Problems Week 4

1. What is the condition for four orthogonal spacetime vectors to be linearly independent?

2. Consider a situation where everything happens in a two-dimensional plane in spacetime (containing both timelike and spacelike vectors). The orthogonal space to an observer's worldline in the plane is one-dimensional. Two observers in the plane follow worldlines with directions $\hat{u}$ and $\hat{v}$. They pass close to each other at an event which we take as the origin. Another event P in the plane happens at time τ before they pass according to U and at time τ after the pass according to V.

a) Find the spacetime point P.

b) How far away is P according to U and V?

3. Two spaceships which are out of fuel pass close by. At proper time τ_A after they pass one ship sends out a radio signal which is received by the other at proper time τ_B. Find the relative velocity of the ships.