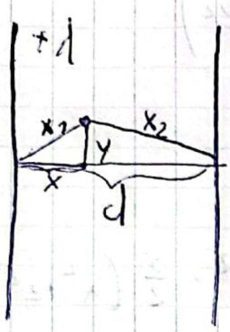
5.4



$$\phi = \frac{\lambda}{2\pi\varepsilon_0} \ln \frac{R_0}{x}$$

$$\phi = \frac{-\lambda}{2\pi\varepsilon_0}\left(\ln\frac{x_1}{R_0} - \ln\frac{x_2}{R_0}\right) = \frac{\lambda}{2\pi\varepsilon_0} \ln\frac{x_2}{x_1}$$

$$x_1 = \sqrt{x^2+y^2}$$

$$x_2 = \sqrt{(d-x)^2+y^2}$$

$$\phi = \frac{\lambda}{2\pi\varepsilon_0} \ln \sqrt{\frac{(d-x^2)+y^2}{x^2+y^2}}$$

$$\exp\left(\frac{2\pi V_0 \varepsilon_0}{\lambda}\right) = \sqrt{\frac{(d-x)^2+y^2}{x^2+y^2}}$$

$$\exp\left(\frac{2\pi V_0 \varepsilon_0}{\lambda}\right)^2 = \frac{(d-x)^2+y^2}{x^2+y^2}$$

$$\exp\left(\frac{2\pi V_0 \varepsilon_0}{\lambda}\right)^2 x^2 + \exp\left(\frac{2\pi V_0 \varepsilon_0}{\lambda}\right)^2 y^2 = d^2 + x^2 + y^2 - 2xd$$

I $V_0 = 0$

$$0 = d^2 - 2xd \Rightarrow x = +\frac{1}{2}d \text{ , - płaszczyzna}$$

II $V_0 \neq 0$

$$(y^2+x^2)\left(\exp\left(\frac{2\pi V_0 \varepsilon_0}{\lambda}\right)^2 - 1\right) + 2xd = d^2$$

$$x^2 + 2x\frac{d}{\exp\left(\frac{2\pi V_0 \varepsilon_0}{\lambda}\right)^2 - 1} + y^2 = \frac{d^2}{\exp\left(\frac{2\pi V_0 \varepsilon_0}{\lambda}\right)^2 - 1}$$

równanie walca $\rightarrow$ $$\Bigg(x + \underbrace{\frac{d}{\exp\left(\frac{2\pi V_0 \varepsilon_0}{\lambda}\right)^2 - 1}}_{\text{środek w } \frac{-d}{\exp\left(\frac{2\pi V_0 \varepsilon_0}{\lambda}\right)^2 - 1}}\Bigg)^2 + y^2 = \frac{d^2 \exp\left(\frac{2\pi V_0 \varepsilon_0}{\lambda}\right)^2}{\left(\exp\left(\frac{2\pi V_0 \varepsilon_0}{\lambda}\right)^2 - 1\right)^2}$$ $\leftarrow$ promień