33.5. **Model:** Consider the solenoid to be long so the field is constant inside and zero outside.
Visualize: Please refer to Figure Ex33.5. The field of a solenoid is along the axis. The flux through the loop is only nonzero inside the solenoid. Since the loop completely surrounds the solenoid, the total flux through the loop will be the same in both the perpendicular and tilted cases.

Solve: The field is constant inside the solenoid so we will use Equation 33.10. Take $\vec{A}$ to be in the same direction as the field. The magnetic flux is

$$\Phi = \vec{A}_{\text{loop}} \cdot \vec{B}_{\text{loop}} = \vec{A}_{\text{sol}} \cdot \vec{B}_{\text{sol}} = \pi r_{\text{sol}}^2 B_{\text{sol}} \cos\theta = \pi(0.010\text{ m})^2(0.20\text{ T}) = 6.28\times10^{-5}\text{ Wb}$$

When the loop is tilted the component of $\vec{B}$ in the direction of $\vec{A}$ is less, but the effective area of the loop surface through which the magnetic field lines cross is increased by the same factor.