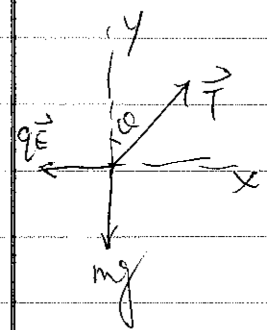
Solution HW #5

22.41 & 22.44

22.41



$y: \; T \cdot \cos\theta - mg = 0$

$x: \; T \cdot \sin\theta - qE = 0$

$\tan\theta = \dfrac{qE}{mg} = \dfrac{q \cdot \sigma}{2mg\varepsilon_0} = 0.351$

$\theta = 19.5^\circ$

22.44 (1) $r<a$ $\quad \vec{E} \cdot 4\pi r^2 = \dfrac{Q}{\varepsilon_0}$ $\quad E = \dfrac{Q}{4\pi\varepsilon_0 r^2}$ outward

$a<r<b$ $\quad E = 0$ $\quad$ within conductor

$r>b$ $\quad E \cdot 4\pi r^2 = \dfrac{Q+(-3Q)}{\varepsilon_0}$ $\quad E = \dfrac{-2Q}{4\pi r^2 \varepsilon_0} = -\dfrac{Q}{2\pi r^2 \varepsilon_0}$ inward

(2) Consider the Gaussian surface with radius r.

$a<r<b$ $\quad E=0$

$\oint \vec{E} \cdot \vec{s} = 0 = \dfrac{Q_{net}}{\varepsilon_0}$

$Q_{net} = 0 = Q + Q_{surface}$

$Q_{surface} = -Q$ $\qquad \sigma_{surface}\big|_{r=a} = \dfrac{-Q}{4\pi a^2}$

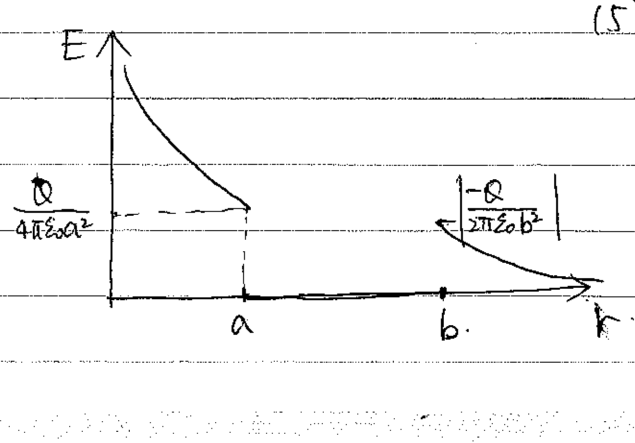
(3) outer the sphere. $\quad r>b \quad E = \dfrac{-Q}{2\pi r^2 \varepsilon_0}$

$\oint \vec{E} \cdot \vec{S} = E \cdot 4\pi r^2 = \dfrac{Q_{net}}{\varepsilon_0}$

$Q_{net} = E \cdot 4\pi r^2 \cdot \varepsilon_0 = \dfrac{-Q}{2\pi r^2 \varepsilon_0} \cdot 4\pi r^2 \varepsilon_0 = -2Q$.

$\sigma_{surface}\big|_{r=b} = \dfrac{-2Q}{4\pi b^2}$

(4)



(5)