Energy-Momentum Assignment

All problems below are from Special Relativity by Robert Katz (which you have).

4-5.4 Two identical cars collide head on in a perfectly inelastic collision. In case (a) one car is moving at speed v and the other car is at rest. In case (b) both cars are moving with the same speed v in opposite directions. Assuming that the damage done is directly proportional to the energy dissipated inelastically, how much more damage is done in case (b) than in case (a)? [4×]

4-6.1 Derive transformation equations for momentum and energy by applying Eqs. 2-5.2 to Eqs. 3-1.1 and 4-3.2.

4-6.2 Verify the transformation from Eq. 4-6.2 to 4-6.3.

4-6.3 Repeat problem 4-5.2 for the relativistic case.

4-6.4 Show that the speed of a particle is given by $v = dE/dp$.

4-7.3 Show that the recoil energy of a nucleus of mass M is $h\nu/2Mc^2$ times the energy of an emitted photon. Find the recoil energy of a Cs^{137} nucleus when a γ ray of 662 KeV is emitted. [1.70 eV]

4-7.4 Is it possible for a photon to interact with an electron at rest and give all of its energy to the electron as kinetic energy?

4-6.6 Prove that if kinetic energy is conserved in the collision between two bodies in one inertial frame, then it is conserved in every inertial frame. Note that momentum is always conserved in collisions, but that kinetic energy is only conserved in elastic collisions.