Initial Variables:

t_0 (s) : 0 $\quad \theta_0(^\circ)$:

z_0 (cm) : $\quad u_0$ (m/s) :

y_0 (cm) : $\quad Re_0 = \frac{e u_0 d}{\mu}$

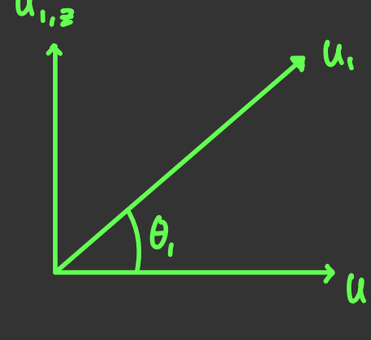
Horizontal Force Balance:

$F_{net,y} = -F_{D,y}$

$ma_y = -F_D \cos\theta$

$$m\left(\frac{u_{1,y} - u_{0,y}}{t}\right) = -\left(\frac{1}{2} C_D e u_{0,y}^2 \frac{\pi D^2}{4}\right)\cos(\theta)$$

$$u_{1,y} = \left[-\left(\frac{1}{2} C_D e u_{0,y}^2 \frac{\pi D^2}{4}\right)\cos(\theta)\right]\left(\frac{t}{m}\right) + u_{0,y}$$



$$u_1 = \sqrt{u_{1,z}^2 + u_{1,y}^2}$$

$$\theta_1 = \tan^{-1}\left(\frac{u_{1,z}}{u_{1,y}}\right)$$

$$Re_1 = \frac{e u_1 D}{\mu}$$

$u_{1,y} = u_1 \cos\theta$

Vertical Force Balance:

$F_{net,z} = F_B - F_g - F_{D,z}$

$ma_z = F_B - F_g - F_D \sin\theta$

$$m\left(\frac{u_{1,z} - u_{0,z}}{t}\right) = \frac{\pi D^3 g}{6}(e - e_s) - \left(\frac{1}{2} C_D e u_{0,z}^2 \frac{\pi D^2}{4}\right)\sin\theta$$

$$u_{1,z} = \left[\frac{\pi D^3 g}{6}(e - e_s) - \left(\frac{1}{2} C_D e u_{0,z}^2 \frac{\pi D^2}{4}\right)\sin\theta\right]\left(\frac{t}{m}\right) + u_{0,z}$$

$u_{1,z} = \frac{z_1 - z_0}{t} \Rightarrow z_1 = t u_{1,z} + z_0$

$u_{1,y} = \frac{y_1 - y_0}{t} \Rightarrow y_1 = t u_{1,y} + y_0$