Griffiths 3-30

(a) By symmetry, P_x, P_y vanish.

$$P_z = \int z\hat{z}\sigma\, da = \int R\cos\theta\, k\cos\theta\, \hat{z}\, R^2 \sin\theta\, d\theta\, d\phi$$

$$= \int R^3 k \cos^2\theta\, \hat{z} \sin\theta\, d\theta\, d\phi$$

$$= kR^3\, 2\pi\, \hat{z} \int_0^{\pi} \cos^2\theta \sin\theta\, d\theta$$

let $x = \cos\theta$ $\quad d\theta = \frac{1}{-\sin\theta}\, dx$

$$= kR^3\, 2\pi\, \hat{z} \int_1^{-1} x^2\, dx$$

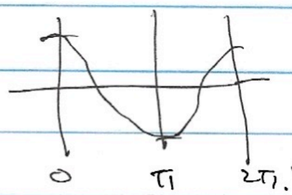
$$= kR^3\, 2\pi\, \hat{z} \int_{-1}^{1} x^2\, dx$$

$$= kR^3\, 2\pi\, \hat{z}\, \frac{1}{3} x^3 \Big|_{-1}^{1}$$

$$= \boxed{\frac{4\pi k R^3}{3}\hat{z}}$$

(b) $\cos\theta$ on $0, \pi$:

$\Rightarrow$ monopole vanish.



$$\Phi = k_0 \frac{\vec{p}\cdot\hat{r}}{r^2} = k_0 \frac{4\pi k R^3}{3r^2}\hat{z}\cdot\hat{r} = \boxed{\frac{k_0 k\, 4\pi R^3}{3r^2}\cos\theta}$$

$$\frac{1}{\cancel{4\pi}\varepsilon_0}\frac{k\cancel{4\pi}R^3}{3r^2}\cos\theta = \boxed{\frac{kR^3}{3\varepsilon_0 r^2}\cos\theta}$$