# Homework #1

1. A vector ${}^{A}P$ is rotated about $\hat{X}_A$ by $\phi$ degrees and is subsequently rotated about $\hat{Z}_A$ by $\theta$ degrees.

   (a) Give the rotation matrix which accomplishes these rotations in the given order.

   (b) What is the result if $\phi = 30°$ and $\theta = 45°$?

2. A frame {B} is located as follows: initially coincident with a frame {A} we rotate {B} about $\hat{Z}_B$ by $\theta$ and then we rotate the resulting frame about $\hat{X}_B$ by $\phi$ degrees.

   (a) Give the rotation matrix, ${}^{A}_{B}R$ which will change the description of vectors from ${}^{B}P$ to ${}^{A}P$.

   (b) What is the result if $\phi = 30°$ and $\theta = 45°$?

   (c) What is ${}^{A}\hat{Y}_B$?

3. A vector is given by

$$ {}^{B}P = \begin{bmatrix} 1.0 \\ 5.0 \\ 10.0 \end{bmatrix}. $$

   Given

$$ {}^{B}_{A}T = \begin{bmatrix} 1.0 & 0.0 & 0.0 & 3.0 \\ 0.0 & 0.6 & 0.8 & -1.0 \\ 0.0 & -0.8 & 0.6 & 1.0 \\ 0.0 & 0.0 & 0.0 & 1.0 \end{bmatrix}, $$

   compute ${}^{A}P$.

4. Given the following 3x3 matrix,

$$ R = \begin{bmatrix} 0 & \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & \frac{1}{2} & -\frac{1}{2} \\ -\frac{1}{\sqrt{2}} & \frac{1}{2} & -\frac{1}{2} \end{bmatrix}. $$

   (a) Show that it is a rotation matrix.

   (b) Determine a unit vector that defines this axis of rotation and the angle (in degrees) of rotation.

   (c) What are the Euler parameters $\varepsilon_1, \varepsilon_2, \varepsilon_3, \varepsilon_4$ of $R$?