Physics 3344 **Professor Scalise**
Spring 2000 **Assignment #4**

Due: 15 February 2000

1. A vector in the first octant (where x, y, and z are all positive) makes an angle $60°$ with the x-axis and an angle $45°$ with the y-axis. What angle does the vector make with the z-axis?

2. What is the angle between the Cartesian vectors $\begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}$ and $\begin{pmatrix} 3 \\ 0 \\ 1 \end{pmatrix}$?

3. What is a unit vector in the same direction as $\begin{pmatrix} 3 \\ 0 \\ 1 \end{pmatrix}$?

4. Find two Cartesian vectors perpendicular to $\begin{pmatrix} 1 \\ 2 \\ 3 \end{pmatrix}$? and to each other. (The answers are not unique.)

5. Are these proper 2-d rotations? If not, why not?

   (a) $\begin{pmatrix} 1/3 & 2\sqrt{2}/3 \\ 2\sqrt{2}/3 & -1/3 \end{pmatrix}$

   (b) $\begin{pmatrix} 1/\sqrt{3} & -\sqrt{2/3} \\ \sqrt{2/3} & 1/\sqrt{3} \end{pmatrix}$

   (c) Is this a proper 3-d rotation? If not, why not? $\begin{pmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \end{pmatrix}$

6. What is the rotation matrix λ that takes $\begin{pmatrix} 1 \\ 0 \end{pmatrix}$ into $\begin{pmatrix} 1/2 \\ \sqrt{3}/2 \end{pmatrix}$?

7. Here is a 2 dimensional rank two tensor: $T_{ij} = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix}$. What is the new tensor under the rotation (from the previous problem) that takes $\begin{pmatrix} 1 \\ 0 \end{pmatrix}$ into $\begin{pmatrix} 1/2 \\ \sqrt{3}/2 \end{pmatrix}$?

8. Here is a 3 dimensional rotation matrix: $\begin{pmatrix} 1/\sqrt{2} & 1/\sqrt{2} & 0 \\ 0 & 0 & 1 \\ 1/\sqrt{2} & -1/\sqrt{2} & 0 \end{pmatrix}$. What vector direction is left unchanged (axis of rotation)?