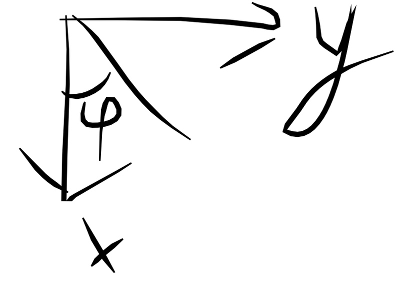

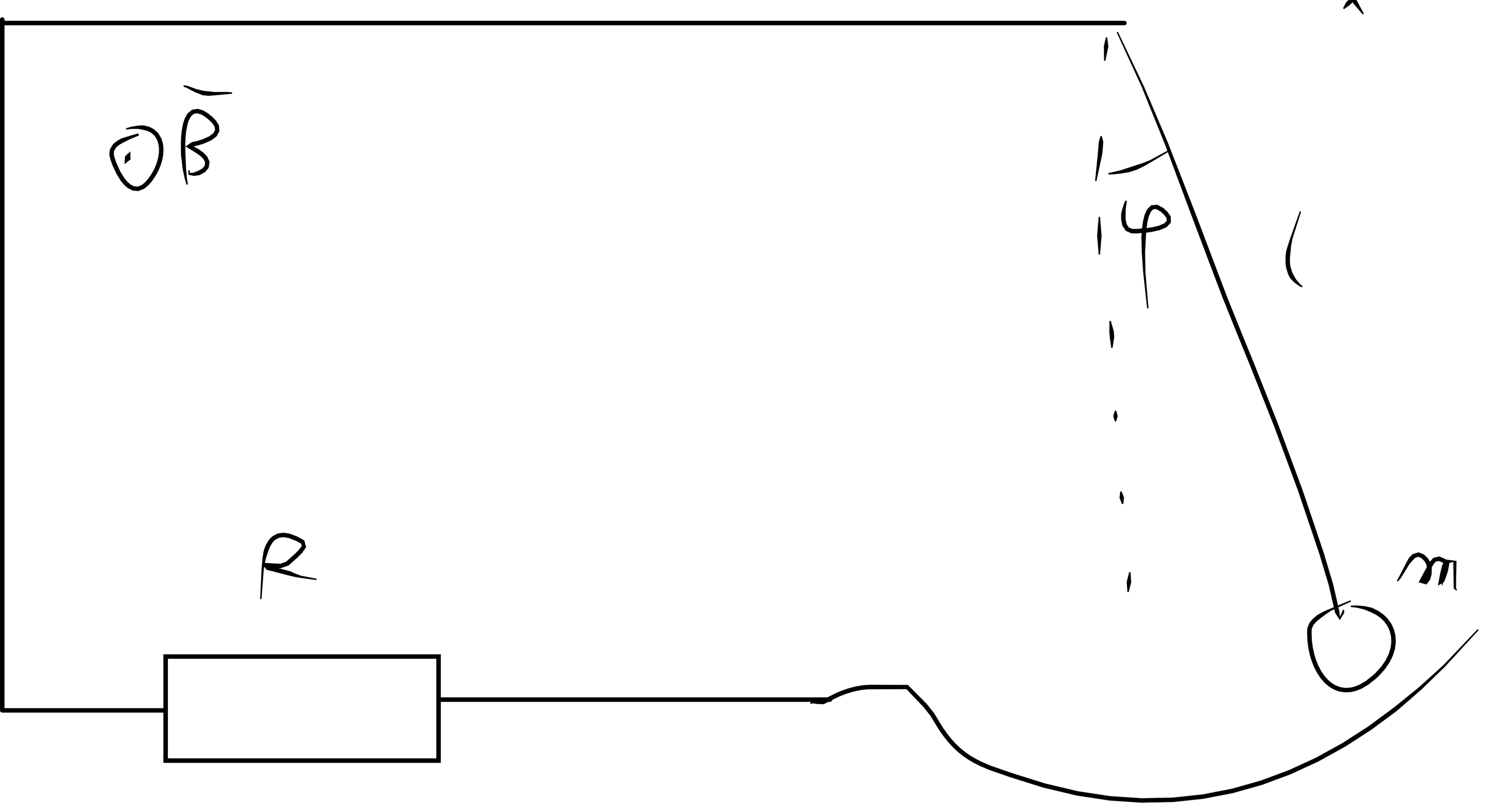

$$d\phi_B = B\frac{l^2}{2}\,d\varphi$$

$$\varepsilon_{ind} = \frac{-d\phi_B}{dt} = -B\frac{l^2}{2}\dot\varphi \qquad I = \frac{\varepsilon_{ind}}{R} = \frac{-Bl^2\dot\varphi}{2R}$$

$$J = ml^2 \qquad d\bar M = \bar r \times d\bar F = I\bar r \times (d\bar l \times \bar B)$$

$$\bar M = \int_0^l B\cdot\left(\frac{-Bl^2\dot\varphi}{2R}\right) r\,dr = -\frac{B^2l^4\dot\varphi}{4R}$$

$$J\ddot\varphi = -mgl\sin\varphi - \frac{B^2l^4\dot\varphi}{4R} \qquad \sin\varphi \approx \varphi$$

$$\ddot\varphi + \frac{B^2l^2}{4Rm}\dot\varphi + \frac{g}{l}\varphi = 0$$

$$\ddot x + 2\beta\dot x + \omega^2 x = 0$$

$$x = Ae^{\lambda t} \qquad \lambda^2 + 2\beta\lambda + \omega^2 = 0$$

$$\lambda = \frac{-2\beta \pm 2\sqrt{\beta^2-\omega^2}}{2} = \beta \pm \sqrt{\beta^2-\omega^2}$$

$$x = e^{\beta}\left(Ae^{\sqrt{\beta^2-\omega^2}\,t} + Be^{-\sqrt{\beta^2-\omega^2}\,t}\right) \qquad \beta = \frac{B^2l^2}{8Rm}$$

słabe tłumienia dla $\beta < \omega$ $\qquad \omega = \sqrt{\frac{g}{l}}$

$$\frac{B^2l^2}{8Rm} < \sqrt{\frac{g}{l}} \qquad x = \varphi$$

$$R > \frac{B^2 l^{\frac{5}{2}}}{8m\sqrt{g}}$$

silne dla $R < \frac{B^2 l^{\frac{5}{2}}}{8m\sqrt{g}}$