44. (a) The ideal solenoid is long enough (and we are evaluating the field at a point far enough inside) such that the open ends of the solenoid are "out of sight" and the situation displays a horizontal-translational symmetry (assuming the axis of the cylindrical shape of the solenoid is horizontal). A view of a "slice" of, say, the bottom of the solenoid would therefore appear similar to that shown in Fig. 30-52, where point P is in the interior of the solenoid and point P' is outside the coil. Now, Fig. 30-52 differs in at least one respect from our "slice" view of the solenoid in that the field at P' would be zero instead of what is shown in that figure. The field vanishes there because the top of the solenoid (similar to that shown in Fig. 30-52, in "slice" view, but with the currents and field directions reversed) would contribute an equal and opposite field to any exterior point, thus canceling it. For interior points, the top and bottom "slices" each contribute $\frac{1}{2}\mu_0\lambda$ (in the same direction) [this is shown in the solution to problem 39] and thus produce an interior field equal to $B = \mu_0\lambda$.

(b) Applying Ampere's law to a rectangular path which passes through points P (interior) and P' (exterior) similar to that described in the solution to part (b) of problem 39, we are not surprised to find

$$\oint \vec{B} \cdot d\vec{s} = \left(\vec{B}_P - \vec{B}_{P'}\right) \cdot \hat{\imath}\Delta x = \mu_0\lambda\Delta x$$

just as we found in part (b) of problem 39 (except that we are now taking the $+x$ direction in the same direction as the field at P, to avoid confusion with signs). The difference with the previous solution is that in 39, $\left(\vec{B}_P - \vec{B}_{P'}\right) \cdot \hat{\imath}$ was equal to $B - (-B) = 2B$, whereas in this case we have $B - 0 = B$. Although the value of B is different in the two problems, we see that the *change* $\left(\vec{B}_P - \vec{B}_{P'}\right) \cdot \hat{\imath}$ is the same: $\mu_0\lambda$.