3)

$$S = \frac{c}{4\pi} |E|^2 \bar{n} =$$

$$= \frac{e^2}{4\pi c^3 R^2} \left| n \times [n \times \dot{v}]] \right|^2 = \frac{e^2}{4\pi c^3 R^2} \dot{v}^2 \sin^2\theta$$

1)

$$E \, 2\pi r h = 4\pi Q$$

$$\cancel{(E + dE_r) 2\pi (r + dr) h = 4\pi \int_{r+dr} \rho \, dV}$$

$$E_{r+dr} 2\pi (r + dr) h = 4\pi (Q + dQ)$$

$$d(E_r r) 2\pi h = 4\pi \, dQ$$

$$dQ = 2\pi r \, dr \cdot h \cdot \rho$$

$$\frac{1}{r} \frac{d(Er)}{dr} = 4\pi \rho \Rightarrow \nabla E = \nabla(\bar{\nabla} \cdot \varphi) = \Delta \varphi =$$

$$= \frac{1}{r} \frac{d}{dr} \left(r \frac{d\varphi}{dr} \right)$$

$$\Delta \varphi = \frac{1}{r} \frac{d}{dr} \left(r \frac{d\varphi}{dr} \right)$$

$$(dS)^2 = \overbrace{\cos^2\varphi \, d\rho^2 + \sin^2\varphi \, d\varphi^2 - 2 \sin\varphi \cos\varphi \, d\rho \, d\varphi}^{dx^2}$$

$$+ \underbrace{\sin^2\varphi \, d\rho + \cos^2\varphi \, d\varphi^2 + 2 \sin\varphi \cos\varphi \, d\rho \, d\varphi}_{dy^2} + dz^2$$

$$= d\rho^2 + \rho^2 d\varphi^2 + dz^2$$

(2) $H = \nabla \times A$

$$\nabla \times A = -\frac{1}{c}\nabla\left(\underbrace{\frac{e}{R - \frac{vR}{c}}}_{=\varphi}\right)\times \bar V + \frac{1}{c}\underbrace{\left(\frac{e}{R - \frac{vR}{c}}\right)}_{=\varphi}(\nabla \times \bar V)$$

$$\nabla \times A = \frac{1}{c}\left(\varphi(\nabla \times \bar V) - \bar V \times (\nabla\varphi)\right)$$

~~$\nabla\varphi$ и $\nabla \times \bar V$ мы посчитали в классе~~

$$\nabla \times \bar V = \cancel{r \times \nabla t_r} - \dot{\bar V}\cdot \nabla t_r$$

$$\nabla \times A = -\frac{1}{c}\left(\cancel{\varphi}\,(\dot{\bar V} \times \nabla t')\varphi + \bar V \times (\nabla\varphi)\right)$$

∇t и $\nabla\varphi$ мы посчитали в классе.

$$\nabla t = -\frac{\bar n}{c}\gamma$$

$$\nabla\varphi = -\frac{e}{R^2}\gamma^2\left(\bar n\gamma + \frac{V}{c} - \frac{\bar n\gamma}{c^2}[\bar R\dot{\bar V} - V^2]\right)$$

Подставим:

$$\nabla \times A = -\frac{1}{c}\frac{\bar R}{c^3R^3}\frac{\gamma^3}{\cancel{\gamma^3}} \times \Big[\overbrace{\cancel{cR\gamma\dot{\bar V}}}^{R(c\bar n - \bar V)\dot{\bar V}} + (R\cdot\dot V)V +$$

$$+ (c^2 - V^2)(c\bar n - \bar V)\Big] = -\frac{1}{c}\frac{\bar n}{c^3R^2}\frac{\gamma^3}{\cancel{\gamma}} \times$$

$$\times\left[cR\dot{\bar V} - \dot{\bar V}(R\bar V) + \bar V(R\dot{\bar V})\} + (c^2 - V^2)(c\bar n - \bar V)\right]$$

$$= -\frac{1}{c}\frac{\bar n}{c^3R^2}\gamma^3 \times \left[cR\dot{\bar V} + (c^2 - V^2)(c\bar n - \bar V) + R\times[\bar V \times \dot{\bar V}]\right] =$$

$$= -\frac{1}{c}\bar n \times E$$

4) $\dot{V}_1 = \frac{4V_0}{T}$ $(0; \frac{T}{2})$; $\dot{V}_2 = -\frac{4V_0}{T}$ $(\frac{T}{2}, T)$

$$S = \frac{c}{4\pi}|E|^2 \bar{n} = \frac{e^2}{4\pi c^3 R^2} \dot{V}^2 \sin^2\theta =$$

$$= \frac{e^2}{4\pi c^3 R^2}\left(\frac{4V_0}{T}\right)^2 \sin^2\theta = S = \frac{dP}{R^2 d\Omega}$$

$$\int dP = \int \frac{e^2}{4\pi c^3}\left(\frac{4V_0}{T}\right)^2 \sin^2\theta \, d\Omega =$$

$$= \frac{e}{4\pi c^3}\left(\frac{4V_0}{T}\right)^2 \iint_S \sin^3\theta \, d\theta \, d\varphi =$$

$$= \frac{2}{3}\frac{e^2}{c^3}\dot{V}^2 \cdot \left(\frac{4V_0}{T}\right)^2 \qquad \left(\frac{\text{Дж}}{\text{с}}\right)$$

[redacted]

5) $r_0(t') = v\,t'$

$|R| = |r - r_0(t')| = c(t - t')$

$|r - v t'| = c(t - t')$

$r^2 - 2 r v t' + v^2 t'^2 = c^2(t^2 - 2tt' + t'^2)$

$$R\left(1 - \frac{\bar n \bar v}{c}\right) = c(t - t')\left[1 - \frac{v}{c}\frac{(r - v t')}{c(t - t')}\right] =$$

$$= c(t - t') - \frac{\bar v \cdot \bar r}{c} + \frac{v^2}{c} t' =$$

$$= \frac{1}{c}\left[(c^2 t - r \bar v) - (c^2 - v^2)\, t'\right]$$

$r_0(t) = v \cdot t'$

$|R| = |r - r_0(t)| = c(t - t')$

$\cancel{r^2 - 2\bar r\, r_0(t) + }$

$\cancel{R^2 - 2R}$ $r^2 - 2\bar r \bar v t' + v^2 t'^2 = c^2(t^2 - 2tt' + t'^2)$

$$t' = \frac{(c^2 t - \bar r \bar v) - \sqrt{(c^2 t - \bar r \bar v)^2 + (c^2 - v^2)(r^2 - c^2 t^2)}}{c^2 - v^2}$$

$$R\left(1 - \frac{\bar n \bar V}{c}\right) = \frac{1}{c}\sqrt{(c^2 t - r \bar V)^2 + (c^2 - V^2)(r^2 - c^2 t^2)}$$

$$(c^2t - \bar r \bar V)^2 + (c^2 - V^2)(r^2 - c^2t^2) =$$

$$= -2c^2(\bar r \cdot \bar V t) + (\bar r \cdot \bar V)^2 + (c^2 - V^2) r^2 + c^2 (Vt)^2$$

$$= -2c^2(\bar r \cdot [\bar r - \bar R]) + (\bar r \cdot \bar V)^2 + (c^2 - V^2) r^2 +$$

$$+ c^2(\bar r - \bar R)^2 =$$

$$= -\cancel{2c^2 r^2} + \cancel{2c^2 \bar r \bar R} + (\bar r \cdot \bar V)^2 + \cancel{c^2 r^2} - V^2 r^2 + \cancel{c^2 r^2} -$$

$$- \cancel{2c^2 \bar r \cdot \bar R} + c^2 R^2 = (\bar r \cdot \bar V)^2 - V^2 r^2 + c^2 R^2 =$$

$$= ([\bar R + \bar V t] \cdot \bar V)^2 - V^2 [\bar R + \bar V t]^2 + c^2 R^2 =$$

$$= (\bar R \cdot \bar V)^2 + \cancel{2(\bar R \cdot \bar V) V^2 t} + \cancel{V^4 t^2} - V^2 R^2 -$$

$$- \cancel{2tV^2(\bar R \cdot \bar V)} - \cancel{V^4 t^2} + (cR)^2 =$$

$$= (R^2 V^2 \cos^2\theta) + (cR)^2 - V^2 R^2 =$$

$$= -R^2 V^2 (1 - \cos^2\theta) + (cR)^2 =$$

$$= c^2 R^2 \left(1 - \frac{V^2}{c^2} \sin^2\theta\right)$$

$$R\left(1 - \frac{\bar n \bar V}{c}\right) = \pm R\sqrt{1 - \frac{V^2}{c^2}\sin^2\theta}$$

$$E = \frac{e\cancel{c}\left(1 - \frac{V^2}{c^2}\right)}{\cancel{c}R^3\left(1 - \frac{\bar n \bar V}{c}\right)^3} \cdot \left(\bar R - \frac{V}{c} R\right) =$$

$$= \frac{e}{R_t^{3*}\left(1 - \frac{V^2}{c^2}\sin^2\theta\right)^{3/2}} \cdot \bar R_t^*$$

$$\bar R - \frac{V}{c} R =$$

$$= \bar r - Vt = \bar R_t^*$$