33. (a) Using $K = m_e c^2(\gamma - 1)$ (Eq. 38-49) and $m_e c^2 = 511\,\text{keV} = 0.511\,\text{MeV}$ (Table 38-3), we obtain

$$\gamma = \frac{K}{m_e c^2} + 1 = \frac{1.00\,\text{keV}}{511\,\text{keV}} + 1 = 1.00196\ .$$

Therefore, the speed parameter is

$$\beta = \sqrt{1 - \frac{1}{\gamma^2}} = \sqrt{1 - \frac{1}{1.00196^2}} = 0.0625\ .$$

(b) We could first find β and then find γ, as illustrated here: With $K = 1.00\,\text{MeV}$, we find

$$\beta = \sqrt{1 - \left(\frac{1.00\,\text{MeV}}{0.511\,\text{MeV}} + 1\right)^{-2}} = 0.941$$

and $\gamma = 1/\sqrt{1 - \beta^2} = 2.96$.

(c) Finally, $K = 1000\,\text{MeV}$, so

$$\beta = \sqrt{1 - \left(\frac{1000\,\text{MeV}}{0.511\,\text{MeV}} + 1\right)^{-2}} = 0.999\,999\,87$$

and $\gamma = 1000\,\text{MeV}/0.511\,\text{MeV} + 1 = 1.96 \times 10^3$. The discussion in Sample Problem 38-7 dealing with these sorts of values may prove helpful for those whose calculators do not yield these answers.