

5-2.34

Assume  $k = 1.22 \times 10^{-3} \frac{C}{m^2}$

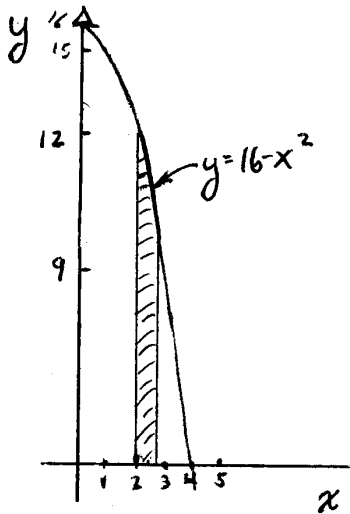
Dielectric lamina with  $\sigma = ky$ .  $Q = ?$

$$Q = \int dq \quad dq = \sigma dA = \sigma dx dy$$

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$x$  varies from  $0 \rightarrow 4$

$y$  varies from  $0 \rightarrow 16 - x^2$



$$Q = \int_{x=0}^{x=4} \left[ \int_{y=0}^{16-x^2} ky dy \right] dx$$

$$Q = \int_0^4 \frac{k}{2} \left[ y^2 \right]_0^{16-x^2} dx = \frac{k}{2} \int_0^4 [(16-x^2)^2 - 0] dx$$

$$Q = \frac{k}{2} \int_0^4 (256 - 32x^2 + x^4) dx$$

$$Q = \frac{k}{2} \left[ \int_0^4 256 dx - 32 \int_0^4 x^2 dx + \int_0^4 x^4 dx \right]$$

$$= \frac{k}{2} \left[ \left[ 256x \right]_0^4 - 32 \left[ \frac{x^3}{3} \right]_0^4 + \left[ \frac{x^5}{5} \right]_0^4 \right]$$

$$= \frac{k}{2} \left[ (1024) - 32 \left( \frac{64}{3} \right) + \left( \frac{1024}{5} \right) \right] = \frac{k}{2} [1024 - 682.67 + 204.80]$$

$$Q = \frac{k}{2} (546.13) = 273.07 k$$

If  $k = 1.22 \times 10^{-3}$   $Q = 0.33 C$