Assignment 2 [60 points]

Problem 1 :- [4+6 = 10 points]

• Imagine a charge configuration of two infinitely large parallel sheets, one with $\sigma = \sigma_0$, the other with $\sigma = -\sigma_0$, held at a distance of 3 from each other.

• Inside the two sheets, a volume charge $\rho(\vec{r})$ is inserted (infinitely) extended in the transverse directions.

• $\rho(\vec{r}) = 2\rho_0 \frac{z}{s}$ (z is the distance from the negatively charged sheets)

(1) Argue, from rotational symmetry, that $\vec{E}$ must point along $\hat{e}_z$ everywhere.

(2) If $\vec{E} = E_0 \hat{e}_z$ for all $z < 0$, find $\vec{E}(\vec{r})$ between the sheets.

Problem 2 (AZ, Problem 3.22) (10 points)

Problem 3 (AZ, Problem 3.23) (10 points)

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Problem 4 :- (points)

(i) Imagine at time $t = 0$, there is a small conducting grounded sphere of radius R_0. (R_0 is so small you can take it to be zero); and it is really a spherical shell, not a solid conductor; 'grounded' means $\phi = 0$ on the surface, and the surface is connected to the earth at all times!

(i) Two charges, q_1 & q_2 are held externally (i.e., they don't move, ever!) at distances a and b ($a<b$) from the sphere.

(ii) The sphere (always staying grounded) starts expanding (at $R(t) = vt + R_0$. In due time, q_1 and q_2 will come inside through small holes without touching the sphere!

- Find the current

$$I(t) = +\frac{dQ}{dt}$$

for (i) $t < a/v$
(ii) $a/v < t < b/v$
(iii) $b/v < t$

} (10 + 10 + 10)

$Q(t)$ is the instantaneous charge induced on the $R(t)$ surface to keep it @ $\varphi = 0$ (the earth is

sending in / taking out charges through the wire).

Looks formidable, but the problem is trivial if you consider all electrostatics to be valid instantaneously.