

your name(s) _____

Physics 841 Quiz #3 - Monday, Feb. 6
Work by yourselves – closed note, closed book.

1. You observe two events at space-times coordinates x and y . You also observe Sally moving with four-velocity u . Express the time difference between the events that Sally would observe in terms of invariants involving x , y and u .
2. You observe uniform electric and magnetic fields,

$$\begin{aligned}\vec{E} &= E_x \hat{x} + E_y \hat{y}, \\ \vec{B} &= B_x \hat{x}.\end{aligned}$$

The strengths of the fields are such that $B_x < E_x$ and $B_x > E_y$. Answer *TRUE* or *FALSE* to the following questions.

- (a) There exists a finite velocity by which you can boost to find a frame where $\vec{B}' = 0$
 - (b) There exists a finite velocity by which you can boost to find a frame where $\vec{E}' = 0$
 - (c) If you boost along the z axis, the \vec{B} field will stay the same
 - (d) If you boost along the z axis, the \vec{E} field will stay the same
3. Beginning with $F^{\alpha\beta} = \partial^\alpha A^\beta - \partial^\beta A^\alpha$, and $\tilde{F}^{\alpha\beta} = (1/2)\epsilon^{\alpha\beta\gamma\delta} F_{\gamma\delta}$, express $F^{\alpha\beta} \tilde{F}_{\alpha\beta}$ in terms of \vec{E} and \vec{B} using

$$\begin{aligned}\vec{E} &= -\nabla A_0 - \partial_t \vec{A}, \\ \vec{B} &= \nabla \times \vec{A}.\end{aligned}$$

Show your work (Don't simply write the answer).