1. gyakalat

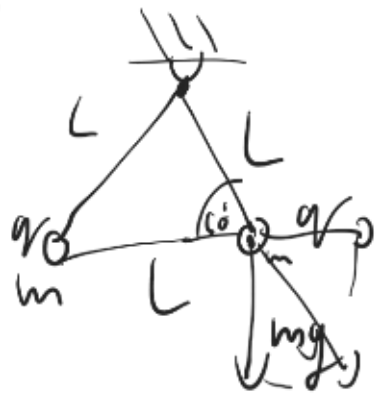
① H atom

$$F_g = G \frac{m_p \cdot m_e}{r^2}$$

$$F_E = k \cdot \frac{q_1 \cdot q_2}{r^2}$$

$$\frac{F_E}{F_g} = \frac{k \cdot q^2}{G \cdot m_p \cdot m_e} \approx 2{,}3 \cdot 10^{39}$$

②

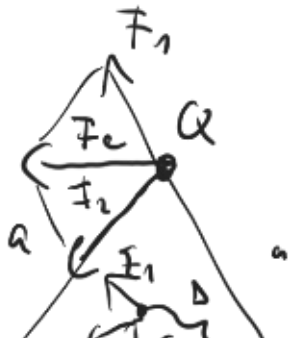


$$\operatorname{tg} 60^\circ = \frac{mg}{F_q}$$

$$\sqrt{3} = \frac{mg}{k \cdot \frac{q^2}{L^2}}$$

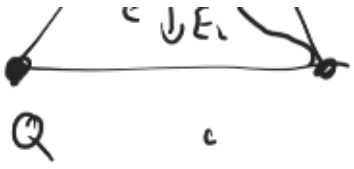
$$m = \sqrt{3}\, k \cdot \frac{q^2}{L^2 g}$$

③



$$F_1 = k \cdot \frac{Q^2}{a^2}$$

$$F_2 = F_1$$



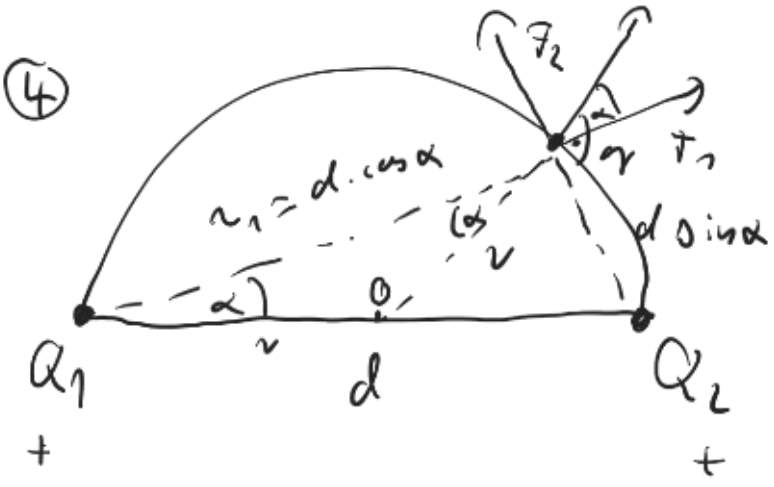
$$F_e = F_1 = F_2 = k \cdot \frac{Q^2}{a^2}$$

$$\Delta = \frac{a}{\sqrt{3}}$$

$$E_1 = k \cdot \frac{q}{\Delta^2} = k \cdot \frac{q}{a^2} \cdot 3 = E_2 = E_3$$

$$\Sigma = 6k\frac{Q}{a^2}$$

④



$$tg\,\alpha = \frac{F_2}{F_1}$$

$$F_1 = k \cdot \frac{Q_1 q}{r_1^2} = k \frac{Q_1 q}{d^2 \cos^2\alpha}$$

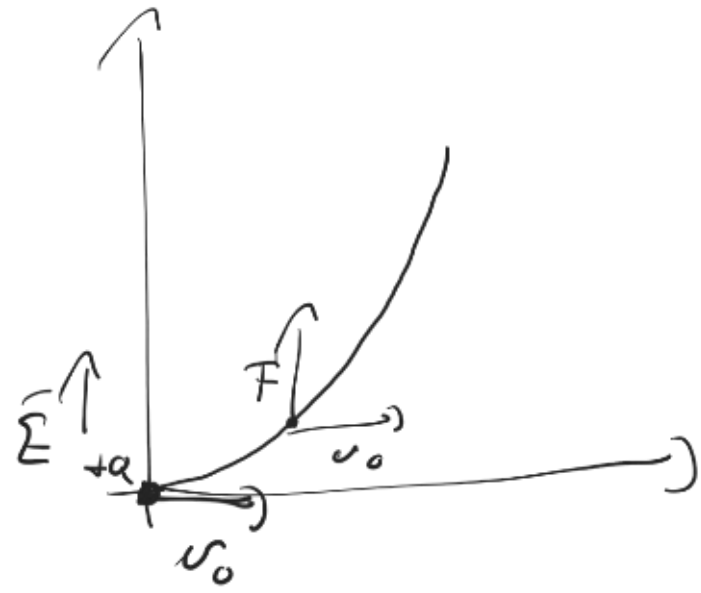
$$F_2 = k \cdot \frac{Q_2 q}{r_2^2} = k \frac{Q_2 q}{d^2 \sin^2\alpha}$$

$$tg\,\alpha = \frac{Q_2}{Q_1} \cdot \frac{\cos^2\alpha}{\sin^2\alpha}$$

$$tg^3\alpha = \frac{Q_2}{Q_1}$$

$$\alpha = \operatorname{arctg}\left(\sqrt[3]{\frac{Q_2}{Q_1}}\right)$$

⑤ $\bar{E} = E_0 \bar{j}$



m +q

$\bar{v}_0 = v_0 \cdot \bar{i}$

$y(x) = ?$

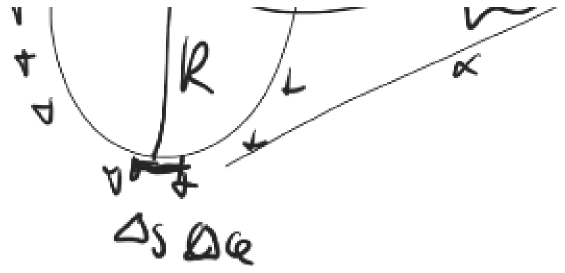
$F = Q \cdot E = m \cdot a_y \rightarrow a_y = \frac{QE}{m}$

$y(t) = \frac{1}{2} a_y \cdot t^2$

$x(t) = v_0 t \rightarrow t = \frac{x}{v_0}$

$y(x) = \frac{1}{2} \frac{QE}{m} \cdot \frac{x^2}{v_0^2}$

⑥



$$\Delta E = k\frac{\Delta Q}{r^2} = k\frac{\lambda \Delta S}{(R^2+x^2)}$$

$$\lambda = \frac{Q}{2\pi R}$$

$$\lambda = \frac{\Delta Q}{\Delta S} \Rightarrow \Delta Q = \lambda \Delta S$$

$$\Delta E_x = \Delta E \cos\alpha$$

$$\Delta E_x = k\frac{\lambda S}{R^2+x^2} \cdot \frac{x}{\sqrt{R^2+x^2}}$$

$2\pi R$

$$\Delta E_x = k \cdot \frac{\lambda \Delta S \cdot x}{(R^2+x^2)^{\frac{3}{2}}}$$

$$E = k \cdot \frac{\lambda 2\pi R x}{(R^2+x^2)^{\frac{3}{2}}} = E(x)$$

$$E(x) = \frac{k \cdot Q x}{(R^2+x^2)^{\frac{3}{2}}}$$

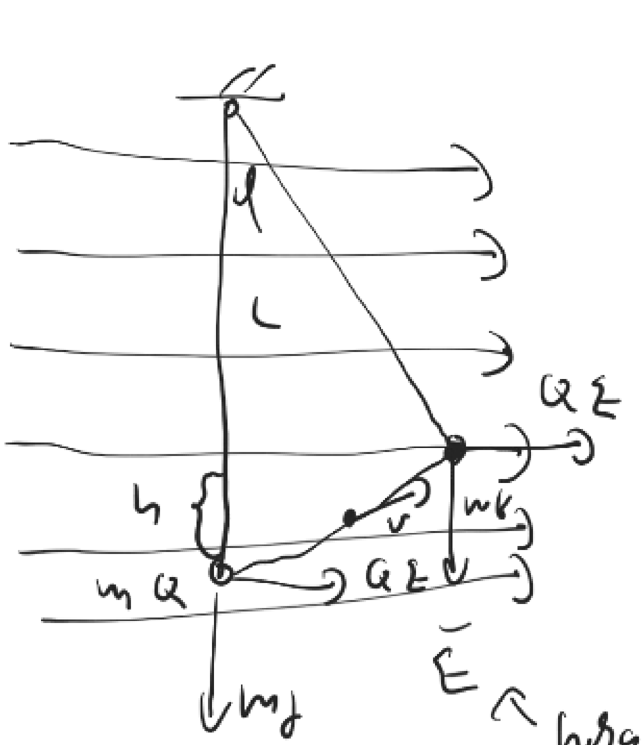
$$\frac{dE}{dx} = k\, Q \cdot \text{—} \; \text{—} = 0$$

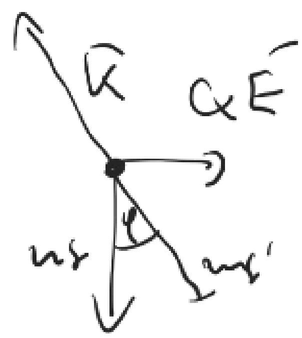
$\downarrow$

x_{max}

$x_{max} = \frac{x}{\sqrt{2}}$

(1)





вправо $t=0$ $\quad tg\,\varphi = \frac{QE}{mg}$

$$(mg')^2 = (mg)^2 + (QE)^2$$

$$g' = \sqrt{g^2 + \frac{Q^2E^2}{m^2}}$$

$$h = l(1 - \cos\varphi)$$

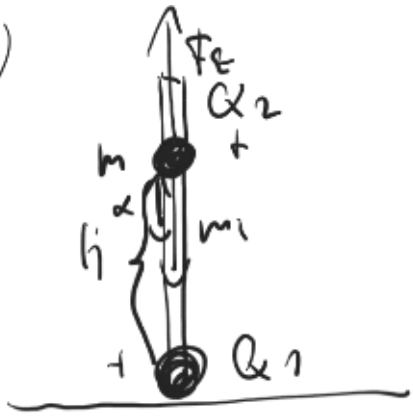
$$v = \sqrt{2gh}$$

$$v = \sqrt{2gl(1-\cos\varphi)}$$

$\frac{lmax}{L}$

$v =$

(8)



$$F_E = mg$$

$$k\frac{Q_1 Q_2}{h^2} = mg$$

$$h = \sqrt{\frac{kQ_1Q_2}{mg}}$$

$T = ?$

$$F_e = k\cdot\frac{Q_1 Q_2}{(h-x)^2} - mg$$

$x \ll h$

$$\frac{1}{(h-x)^2}\cdot\frac{(h+x)^2}{(h+x)^2}\quad\frac{h^2+2hx+x^2}{(h^2-x^2)^2} \approx h^4 =$$

$$= \frac{1}{(h-x)^2} \approx \frac{1}{h^2} + \frac{2x}{h^3}$$

$$F(x) = k\,Q_1 Q_2 \cdot\left(\frac{1}{h^2} + \frac{2x}{h^3}\right) - mg$$

$$F(x) = k\frac{Q_1Q_2}{h^2} + \frac{kQ_1Q_2 2x}{h^3} - mg$$

$$|F(x)| = \frac{kQQ_2 2x}{h^3}$$

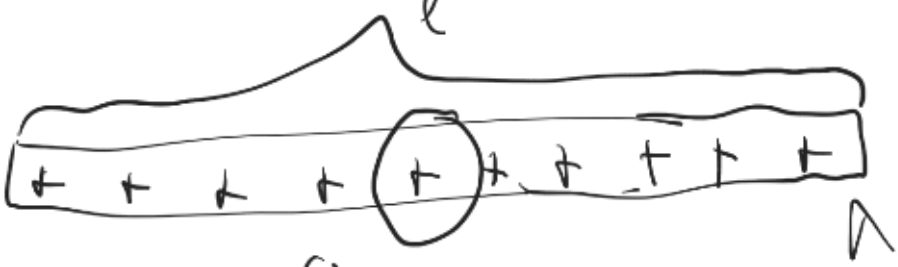
$$ma = -\frac{2kQ_1Q_2}{h^3}x$$

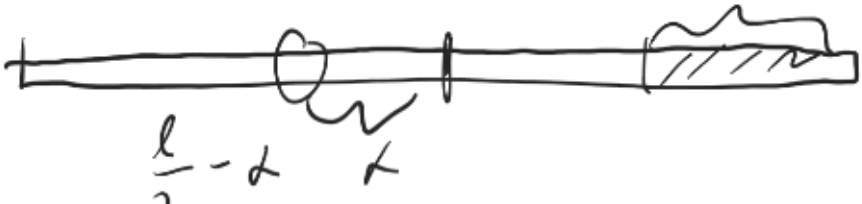
$$a = -\frac{2kQ_1Q_2}{mh^3}x$$

$$\omega = \sqrt{\frac{2kQ_1Q_2}{mh^3}} = \frac{2\pi}{T}$$

$$\Rightarrow T = 2\pi\sqrt{\frac{mh^3}{2kQ_1Q_2}}$$

(9)





$2\lambda \rightsquigarrow Q' = 2\alpha\lambda$

$x \ll l$

$$F_{el} = k\frac{QQ'}{\left(\frac{l}{2}-x\right)^2} \approx$$

$$\approx \frac{kQ\,2\lambda}{\frac{l^2}{4}}x = \frac{8kQ\lambda}{l^2}x$$

$$\Rightarrow \frac{8kQ\lambda}{l^2}$$

$$F(x) = -\left(\frac{8\pi\alpha A}{\ell^2}\right)x$$

$$a = \left(\frac{8\pi\alpha A}{m\ell^2}\right)x$$

$$\left(= \omega^2\right)$$

$$T = 2\pi\sqrt{\frac{m\ell^2}{8\pi\alpha A}}$$