45. (a) Since the area of a hemisphere is $2\pi r^2$ then the magnitude of the current density vector is

$$\left|\vec{J}\right| = \frac{i}{A} = \frac{I}{2\pi r^2} \ .$$

(b) Eq. 27-11 yields $\left|\vec{E}\right| = \rho \left|\vec{J}\right| = \rho I/2\pi r^2$.

(c) Eq. 25-18 leads to

$$\Delta V = V_r - V_b = -\int_b^r \vec{E} \cdot d\vec{r} = -\int_b^r \left(\frac{\rho I}{2\pi r^2}\right) dr = \frac{\rho I}{2\pi}\left(\frac{1}{r} - \frac{1}{b}\right) \ .$$

(d) Using the given values, we obtain $\left|\vec{J}\right| = \frac{100}{2\pi(10)^2} = 0.16$ A/m^2.

(e) Also, $\left|\vec{E}\right| = 16$ V/m (or 16 N/C).

(f) With $b = 0.010$ m, the voltage is $\Delta V = -1.6 \times 10^5$ V.