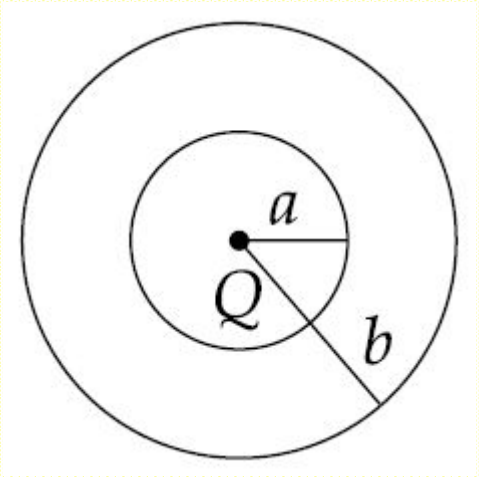
The region between two concentric spheres of radii 'a' and 'b', respectively (see figure), has volume charge density $\rho = \frac{A}{r}$, where A is a constant and r is the distance from the centre. At the centre of the spheres is a point charge Q. The value of A such that the electric field in the region between the spheres will be constant, is:



(1) $\frac{Q}{2\pi a^2}$

(2) $\frac{Q}{2\pi(b^2-a^2)}$

(3) $\frac{2Q}{\pi(a^2-b^2)}$

(4) $\frac{2Q}{\pi a^2}$

Consider a point (r) in the region between the spheres.

According to Gauss's law,

$$E.4\pi r^2 = \frac{Q + \int_a^r \rho.dV}{\epsilon_0}$$

$$\therefore E.4\pi r^2 = \frac{Q + \int_a^r \frac{A}{r}.4\pi r^2 dr}{\epsilon_0}$$

$$\therefore E.4\pi r^2 = \frac{Q + 2\pi A(r^2 - a^2)}{\epsilon_0}$$

$$\therefore E = \frac{1}{4\pi\epsilon_0}\left(\frac{Q - 2\pi A a^2}{r^2} + 2\pi A\right)$$

For E to be constant or independent of r, the term involving r must be 0.

$$\therefore \frac{Q - 2\pi A a^2}{r^2} = 0$$

$$\therefore A = \frac{Q}{2\pi a^2}$$

Hence, Option (1).

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