3. In lecture we found explicitly a matrix which would transform the components of a vector in three dimensional space from an initial frame of reference to a rotated frame specified by the pseudo-Euler angles.

a) Substitute to find the transformation if $\varphi = \frac{\pi}{2}$, $\theta = \frac{\pi}{4}$, and $\psi = \frac{\pi}{2}$

b) Substitute to find the transformation if $\varphi = \frac{\pi}{4}$, $\theta = \frac{\pi}{2}$, and $\psi = \frac{\pi}{2}$

c) If the components of a vector V are as a column matrix

$$V = \begin{pmatrix} 1 \\ 4 \\ 6 \end{pmatrix},$$

find the transformed components for each transformation (a) and (b) and for each case show that $\tilde{V}'\,V' = \tilde{V}\,V$

4. S is an inertial frame with time and coordinates t, x, y, z in which the air is at rest. S' is an inertial frame with time and coordinates t', x', y', z' which are aligned with the coordinates in S and arranged so that the origins coincide at t = t' = 0. S' moves with a velocity u in the x direction. A warning horn at the origin of S and at rest in S sounds a short burst at t = 0. If the sound moves with speed v in the air, then the locus of points at which listeners in S hear the sound at t is given by the equation

$$0 = (vt)^2 - x^2 - y^2 - z^2$$

which is a sphere about the origin. If some listeners are at rest in the S' frame, perform a Galilean transformation to find the locus of points in terms of x', y', z' at which they will hear the horn at time t'.