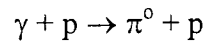


6. A high energy photon, often called a gamma ray, is incident on a proton at rest and causes the reaction

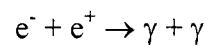


The rest energies of the proton and the π^0 meson are

$$m c^2 (\text{proton}) = 938.272 \text{ MeV}$$
$$m c^2 (\pi^0 \text{-meson}) = 134.977 \text{ MeV}$$

Find the minimum energy gamma ray that can cause this reaction.

7. The electron and its antiparticle, the positron, have the same rest energy and can annihilate each other approximately at rest producing two gamma rays.



Determine the energy gamma rays and their relative directions.