No.

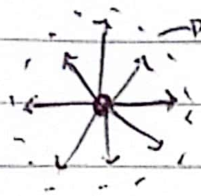
Date 25 . 03 . 2024

Kalisma

Integral Lipat Tiga

↓

Medan Listrik → Simetri tinggi (Panjang banget / Bulet)



→ Permukaan Gause

$$\Delta V \neq dv$$

$$\oint \vec{E}\, d\vec{a} = \int (\nabla \cdot \vec{E})\, d\tau$$

$$\oint \vec{E}\, d\vec{a} = \oint \frac{q}{4\pi\varepsilon_0 r^2} r^2 \sin\theta\, d\theta$$

$$= \frac{q}{4\pi\varepsilon_0} \int_0^{\pi}\int_0^{2\pi} \sin\theta\, d\theta\, d\phi$$

$$= \frac{q(2\pi)}{4\pi\varepsilon_0} \int_0^{a} \sin\theta\, d\theta$$

$$\oint \vec{E}\, da = \frac{4\pi q}{4\pi\varepsilon_0}$$

$$\vec{E} \cdot 4\pi r^2 = \frac{q}{\varepsilon_0}$$

∇ = divergensi

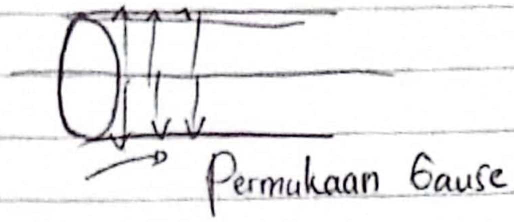
(Dari bawah ke atas - perubahan)

$$\iiint \nabla E\, d\tau = \iiint \frac{\rho\, d\tau}{\varepsilon_0} \rightarrow \boxed{\nabla \cdot E = \frac{1}{\varepsilon_0}\rho}$$ hal. 56

$$\nabla \cdot E = \frac{\rho}{\varepsilon_0}$$

Date

Contoh soal :



$$\oint \vec{E} \cdot da = \frac{q}{\varepsilon_0} \rightarrow \lambda . l$$

$$\oint \vec{E} \cdot d\vec{a} = \frac{\lambda l}{\varepsilon_0}$$

$$E(2\pi r l) = \frac{\lambda l}{\varepsilon_0}$$

$$\vec{E} = \frac{\lambda}{2\pi \varepsilon_0 r} \hat{r}_0$$

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2. Sebuah silinder pejal panjang sekali, dengan jari² silinder R, rapat muatannya q, hitung medan listrik di dalam silinder!

(Pada halaman 61)

$\vec{E}(r)$ pada $r < R$

$$\oint \vec{E} \cdot dA = \frac{q}{\varepsilon_0}$$

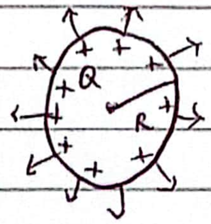
$$\vec{E}(2\pi r l) = \frac{q}{\varepsilon_0}$$

$$E = \frac{q}{2\pi \varepsilon_0 r l} \hat{r_0} \quad \text{dimana } r < R$$

Pada $r = R$ maka $E(2\pi R l) = \frac{q}{\varepsilon_0} r_0$

$$\vec{E} = \frac{q}{2\pi \varepsilon_0 r l} \hat{r_0}$$

3. Bola



Hitung E pada

a. $r < R$

b. $r > R$

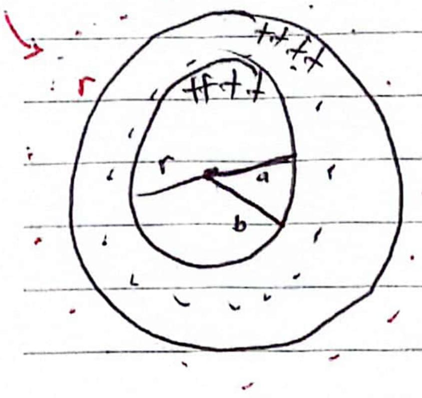
$$\oint_S \vec{E} \cdot da = \frac{Q_{net}}{\varepsilon_0}$$

$$E(4\pi r^2) = \frac{Q_{net}}{\varepsilon_0} \qquad \vec{E} = \frac{Q}{4\pi \varepsilon_0 r^2} \hat{r}$$

Contoh soal hal-62 dan 63

Kanan = muatan

kiri medan



$r < a \rightarrow \vec{E} = 0$

$a < r < b$

$\oint \vec{E} \cdot da = \frac{Q}{\varepsilon_0}$

$E(4\pi r^2) = \frac{1}{\varepsilon_0} \iiint \rho \, d\tau$

$= \frac{1}{\varepsilon_0} \int_0^a \int_0^\pi \int_0^{2\pi} r^2 \sin\theta \, d\theta \, d\phi \, dr$

$\boxed{\int_0^\pi \int_0^{2\pi} \sin\theta \, d\theta \, d\phi = 4\pi}$

$= \frac{4\pi}{\varepsilon_0} \int_0^a r^2 \, d\phi$

$\vec{E}(4\pi r^2) = \frac{4\pi}{\varepsilon_0} \int_0^a r^2 \, d\rho$

$= \frac{4\pi}{\varepsilon_0} \left(\frac{1}{3} r^3 \Big|_0^a \right.$

$\vec{E}(4\pi r^2) = \frac{4}{3} \frac{\pi . a^3}{\varepsilon_0}$

$\vec{E} = \frac{\rho a^3}{3\varepsilon_0 r^2} \hat{r}_0$

$\vec{E} \rightarrow r > b$

$\oint \vec{E} \cdot d\vec{a} = \frac{Q}{\varepsilon_0}$

$E(4\pi r^2) = \frac{1}{\varepsilon_0} \int_a^b \int_0^{2\pi} \int_0^\pi \cancel{\rho} \rho r^2 \sin\theta \, d\theta \, d\phi \, dr$

$\rho > b.$

$E(\cancel{4\pi} r^2) = \frac{\rho}{\varepsilon_0} 4\pi \int_a^b r^2 \, dr$

$= \frac{\rho 4\pi}{\varepsilon_0} \left(\frac{1}{3} r^3 \Big|_a^b \right)$

$= \frac{\rho \cancel{4\pi}}{3\varepsilon_0} (b^3 - a^3)$

$\vec{E} = \frac{\rho}{3\varepsilon_0 r^2} (b^3 - a^3)$