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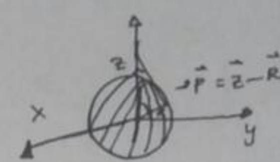
Kelas : B

a. Bola konduktor bermuatan homogen dengan rapat muatan σ berapa potensial dititik P.

solusi : distribusi muatan pada permukaan bola, maka

$$V(P) = \int \frac{1}{4\pi\varepsilon_0} \frac{\sigma \, d\vec{s}}{r}$$

$$= \frac{\sigma}{4\pi\varepsilon_0} \int \frac{R^2 \sin\theta \, d\theta \, d\varphi}{(z^2 + R^2 - 2Rz\cos\theta)^{\frac{1}{2}}}$$



$$= \frac{\sigma R^2}{4\pi\varepsilon_0} \int_0^{\pi}\int_0^{2\pi} \frac{d\phi \sin\theta \, d\theta}{(z^2 + R^2 - 2Rz\cos\theta)^{\frac{1}{2}}}$$

$$= \frac{\sigma R^2}{4\pi\varepsilon_0} \frac{1}{2} \int_0^{\pi} \frac{1}{Rz} \frac{\sigma(-2Rz\cos\theta}{(z^2 + R^2 - 2Rz\cos\theta)^{\frac{1}{2}}}$$

$$= \frac{\sigma R^2}{4\pi\varepsilon_0 z} \left[(z^2 + R^2 + 2Rz)^{\frac{1}{2}} - (z^2 + R^2 - 2Rz)^{\frac{1}{2}} \right]$$

$$* \; V(P) = \frac{\sigma R}{2\varepsilon_0 z} \left\{ \left[(R+z)^2\right]^{\frac{1}{2}} - \left[(R-z)^2\right]^{\frac{1}{2}} \right\}$$

Bila $z > R$, maka

$\left[(R-z)^2\right]^{\frac{1}{2}} = z - R$, sehingga.

$$V(P) = \frac{\sigma R}{2\varepsilon_0 z} \left[(R+z) - (z-R)\right]$$

$$= \frac{\sigma R^2}{\varepsilon_0 z}$$

Bila $R > z$, maka

$\left[(R-z)^2\right]^{\frac{1}{2}} = R - z$

$$V(P) = \frac{\sigma R}{2\varepsilon_0 z} \left[(R+z) - R + z\right]$$

$$= \frac{\sigma R}{\varepsilon_0 z}$$

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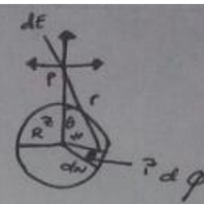
$\left[(R-z)^2\right]^{\frac{1}{2}} = R - z$

$$V(P) = \frac{\sigma R}{2\varepsilon_0 z} \left[(R+z) - R + z\right]$$

$$V(P) = \frac{\sigma R}{\varepsilon_0}$$

b. persoalan dengan rumus :

$$V(p) = -\int \vec{E}_z \cdot d\vec{z}$$



maka,

$$V(p) = \frac{1}{4\pi\varepsilon_0}\int_s \frac{\sigma d\vec{s}}{r}$$

$$= \frac{\delta}{4\pi\varepsilon_0}\int \frac{r'\,dr'\,d\phi}{(z^2+r'^2)^{\frac{1}{2}}}$$

$$= \frac{\sigma}{4\pi\varepsilon_0}\int_0^R\int_0^{2\pi} \frac{d\phi\, r'\,dr'}{(z^2+r'^2)^{\frac{1}{2}}}$$

$$= \frac{2\pi\sigma}{4\pi\varepsilon_0}\int_0^R \frac{1}{2}\,\frac{dr(r'^2}{(z^2+r'^2)^{\frac{1}{2}}}$$

$$= \frac{r}{2\varepsilon_0}\left[\frac{1}{\cancel{2}}\cdot\cancel{2}\left(z^2+r'^2\right)^{\frac{1}{2}}\right]_0^R$$

$$V(p) = \frac{r}{3\varepsilon_0}\left[\sqrt{z^2+R^2}-z\right]$$