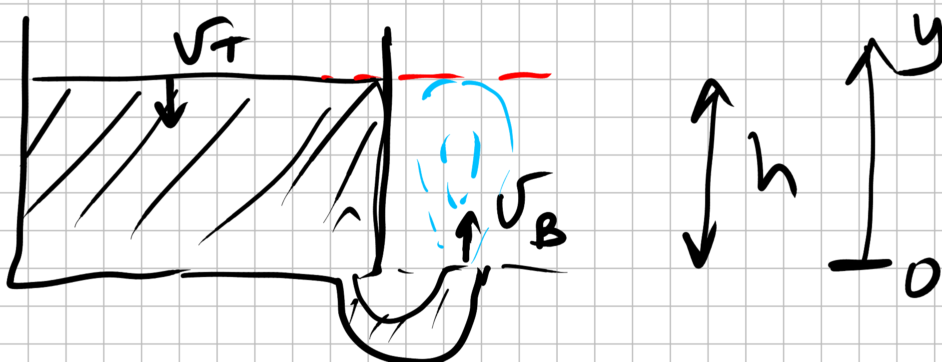
Fluid : incompessable which flows laminar with vortices or turbulense

$$P + \rho \frac{v^2}{2} + \rho g h = \text{constant}$$



$$P_T + \rho \frac{v_T^2}{2} + \rho g h = P_B + \rho \frac{v_B^2}{2} + 0$$

$$P_T + P_B = P_{atmosphere}$$

Flow rate

$$Q = v \cdot A = \text{const}$$

$$v_T \cdot A_T = v_B \cdot A_B \implies$$

Assumption

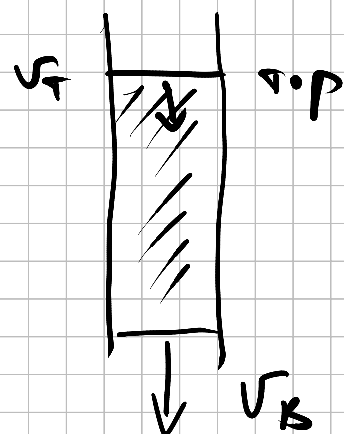
$$A_T \gg A_B$$

$$v_T \approx 0$$

$$v_T = v_B \cdot \frac{A_B}{A_T}$$

$$\cancel{\rho} g h = \cancel{\rho} v_B^2 / 2 \Rightarrow v_B = \sqrt{2gh}$$

Case 2.

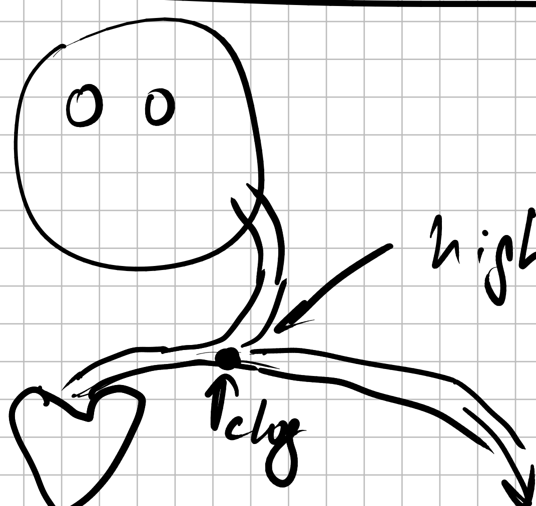


$$\cancel{P_T} + \cancel{\frac{\rho v_T^2}{2}} + \rho g h = \cancel{P_B} + \cancel{\frac{\rho v_B^2}{2}}$$

Flow rate $\Rightarrow v_T = v_B$

$P_T = P_B =$ atmosperic pressure

$\Rightarrow$ Paradox $\rho g h = 0$



higher speed $\Rightarrow$ low pressure

$\Rightarrow$ less blood to the head

Harmonic oscillator

repeat itself

Period $- T$

frequency

$f = 1/T$

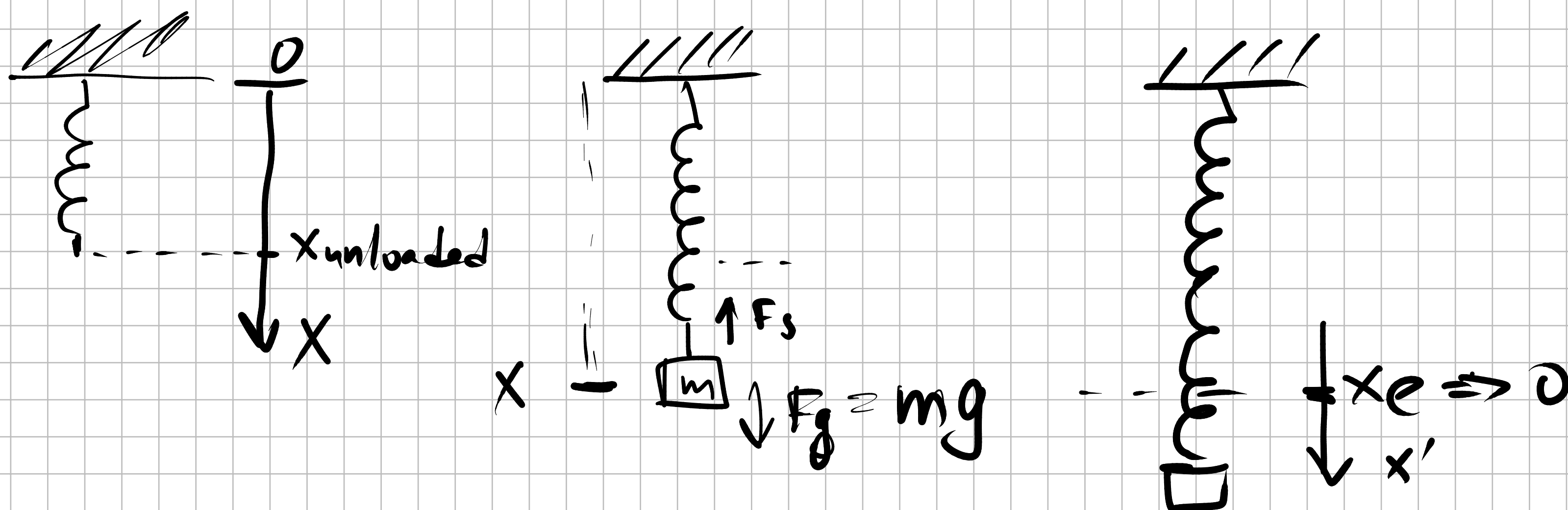
if Force acting on the object $F = -\text{const} \cdot x$

$$F = ma = m\frac{d^2x}{dt^2} = \boxed{m\ddot{x} = -\text{const} \cdot x}$$

Spring : $\Rightarrow$ Hooke law

$$F = -k \cdot x$$

spring constant



$$ma = -F_s + mg = -k(x - x_{unload}) + mg$$

equilibrium $\quad F_{net} = 0 = -k(x_{equilibrium} - x_{unl}) + mg = 0$

$$x = x_e + x' \Rightarrow x' = x - x_e$$

displacement from equilibrium

$$\ddot{x} = \ddot{x}'$$

$$m\ddot{x}' = -k(x' + x_e - x_{unL}) + mg$$

$$= -kx' \underbrace{- k(x_e - x_{unl}) + mg}_{0}$$

0 see above condition for equilibrium

$$m\ddot{x}' = -kx'$$

relabeling $x' \rightarrow x$ (with respect to equilibrium)

$$\boxed{m\ddot{x} = -kx(t)} \Rightarrow \boxed{\ddot{x} = -\frac{k}{m}x}$$

$$x(t) = A \cdot \cos(\omega t) \leftarrow \text{guess}$$

$$\dot{x}(t) = \frac{dx(t)}{dt} = A(-1)\sin(\omega t)\underbrace{\frac{d(\omega t)}{dt}}_{\omega}$$

$$= -\omega A \sin(\omega t)$$

$$\ddot{x}(t) = \frac{d}{dt}(\dot{x}) = -\omega A\cos(\omega t)\underbrace{\frac{d(\omega t)}{dt}}_{\omega}$$

$$\ddot{x} = -\omega^2 A \cos(\omega t) = -\omega^2 x(t)$$

$$\ddot{x} = -\frac{k}{m} x(t)$$

$$\Rightarrow \boxed{\omega = \sqrt{\frac{k}{m}}}$$

Better guess $\boxed{x(t) = A\cos(\omega t + \varphi)}$