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Name: \_\_\_\_\_

Physics 4D  
Spring 2010  
Exam 1

**MAKE SURE TO SHOW ALL WORK IN COMPLETE DETAIL. NO CREDIT WILL  
BE GIVEN IF NO WORK IS SHOWN. EXPRESS ALL ANSWERS IN SI UNITS.**

1. Object 1, of mass  $9m_0$  and moving at  $0.8c$ , collides with object 2, of mass  $12m_0$  and moving in the opposite direction at  $0.6c$ . After the collision the two masses stick together. (10 pts)
  - a) Find the speed of the resulting combined object.
  - b) Find the mass of the resulting combined object.

2. The identical twins Speedo and Goslo join migration from earth to planet X. It is 30.0 ly away in a reference frame in which both planets are at rest. The twins, of the same age, depart at the same time on different spaceships. Speedo's ship travels steadily at  $0.98c$ , and Goslo's at  $0.70c$ . Calculate the age difference between the twins after Goslo's spaceship reaches planet X. Which twin is older? (10 pts)

3. A person holds a 16 ft. pole. A barn has doors at both ends, 10 ft. apart. The person on the outside of the barn begins running toward one of the open barn doors, holding the pole level in the direction he's running. When passing through the barn, the pole fits (barely) entirely within the barn all at once. (15 pts)
- Calculate how fast the person is running.
  - According to whom – the person holding the pole or an observer stationary in the barn – does the pole fit in all at once? Explain!!!
  - According to the other person, which occurs first, the front end of the pole leaving the barn or the back end entering?
  - What is the time interval between the two events in part (c).

4. You fire a light signal at  $60^\circ$  north of west. (10 pts)
- a) Find the velocity components of this signal according to an observer moving eastward relative to you at half the speed of light. From the components, determine the magnitude and direction of the light signal's velocity according to this observer.
  - b) Find the components according to a different observer, moving westward relative to you at half the speed of light.