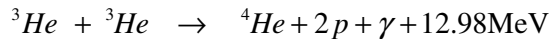
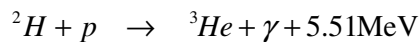
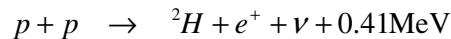


- 1) Express the following quantities in natural units, i.e. MeV/c² etc...
 ($c = 3 \times 10^8 \text{ ms}^{-1}$, $e = 1.6 \times 10^{-19} \text{ C}$).
- Electron mass: $m_e = 9.1 \times 10^{-31} \text{ kg}$.
 - Proton mass: $m_p = 1.67 \times 10^{-27} \text{ kg}$.
 - Total energy of an electron with momentum $p = 1 \text{ MeV}/c$.
 - Kinetic energy of a proton with momentum $p = 1 \text{ MeV}/c$.
 - Repeat (d) using the Newtonian formula $K = p^2 / 2m$.
 - Kinetic energy of a proton with speed $v = 0.5c$.
- 2) The sun produces energy by fusion of hydrogen into helium. One series of processes is:



Calculate the total energy released in the formation of one α -particle (${}^4\text{He}$ nucleus). Note that the e^+ (positrons) will annihilate with electrons in the sun giving extra energy. (*Hint: how many times must each reaction occur in order to produce a single helium nucleus?*).

- A π^0 decays at rest into 2 photons. If $m_{\pi^0} = 135 \text{ MeV}/c^2$, calculate
 - The energy of each photon
 - Their momenta
- A K^0 decays at rest into 2 π^0 's. If $m_{K^0} = 498 \text{ MeV}/c^2$, calculate
 - The energy of each π^0 .
 - Their momenta.

Answers

- (a) $511 \text{ keV}/c^2$, (b) $939 \text{ MeV}/c^2$, (c) 1.12 MeV , (d) 530 eV , (e) 530 eV , (f) 145 MeV
- 26.86 MeV
- (a) 67.5 MeV , (b) $67.5 \text{ MeV}/c$.
- (a) 249 MeV , (b) $209 \text{ MeV}/c$.