Physics 3710 – Problem Set #5 *Relativistic dynamics, I*

Problems 1-5 refer to: One mass, $m_1 = 1$ (in some units), collides head-on with a second mass, $m_2 = 2$, and sticks to it, forming a composite body of mass M. There are no external forces. Observer O records m_1 as initially moving with dimensionless velocity, $u_1 = +0.9$ in the x-direction, while m_2 is recorded to be at rest. Do not make unwarranted assumptions about M, please; that's the point of this set of problems.

1. Calculate $\tilde{\gamma}_1$ for m_1 according to O.

2. What is the *kinetic energy* of m_1?

3. What is the *momentum* of the composite body according to O? Explain.

4. Now we are going to invoke conservation of (total, relativistic) energy. What is the total energy (in mass units) of the composite body according to O? Explain.

5. Given that the momentum (in mass units) of the composite body is $M\tilde{\gamma}u$ and its total energy is $M\tilde{\gamma}$, determine u. Compare this value with what you would have obtained if Newton were right.

7. Determine M. What would M be if Newton were right?

8. What is the kinetic energy of the composite body. Using this kinetic energy and the result of 2, account for the mass difference in 7.