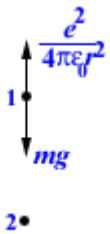
284.

Problem 27.29 (RHK)

An electron is in a vacuum near the surface of the Earth. We have to place a second electron so that the net force on the first electron, owing to the other electron and the gravity, is zero.

Solution:

Let the second electron be placed at a distance r vertically below the first electron. This will ensure that the Coulomb force exerted by the second electron on the first electron and the force of gravity due to the Earth on the first electron act in opposite directions. We have to adjust their separation r such that the net force on the first electron is zero.



That is

$$\frac{e^2}{4\pi\varepsilon_0 r^2} = mg,$$

or

$$r = \left(\frac{e^2}{4\pi\varepsilon_0 mg} \right)^{1/2} = 1.6\times10^{-19} \times \left(\frac{8.99\times10^{9}}{9.11\times10^{-31}\times9.8} \right)^{1/2} \text{ m} = 5.08 \text{ m}.$$

The second electron if kept 5.08 m below the first electron will cancel the gravitational pull of the Earth on the first electron.