Name _____ Date _____

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Quiz 1: Relativity and so forth

$$\Delta t' = \gamma \Delta t_p \quad L' = \frac{L_p}{\gamma} \quad c = 3 \cdot 10^8 \,\mathrm{m/s} \quad \gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \quad v_{\mathrm{obj}} = \frac{v + v'_{\mathrm{obj}}}{1 + \frac{v v'_{\mathrm{obj}}}{c^2}} \quad v'_{\mathrm{obj}} = \frac{v_{\mathrm{obj}} - v}{1 - \frac{v v_{\mathrm{obj}}}{c^2}} \quad x' = \gamma (x - vt)$$

$$t' = \gamma \left(t - \frac{vx}{c^2} \right) \quad p = \gamma m v \quad E_{tot} = \gamma m c^2 = KE + E_R \quad E_R = mc^2 \quad KE = (\gamma - 1) mc^2 \quad E^2 - (pc)^2 = \left(mc^2\right)^2 \quad Ev = pc^2$$

1. An airplane 10.0 m long is flying at 300 m/s. How much shorter will this airplane appear to be to an observer on the ground?

- ◯ 5×10^{-6} m
- ◯ 2×10^{-3} m
- ◯ 0.1 m
- ◯ 5 m

2. An electron in a television picture tube moves with $v = 0.250c$. What is its kinetic energy in electron volts? Note that the rest energy of an electron is $m_e c^2 = 0.511$ MeV

- ◯ 0.528 MeV
- ◯ 0.511 MeV
- ◯ 0.017 MeV
- ◯ 0.253 MeV

3. A crew watches a movie that is two hours long in a space-craft that is moving at high speed through space. Will an Earthbound observer, who is watching the movie through a powerful telescope, measure the duration of the movie to be:

- ◯ Longer than two hours.
- ◯ Shorter than two hours.
- ◯ Equal to two hours.
- ◯ I'd tell you, but that would violate the temporal prime directive.

4. A proton has a mass of 1.67×10^{-27} kg. What is its rest energy in electron volts (eV)? Note $1\,\mathrm{eV} = 1.60 \times 10^{-19}$ J, and M is the metric prefix for 10^6.

- ◯ 42 MeV
- ◯ 313 MeV
- ◯ 938 MeV
- ◯ 1320 MeV

5. Which one of these things can two observers in different frames **not** agree on?

- ◯ Their relative speed of motion with respect to each other.
- ◯ The speed of light c.
- ◯ The simultaneity of two events taking place at the same position and same time in some frame.
- ◯ The distance between two points that remain fixed in one of their frames.