Momentum and Collisions

How do things look from a different reference frame; and how do we analyze a collision?

Useful equations

$m^2 = E^2 - p^2$ $\qquad$ $\gamma = \frac{1}{\sqrt{1-v^2}}$, where v is expressed as a fraction of c.

$E = m\gamma$ $\qquad$ $E = E_{rest} + K$, where $E_{rest} = m$

$\vec{p}_x = m\vec{v}_x\gamma$ $\qquad$ $v = \frac{p}{E}$

An object of mass 8 units is traveling with a velocity of 0.6c in the positive x-direction, according to you.

According to you:
What is the object's energy, E?

What is the object's kinetic energy, K?

What is the object's momentum, $\vec{p}$?

In Karen's frame of reference the object has a velocity of 0.9c in the positive x-direction.

According to Karen:
What is the object's energy, E?

What is the object's kinetic energy, K?

What is the object's momentum, $\vec{p}$?

Now let’s analyze a collision.

In your reference frame an object with a mass of 3 mass units is traveling in the positive x-direction at a speed of 0.8c. It collides with a second object that has a mass of 8 units and that is traveling in the negative x-direction at a speed of 0.6c.

Sketch the momenergy vectors for the first object, the second object, and the system of two objects, before the collision.

The total energy in this system is: _____

The total momentum in this system is: _____

The total momenergy in this system is: _____

The objects stick together after the collision.

What is the velocity of the object after the collision?

What is the mass of the combined object after the collision?