Name:______________________________________

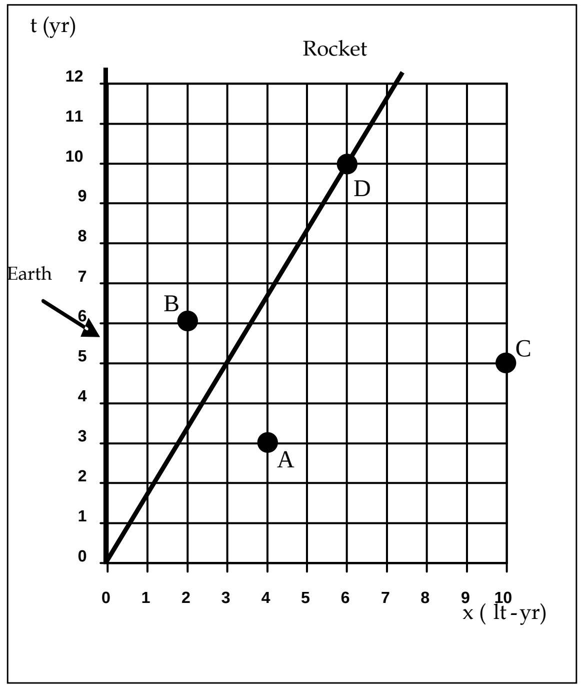
$$v = \frac{\Delta x}{\Delta t} \qquad \frac{\text{speed 1} \pm \text{speed 2}}{1 \pm \frac{(\text{speed 1})(\text{speed 2})}{c^2}} \qquad \begin{aligned}(\Delta S)^2 &= (c\Delta t)^2 - \left[(\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2\right] \\ &= (c\Delta t)^2 - (\Delta x)^2\end{aligned}$$

$$\Delta t_{proper} = \Delta t_{2-clock}\sqrt{1-(v/c)^2} \qquad L_{other} = L_{rest}\sqrt{1-(v/c)^2} \qquad (\Delta S)^2 = (\Delta S')^2$$

1) Michael Knight is driving the Knight Industries Two Thousand Yacht (KITTY) in pursuit of Garth Knight, who drops two exploding mines into the ocean. According to observers at rest with respect to the ocean, the explosions are separated by a distance of 10 lt-μs and the time between explosions is 20 μs. According to Michael and KITTY, the time between explosions is 17.5 μs. What is the distance between the explosions according to Michael and KITTY?
(note: 1 μs = 1 microsecond = 1 x 10^{-6} s)

2) A crew of traveling bakers wants to make the trip from Earth to Planet Dozen (12 lt-yr apart in the Earth/Dozen rest frame) in only 5 years as measured by clocks on board the bakers' spaceship (which travels at constant velocity with respect to the Earth/Dozen rest frame). Determine how fast the bakers must travel relative to Earth (and Dozen).

3) The spacetime diagram shows the worldlines of Earth and a Rocket, as well as several labeled events (A, B, C, and D).



a) How fast is the Rocket moving relative to the Earth?

b) Which of the pairs of events is (are) ***time-like***? (circle all that apply)

AB AC AD BC BD CD none

c) Order events A, B, C, and D from earliest to latest in the ***Rocket's*** reference frame. Indicate any ties with an = sign.

Earliest | | Latest

d) Event B is the sending of a radio signal from a lost astronaut. The signal leaves the astronaut and travels toward the rocket at the speed of light. ***Carefully draw and label the world line*** of this signal on the diagram.

e) Briefly explain why no observer can measure the proper time between events A and C.

f) In some reference frame, events A and C occur at the same time. Determine the ***distance between the events A and C*** in the frame where they are simultaneous.