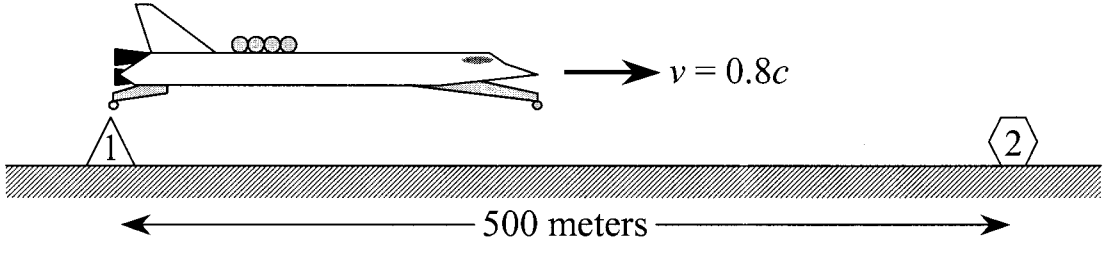
In this problem you are to use the approximation that the speed of light is 0.3 meters per nanosecond.

Recall that the Lorentz transformations are

$$\Delta x' = \gamma\left(\Delta x - \beta c \Delta t\right) \quad \text{and} \quad \Delta t' = \gamma\left(\Delta t - \beta\, \Delta x/c\right) \quad \text{where} \quad \beta \equiv v/c \quad \text{and} \quad \gamma \equiv \left(1-\beta^2\right)^{-1/2}.$$

β describes the motion of the primed coordinate axes relative to the unprimed frame.

A relativistic spaceship with ***rest length*** 100 meters is traveling above the surface of the moon, moving to the right at speed $0.8c$, as shown in the figure. Two objects, labeled 1 and 2 in the figure, are separated along the direction of travel of the spaceship by 500 meters as measured in the rest frame of the moon. (Note that lengths are ***not drawn to scale*** in the figure.)



At time $t = t' = 0$ the spaceship grabs Object 1 with a manipulator located ***at the rear*** of the ship as it passes above the object. A short time later the spaceship grabs Object 2 with a manipulator located ***at the front*** of the ship.

(a) Calculate the time interval between when the two objects are grabbed, as measured in the ***rest frame of the spaceship***.

(b) Calculate the time interval between when the two objects are grabbed, as measured in the ***rest frame of the moon***.

(c) Draw a pair of world-line diagrams that show the space-time trajectories of the manipulators and objects. One diagram should correspond to the rest frame of the moon, the other the rest frame of the spaceship. (Please label the axes x and ct for one graph and x' and ct' for the other.) Indicate clearly the space-time points at which the objects are grabbed by the manipulators.