32. (a) The rest energy of an electron is given by $E = m_e c^2$. Thus the momentum of the photon in question is given by

$$\begin{aligned} p &= \frac{E}{c} = \frac{m_e c^2}{c} = m_e c \\ &= (9.11 \times 10^{-31}\,\text{kg})(2.998 \times 10^8\,\text{m/s}) \\ &= 2.73 \times 10^{-22}\ \text{kg·m/s} \ . \end{aligned}$$

We may also express the momentum in terms of MeV/c: $p = m_e c^2/c = 0.511\,\text{MeV}/c$.

(b) From Eq. 39-7,

$$\lambda = \frac{h}{p} = \frac{6.63 \times 10^{-34}\,\text{J·s}}{2.73 \times 10^{-22}\,\text{kg·m/s}} = 2.43 \times 10^{-12}\,\text{m} = 2.43\ \text{pm} \ .$$

(c) Using Eq. 39-1,

$$f = \frac{c}{\lambda} = \frac{2.998 \times 10^8\,\text{m/s}}{2.43 \times 10^{-12}\,\text{m}} = 1.24 \times 10^{20}\ \text{Hz} \ .$$