Physics 262 Fall 2010 Exam 5

$$x' = \gamma(x - Vt)$$

$$ct' = \gamma(ct - \frac{Vx}{c})$$

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$f = f_0\sqrt{\frac{1-v/c}{1+v/c}}$$

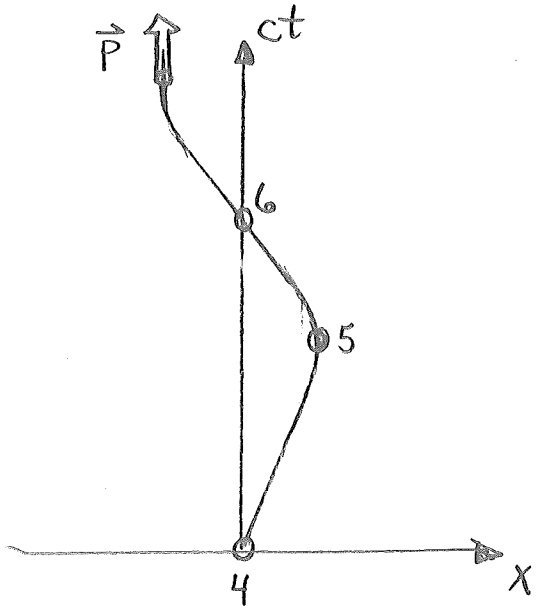
$$\Delta s = \sqrt{c^2t^2 - x^2}$$

$$v_{o/a} = \frac{v_{o/b} + v_{b/a}}{1 + \frac{v_{o/b}v_{b/a}}{c^2}}$$

1&2] A mass 2m collides and sticks to initially stationary mass m. The combined lump moves off at 0.8c. What was the initial speed of mass 2m?

3]By what % did the total mass increase? (enter 9 for anything > 9%)

4&5&6] Accurately draw energy momentum 4-vectors on the worldline shown, at the points indicated. (Dr. T will grade this part by hand.)



Consider two charges in a spaceship, oriented at 45° to the direction of travel. In the spaceship, the electric force between the charges is 707 N. The spaceship is moving at 0.98c in the +x direction.

7&8] What is the magnitude of the x-component of the force on the upper charge in the earth frame?

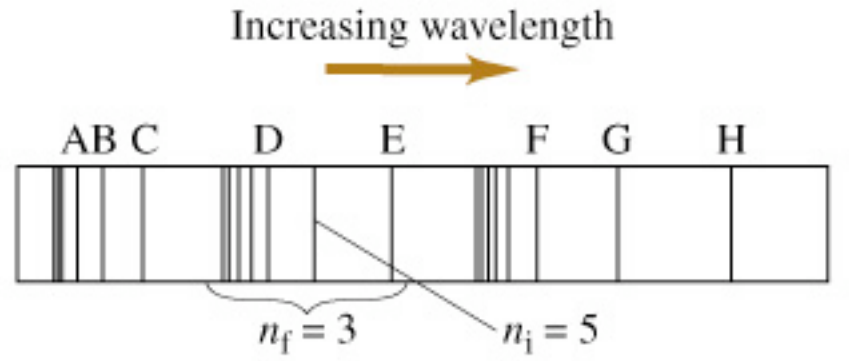
9&10] What is the magnitude of the y-component of the force on the upper charge in the earth frame?

11&12] A wire in the lab carries a current of electrons, with a linear charge density of $2\text{x}10^6$ e/m, each moving at 0.1c. In the rest frame of the electrons, what is their linear charge density?

13] In the rest frame of the electrons, the linear charge density of the positive nuclei in the wire is
a) Bigger than their own density by a factor of γ
b) Bigger than their own density by a factor of γ^2
c) Bigger than their own density by a factor of γ^3
d) Smaller than their own density by a factor of γ
e) Smaller than their own density by a factor of γ^2
f) Smaller than their own density by a factor of γ^3
g) The same as their own density.

14&15] Light shines on a metal with a work function of 1.4 eV. What is the longest wavelength that can still eject electrons from the metal (in nm)?

16] If the intensity of light (at a wavelength that can emit electrons) is increased:
A] the energy of the emitted electrons increases
B] the rate at which electrons are emitted increases
C] both increase
D] neither increases



17] The spectrum of a Bohr atom (hydrogen) is spread out with a prism. Red is to the right. Which letter corresponds to the transition $n_i = 5$ to $n_f = 2$?

18] If the ionization energy of hydrogen is 13.6 ev,what is the energy (in eV) of the photon emitted?