HW 3

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1. The distance from Earth to Alpha Centauri is about 41×10^{12} km. A spaceship travels directly from Earth to Alpha Centauri at a speed of 0.9 c.

(a) (3 pts) How much shorter than 41×10^{12} km is the distance according to the spaceship travellers.

$$L = L_0\sqrt{1 - \frac{v^2}{c^2}} = 17.87 \times 10^{12} \text{ km}$$
$$L_0 - L = 23.13 \times 10^{12} \text{ km}$$

(b) (5 pts) How much do the spaceship travellers think that they have aged? Calculate this in two ways.

$$t = \gamma(u)(t_0) \rightarrow \frac{41000 \times 10^{12}}{0.9c} = \gamma(0.9c)(t_0) \tag{1}$$
$$t_0 = 6.6231 \times 10^7 \text{ seconds}$$
$$d = rt \rightarrow 17.87 \times 10^{12} = (0.9c)(t) \tag{2}$$
$$t = 6.6231 \times 10^7 \text{ seconds}$$

2. The Enterprise is moving directly away from the Millineum Falcon at relative speed of 0.73 c. On the Millineum Falcon, Han Solo bounces a ball off a wall 3 meters away. It takes the ball 100 ms to bounce off the wall and back.

(a) (3 pts) How far away from the wall in Han Solo according to an observer on the Enterprise?

$$L = L_0\sqrt{1 - \frac{(0.73c)^2}{c^2}}$$
$$= 3\sqrt{1 - 0.73^2}$$
$$= 2.05 \text{ m}$$

(b) (3 pts) How long does it take the ball to get back to Han Solo according to an observer on the Enterprise?

$$t = \gamma(u)t_0 \rightarrow \gamma(0.73c)(100)$$
$$= 146 \text{ ms}$$