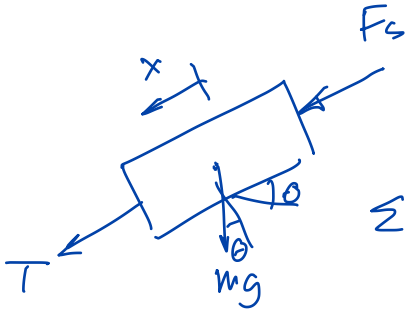
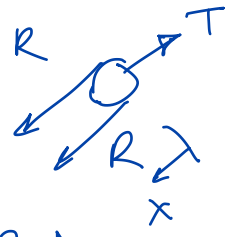
UBC-DYN-18-023

find ω_n



$\Sigma F_x: F_s + T + mg\sin\theta = m\ddot{x}$

$F_s = -k(x + x_{eq})$

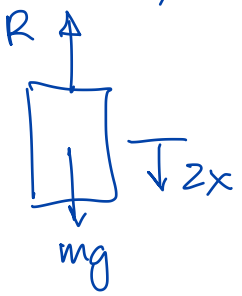


$(m=0)$

$\Sigma F_x: 2R - T = 0$

$T = 2R$

$= 2mg - 4m\ddot{x}$

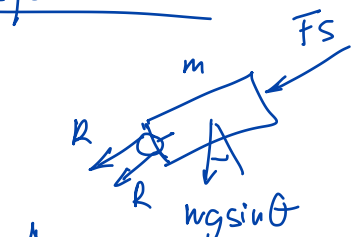


$\Sigma F_x: -R + mg = m(2\ddot{x})$

$R = mg - m(2\ddot{x})$

$\Rightarrow -kx - kx_{eq} + 2mg - 4m\ddot{x} + mg\sin\theta = m\ddot{x}$

at equilibrium



$\Sigma F_x: F_s + 2R + mg\sin\theta = 0$

$-kx_{eq} + 2mg + mg\sin\theta = 0$

$kx_{eq} = 2mg + mg\sin\theta$

$R = mg$

$\Rightarrow -kx - 4m\ddot{x} = m\ddot{x}$

$5m\ddot{x} + kx = 0$

$\ddot{x} + \frac{k}{5m}x = 0$

$\Rightarrow \boxed{\omega_n = \sqrt{\frac{k}{5m}}}$