36.27. **Model:** S is the ground's reference frame and S′ is the meter stick's reference frame. In the S′ frame, which moves with a velocity v relative to S, the length of the meter stick is the proper length because the meter stick is at rest in this frame. So $L' = \ell$.

Solve: An experimenter on the ground measures the length to be contracted to

$$L = \sqrt{1-\beta^2}\,\ell \approx \left(1 - \frac{1}{2}\beta^2\right)\ell \Rightarrow \text{ shrinking} = \ell - L = \frac{1}{2}\beta^2\ell$$

Thus the speed is

$$\beta = \sqrt{\frac{2(\ell - L)}{\ell}} = \sqrt{\frac{2\left(50\times10^{-9}\text{ m}\right)}{1.00\text{ m}}} = 0.00032 \Rightarrow v = \beta c = 9.5\times10^{4}\text{ m/s}$$