$$\sqrt{\frac{c^2 - u^2 - 2uv + 2uv + \dots}{c^2 - 2u\cancel{v} + \frac{u^2v^2}{c^2}}}$$

$$= \sqrt{\frac{c^2 - u^2 + \frac{u^2v^2}{c^2}}{c^2 - 2u\xi + \frac{u^2v^2}{c^2}}}$$

$$= \cancel{\gamma}\sqrt{1 - \left(\frac{u}{c}\right)^2}$$

$$ax^2 + 2bxy + cy^2 = S \qquad \left(\begin{cases} x = E_x, \; y = E_y \\ b = \frac{E_2}{E_1}\cos\alpha, \; c = \left(\frac{E_2}{E_1}\right)^2 \end{cases} \right)$$

$$\begin{cases} x = x'\cos\theta - y'\sin\theta \\ y = x'\sin\theta + y'\cos\theta \end{cases}$$

$$x'^2\cos^2\theta - 2x'y'\cos\theta\sin\theta + (y'\sin\theta)^2 + 2b(x'^2\sin\theta\cos\theta + x'y'\cos^2\theta - x'y'\sin^2\theta - y'^2\sin\theta\cos\theta) + c((x'\sin\theta)^2 + 2x'y'\sin\theta\cos\theta + (y'\cos\theta)^2)$$

$$\underline{x'^2}(\cos^2\theta + 2b\sin\theta\cos\theta + c\sin^2\theta) +$$

$$+ \underline{y'^2}(\sin^2\theta - 2b\sin\theta\cos\theta + c\cos^2\theta) + \cancel{x}$$

$$+ \underline{x'y'}\underbrace{(-2\cos\theta\sin\theta + 2b\cos^2\theta - 2b\sin^2\theta + 2c\sin\theta\cos\theta)}_{=\gamma}$$

$$\gamma = \cancel{2b} \; 2b\cos 2\theta + \cancel{2} c\sin 2\theta - \sin 2\theta =$$

$$= 2b\cos 2\theta + \cancel{c}\sin 2\theta(c-1)$$

$$2b\cos 2\theta + \sin 2\theta(c-1) = 0$$

$$2b + \operatorname{tg} 2\theta(c-1) = 0$$

$$\operatorname{tg} 2\theta = -\frac{2b}{(c-1)} = \frac{+2\frac{E_2}{E_1}\cos\alpha}{1 - \left(\frac{E_2}{E_1}\right)^2}$$

$$\theta = \frac{1}{2}\operatorname{arctg}\left(+\frac{2b}{(1-c)}\right)$$

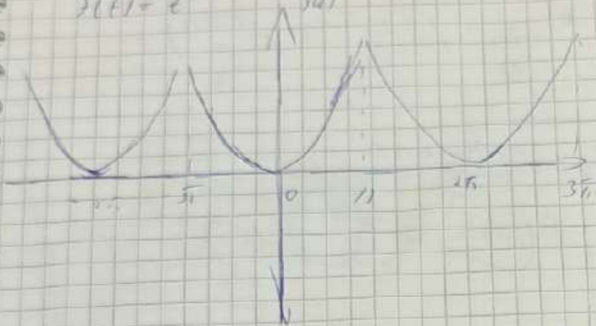
$$\cos\theta = \varepsilon; \quad \sin\theta = \xi \qquad \sin 2\theta = \varkappa$$

$$x'^2(\varepsilon^2 + b\varkappa + c\xi^2) + y'^2(\xi^2 - b\varkappa + c\varepsilon^2) =$$

$$S =$$

$$\frac{x'^2}{(\xi^2-6x+c\xi^2)}+\frac{y'^2}{(\xi^2+6x+c\xi^2)}=S^1$$

$f(t)=t^2$



$f(t)=\frac{1}{2}a_0+\sum a_n \ldots \qquad f(t)=\sum_{-\infty}^{\infty} c_n e^{-int}$

$c_n=\frac{1}{2\pi}\int_0^{2\pi} e^{-int} f(t)\,dt=\frac{1}{2\pi}\int_0^{2\pi} t^2 e^{-int}\,dt=$

$=\frac{1}{2\pi}\left(\frac{i}{n}t^2e^{-int}\Big|_0^{2\pi}-\frac{i}{n}\int_0^{2\pi} t e^{-int}\,dt\right)=$

$=\frac{1}{2\pi}\left(\frac{4\pi^2 i}{n}-\frac{i}{n}\left(\frac{i}{n}te^{-int}\Big|_0^{2\pi}-\frac{i}{n}\int_0^{2\pi} e^{-int}\,dt\right)\right)=$

$=\frac{1}{2\pi}\left(\frac{4\pi^2 i}{n}-\frac{i}{n}\left(\frac{2\pi i}{n}+\frac{1}{n}e^{-int}\Big|_0^{2\pi}\right)\right)=$

$=\frac{1}{2\pi}\left(\frac{4\pi^2 i}{n}-\frac{i}{n}\left(\frac{2\pi i}{n}\right)\right)=\frac{1}{2\pi}\left(\frac{4\pi^2 i}{n}+\frac{2\pi}{n^2}\right)$

$\frac{1}{2\pi}\left(\frac{4\pi^2 i}{n}+\frac{2\pi}{n^2}\right)=\frac{1}{2\pi n^2}(4\pi^2 i n+2\pi)=$

$f(t)=\sum_{-\infty}^{+\infty}\frac{4\pi^2 i n+2\pi}{2\pi n^2}e^{int}$

$$C_n = \frac{1}{2\pi}\int_{-\pi}^{\pi} t^2 e^{+int} = \frac{1}{2\pi}\left(-\frac{i}{n} t^2 e^{int}\Big|_{-\pi}^{\pi} + \right.$$

$$+\frac{i}{n}\int_{-\pi}^{\pi} t e^{int}\, d(t) = \frac{1}{2\pi}\left(\cancel{\ldots}\right) + \frac{i}{n}\left(-\frac{2i}{n} t e^{int}\Big|_{-\pi}^{\pi}\right) =$$

$$= \frac{1}{2\pi}\cdot\frac{2\pi}{n^2}\left(e^{i\pi n} + e^{-i\pi n}\right) =$$

$$= \frac{2}{n^2}(-1)^n$$

$$f(t) = \sum_{-\infty}^{\infty} \frac{2}{n^2}(-1)^n e^{-int}$$

$$\cancel{f(\pi) = 2\sum_{-\infty}^{\infty} \frac{1}{n^2}(-1)^{n+1} = \pi^2}$$

$$f(t) = \sum_{1}^{\infty}\left(\frac{2}{n^2}(-1)^n\right)\left(e^{int} + e^{-int}\right) + C_0$$

$$C_0 = \frac{1}{2\pi}\int_{-\pi}^{\pi} t^2\, dt = \frac{1}{6\pi}\left(t^3\right)\Big|_{-\pi}^{\pi} = \frac{\pi^2}{3}$$

$$f(\pi) = \sum_{1}^{\infty}\left(\frac{2}{n^2}(-1)^n\right)\left(e^{i\pi n} + e^{-i\pi n}\right) + \frac{\pi^2}{3} =$$

$$= 4\sum_{1}^{\infty}\frac{1}{n^2} + \frac{\pi^2}{3} = \pi^2 \Rightarrow \sum_{1}^{\infty}\frac{1}{n^2} = \frac{\pi^2}{6}$$

(3) $v = \frac{v' + u}{1 + \frac{v' u}{c^2}}$

$\uparrow \vec{v}_+'$

$\downarrow \vec{v}_-'$

$\vec{v}_+' = u$

$v_-' = \frac{u - v_-}{1 - \frac{u v_-}{c^2}}$

$\cancel{\lambda = \lambda}$ λ_0 $q = \lambda l$ – const (и-но при $l \uparrow$ $\lambda \downarrow$)

$l' = l\gamma$ (в движ.)

$\lambda' = \lambda \gamma$

$\lambda_+' = \lambda \cdot \frac{1}{\sqrt{1 - \left(\frac{u}{c}\right)^2}}$ $\lambda_-' = \lambda \cdot \frac{\sqrt{1 - \left(\frac{v_-}{c}\right)^2}}{\sqrt{1 - \left(\frac{v_-'}{c}\right)^2}}$

$\frac{1}{\sqrt{1 - \left(\frac{v'}{c}\right)^2}}$

$$\lambda_+' - \lambda_-' = \lambda \left(\frac{1}{\sqrt{1 - \left(\frac{u}{c}\right)^2}} - \frac{\sqrt{1 - \left(\frac{v_-}{c}\right)^2}}{\sqrt{1 - \left(\frac{v_-'}{c}\right)^2}} \right) =$$

$$= \lambda \left(\frac{1}{\sqrt{1 - \left(\frac{u}{c}\right)^2}} - \frac{\sqrt{1 - \left(\frac{v_-}{c}\right)^2}}{\sqrt{1 - \frac{u^2 - 2uv_- + v_-^2}{c^2 - 2uv_- + \frac{u^2 v_-^2}{c^2}}}} \right) =$$

$$= \lambda \left(\frac{1}{\sqrt{1 - \left(\frac{u}{c}\right)^2}} - \frac{\sqrt{1 - \left(\frac{v_-}{c}\right)^2}}{\sqrt{\left(1 - \left(\frac{v_-}{c}\right)^2\right)\left(1 - \left(\frac{u}{c}\right)^2\right)}} \left(1 - \frac{u v_-}{c^2}\right) \right)$$

$$\cancel{\lambda_- \sqrt{1-\left(\frac{v_-}{c}\right)^2} = \lambda'_- \sqrt{1-\left(\frac{v'_-}{c}\right)^2}}$$

$$= \frac{\lambda}{\sqrt{1-\left(\frac{u}{c}\right)^2}} \left(1-\frac{u v_-}{c^2}\right) = \frac{\lambda u v}{c^2} \gamma$$

$$E = \frac{2\lambda'}{R} = \frac{2 \lambda u v_- \gamma}{c^2 R}$$

4)

~~$(a\nabla)\vec{A} =$~~

1) $(a\nabla)r = \left(a_x\frac{\partial}{\partial x} + a_y\frac{\partial}{\partial y} + a_z\frac{\partial}{\partial z}\right)(x\vec{i} + y\vec{j} + z\vec{k}) =$

$= a_x\vec{i} + a_y\vec{j} + a_z\vec{k} = \vec{a}$

2) ~~$\nabla\times(\vec{a}\times\vec{b}) = \vec{a}\cdot(\nabla\cdot\vec{b}) - \vec{b}\cdot(\nabla\vec{a}) =$~~

~~$\frac{\partial}{\partial x} + \frac{\partial}{\partial}$~~

$$\nabla\times\begin{vmatrix} i & j & k \\ a_x & a_y & a_z \\ b_x & b_y & b_z \end{vmatrix} = \nabla\times\Big(i\,\overbrace{(a_y b_z - a_z b_y)}^{P} +$$

$$+\, j\,\overbrace{(a_z b_x - a_x b_z)}^{Q} + k\,\overbrace{(a_x b_y - a_y b_x)}^{R}\Big) =$$

$$= \begin{vmatrix} i & j & k \\ \partial_x & \partial_y & \partial_z \\ P & Q & R \end{vmatrix} = i\left(a_x\frac{\partial b_y}{\partial y} - b_x\frac{\partial a_y}{\partial y}\right) -$$

$$-\, b_x\frac{\partial a_z}{\partial z} + a_x\frac{\partial b_z}{\partial z}\Big) + j\left(b_z\frac{\partial a_x}{\partial x} - a_z\frac{\partial b_x}{\partial x}\right) -$$

$$a_y\frac{\partial b_z}{\partial z} + b_y\frac{\partial a_z}{\partial z} + k\left(a_z\frac{\partial b_x}{\partial x} - b_z\frac{\partial a_x}{\partial x}\right) -$$

$$-\, a_y\frac{\partial a_z}{\partial z} + b_y\frac{\partial a_z}{\partial z}$$

$$= i\left(\frac{\partial(a_x b_y - a_y b_x)}{\partial y} - \frac{\partial(a_z b_x - a_x b_z)}{\partial z}\right) +$$

$$+ \ldots = i\left(b_x\frac{\partial a_x}{\partial x} + b_y\frac{\partial a_y}{\partial y} + b_z\frac{\partial a_z}{\partial z} - b_x\frac{\partial a_x}{\partial x} - b_x\frac{\partial a_y}{\partial y} \ldots\right)$$

$$= i\big((b\nabla)a_x - b_x(\nabla\vec{a})\big) + j\big((b\nabla)a_y - b_y(\nabla\vec{a})\big) + \ldots$$

5) ① $\nabla \times f(r) \cdot \bar{r} = \begin{vmatrix} i & j & k \\ \partial_x & \partial_y & \partial_z \\ f(r)x & f(r)y & f(r)z \end{vmatrix} =$

$= i\left(z \frac{\partial f}{\partial y} - y \frac{\partial f}{\partial z}\right) + j\left(x \frac{\partial f}{\partial z} - z \frac{\partial f}{\partial x}\right) + k\left(y \frac{\partial f}{\partial x} - x \frac{\partial f}{\partial y}\right) =$

$= i\left(z \frac{df}{dr} \frac{\partial r}{\partial y} - y \frac{df}{dr} \frac{\partial r}{\partial z}\right) + \ldots =$

$= i\left(\frac{zy}{r} \frac{\partial f}{\partial r} - \frac{zy}{r} \frac{\partial f}{\partial r}\right) + \ldots = 0$

2) $\nabla \times (\bar{a} \times \bar{r}) = - \nabla \times (\bar{r} \times \bar{a}) =$

$= - ((\bar{a} \nabla) r - \bar{a} (\nabla \bar{r})) = - (\bar{a} - 3\bar{a}) = 2\bar{a}$

$$= \sqrt{\frac{c^2 - u^2 - 2uv + 2uv + \frac{u^2v^2}{c^2}}{c^2 - 2uv + \frac{u^2v^2}{c^2}}}$$

$$= \sqrt{\frac{c^2 - u^2 + \frac{u^2v^2}{c^2}}{c^2 - 2uv + \frac{u^2v^2}{c^2}}} =$$

$$= \frac{1}{c}\sqrt{\frac{1 - (\frac{u}{c})^2 + \frac{u^2v^2}{c^4}}{1 - \frac{2uv}{c^2} + (\frac{v}{c})^2}}$$

6) $$\frac{1}{c^2(x)}\frac{\partial^2 \xi}{\partial t^2} - \frac{\partial^2 \xi}{\partial x^2} = 0$$

$$\xi = \xi_0 \cos(\omega t)$$

$$\frac{\partial^2 \xi}{\partial t^2} = -\xi_0 \omega^2 \cos \omega t$$

1 $$\frac{\partial^2 \xi}{\partial x^2} + \underbrace{\frac{\omega^2}{c^2(x)}}_{k^2(x)} \xi$$

2 $$\frac{\partial^2 \xi}{\xi} = -k^2(x)\, dx^2$$

$$\frac{d c(x)}{dx} \ll \lambda$$

$$c(x+\lambda) = c(x) + \frac{d c(x)}{dx}\lambda$$

$$c(x+\lambda) - c(x) = \frac{d c(x)}{dx}\frac{2\pi}{\omega} c(x)$$

$$\frac{c(x+\lambda) - c(x)}{c(x)} = \frac{d c(x)}{dx}\frac{2\pi}{\omega} \ll 1$$

$$\frac{d\left(\frac{\omega}{k(x)}\right)}{dx}\frac{2\pi}{\omega} \ll 1$$

$$2\pi \frac{d k(x)}{dx}\frac{1}{k^2} \ll 1$$

3 $$\xi = e^S \Rightarrow$$

$$\Rightarrow \frac{d^2 \xi}{dx^2} + k^2 \xi =$$

$$= \frac{d^2 S}{dx^2} + \left(\frac{dS}{dx}\right)^2 + k^2 = 0$$

3)

4 $$\frac{d^2 S}{dx^2} \ll k^2 \Rightarrow \left(\frac{dS}{dx}\right)^2 = -k^2$$

$$\underline{S = \pm i \int k(x)\, dx}$$

7) $\nabla(\nabla \cdot H) = \frac{4\pi}{c}\nabla j + \frac{1}{c}\frac{\partial(\nabla E)}{\partial t} =$

$= \frac{4\pi}{c}\nabla j + \frac{4\pi}{c}\frac{\partial \rho}{\partial t} = 0$

$\nabla j + \frac{\partial \rho}{\partial t} = 0$

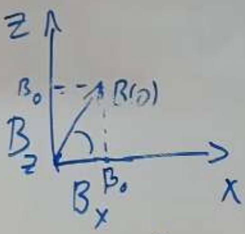
8) $\nabla \bar{A} + \frac{1}{c}\frac{\partial \varphi}{\partial t} = 0$

$\bar{A} = \bar{A}' + \nabla f \quad ; \quad \varphi = \varphi' - \frac{1}{c}\frac{\partial f}{\partial t}$

$\nabla(A' + \nabla f) + \frac{1}{c}\frac{\partial}{\partial t}\left(\varphi' - \frac{1}{c}\frac{\partial f}{\partial t}\right) = 0$

$\nabla \bar{A}' + \frac{1}{c}\frac{\partial \varphi'}{\partial t} + \underbrace{\Delta f - \frac{1}{c}\frac{\partial^2 f}{\partial t^2}}_{= 0} = 0$

① $B_z(z) = B_0 - \alpha z$



$$\nabla(\vec{B}) = 0$$

$$\vec{B} = B_z \vec{i} + B_x \vec{j}$$

$$\nabla \vec{B} = \frac{\partial B_z}{\partial z} + \frac{\partial B_x}{\partial x}$$

$$-\alpha + \frac{\partial B_x}{\partial x} = 0$$

$$\frac{\partial B_x}{\partial x} = \alpha$$

$$B_x = x\alpha + B_0 \quad (f(z))$$

②

10)

$i = i_0 \sin\omega t$

$i = \frac{dI}{dl}$

$$\oint B\,dl = \frac{4\pi}{c}\int_S j\,dS =$$

$$2Bl = \frac{4\pi}{c} i_0 \sin\omega t \cdot l$$

$$B = \underbrace{\frac{2\pi}{c} i_0}_{B_0} \sin\omega t$$

$$\cancel{B = C_1 \sin\omega t + C_2 \cos\omega t}$$

$$B = B_0 \sin\omega t$$

$$\nabla \times E = -\frac{1}{c}\frac{\partial B}{\partial t} = B_0 \omega \cos\omega t$$