№1

$R \propto T \qquad P \sim T^4 \qquad \alpha, \beta - const$

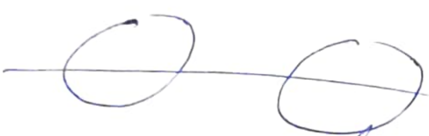
$R = \alpha T \qquad P = \beta T^4$

$P = \beta \dfrac{R^4}{\alpha^4} \qquad P(U) = \beta \dfrac{U^4}{\alpha^4 I^4}$

$R = \dfrac{U}{I}$

Ответ: $P(U) = \dfrac{\beta}{\alpha^4 I^4} U^4$

№2



$$\Delta\varphi = U_1 - U_2 = \int_a^{d-a} E_1\,dl - \int_a^{d-a} E_2\,dl = \int_a^{d-a} \frac{j_1}{\sigma}\,dl - \int_a^{d-a} \frac{j_2}{\sigma}\,dl \ominus$$

$j_1 = \dfrac{I}{2\pi r^2}$

$j_2 = -\dfrac{I}{2\pi r^2}$

$$\ominus \int_a^{d-a} \frac{2I}{2\pi\sigma r^2}\,dr = \frac{I}{\pi\sigma}\left(\frac{1}{a} + \frac{1}{d-a}\right) = \frac{Id}{\pi\sigma a(d-a)}$$

$$R = \frac{U}{I} = \frac{d}{\pi\sigma a(d-a)} = \underline{128{,}6\ \text{Ом}}$$

№3

$$\Delta\varphi = -\int_0^{d} E_1\,dr + \int_0^{d+\delta} E_2\,dr = -\int_0^{d} \frac{\rho I}{2\pi r^2}\,dr - \int_0^{d+\delta} \frac{\rho I}{2\pi r^2}\,dr$$

$$= \frac{\rho I}{2\pi}\left(\frac{1}{d} + \frac{1}{d+\delta}\right) = \frac{\rho I}{2\pi}\,\frac{2d+\delta}{d(d+\delta)} = \underline{23\ \text{кВ}}$$

$j_1 = \dfrac{I}{2\pi r^2}$

$j_2 = \dfrac{-I}{2\pi r^2}$

№4

(а) $\left[\dfrac{\partial}{\partial t}\,\dfrac{\varepsilon_2\vec{E}_2-\varepsilon_1\vec{E}_1}{4\pi}+\sigma_2\vec{E}_2-\sigma_1\vec{E}_1\right]\cdot\vec{n}=0$

$f \ll \dfrac{4\pi\sigma}{\varepsilon_0}$

$\dfrac{\varepsilon_2 f_2 E_2-\varepsilon_1 f_1 E_1}{4\pi}+\sigma_2 E_2-\sigma_1 E_1=0$

$E_1=E_2=E_0$

$f_1=f_2=f_0$

$\varepsilon_1=1 \qquad \varepsilon_2=\varepsilon$

$\sigma_1=0 \qquad \sigma_2=\sigma$

$\dfrac{\varepsilon f_0 E_0}{4\pi}+\sigma E_0=\dfrac{f E_0}{4\pi}$

$\sigma E_0\left(\dfrac{\varepsilon f_0}{4\pi}+1\right)=\dfrac{f E_0}{4\pi}$

$\varepsilon=\dfrac{4\pi\sigma E_0}{f}$

(б)

№5

$j = \frac{I}{S}$

$j = \sigma E$

$$U = \int_{R_0}^{R_0+H} E\,dR = \int_{R_0}^{R_0+H} \frac{j}{\sigma_0 + A(R-R_0)^2}\,dR =$$

$$= \int_{R_0}^{R_0+H} \frac{I}{4\pi R^2}\,\frac{1}{\sigma_0 + A(R-R_0)^2}\,dR = \int_0^H \frac{I}{4\pi(R_0+x)^2}\,\frac{dx}{\sigma_0 + Ax^2} =$$

$R_0 + x \approx R_0$

т.к x максимально 50км

$R_0 = 6400$км

$$= \int_0^H \frac{I}{4\pi R_0^2 \sigma_0}\,\frac{dx}{1 + \frac{A}{\sigma_0}x^2} =$$

$$= \frac{I}{4\pi R_0^2 \sigma_0}\int_0^H \frac{dx}{1 + \frac{A}{\sigma_0}x^2} = \frac{I}{4\pi R_0^2 \sigma_0}\sqrt{\frac{\sigma_0}{A}}\,\mathrm{arctg}\left(\sqrt{\frac{A}{\sigma_0}}\,x\right)\Big|_0^H =$$

$$= \frac{I}{4\pi R_0^2 \sigma_0}\sqrt{\frac{\sigma_0}{A}}\,\mathrm{arctg}\left(\sqrt{\frac{A}{\sigma_0}}\,H\right)$$

$$\tilde{R} = \frac{U}{I} = \frac{1}{4\pi R_0^2 \sqrt{\sigma_0 A}}\,\mathrm{arctg}\left(\sqrt{\frac{A}{\sigma_0}}\,H\right) = \underline{13.8\text{ кОм}}$$

чоло

? сопротивление