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Problem 27.27 (RHK)

A neutron is thought to be composed of one "up" quark of charge $+\frac{2}{3}e$ *and two "down" quarks each having charge* $-\frac{1}{3}e$. *If the down quarks are* 2.6×10^{-15} m *apart inside the neutron, we have to calculate the repulsive electrical force between them.*

Solution:

Charge of a down-quark is $-\frac{1}{3}e$, where $e=1.6\times10^{-19}\text{C}$.

It is given that the separation between the two down-quarks inside a neutron is 2.6×10^{-15} m. Therefore, the magnitude of the force of repulsion between the two down-quarks inside a neutron will be

$$F=\frac{\left(\frac{e}{3}\right)^2}{4\pi\varepsilon_0 r^2}=\frac{\left(1.6\times10^{-19}\right)^2\times8.99\times10^9}{9\times\left(2.6\times10^{-15}\right)^2}\ \text{N}=3.78\ \text{N}.$$