

61. Since the electron has the maximum possible kinetic energy, no neutrino is emitted. Since momentum is conserved, the momentum of the electron and the momentum of the residual sulfur nucleus are equal in magnitude and opposite in direction. If p_e is the momentum of the electron and p_S is the momentum of the sulfur nucleus, then $p_S = -p_e$. The kinetic energy K_S of the sulfur nucleus is $K_S = p_S^2/2M_S = p_e^2/2M_S$, where M_S is the mass of the sulfur nucleus. Now, the electron's kinetic energy K_e is related to its momentum by the relativistic equation $(p_e c)^2 = K_e^2 + 2K_e mc^2$, where m is the mass of an electron. See Eq. 38-51. Thus,

$$\begin{aligned} K_S &= \frac{(p_e c)^2}{2M_S c^2} = \frac{K_e^2 + 2K_e mc^2}{2M_S c^2} = \frac{(1.71 \text{ MeV})^2 + 2(1.71 \text{ MeV})(0.511 \text{ MeV})}{2(32 \text{ u})(931.5 \text{ MeV/u})} \\ &= 7.83 \times 10^{-5} \text{ MeV} = 78.3 \text{ eV} \end{aligned}$$

where $mc^2 = 0.511 \text{ MeV}$ is used (see Table 38-3).