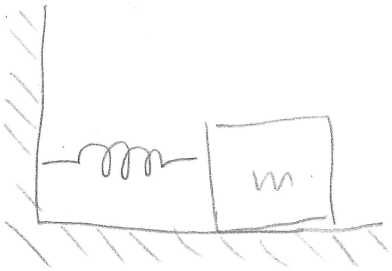
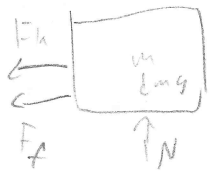
20-R-VIB-DY-26 Beginner

A box of mass $m = 5kg$ is connected to a spring, $k = 20 N/m$ on the wall. The ground has a static & kinetic friction coefficient $\mu = 0.2$. Given an initial displacement of $1 m$, determine how long it takes to come to a stop.



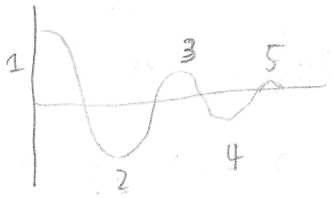
FBD:



$F_f > F_k$ at stop

$$x(t) = \left(x_0 - \frac{(2n-1)\mu mg}{k}\right)\cos \omega_n t + \frac{\mu mg}{k}(-1)^{(n+1)}$$

n = every peak has to stop at peak because $f_{static} > f_{kinetic}$



$$\omega_n = \sqrt{\frac{k}{m}} = \sqrt{40}$$

$$\mu mg > |kx(t)|$$

$$\frac{\mu mg}{k} > \left|\left(x_0 - \frac{(2n-1)\mu mg}{k}\right)\cos \omega_n t + \frac{\mu mg}{k}(-1)^{(n+1)}\right|$$

$$0.04905 > \left|(1m - 0.04905(2n-1)\cos\sqrt{40}t + 0.04905(-1)^{(n+1)}\right|$$

$$0.04905 > \left(x_0 - \frac{\mu mg}{k}(2n-2)\right.$$

$n = 11$ 5 full periods

$\sqrt{40}\,t = 10\pi$

$$t = \frac{10\pi}{\sqrt{40}}$$