

25.7: Sample problems and solutions

? Exercise 25.7.1

- What is the displacement vector from position (1, 2, 3) to position (4, 5, 6)?
- What angle does that displacement vector make with the x axis?

Answer

- The displacement vector is given by:

$$\vec{d} = \begin{pmatrix} 4 \\ 5 \\ 6 \end{pmatrix} - \begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix} = \begin{pmatrix} 3 \\ 3 \\ 3 \end{pmatrix}$$

- We can find the angle that this vector makes with the x axis by taking the scalar product of the displacement vector and the unit vector in the x direction (1,0,0):

$$\hat{x} \cdot \vec{d} = (1)(3) + (0)(3) + (0)(3) = 3$$

This is equal to the product of the magnitude of \hat{x} and \vec{d} multiplied by the cosine of the angle between them:

$$\begin{aligned}\hat{x} \cdot \vec{d} &= ||\hat{x}|| ||\vec{d}|| \cos \theta = (1)(\sqrt{3^2 + 3^2 + 3^2}) \cos \theta = \sqrt{27} \cos \theta \\ 3 &= \sqrt{27} \cos \theta \\ \therefore \cos \theta &= \frac{3}{\sqrt{27}} = \frac{1}{\sqrt{3}} \\ \theta &= 54.7^\circ\end{aligned}$$

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