SPECIAL RELATIVITY Q1.0H

$\gamma = \dfrac{1}{\sqrt{1-\dfrac{v^2}{c^2}}} \geq 1 \quad c = 3\times10^8 \ {}^{m}\!/\!_{s} \quad \Delta t = \gamma \Delta t' \quad \ell = \dfrac{\ell'}{\gamma}$ where $\Delta t'$ and ℓ' are proper time and length

$u = \dfrac{u' + v}{1 + \dfrac{u'v}{c^2}}$ where v is the velocity of the x' -reference frame w.r.t the x - reference frame

Lorentz Transformation Equations

$x = \dfrac{x' + vt'}{\sqrt{1-\dfrac{v^2}{c^2}}} \quad y = y' \quad z = z' \quad t = \dfrac{t' + \left(\frac{v}{c^2}\right)x'}{\sqrt{1-\dfrac{v^2}{c^2}}}$ | $x' = \dfrac{x - vt}{\sqrt{1-\dfrac{v^2}{c^2}}} \quad y' = y \quad z' = z \quad t' = \dfrac{t - \left(\frac{v}{c^2}\right)x}{\sqrt{1-\dfrac{v^2}{c^2}}}$

$m = \gamma m_0 \quad \vec{p} = m\vec{v} \quad \vec{F} = m\vec{a} \quad K = mc^2 - m_0c^2 \quad E = K + m_0c^2 = mc^2$

v	γ
.1c	1.01
.2c	1.02
.3c	1.05
.5c	1.15
.8c	1.67
.9c	2.29
.99c	7.09
.995c	10.0
.999c	22.4

1. An alien spaceship passes by the earth at a speed of .5c and observes some physics students measuring the period of an oscillating spring-mass system. They learn that the students measure the period as 3.00s and decide to measure the period themselves. What is the period as measured by the aliens?

2. A flying saucer passes a space station located on an asteroid. The space station has measured it's length at 3000m. If the saucer flies by the length of the station at .6c, what length will the flying saucer pilots measure?

3. If a spaceship passes by at .8c and launches a projectile in the same direction at .3c with respect to the spaceship, what will we observe the projectile's speed to be?

4. If a horizontal bar is dropped with both ends landing on the ground at the same time (from a stationary observer's point of view). What would a moving observer see if she ran by at a "relativistic" speed?

5. If a spaceship traveled from the earth to a star system 10 light-years away at a speed of .995c, how long would it take? Explain.