QUES 03:-

Check that the ratio $\frac{ke^2}{Gm_em_p}$ is dimensionless. Look up a table of physical constants and determine the value of this ratio. What does this ratio signify?

Sol. $\left[k\frac{e^2}{Gm_em_p}\right] = \frac{[\mathrm{Nm^2C^{-2}}]\times[\mathrm{C}]^2}{[\mathrm{Nm^2\,kg^{-2}}]\times[\mathrm{kg}][\mathrm{kg}]}$ = no unit

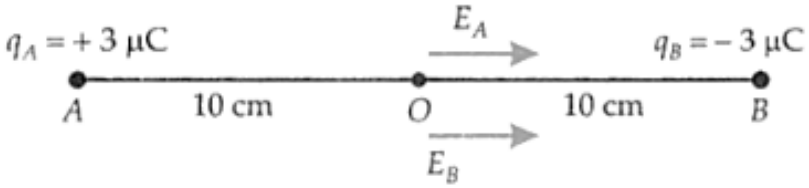
As the ratio $\frac{ke^2}{Gm_em_p}$ has no unit, so it is dimensionless.

Now, $k = 9 \times 10^9\ \mathrm{Nm^2C^{-2}}$

$G = 6.67 \times 10^{-11}\ \mathrm{Nm^2\,kg^{-2}}$

$e = 1.6 \times 10^{-19}$ kg

$m_e = 9.1 \times 10^{-31}$ kg



and $m_p = 1.66 \times 10^{-27}$ kg

$\therefore \quad k\frac{e^2}{Gm_em_p} = \frac{9\times10^9\times\left(1.6\times10^{-19}\right)^2}{6.67\times10^{-11}\times9.1\times10^{-31}\times1.66\times10^{-27}}$

$= 2.287 \times 10^{39}$

The factor $\frac{ke^2}{Gm_em_p}$ represents the ratio of electrostatic force to the gravitational force between an electron and a proton. Also, the large value of the ratio signifies that the electrostatic force is much stronger than the gravitational force.