Physics 200-04
Assignment 4

1) French– Problem 6.5 [Note– in problems from French, the most important thing is to show how you go the answer, not the answer itself.]

2) [Based on French 6-8]. A propulsion system has been proposed where a strong llaser is shone at a totally reflecting "sail" in space. The sail is assumed to be perfectly reflecting in its own rest frame. Ie, the energy of the photon reflected equals the incident energy in this frame (assuming that the rest mass energy of the sail is much greater than that of the photon) Ie, you can assume that in the frame the sail, the photon has the same energy after reflection as when it was incident.]

i) First, assume that the sail is much heavier than the particle. show that if the sail is travelling with velocity v, the energy transfered to the sail by a single photon of incident energy ϵ (travelling in the same direction as the sail) is $2\epsilon\frac{v}{1+v}$. (Hint– transform the photon to the frame moving with the sail, assume specular reflection and then transform the reflected photon back to the original frame.

ii) Consider the photons emitted from the source at n per second. How many photons per unit length are there travelling from the source to the sail? What is the total number between the source and the sail when the sail is a distance x from the source. How many photons per second hit the sail in the frame of the source? What is the energy transfer per unit time to the sail?

3) French 6.10

4) French 6.12

5) French 6.14

6) French 7.7a

7) French 7.1

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