vec{e}_2, \vec{e}_3\}\}$ be an orthonormal reference frame for a Euclidean space A . If f is

$$\begin{cases} x' = \frac{2}{3}x + \frac{1}{3}y + \frac{2}{3}z + 1 \end{cases}$$

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