PROBLEM:

A 25-μC point charge is located at the origin. Calculate the electric flux passing through: (a) that portion of the sphere r= 20 cm bounded by θ =o and Π, ϕ =o and $\Pi/2$; (b) the closed Surface ρ = 0.8 m, Z = $\pm$ 0.5 m.

SOLUTIONS :

(a) r = 20 cm = 0.2 m

The area of the strip is given by,

$$A = \int_0^{\Pi}\int_0^{\frac{\Pi}{2}} r^2 \sin\theta \, d\theta \, d\phi$$

$$= \int_0^{\Pi}\int_0^{\frac{\Pi}{2}} 0.2^2 \sin\theta \, d\theta \, d\phi$$

$$= \blacksquare \quad -0.0\blacksquare \int_0^{\frac{\Pi}{2}} (\cos\Pi - \cos o)\, d\phi$$

$$= \blacksquare \quad -0.0\blacksquare \quad (-1-1) \int_0^{\frac{\Pi}{2}} \blacksquare \, d\phi$$

$$= \blacksquare\, 0.0\blacksquare \quad \frac{3.1416}{2} = \blacksquare\, 0.12566\blacksquare \quad m^2$$

Then the flux through the strip is,

$$\Psi net = \blacksquare \quad \frac{A}{4\Pi r^2} \quad Q$$

$$= \blacksquare \quad \frac{0.125664}{(4)(3.1416)} \quad \frac{25x10^{-2}}{0.2^2}$$

$$= \blacksquare \quad 6.25x10^{-6} \quad C \quad or \quad 6.25\mu C$$

(b)

$$\Psi = \blacksquare \quad Ds \int_{-0.5}^{0.5} \int_{o}^{2\Pi} \rho \, d\theta \, dZ$$

$$\text{but} \quad Ds = \blacksquare \quad \frac{Q}{2\Pi\rho}$$

$$= \blacksquare \quad \frac{Q}{2\Pi\rho} \int_{-0.5}^{0.5} \int_{o}^{2\Pi} \rho \, d\phi \, dZ$$

$$= \blacksquare \quad \frac{25x10^{-6}}{2\Pi} .2\Pi \int_{-0.5}^{0.5} \blacksquare \, dZ$$

$$= \blacksquare \quad 25x10^{-6} \quad (0.5 + 0.5)$$

$$= \blacksquare \quad 25x10^{-6} \quad C \quad \text{or} \quad 25\mu C$$