EE381 HW 5

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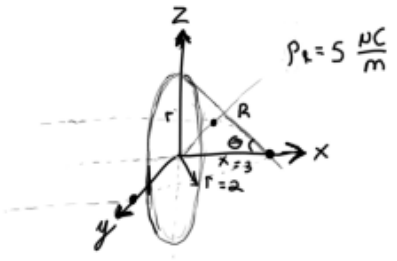
(a)



$$D = \epsilon E$$

$$= \frac{1}{4\pi}\int \frac{\rho_\ell\, d\ell \cos\theta}{R^2}$$

$$\cos\theta = \frac{x}{R}$$

$$= \frac{\rho_\ell |x| \hat{x}}{4\pi R^3}\int_{2\pi r} d\ell$$

$$= \frac{2\pi r |x| \rho_\ell}{4\pi R^3}\hat{x}$$

$$R^3 = (x^2 + r^2)^{3/2}$$

$$= 46.9$$

$$= \frac{2 \cdot 3 \cdot 5\times10^{-6}\left[\frac{C}{m}\right]}{2 \cdot 46.9}\hat{x}$$

$$\boxed{D = 0.32\ \frac{\mu C}{m^2}\hat{x}}$$

(b)

$$D_Q = \frac{Q}{4\pi R_Q^3}\hat{R}$$

$$= \frac{Q}{4\pi R_Q^3} \cdot 2(3\hat{x})$$

$$R_Q^3 = (3^2 + 3^2)^{3/2}$$

$$= 76.4$$

$$\boxed{D_Q = \frac{6Q}{4\pi \cdot 76.4}\hat{x}} = 6.25\times10^{-3}\,Q\,\hat{x}$$

$$D' = D + D_Q = 0$$

$$6.25\times10^{-3} Q\,\hat{x} = -0.32$$

$$\boxed{Q = -51.2\ \mu C}$$