Exercise 7

Please attempt all of the following problems before the due date. Your grade on this assignment will be calculated from the best two answers.

Problem 7.1

In space near the Earth's orbit, the intensity of sunlight is 1.37 watts per square meter. Realizing that sunlight consists of photons, which each carry both energy and momentum, calculate the force that sunlight would exert on one square meter of "solar sail."

Answer 7.1

Put all of your calculations here. When you have completed all of the problems, wrap the resulting file and e-mail it to me at rgowdy@saturn.vcu.edu.

Problem 7.2

Use conservation of four-momentum to show that a positron-electron pair cannot decay into a single photon.

Answer 7.2

Put all of your calculations here. When you have completed all of the problems, wrap the resulting file and e-mail it to me at rgowdy@saturn.vcu.edu.

Problem 7.3

A photon with frequency $f$ traveling in the direction of the unit vector $\hat{n}$ is absorbed by an atom of mass $M$ that is initially at rest. The excited atom recoils in the direction of $\hat{n}$ and then drops back to its ground state by emitting a photon in the direction of the unit vector $\hat{n}'$. Use four-momentum conservation to find an expression for the frequency of the re-emitted photon.

Answer 7.3

Put all of your calculations here. When you have completed all of the problems, wrap the resulting file and e-mail it to me at rgowdy@saturn.vcu.edu.