Electric Potential of a Uniformly Charged Solid Sphere

- Electric charge on sphere: \( Q = \rho V = \frac{4\pi}{3} \rho R^3 \)

- Electric field at \( r > R \): \( E = \frac{kQ}{r^2} \)

- Electric field at \( r < R \): \( E = \frac{kQ}{R^3} r \)

- Electric potential at \( r > R \):

\[
V = - \int_{\infty}^{r} \frac{kQ}{r^2} dr = \frac{kQ}{r}
\]

- Electric potential at \( r < R \):

\[
V = - \int_{\infty}^{R} \frac{kQ}{r^2} dr - \int_{R}^{r} \frac{kQ}{R^3} r dr
\]

\[
\Rightarrow V = \frac{kQ}{R} - \frac{kQ}{2R^3} \left( r^2 - R^2 \right) = \frac{kQ}{2R} \left( 3 - \frac{r^2}{R^2} \right)
\]