Homework 12. Relativity & CH. 6 Problems PH3110 Fall 2006 Due 12/13/06

Note: the use of a solution manual or any solutions from a publisher or other institution is not permitted. You may discuss homework with me together with others in class but your work must be your own.

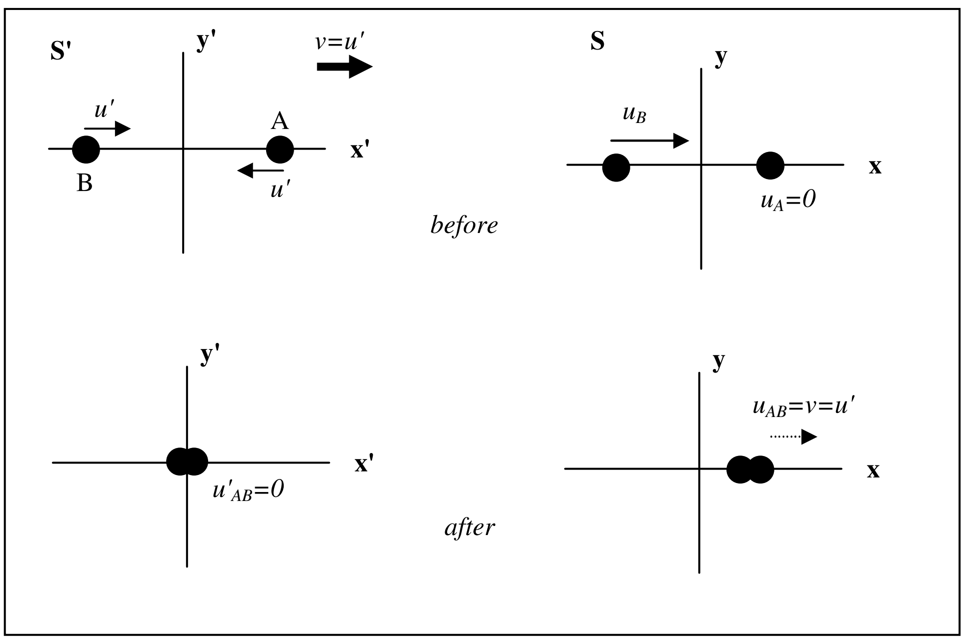
1. Complete the derivation we started in class show that to show that $\Delta K = (\gamma - 1)mc^2$,

by first showing that $$\frac{dp}{du} = \gamma^3 m \quad .$$

and then using this result, show that

$$\Delta K = W = \int_{u=0}^{u=u} F dx = fill\ in\ the\ steps = (\gamma - 1)mc^2 \quad .$$

2. Two particles, each of mass *m*, collide with each other in a completely inelastic collision. In frame S', the two particles have identical speeds *u* but move in opposite directions. After the collision the composite particle is at rest in S'. S' moves with constant velocity *u*' in the x-direction relative to frame S.



(a) Compute u_B in S. Apply conservation of relativistic momentum in the S frame and see what you conclude about the mass M_{AB} of the composite particle. Compute $\Delta m \equiv M_{AB} - 2m$.

(b) (never mind….)

(c) If we were treating the case of two protons in this example, each moving at speed c/2 in S', compute the ratio $\Delta m/m_p$, where m_p is the mass of a proton. The rest energy of a proton in 938 MeV.

(d) What is the energy equivalent of the gain in the mass of the composite particle from part (c), Δmc^2? Where did this energy come from?

3. What is the energy equivalent of 1 gram of a substance in million-electron-volt units (MeV)?

4. Compute the speed of (a) electrons and (b) protons which fall through a potential difference of 10 MeV. (c) What is the ratio of the total relativistic energy to the rest energy in each case?

5. By considering the gravitational force inside and outside of a thin spherical shell, find f(r) inside of a solid sphere of total mass M and radius R.

6. F&C 6.2(b)

7. F&C 6.12