

2.39
& 2.40

a) $\sigma_a = \frac{-q_a}{4\pi a^2}$; $\sigma_b = \frac{-q_b}{4\pi b^2}$; $\sigma_R = \frac{q_a + q_b}{4\pi R^2}$

b) $E = \frac{q_a + q_b}{4\pi\epsilon_0 r^2} \hat{r}$ for $r \geq R$

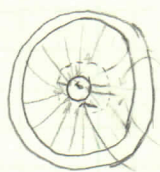
c) $E = \frac{q_a}{4\pi\epsilon_0 r_a^2} \hat{r}_a$ for $r_a \leq a$ where \hat{r}_a is a radius vector originating from the center of cavity a.

$E = \frac{q_b}{4\pi\epsilon_0 r_b^2} \hat{r}_b$ for $r_b \leq b$ where \hat{r}_b is a radius vector originating from the center of cavity b

d) $F_a = F_b = 0$. q_a & q_b are held in place by the surface charges σ_a & σ_b respectively.

e) σ_R only would change (positively part b).

2.40 a) Yes. This problem is similar to the force gravity inside a shell. The geometry is such to never cause a net force. Likewise, the geometry of the cavity will cause charge build up commensurate in strength to the charge's proximity



This part must be shown $\oint \vec{E} \cdot d\vec{l} = 0$ and $d\vec{l} \neq 0$
 \therefore from Gauss's law $\oint \vec{E} \cdot d\vec{l} = \frac{q_{enc}}{\epsilon_0}$ within the cavity!

The charge $q_{enc} = q_a + q_b$