Day 2

time equations:

$L = \frac{t_o}{\gamma}$

$L = vt_o$

$L_o = vt$

Length Contraction: $L = \frac{L_o}{\gamma}$

L=affected distance

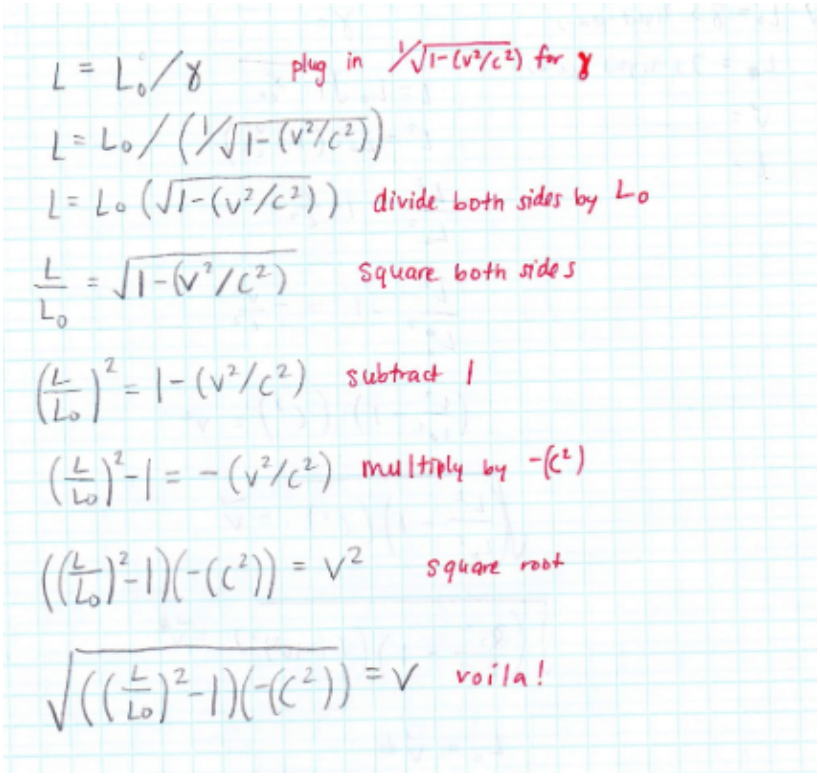
Lo=normal, unaffected distance

v = velocity

t = time of object observing moving object in Space Dimension

to = time of object in moving in Space Dimension

gamma=special relativity modulus = $\frac{1}{\sqrt{1-(v^2/c^2)}}$



2.) In an Earth reference frame, a star is 82 light-years away. How fast would you have to travel in a ship (in terms of c) so that to you the distance would be only 35 light-years?

Lo =82 light-years

v = ?

L = 35 light-years

so we'd do all that fanciness so

that the equation equals v

L=(Lo)*(sqrt(1-(v^2/c^2)))

(L/Lo)^2 = 1-(v^2/c^2)

(((L/Lo)^2)-1) * (-c^2) = v^2

sqrt[(((L/Lo)^2)-1) * (-c^2)] = v

$$\sqrt{(\frac{L^2}{L_o^2} - 1)(-(c^2))} = v$$

now, plug in the values! Once the equation is derived (the hard part) it is a simple plug and chug problem.

As for entering it into the calculator, I would find L^2/Lo^2, the subtract 1, then multiply by (in parenthesis) negative (3E8)^2, then press enter to get "ans" and put that to the power of ½.

I got 271299667.9, which you would then divide the speed of light 3E8 to get an answer in terms of c: **0.904c**

^ ** you don't have to multiply and divide by 3E8, as the data they gave us is using the unit C already, and they're asking for the answer in C units (lightyears) as well; the 3E8 thing will just cancel out

-- I'm assuming I'm the Hyena.

3.) Suppose you decide to travel to a star 85 light-years away at a speed that tells you the distance is only 25 light-years. How many years would it take you to make the trip?

Lo= 85 light-years

L=25 light-years

v=?

to=?

seconds in a year: 31536000s

So, must we find v first? Oh, I see. Geez, Vanessa.

$$\sqrt{(\frac{L^2}{L_o^2} - 1)(-c^2)} = v$$

L = v * to oh, oh, just checked my notes and found the equations

L/v = to

25 light years / 286730767.2 meters = (25((3E8 m/s)(31536000s)) / 286730767.2 m =

824885317.7 / 31536000 = **26.2 years**

4.) Suppose a news report stated that starship Enterprise had just returned from a 5-year voyage while traveling at .84c.

a.) if the report meant 5.0 years of Earth time, how much time elapsed on the ship?

b.) if the report meant 5.0 years of ship time, how much time passed on Earth?

a.)

t = 5 years

v=0.84c

to = ?

$$t = t_o/\sqrt{1 - (v^2/c^2)}$$

now we are trying to find *to* so we shall multiply both sides by that radical goodness.

$$t\sqrt{1 - (v^2/c^2)} = t_o$$

now plug and chug

to = (5 years)*√1-((.84c)^2)/(c^2))

to = (5 years)*√1-(.84^2)

to = **2.71 years**

b.)

to = 5 years

v = 0.84c

t= ?

We must use the time dilation equation t = gamma(to)

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

so we plug and chug into the equation

$t = t_o/\sqrt{1 - (v^2/c^2)}$

t = 5 years / √1-[(.84c)^2/c^2]

t = 5 years / √1-(.84)^2

t = 5 years / √1-(.84)^2

t = **9.22 years**

5.) A friend speeds by you in her spacecraft at a speed of .66c. It is measured in your frame to be 4.8 m long and 1.25 m high.

a.) What will be its length and height at rest?

b.) How many seconds would you say elapsed on your friend's watch when 20 s passed on yours?

c.) How fast did you appear to be traveling according to your friend?

d.) How many seconds would she say elapsed on your watch when she saw 20 s pass on hers?