

359.

Problem 30.63 (RHK)

A charged metal sphere of radius 16.2 cm has a net charge of 31.5 nC. (a) We have to find the electric potential at the sphere's surface. (b) We have to find the distance from the surface of the sphere where the potential has decreased by 550 V.

Solution:

Radius of the metal sphere $R = 16.2 \text{ cm} = 16.2 \times 10^{-2} \text{ m}$.

Charge on the metal sphere $q = 31.5 \text{ nC} = 31.5 \times 10^{-9} \text{ C}$.

Potential due to the charge on the sphere

$$V(r) = \frac{q}{4\pi\epsilon_0 r} = \frac{8.99 \times 10^9 \times 31.5 \times 10^{-9}}{r} \text{ V} = \frac{283.18}{r} \text{ V, for } r \geq R.$$

Therefore, potential at the sphere's surface will be

$$V(R) = \frac{283.18}{16.2 \times 10^{-2}} \text{ V} = 1748 \text{ V}.$$

We will next find r at which potential

$$V(r) = (1748 - 550) \text{ V} = 1198 \text{ V}.$$

$$r = \frac{283.18}{1198} \text{ m} = 23.64 \text{ cm}.$$

This is at a distance of $(23.64 - 16.2) \text{ cm} = 7.4 \text{ cm}$.

