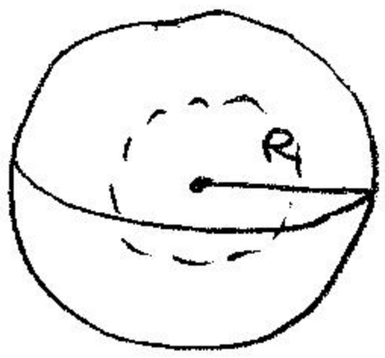
22-42 GIVEN: NON CONDUCTING SPHERE $R = 10\,cm$

$$\varphi = Ar$$

FIND: Q_{TOT}, $|E(r<R)|$, $|E(r>R)|$, SKETCH



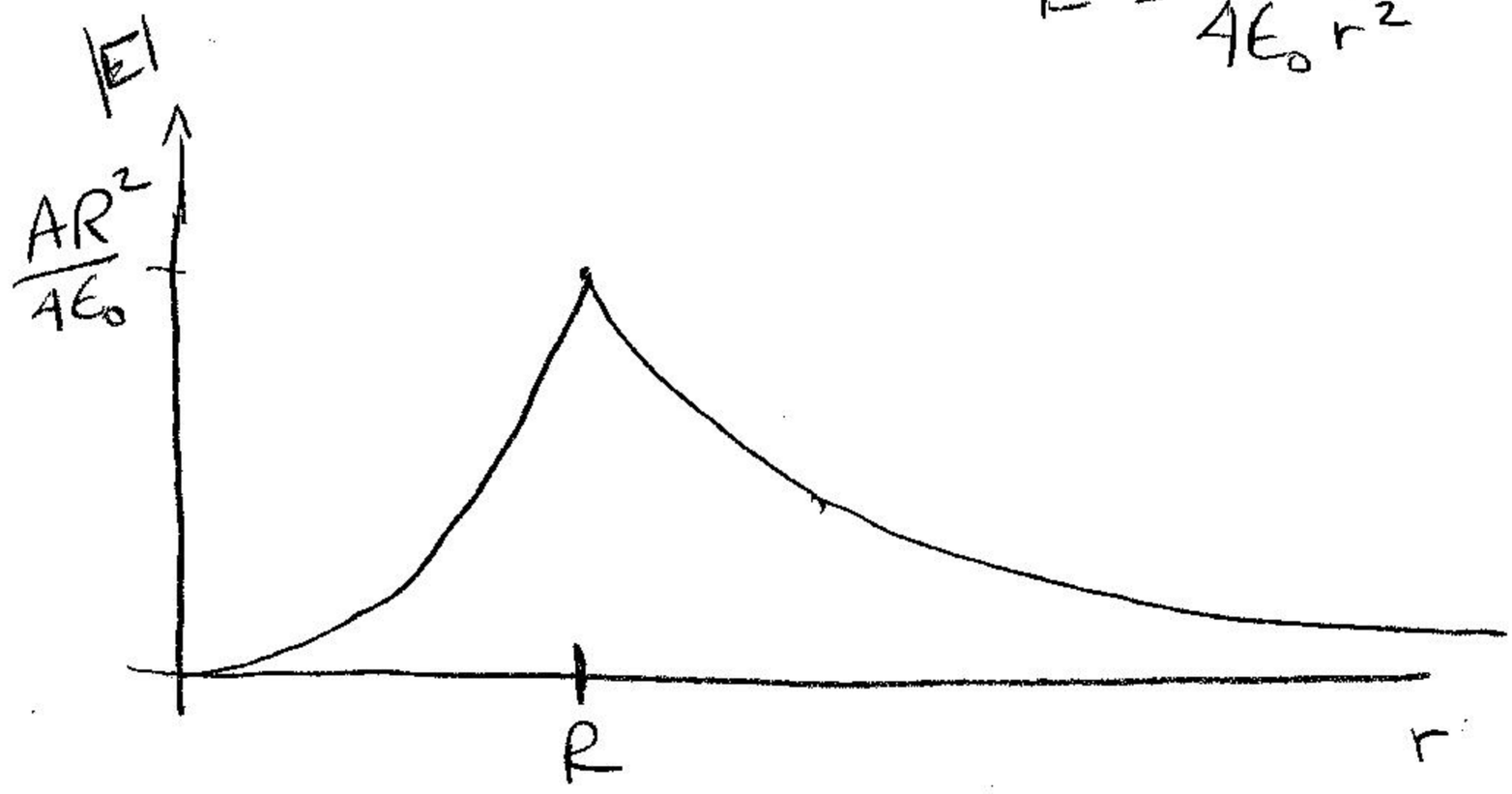
$$\varphi = Ar$$

$$Q = \int dq = \int_0^R \varphi\, dV = \int_0^R Ar\, 4\pi r^2 dr$$

$$= \cancel{4}\pi A \frac{r^4}{\cancel{4}}\Big|_0^R = \boxed{\pi A R^4}$$

$r < R$ $$\oint \vec{E}\cdot\hat{n}\, dA = \frac{q_{in}}{\epsilon_0} = |\vec{E}|\cancel{4\pi r^2} = \frac{\cancel{\pi} A r^{\cancel{4}\,2}}{\cancel{4}\,\epsilon_0}$$

$$E = \frac{Ar^2}{4\epsilon_0}$$

$r > R$ $$\oint \vec{E}\cdot\hat{n}\, dA = \frac{q_{IN}}{\epsilon_0} = |\vec{E}|(4\cancel{\pi r^2}) = \frac{\cancel{\pi} A R^4}{\epsilon_0}$$

$$E = \frac{AR^4}{4\epsilon_0 r^2}$$