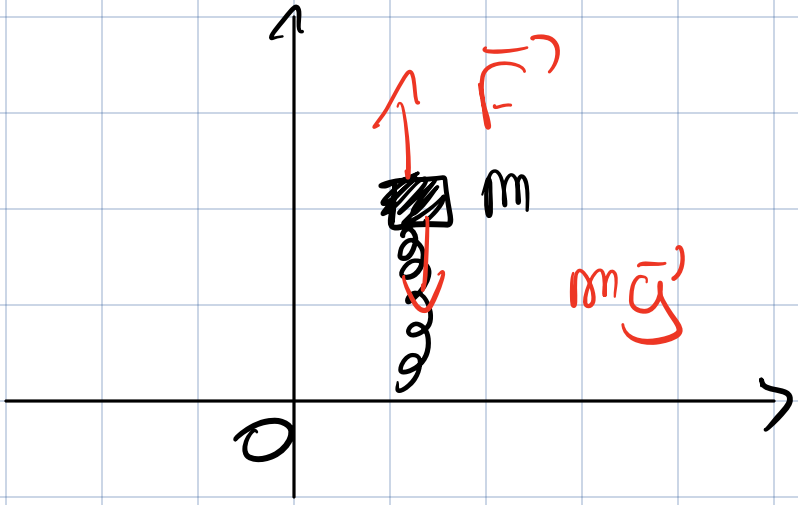
Ex 4



(a) $\sum \vec{F} = m\vec{a}$

$= m\vec{g} + \vec{F}$

$m\ddot{z} = -k(z - l_0) + mg$

$= -kz + kl_0 + mg$

$$\frac{-m}{k}\ddot{z} = z - l_0 - \frac{mg}{k}$$

$$u = z - l_0 \dots$$

$$z(t) = A\cos(\omega t) + B\sin(\omega t) + l_0 + \frac{mg}{k}$$

$$A = \left(z_0 - l_0 - \frac{mg}{k}\right)$$

$$\dot{z}(t) = -A\omega\sin(\omega t) + B\omega\cos(\omega t)$$

$$B = \frac{v_0}{\omega}$$

$$T = \frac{2\pi}{\omega}$$

$$z(t) = \left(z_0 - l_0 - \frac{mg}{k}\right)\cos(\omega t) + \frac{v_0}{\omega}\sin(\omega t) + l_0 + \frac{mg}{k}$$

$$\omega = -\sqrt{\frac{k}{m}} \Leftrightarrow \omega^2 = \frac{k}{m}$$

$$\Leftrightarrow k = \omega^2 \cdot m$$

$$T = \frac{2\pi}{\omega} \Leftrightarrow \omega = \frac{2\pi}{T}$$

$$k = \left(\frac{2\pi}{T}\right)^2 \cdot m$$

(b)

$$z_1(t) = \left(z_0 - l_0 - \frac{mg}{k}\right)\cos(\omega t) + \frac{v_0}{\omega}\sin(\omega t) + l_0 + \frac{mg}{k}$$

$$z_1(t_{eq}) = z_2(t_{eq}) + \Delta z$$

$$\cancel{l_0} + \frac{(m+M)}{g} = \cancel{l_0} + \frac{M}{g} + \Delta z$$

$$\frac{m}{g} = \Delta z$$

$$k = \omega^2 . m$$

on fixe k pour que $T = \frac{2\pi}{\omega}$ soit