Hinkle, Zachary	EM Griffiths	09/14/18	1/1

4.10 a) $\vec{p}(\vec{r}) = kr\hat{r} = k(x\hat{x} + y\hat{y} + z\hat{z})$

$\sigma_b = \vec{p}(R\hat{r})\cdot\hat{n} = \vec{P}(R\hat{r})\cdot\hat{r} = kR\hat{r}\cdot\hat{r} = kR$

$\rho_b(\vec{r}) = -\vec{\nabla}\cdot\vec{p}(\vec{r}) = -k\,\vec{\nabla}\cdot(x\hat{x} + y\hat{y} + z\hat{z}) = -3k$

b) the fields can be found by treating this as a problem of finding the electric field of a constant surface charge and constant volume charge. These problems have both been solved already previously in Chapter 2. The answers are

$$E_\sigma(\vec{r}) = \begin{cases} 0 & \text{for } r<R \\ \frac{\sigma}{\varepsilon_0}\left(\frac{R}{r}\right)^2\hat{r} & \text{for } r>R \end{cases} = \begin{cases} 0 & \text{for } r<R \\ \frac{kR}{\varepsilon_0}\left(\frac{R}{r}\right)^2\hat{r} & \text{for } r>R \end{cases}$$

$$E_\rho(\vec{r}) = \begin{cases} \frac{\rho r}{3\varepsilon_0}\hat{r} & \text{fro } r<R \\ \frac{\rho R^3}{3\varepsilon_0 r^2}\hat{r} & \text{for } r>R \end{cases} = \begin{cases} -\frac{k}{\varepsilon_0}\vec{r} & \text{for } r<R \\ -\frac{kR^3}{\varepsilon_0 r^2}\hat{r} \end{cases}$$

Thus $$\vec{E}_{\vec{p}}(\vec{r}) = \begin{cases} -\frac{k}{\varepsilon_0}\hat{r} & \text{for } r<R \\ 0 & \text{for } r>R \end{cases}$$