Trajectories – Physics
Winter – Quiz 4 Make-up

Name:_____

$$v = \frac{\Delta x}{\Delta t} \qquad \frac{\text{speed 1} \pm \text{speed 2}}{1 \pm \frac{(\text{speed 1})(\text{speed 2})}{c^2}} \qquad \Delta t_{proper} = \Delta t_{2-clock}\sqrt{1-\left(\frac{v}{c}\right)^2} \qquad L_{other} = L_{rest}\sqrt{1-\left(\frac{v}{c}\right)^2}$$

$$c = 3.0\times10^8 \text{ m/s} = 1 \text{ lt}\cdot\text{s/s} = 1 \text{ lt}\cdot\text{min/min} = 1 \text{ lt}\cdot\text{yr/yr, etc.}$$

1) According to observers on the ground, Eva Green runs to the right at 0.6*c* relative to the ground. According to those same observers on the ground, Gooey the duck flies to the left at 0.2*c* relative to the ground. Determine Gooey's speed with respect to Eva.

2) During migration, two fast Canadian terns fly one behind the other, a fixed distance apart, over the U.S. toward the Mexican border at 0.8*c*. As they pass the border, a guard at the border station notes that, according to his clock, 0.0125 s (12.5 ms) go by between the first bird's passing and the second.

a) How much time passed between these two events, according to the birds?

b) How far apart are the birds according to people on the ground?

3) According to people sitting on a train, the train is 125 m long. The train is zipping along at 0.6*c*, according to workmen standing on a nearby bridge. The bridge is measured to be 100 m long by the workmen.

a) How long is the train, according to the workmen?

b) How long is the bridge, according to the people on the train?

4) You are standing on a train moving at constant velocity of 0.5*c* to the left with respect to the ground. You shine a pulse of light to the right. The speed of light is 1.0*c* in your reference frame. What does a ground-based observer measure for the speed and direction of the light pulse?

0.5*c*	**1.0*c***	**1.5*c***	**0.5*c***	**1.0*c***	**1.5*c***
(to the left)	**(to the left)**	**(to the left)**	**(to the right)**	**(to the right)**	**(to the right)**