HW 1.

4.5 (a) $\rho_e = 12x^2$ mC/m, $0 < x < 5$

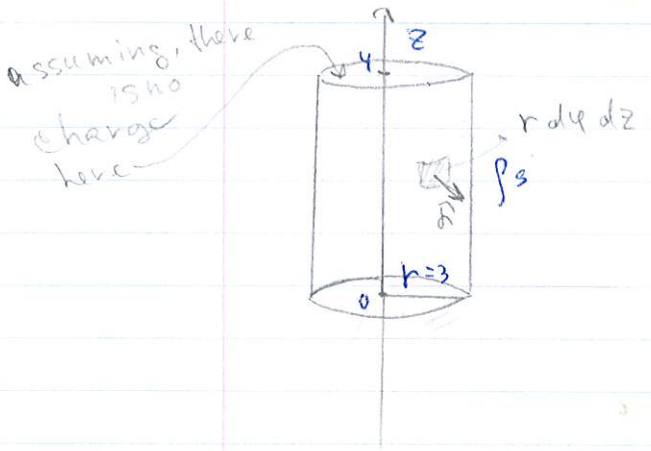
$$Q_T = \int_0^5 \rho_e \, dx = \int_0^5 12x^2 \, dx = 4x^3 \Big|_0^5 = 4(5^3 - 0) =$$

$$= 500 \text{ mC} = 0.5 \text{ C}$$

$$\boxed{Q_T = 0.5 \text{ C}}$$

(b) On the cylinder $r = 3$, $0 \le z \le 4$ m

$$\rho_s = r z^2 \text{ nC/m}^2$$



$$Q_T = \int_0^4 \int_0^{2\pi} r z^2 \, r \, d\varphi \, dz = 2\pi \cdot 3^2 \int_0^4 z^2 \, dz =$$

$$= 2\pi \cdot 3^2 \cdot \frac{z^3}{3} \Big|_0^4 = 6\pi \cdot 4^3 =$$

$$= 1206.37 \text{ nC} = 1.206 \, \mu\text{C}$$

$$\boxed{Q_T = 1.206 \, \mu\text{C}}$$

If to consider charge on top: Q_{top} ($z = 4$) $\int_0^{2\pi} \int_0^3 r \cdot 16 \, r \, dr \, d\varphi = 2\pi \cdot 16 \cdot \frac{r^3}{3} \Big|_0^3 = 904.78$ nC

$$\Rightarrow \boxed{Q_{tot} = 2.11 \, \mu\text{C}}$$

(c) Within the sphere $r = 4$ m

$$\rho_v = \frac{10}{r \sin\theta} \text{ C/m}^3$$

$$dV = r^2 \sin\theta \, dr \, d\theta \, d\varphi$$

$$Q_T = \int_0^{\pi} \int_0^{2\pi} \int_0^{4} \frac{10}{r \sin\theta} \, r^2 \sin\theta \, dr \, d\theta \, d\varphi =$$

$$= \int_0^{\pi} \int_0^{2\pi} \int_0^{4} 10 r \, dr \, d\theta \, d\varphi = 2\pi^2 \cdot 10 \cdot \frac{r^2}{2} \Big|_0^4 = 160 \cdot \pi^2 = 1579 \, C$$

$$\boxed{Q_T = 1579 \, C}$$