Physics 200-05
Practice 3

1. Given the two matricees

$$A = \begin{pmatrix} 0 & 7 & 5 \\ -2 & 1 & 2 \\ 1 & 1 & 0 \\ -2 & -1 & 1 \end{pmatrix} \tag{1}$$

$$B = \begin{pmatrix} 0 & 2 & 0 \\ 1 & 1 & 1 \\ 0 & 2 & 1 \end{pmatrix} \tag{2}$$

Do the following matrices exist? If they do show what they are. AB, BA, A^T,B^T,A^TB, $A+B$, $B+B$, $2B$.

2. Show that

$$A = \begin{pmatrix} cosh(\mu) & sinh(\mu) & 0 & 0 \\ sinh(\mu) & cosh(\mu) & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \tag{3}$$

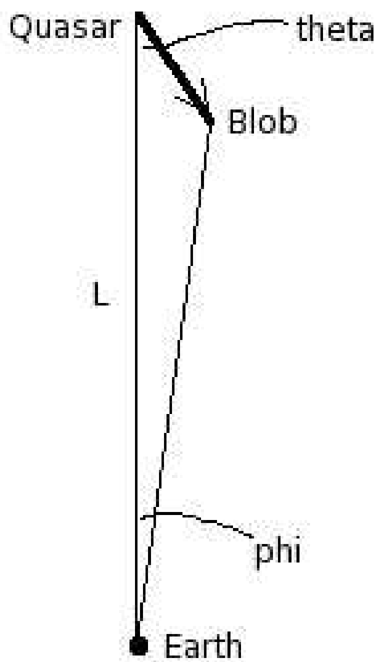
$$B = \begin{pmatrix} 1 & 0 & 0 & 0 & \\ 0 & cos(\theta) & sin(\theta) & 0 & (4) \\ 0 & -sin(\theta) & cos(\theta) & 0 & \\ 0 & 0 & 0 & 1 & \end{pmatrix} \tag{5}$$

are both Lorentz transformations (with the time having been chosen so that $c = 1.$). Show that $(GB^TG)AB$ is also a Lorentz transformation, and corresponds to an ordinary transformation along the direction at θ degrees to the x axis.

3.) Bob heads off for the nearest star (Alpha Centauri) which is 4 light years away at a velocity of .9 c. He arrives and then discovers that he left his key to the house on earth, and immediately returns at .95c. How long will he have been gone from earth according to the people on earth and how long with respect to Bob himself.

4.) How much shorter or longer is the track according to the runner for the 100m dash if the runner runs at 10m/s?

5.) A quasar ejects a blob of material at .9c Assume that the quasar is a distance L away from the earth and that the material is ejected at an angle θ with respect to the direction from the quasar to the earth. What is the rate of change of the angle ϕ of the blob as seen from the earth as a function of θ?



What is the maximum value of this angular change in position as a function of θ? If you ascribe a transverse velocity to this material by $v_T = L\frac{d\phi}{dt}$, how large can v_T be. (assume that L is very large, much larger than the distance between the blob and the quasar.) (Note that you must take into account the propagation of light from the blob to the observer).