

7. From Eq. 38-45, the Lorentz factor would be

$$\gamma = \frac{E}{mc^2} = \frac{1.5 \times 10^6 \text{ eV}}{20 \text{ eV}} = 75000 .$$

Solving Eq. 38-8 for the speed, we find

$$\gamma = \frac{1}{\sqrt{1 - (v/c)^2}} \implies v = c \sqrt{1 - \frac{1}{\gamma^2}}$$

which implies that the difference between v and c is

$$c - v = c \left(1 - \sqrt{1 - \frac{1}{\gamma^2}} \right) \approx c \left(1 - \left(1 - \frac{1}{2\gamma^2} + \dots \right) \right)$$

where we use the binomial expansion (see Appendix E) in the last step. Therefore,

$$c - v \approx c \left(\frac{1}{2\gamma^2} \right) = (299792458 \text{ m/s}) \left(\frac{1}{2(75000)^2} \right) = 0.0266 \text{ m/s} .$$