תרגיל 7

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24 במאי 2009

1 א

$$\rho(r) = {}^{A}/_{r^2}$$

אם $r < a$

$$\begin{aligned}
\int D d\vec{s} &= 4\pi k \int \rho dr \\
D 4\pi r^2 &= 4\pi k \int_0^r 4\pi r^2 dr \cdot 4\pi k A 4\pi r \\
D r^2 &= 4\pi k A r \\
D &= \frac{4\pi k A}{r}\hat{r} \\
D &= \varepsilon E \\
\vec{E} &= \frac{4\pi k A}{\varepsilon r}\hat{r}
\end{aligned}$$

בתוך מוליך השדה תמיד אפס: $a < r < b \Rightarrow E = 0$
כאשר $r > b$

$$\begin{aligned}
E r^2 &= 4\pi k A a \\
\vec{E} &= \frac{4\pi k A a}{r^2}\hat{r}
\end{aligned}$$

2 ב

$$\vec{\nabla} \cdot (f(r)\hat{r}) = \frac{\partial f(r)}{\partial r} + \frac{2}{r} f(r)$$

$$\vec{P} : \frac{\vec{E}(\varepsilon - 1)}{4\pi k} = \frac{4\pi k A}{\varepsilon r} \cdot \frac{(\varepsilon - 1)}{4\pi k} = \frac{A(\varepsilon - 1)}{\varepsilon r}\hat{r}$$

$$\rho = -\vec{\nabla}\vec{P}\left(\vec{r}\right) = -\frac{A\left(\varepsilon - 1\right)}{\varepsilon}\nabla\frac{1}{r}\hat{r}$$

$$\nabla\frac{1}{r}\hat{r} = \frac{\partial f\left(r\right)}{\partial r} + \frac{2}{r}P\left(r\right) = -\frac{1}{r^2} + \frac{2}{r}\cdot\frac{1}{r} = \frac{1}{r^2}$$

$$\rho = -\frac{A\left(\varepsilon - 1\right)}{\varepsilon}\frac{1}{r^2}$$

$$\sigma = \rho \Rightarrow \frac{A\left(\varepsilon - 1\right)}{\varepsilon a}\hat{r} = \sigma P$$