ECE 417 --- ROBOTICS
Homework 9, Spring 2021

1. Convert the following quaternions to rotation matrix and axis/angle forms: $(1,0,0,0)^T$, $(0,1,0,0)^T$, $(0,0,0,-1)^T$, and $(1/2, 1/2, -1/2, -1/2)^T$

2. What **two** quaternions correspond to the inverse of $(1/2, -1/2, 1/2, -1/2)^T$?

3. What **two** quaternions correspond to each of the following (HINT: convert to unit vectors):
    1. A +90 degree rotation about the +X axis.
    2. A -90 degree rotation about the +X axis.
    3. A 90 degree rotation about the axis (1, 0, 1).
    4. A 180 degree rotation about the axis (1, 0, 1).
    5. A 180 degree rotation about the axis (1,1,-1).

4. Multiply the quaternions $(1/2, 1/2, -1/2, -1/2)^T$ and $(-1/7, 4/7, 4/7, -4/7)^T$ (**not** dot product).

5. What is the angle between two orientations given by the quaternions $(1/2, 1/2, -1/2, -1/2)^T$ and $(-1/7, 4/7, 4/7, -4/7)^T$?

6. Transform the vector $(1, 2, 3)^T$ by the orientation given by $(1/2, 1/2, -1/2, -1/2)^T$ (without converting to another representation of orientation).

7. Convert the orientation to quaternion form

$$\mathbf{R} = \begin{bmatrix} 4/9 & -7/9 & 4/9 \\ -1/9 & 4/9 & 8/9 \\ -8/9 & -4/9 & 1/9 \end{bmatrix}$$

8. Give the quaternion corresponding to System II Euler angles $(\phi, \theta, \psi) = (30, -45, 60)$.