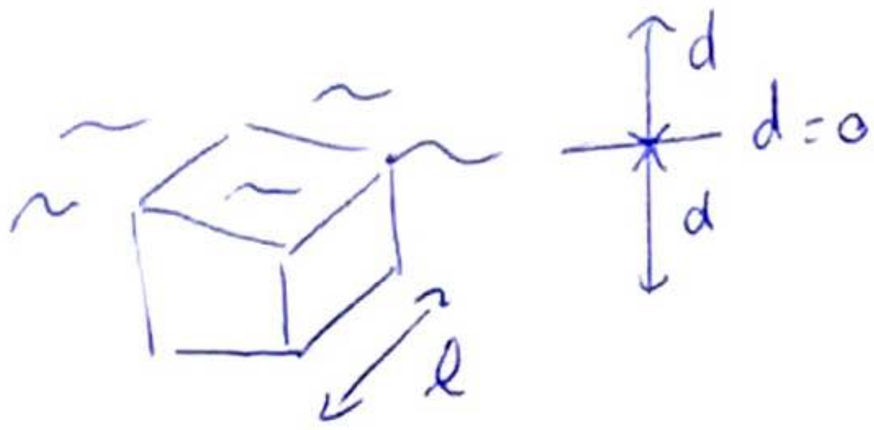
(112) Bouée.



$f = mg - \rho_0 g l^2 \max(0, l + \min(d, 0)) - \frac{1}{2}\rho_0 \cdot \sigma|\sigma| \cdot l^2 C_x$

f_g ↑ f_a ↑ f_d ↕

(b > 0) → bouée coule

(b < 0) → bouée remonte à la surface.

on a $\dot{b} = u$ avec $u \in [-1, 1]$

$b \in [-1, 1]$ (volume limité)

(1) on a $x = \begin{pmatrix} d \\ \sigma \\ b \end{pmatrix}$

$$\Rightarrow \boxed{\begin{cases} \dot{d} = \sigma \\ \dot{\sigma} = \frac{1}{m} \cdot \left(mg - \rho_0 \cdot g \cdot l^2 \cdot \max(0, l + \min(d,0)) - \frac{1}{2}\rho_0 \cdot \sigma \cdot |\sigma| \cdot l^2 C_x \right) \\ \dot{b} = u \end{cases}}$$

(*) $\sum \vec{F}_{ext} = m\vec{a}$ avec $\vec{a} = \dot{\vec{v}}$ d'où $m\dot{\sigma} = f_g - f_a - f_d$

$$\Rightarrow m\dot{\sigma} = m \cdot g - \rho_0 g l^2 \cdot \max(0, l + \min(d,0)) - \frac{1}{2}\rho_0 \cdot |\sigma| \cdot \sigma \cdot l^2 \cdot C_x$$

$$\rightarrow \boxed{\dot{\sigma} = (*) \quad \text{(voir éq d'état)}}$$

② $y = d$

$\dot{y} = \dot{d} = v$

$\ddot{y} = \dot{v} = g - \left(g\varrho + \frac{1}{2} \cdot v|v| \cdot \rho c_x\right) / (1 + \beta \cdot b)\, \ell$

- $s(x,t) = \underbrace{(\ddot{y}_d - \ddot{y})}_{\ddot{e}} + 2 \cdot \underbrace{(\dot{y}_d - \dot{y})}_{\dot{e}} + \underbrace{(y_d - y)}_{e} = 0$

$\Leftrightarrow \quad \ddot{e} + 2\dot{e} + e = 0$ is stable $\Leftrightarrow$ $\lim_{t \to t_\infty} e(t) = 0$

$T = 1$ sec.