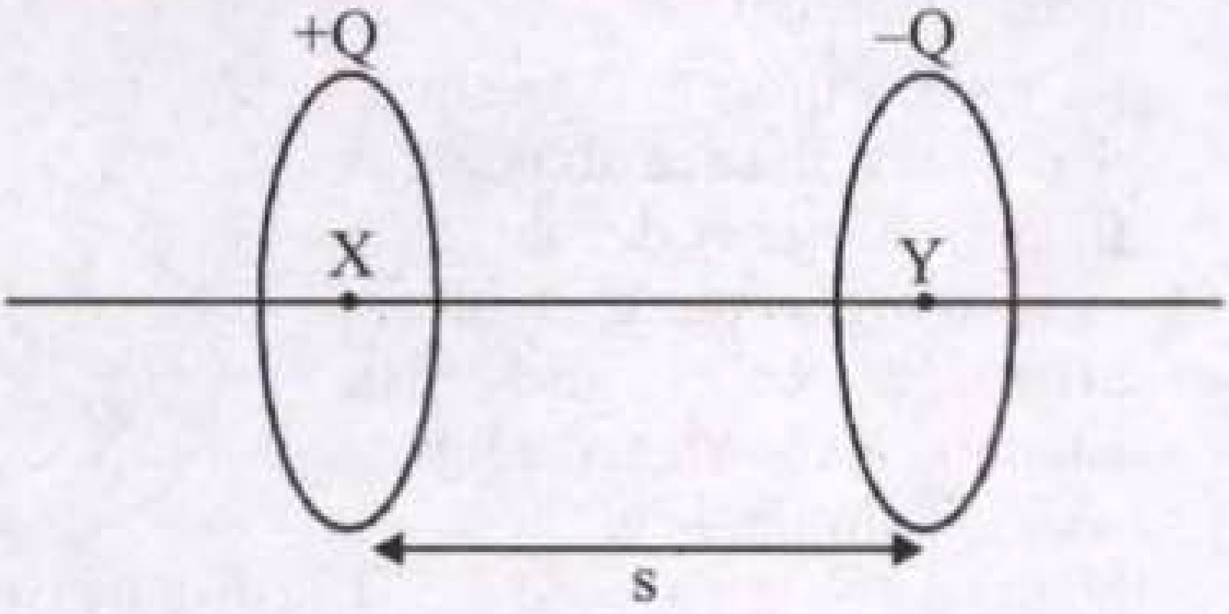
The two thin coaxial rings, each of radius 'a' and having charges +Q and –Q respectively are separated by a distance of 's'. The potential difference between the centres of the two rings is : [Aug. 26, 2021 (II)]

(a) $\frac{Q}{2\pi\varepsilon_0}\left[\frac{1}{a}+\frac{1}{\sqrt{s^2+a^2}}\right]$ (b) $\frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{a}+\frac{1}{\sqrt{s^2+a^2}}\right]$

(c) $\frac{Q}{4\pi\varepsilon_0}\left[\frac{1}{a}-\frac{1}{\sqrt{s^2+a^2}}\right]$ (d) $\frac{Q}{2\pi\varepsilon_0}\left[\frac{1}{a}-\frac{1}{\sqrt{s^2+a^2}}\right]$

**(d)**




Potential at the centre of ring X

$$V_X = \frac{Q}{4\pi \epsilon_0 a} - \frac{Q}{4\pi \epsilon_0 \sqrt{a^2 + s^2}}$$

Potential at the centre of ring Y

$$V_Y = \frac{-Q}{4\pi \epsilon_0 a} + \frac{Q}{4\pi \epsilon_0 \sqrt{a^2 + s^2}}$$

$$V_X - V_Y = \frac{2Q}{4\pi \epsilon_0 a} - \frac{2Q}{4\pi \epsilon_0 \sqrt{a^2 + s^2}}$$

$$= \frac{Q}{2\pi \epsilon_0}\left(\frac{1}{a} - \frac{1}{\sqrt{s^2 + a^2}}\right)$$