A relationship for the current density as a function of electric and magnetic fields (good to first order in E and to second order in B) is the following:

$$\vec{j} = \sigma_0\left[(1-\mu^2 B^2 r_3)\vec{E} - r_2\mu(\vec{E}\times\vec{B}) + r_3\mu^2(\vec{B}\cdot\vec{E})\vec{B}\right]$$

Here σ_0 is the conductivity (for $B = 0$), μ is the carrier mobility, and r_2 and r_3 are dimensionless parameters of order one. You may take $r_2 = r_3 = 1$ in the problem below.

Now consider the following: A thin (thickness: d) rectangular piece of semiconductor, as shown in the figure, carries a current I_x. A uniform magnetic field is applied perpendicular to the sample. The resistance of the sample for $B = 0$ is given as $R_0 = V_x/I_x$, and other parameters are defined in the figure.

How large are the voltages V_x and V_y for the current and magnetic field given below?
(2 points for each of the voltages).
You can assume that the current density is uniform throughout the sample, that the contacts are ideal, and that no current is drawn by the voltmeters.
Be sure that you retain B-terms up to second order.

$d = 10^{-4}$cm
$W = 10^{-1}$cm
$L = 1.0$cm
$\mu = 8\text{x}10^3\text{cm}^2/\text{Vsec}$
$R_0 = 10^5\Omega$
$\vec{B} = (0/0/B_z)$ with: $B_z = 0.5\text{T} = 2\text{x}10^{-5}\text{Vsec/cm}^2$
$I_x = 2$mA