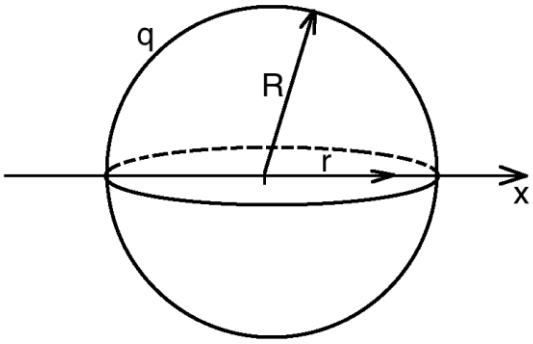
A sphere of radius 20 cm, has a total charge of 3.14 micro coulomb distributed on its surface. Calculate the electric potential at points, 5 cm, 10cm, 15 cm,20 cm,.....50 cm. what will be the possible graph?

Solution:

$q = 3.14\ \times 10^{-6}C -$ charge of the sphere;
$R = 20cm = 0.2m -$ radius of the sphere;
$r -$ distance to the center of the sphere;



Formula for the electric potential of the sphere :

$$\varphi = \begin{cases} \frac{qk}{r}, \text{if } r \geq R \\ \frac{qk}{R}, \text{if } r < R \end{cases}, \text{where } k = \frac{1}{4\pi\varepsilon_0}$$

$$= 9 \times 10^9 \frac{N \cdot m^2}{C^2}$$

Electric potential for the radius which is smaller than the sphere radius($r = 5\text{ cm}, 10\text{ cm}, 15\text{ cm}$):

$$\varphi_{5cm} = \varphi_{10cm} = \varphi_{15cm} = \varphi_{20cm} = \frac{qk}{R} =$$

$$= \frac{3.14\ \times 10^{-6}C \cdot 9 \times 10^9 \frac{N \cdot m^2}{C^2}}{0.2\text{ m}} = 141\ \times 10^3\text{ V}$$

Electric potential for the radius which is bigger than the sphere radius($r = 20\text{ cm}, 25\text{ cm}, 30\text{ cm}, 35\text{ cm}, 40cm,\ 45cm,\ 50\text{ cm}$):

$$\varphi_{25cm} = \frac{qk}{r} = \frac{3.14\ \times 10^{-6}C \cdot 9 \times 10^9 \frac{N \cdot m^2}{C^2}}{0.25\text{ m}} = 113 \times 10^3\text{ V}$$

$$\varphi_{30cm} = \frac{qk}{r} = \frac{3.14\ \times 10^{-6}C \cdot 9 \times 10^9 \frac{N \cdot m^2}{C^2}}{0.3\text{ m}} = 94 \times 10^3\text{ V}$$

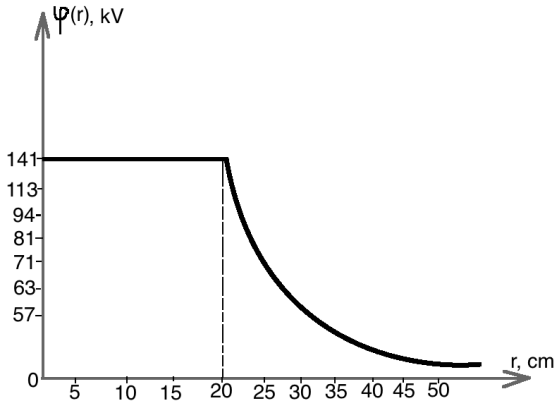
$$\varphi_{35cm} = \frac{qk}{r} = \frac{3.14\ \times 10^{-6}C \cdot 9 \times 10^9 \frac{N \cdot m^2}{C^2}}{0.35\text{ m}} = 81 \times 10^3\text{ V}$$

$$\varphi_{40cm} = \frac{qk}{r} = \frac{3.14\ \times 10^{-6}C \cdot 9 \times 10^9 \frac{N \cdot m^2}{C^2}}{0.4\text{ m}} = 71 \times 10^3\text{ V}$$

$$\varphi_{45cm} = \frac{qk}{r} = \frac{3.14\ \times 10^{-6}C \cdot 9 \times 10^9 \frac{N \cdot m^2}{C^2}}{0.45\text{ m}} = 63 \times 10^3\text{ V}$$

$$\varphi_{50cm} = \frac{qk}{r} = \frac{3.14\ \times 10^{-6}C \cdot 9 \times 10^9 \frac{N \cdot m^2}{C^2}}{0.5\text{ m}} = 57 \times 10^3\text{ V}$$

Possible graph for the electric potential:



Answer: $\varphi_{5\text{cm}} = \varphi_{10\text{cm}} = \varphi_{15\text{cm}} = \varphi_{20\text{cm}} = \frac{qk}{R} = 141 \times 10^3\ \text{V}$

$\varphi_{25\text{cm}} = 113 \times 10^3\ \text{V}$

$\varphi_{30\text{cm}} = 94 \times 10^3\ \text{V}$

$\varphi_{35\text{cm}} = 81 \times 10^3\ \text{V}$

$\varphi_{40\text{cm}} = 71 \times 10^3\ \text{V}$

$\varphi_{45\text{cm}} = 63 \times 10^3\ \text{V}$

$\varphi_{50\text{cm}} = 57 \times 10^3\ \text{V}$