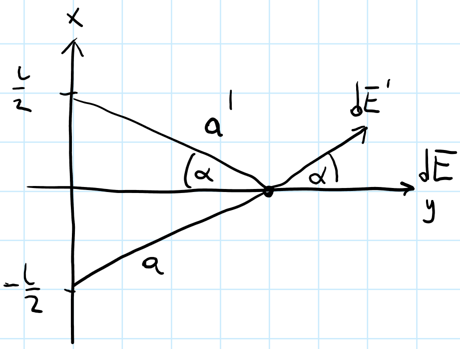
Ćwiczenia 4

wtorek, 23 października 2018 11:16



$$dE = 2\,dE'\cos\alpha$$

$$\cos\alpha = \frac{a}{a'} = \frac{a}{\sqrt{x^2+a^2}}$$

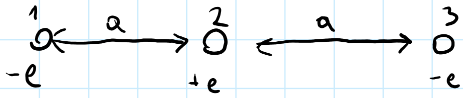
$$dE = 2\,\frac{Q_l\,dx}{4\pi\varepsilon_0 (x^2+a^2)} \cdot \frac{a}{\sqrt{x^2+a^2}}$$

$$E = \int_0^{\frac{l}{2}} \frac{Q_l\,a\,dx}{2\pi\varepsilon_0 (x^2+a^2)^{3/2}} = \frac{Q_l \cdot \frac{l}{2}}{2\pi\varepsilon_0 \left[a^2+(\frac{l}{2})^2\right]^{\frac{1}{2}}}$$

$$\lim_{l\to\infty} \frac{Q_l \cdot \frac{l}{2}}{2\pi\varepsilon_0 \sqrt{a^2+(\frac{l}{2})^2}} \to \frac{Q_l}{2\pi\varepsilon_0 a}$$

LISTA 3

1 siły, potencjały, energia układu



$$F_1 = k\left(\frac{e(-e)}{a^2} + \frac{e^2}{4a^2}\right) = k\left(\frac{e^2}{a^2} + \frac{e^2}{4a^2}\right) = k\left(-\frac{5}{4}\frac{e^2}{a^2}\right)$$

$$F_2 = 0$$

$$F_3 = k\left(-\frac{5}{4}\frac{e^2}{a^2}\right)$$

$$E_{p1} = k\left(\frac{e(-e)}{a} + \frac{e^2}{2a}\right) = k\left(\frac{-e^2}{2a}\right)$$

$$E_{p2} = 0$$

$$E_{p3} = k\left(\frac{-e\cdot e}{a} + \frac{e^2}{2a}\right) = k\left(\frac{-e^2}{2a}\right)$$

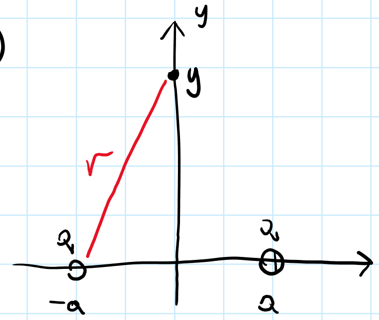
$$V_1 = k\left(\frac{e_2}{a} - \frac{e_1}{2a}\right)$$

$$V_2 = 0$$

$$V_2 = 0$$

$$V_3 = k\left(\frac{Q_2}{a} - \frac{Q_1}{2a}\right.$$

(2)



$$E = 2\cos\alpha \cdot \frac{Q}{r^2} \cdot \frac{1}{4\pi\varepsilon_0}$$

$$\cos\alpha = \frac{y}{\sqrt{y^2+a^2}}$$

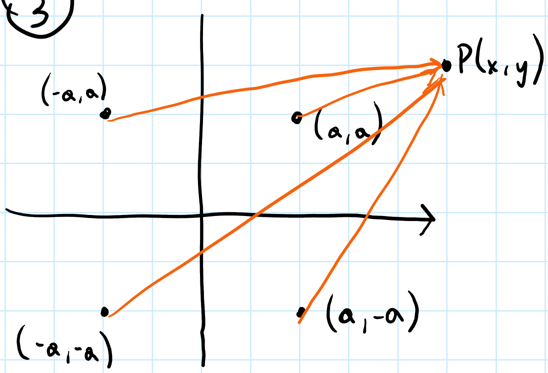
$$E(y) = \frac{2Qy}{4\pi\varepsilon_0\sqrt{y^2+a^2}^3}$$

$$V = \int \frac{2Qy}{4\pi\varepsilon_0\sqrt{y^2+a^2}^3}\,dy = \frac{2Q}{4\pi\varepsilon_0}\int\frac{y}{\sqrt{y^2+a^2}^3}\,dy = \left|\begin{array}{l} y^2+a^2 = u \\ 2y\,dy = du \end{array}\right| =$$

$$= \frac{Q}{4\pi\varepsilon_0}\int\frac{1}{\sqrt{u}^3}\,du = \frac{-Q}{4\pi\varepsilon_0}\frac{1}{\sqrt{y^2+a^2}}$$

$$\int u^{-\frac{3}{2}}\,du \Rightarrow -2u^{-\frac{1}{2}}$$

(3)



$$\vec{r}_1 = (x-a,\, y-a)$$

$$\vec{r}_2 = (x+a,\, y-a)$$

$$\vec{r}_3 = (x+a,\, y+a)$$

$$\vec{r}_4 = (x-a,\, y+a)$$

$$V_1 = \frac{kQ}{r_1} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{\sqrt{(x-a)^2+(y-a)^2}}$$

$$V = \sum_1^n V_i$$

$$V_2 = \frac{-Q}{4\pi\varepsilon_0\sqrt{(x+a)^2+(y-a)^2}}$$

$$V_3 = \frac{Q}{4\pi\varepsilon_0\sqrt{(x+a)^2+(y+a)^2}}$$

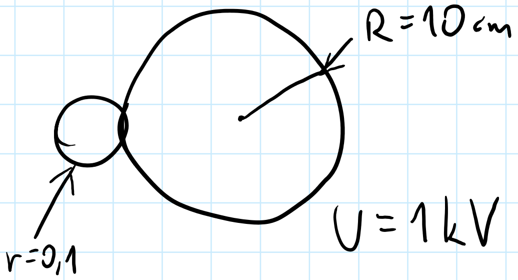
$$V_4 = \frac{-Q}{4\pi\varepsilon_0\sqrt{(x-a)^2+(y+a)^2}}$$

(4) $U = \frac{Q}{}$

4

$$U = \frac{Q}{4\pi\varepsilon_0 r}$$

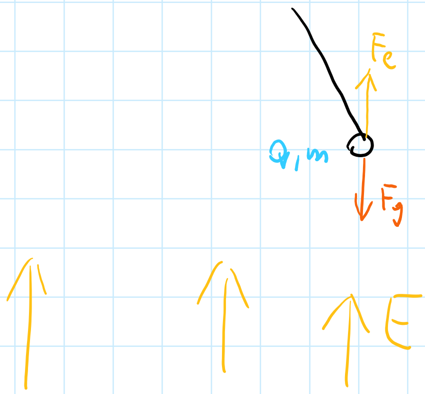
$$E = \frac{Q}{4\pi\varepsilon_0 r^2}$$



$$E_R = \frac{U}{R} = \frac{10^3}{10^{-1}} = 10^4 \frac{V}{m}$$

$$E_r = \frac{U}{r} = \frac{10^3}{10^{-4}} = 10^7 \frac{V}{m}$$

5



T_1

$T_2 = kT_1$

wyznaczyć $k(E)$

$k(U)$

$$T = 2\pi\sqrt{\frac{L}{g}}$$

$\to U=0$

$$F_w = \vec{F}_e + \vec{F}_g$$

$$ma = Eq + mg = -\frac{U}{d}q + mg$$

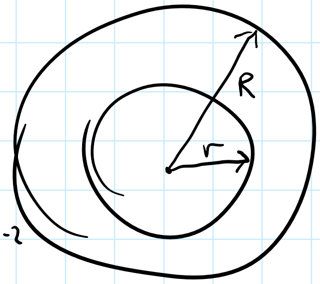
$$a = -\frac{Uq}{m} + g$$

$$T_2 = kT_1 = 2\pi\sqrt{\frac{L}{\frac{-Uq}{am}+g}}$$

$$k = \sqrt{\frac{Q}{\frac{-Uq}{dm}+g}}$$

6

$$qV = \frac{a}{r^2}$$



I : 0

II : ar^{-2}

III : 0

$\rho_V = \frac{a}{r^2}$

$E(r) = ?$

$V(r) = ?$

$$\xrightarrow{\quad r_1 \quad}\xrightarrow{\quad r_2 \quad}\longrightarrow r$$

E

$$Q_{wew} = \frac{1}{\varepsilon_0} \cdot E \cdot 4\pi r^2$$

$$Q = \frac{\rho_V \cdot \frac{4}{3}\pi r^3}{\frac{4}{3}\pi R^3} \quad \rho_V = \frac{\rho_V R^3}{r^3}$$

$$\frac{R^3}{r \cdot 3 \cdot \rho_V} = \frac{E \cdot 4\pi r^2}{\varepsilon_0}$$

Prawo Gaussa:

$$\oint \vec{D} \circ d\vec{s} = Q$$

$$\oint \vec{D} \circ d\vec{s} = D(r) 4\pi r^2 = \oint \rho_V dV$$

$$\int_V \rho_V dV = \rho_V \int_0^r \int_0^\pi \int_0^{2\pi} a r^{-2} \cdot r^2 \sin\theta \, d\theta \, d\varphi$$

$$\int_0^r = \int_0^{R_1} + \int_{R_1}^r$$

$$D(r) 4\pi r^2 = a(r - R_1) 4\pi$$

$$D(r) = \frac{a(r - R_1)}{r}$$

$$E(r) = \frac{D(r)}{\varepsilon_0}$$

$$\mathrm{I}: E(r) = 0$$

II: