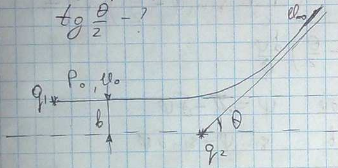
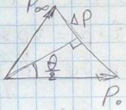
№ 2.3.

Дано: q_1, q_2, θ, b

$tg\,\frac{\theta}{2} - ?$



$$\frac{m v_0^2}{2} = \frac{m v_\infty^2}{2}$$



$P_0 = P_\infty$, $v_0 = v_\infty$

$$\frac{\Delta P}{2} = P_0 \sin\frac{\theta}{2}$$

$$\Delta P = 2p_0 \sin\frac{\theta}{2}$$

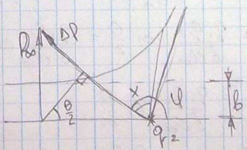
$$F = \frac{dp}{dt} \Rightarrow dp = F\,dt$$

$$F = q_1 E = q_1 \frac{q_2 r}{r^3} = \frac{q_1 q_2}{r^2}$$

Спроект. F на ΔP: $F_{пр} = F\cos x$

$$x = \frac{\pi}{2} + \frac{\theta}{2} - \varphi$$

$$F_{пр} = \frac{q_1 q_2}{r^2}\cos x$$

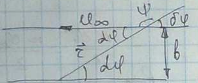


$$F_{пр} = \frac{q_1 \cdot q_2}{r^2}\cos x =$$

$$= \frac{q_1 q_2}{r^2} \cos\left(\frac{\pi}{2} + \frac{\theta}{2} - \varphi\right) = \frac{q_1 q_2}{r^2} \sin\left(\varphi - \frac{\theta}{2}\right)$$

$$|\Delta p| = \int F_{np}\, dt = \int \frac{q_1 q_2}{r^2} \sin\left(\varphi - \frac{\theta}{2}\right) dt =$$

$$= \int_0^{\pi} \frac{q_1 q_2}{r^2} \sin\left(\varphi - \frac{\theta}{2}\right) \frac{d\varphi}{\dot\varphi}$$



$$\psi = \pi - \delta\varphi$$

$$\sin\psi = \sin\delta\varphi$$

$$\vec M = \vec r \times \vec p = r p \sin\psi = r m u_\infty \sin\psi = r m u_\infty \sin\delta\varphi =$$

$$= \{\{ r \sin\delta\varphi = b \}\} = m u_\infty b$$

$$M = m r^2 \dot\varphi$$

$$b m u_\infty = m r^2 \dot\varphi$$

$$b u_\infty = r^2 \dot\varphi$$

$$|\Delta p| = \int_0^{\pi} \frac{q_1 q_2}{r^2 \dot\varphi} \sin\left(\varphi - \frac{\theta}{2}\right) d\varphi = \int_0^{\pi} \frac{q_1 q_2}{b u_\infty} \sin\left(\varphi - \frac{\theta}{2}\right) d\varphi =$$

$$= - \frac{q_1 q_2}{b u_\infty} \cos\left(\varphi - \frac{\theta}{2}\right)\Big|_0^{\pi} = - \frac{q_1 q_2}{b u_\infty} \cos\left(\pi - \frac{\theta}{2}\right) +$$

$$+ \frac{q_1 q_2}{b u_\infty} \cos\frac{\theta}{2} = \frac{q_1 q_2}{b u_\infty} \cos\frac{\theta}{2} + \frac{q_1 q_2}{b u_\infty} \cos\frac{\theta}{2} =$$

$$= 2 \frac{q_1 q_2}{b u_\infty} \cos\frac{\theta}{2}$$

$$|\Delta p| = 2 \frac{q_1 q_2}{b u_\infty} \cos\frac{\theta}{2}$$

$2 p_0 \sin$

$tg\,\frac{\theta}{2}$

$= \frac{q_1}{2}$

Зада

Дано:

$tg\,\frac{\theta}{2}$

$q_1 = 2$

$q_2 =$

tg

$\rho = 3$

Зад

Дано

$$2p_0 \sin\frac{\theta}{2} = 2\frac{q_1 q_2}{b v_\infty}\cos\frac{\theta}{2}$$

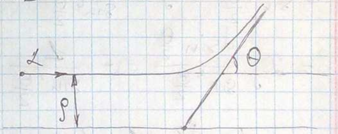
$$tg\frac{\theta}{2} = \frac{q_1 q_2}{p_0 b v_\infty} = \frac{q_1 q_2}{m v_\infty^2 b} = \frac{q_1 q_2 \cdot 2}{2 m v_\infty^2 b} = \left\{ K_\alpha = \frac{m v_\infty^2}{2} \right\}$$

$$= \frac{q_1 q_2}{2 K_\alpha b} = tg\frac{\theta}{2}$$

Задача 2.4.

Дано: $K_\alpha = 53$ МэВ $\quad \theta = 60°$

$\rho - ?$



$$tg\frac{\theta}{2} = \frac{q_1 q_2}{2\rho K_\alpha}$$

$q_1 = 2e$

$q_2 = Ze$

$$tg\frac{\theta}{2} = \frac{Ze^2}{\rho K_\alpha} \qquad \frac{Ze^2}{\rho K_\alpha} = \frac{Ze^2}{\rho \cdot 53 \cdot 1{,}6 \cdot 10^{-6}} = \frac{\sqrt{3}}{3}$$

$$\rho = \frac{3Ze^2}{\sqrt{3}\, 84{,}8 \cdot 10^{-6}} = 41{,}4 \cdot 10^{-14} = 41{,}4 \cdot 10^{-12} \text{ (см)}$$

Задача 2.22.

Дано: $K = 1$ МэВ $\quad \rho_1 = 1{,}5$ мг/см² $\quad \theta = 30°$

$^{63}_{23}Cu : {}^{64}_{30}Zn = 7:3$

$$\frac{\Delta N_p}{N_{над}} - ?$$

$$\frac{\Delta N_p}{N_{над}} = n\left(\frac{Ze^2}{4K}\right)^2 \frac{\Delta \omega}{\sin^4\frac{\theta}{2}} = n\left(\frac{Ze^2}{4K}\right)^2 \frac{2\pi \sin\theta\, d\theta}{\sin^4\frac{\theta}{2}}$$

$$\frac{\Delta N_{рас}}{N_{над}} = n\left(\frac{Ze^2}{4K}\right)^2 2\pi \int \frac{\sin\theta\, d\theta}{\sin^4\frac{\theta}{2}} =$$

$$\int \frac{\sin\theta\, d\theta}{\sin^4\frac{\theta}{2}} = 2\int \frac{\sin\frac{\theta}{2}\cos\frac{\theta}{2}}{\sin^4\frac{\theta}{2}}\, d\theta = 2\int \frac{\cos\frac{\theta}{2}}{\sin^3\frac{\theta}{2}}\, d\theta =$$

$$= 2\int \frac{d\sin\frac{\theta}{2}}{\sin^3\frac{\theta}{2}} = -\frac{1}{\sin^2\frac{\theta}{2}}$$

$$= n_e\left(\frac{Ze^2}{4K}\right)^2 2\pi\left(-\frac{1}{\sin^2\frac{\pi}{2}} + \frac{1}{\sin^2\frac{\theta}{2}}\right) =$$

$$= -2\pi n_e\left(\frac{Ze^2}{4K}\right)^2\left(1 - \frac{1}{\sin^2\frac{\theta}{2}}\right) =$$

$$= -2\pi n_e\left(\frac{Ze^2}{4K}\right)^2\left(1 - \frac{2}{1-\cos\frac{\pi}{6}}\right) =$$

$$= -2\pi n_e\left(\frac{Ze^2}{4K}\right)^2\left(1 - \frac{4}{2-\sqrt{3}}\right) = -2\pi n_e\left(\frac{Ze^2}{4K}\right)^2\left(\frac{-2-\sqrt{3}}{2-\sqrt{3}}\right) =$$

$$= 2\pi\left(\frac{2+\sqrt{3}}{2-\sqrt{3}}\right)\left(T_{Cu} + T_{Zn}\right)$$

$$Cu : Zn = 7 : 3$$

$$T_{Cu} = \frac{N_A \rho d}{A}\left(\frac{29\,(22\cdot 10^{-20})}{4\cdot 1{,}6\cdot 10^{-6}}\right)^2 = \cancel{6{,}02\cdot 10^{23}\cdot 1{,}5\cdot 10^{-3}} =$$

$$= \frac{6{,}02\cdot 10^{23}\cdot 1{,}5\cdot 10^{-3}\cdot 0{,}7}{63}\left(\frac{668{,}16\cdot 10^{-20}}{6{,}4\cdot 10^{-6}}\right)^2 =$$

$$= 10^{20}\cdot 1093{,}53\cdot 10^{-28} = 0{,}1\cdot 10^{-4}$$

$$T_{Zn} = \frac{6{,}02\cdot 10^{23}\cdot 1{,}5\cdot 10^{-3}\cdot 0{,}3}{65}\left(\frac{30\,(4{,}8\cdot 10^{-10})^2}{4\cdot 1{,}6\cdot 10^{-6}}\right)^2 = 0{,}05\cdot 10^{-4}$$

$$\frac{\Delta N_p}{\Delta N_{пад}} = 2\pi\,\frac{2+\sqrt{3}}{2-\sqrt{3}}\left(0{,}1\cdot 10^{-4} + 0{,}05\cdot 10^{-4}\right) = 1{,}3\cdot 10^{-3}$$

ДЗ №1.

№2.5.

б)

$$|\Delta p| = \sin\frac{\theta}{2}\cdot 2\,|\vec{p}_2|$$

$$K_2 = \frac{p_2^2}{2m} \qquad p_2 = \sqrt{2mK_2}$$

$$tg\frac{\theta}{2} = \left(\frac{q_1 q_2}{2bK}\right) \qquad tg\frac{\theta}{2}\ \frac{\sin\frac{\theta}{2}}{\sqrt{1-\sin^2\frac{\theta}{2}}}$$

$$\sin\frac{\theta}{2} = \frac{tg\frac{\theta}{2}}{\sqrt{1+tg^2\frac{\theta}{2}}}$$

$$tg\frac{\theta}{2} = \frac{82e^2}{bK_2} =$$

$$|\Delta p| = \frac{\frac{82e^2}{bK}}{\sqrt{1+\frac{6724e^4}{b^2K^2}}}\cdot\sqrt{2mK_2} =$$

$$= \frac{82e^2\cdot\sqrt{2mK_2}}{\sqrt{b^2K^2+6724e^4}}$$

$$|\Delta p| = \cancel{\frac{82e^2\,2m}{2\sqrt{2mK_2}\sqrt{b^2K^2+6724e^4}}} =$$

$$\cancel{\left(\frac{ze^2 2m}{2\sqrt{2mk_2}} \cdot \frac{}{\sqrt{6^2k^2+6z^2e^4}} - \frac{ze^2 \cdot 2 6^2 k}{\frac{3}{2}\sqrt{6^2k^2+z^2e^4}}\right)}$$

$$\cancel{\frac{}{\frac{3}{2}\sqrt{6^2k^2}}}$$

$-\frac{1}{2}-1=$

$=\frac{-1-2}{2}=$

$=-\frac{3}{2}$

$0{,}5$

$$= \frac{ze^2 2m}{2\sqrt{2mk_2}} \frac{}{\sqrt{6^2k^2+ze^4}} - \frac{2 6\sqrt{2mk_2}\, ze^2 \cdot 2 6 k^2}{\frac{3}{2}\sqrt{6^2k^2+z^2e^4}} = 0.$$

$$\frac{\sqrt{}}{\sqrt{2k_2}} - (6^2k^2+e^4z^4)^{-\frac{1}{2}} - \sqrt{2mk_2}(6^2k^2+e^4z^2)^{-\frac{3}{2}} \cdot 2 6k = 0$$

$$\frac{1}{\sqrt{2k_2}} - \frac{\sqrt{2k_2} \cdot 2 6 k_2}{6^2k^2+e^4z^2} = 0.$$

$$1 - \frac{4k^2 6}{6^2k^2-e^4z^2} = 0 \qquad 6^2k^2 - e^4z^2 - 4k^2 6 = 0$$

$$b^2k^2 + e^4z^2 - 4k^2b = 0$$

$$-3k^2b + e^4z^2 = 0 \quad 3k^2b = e^4z^2$$

$$k = \sqrt{\frac{e^4z^2}{3b}} =$$

$$= \frac{e^2z^2}{1{,}7 \cdot b} = \frac{82 \cdot 25 \cdot 10^{-20}}{1{,}7 \cdot 0{,}9 \cdot 10^{-11}}$$

$$= \cancel{1{,}33}\ \cancel{1339{,}8} \cdot \cancel{10^{-8}}\ 1{,}3 \cdot$$

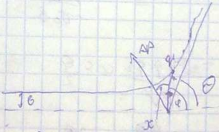
$$\theta = 2\,\mathrm{arctg}\,\frac{25 \cdot 10^{-20} \cdot 82}{\cancel{1339{,}8} \cdot 9\,10^{-11}} = 2\,\mathrm{arctg}\,1252$$

$1{,}3 \cdot 10^{-6}$

$$= \theta \approx 100^\circ$$

№2.3.

$$\mathrm{tg}\left(\frac{\theta}{2}\right) = \frac{q_1q_2}{2bK}$$



$L = \mathrm{const}$
$E = \mathrm{const}$

$$p = \sqrt{2mK} \qquad K = \frac{p^2}{2m}$$

b^2K

$= 0.$

$K_x(b^2K^2 + e^4z^2)^{-\frac{3}{2}}$

$2bK = 0$

$4K^2b = 0$