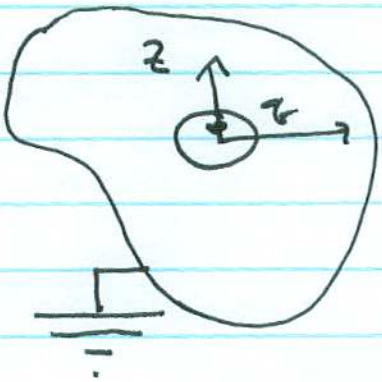
4-19



A cavity has radius a and the charge q at (0, 0, b).

a) Use Method of Images to find $V(\bar{r})$, inside cavity

$V(r=a) = 0$. Eqn. 4-29 gives the image charge, but you have to be careful. Treat "image" as charge:

$q' = -qR/z_0$ becomes $q = -q_i a/z_i$

$z_0' = R^2/z_0$ becomes $ab = a^2/z_i$

e.g. $q_i = -q z_i/a$

$z_i = a^2/b$

$$V_{\text{inside}}(\bar{r}) = \frac{q}{4\pi\varepsilon_0|\bar{x}-\bar{x}'|} + \frac{q_i}{4\pi\varepsilon_0|\bar{x}-z_i\hat{k}|} \qquad \text{but } \bar{x}' = b\hat{k}$$

$$V = \frac{q}{4\pi\varepsilon_0}\left[\frac{1}{\sqrt{r^2+b^2-2rb\cos\theta}} - \frac{a/b}{\sqrt{r^2+(a^2/b)^2-2r(a^2/b)\cos\theta}}\right]$$

b) $\sigma(\theta) = ?$ $\quad E_n = \sigma/\varepsilon_0$ but $\hat{n} = -\hat{r} \rightarrow \sigma = -\varepsilon_0 E_r$

$E_r = -\partial V/\partial r\big|_a = -$