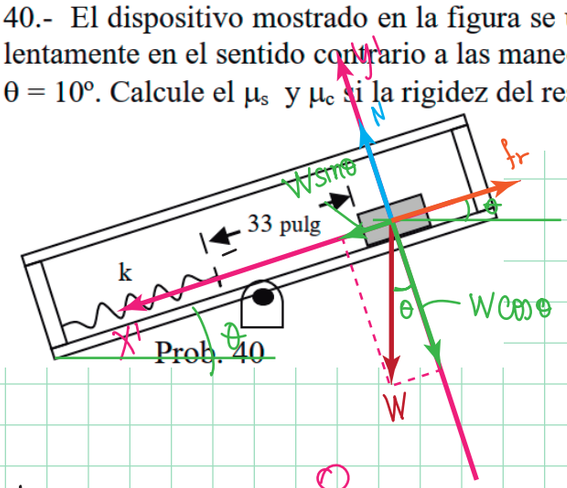
40.- El dispositivo mostrado en la figura se utiliza para medir coeficientes de fricción. En este, el contenedor gira lentamente en el sentido contrario a las manecillas del reloj hasta que un bloque de 4 lb empieza a deslizar cuando $\theta = 10^\circ$. Calcule el μ_s y μ_c si la rigidez del resorte es k = 5 lb/pulg y su deformación máxima es 1,5 pulgadas.

R. 0.18 y 0.13



Prob. 40

$W = 4\,lb$, $\theta = 10^\circ$, $\mu_s = ?$, $\mu_c = ?$ $\Rightarrow a = 0$

$k = 5\,\frac{lb}{in}$

$\Delta x = x = 1{,}5\,in$

$+\leftarrow \sum F_{x'} = ma_{x'}$ (0)

$W\sin\theta - f_r = 0$

$W\sin\theta = f_r$

$W\sin\theta = \mu_s W\cos\theta$

$\mu_s = \frac{\sin\theta}{\cos\theta}$

$\mu_s = \tan\theta = \tan 10^\circ$

$\boxed{\mu_s = 0{,}18}$ // sol. a)

$f_r = \mu N$

$+\uparrow \sum F_{y'} = 0$

$N - W\cos\theta = 0$

$N = W\cos\theta$

$\therefore f_r = \mu_s W\cos\theta$

b) $\mu_c = ?$ $\Rightarrow a \neq 0$

$\sum F_{x'} = ma_x = \frac{W}{g}a_x$

$a_x = a$

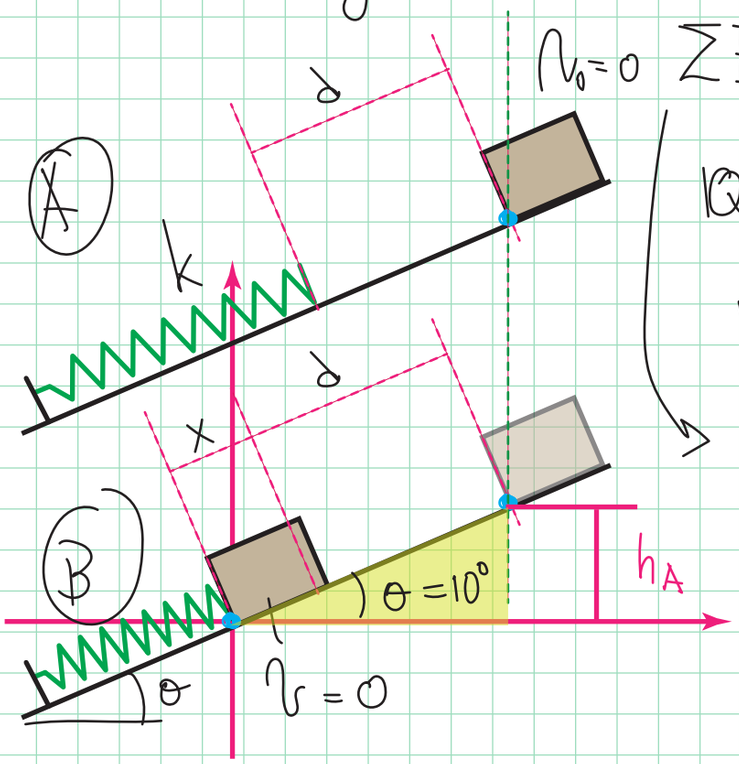
$W\sin\theta - f_r = \frac{W}{g}a \Rightarrow W\sin\theta - \mu_c W\cos\theta = \frac{W}{g}a$

$\mu_c\cos\theta = \sin\theta - \frac{a}{g}$

$\mu_c = \tan\theta - \frac{a}{g\cos\theta}$ // Por dinamica $a = ?$

Por Energías

$d = 3\,in$



$\eta_0 = 0 \quad \sum E_A = \sum E_B + |Q|$

$|Q| = |W_{fr}| = f_r \Delta x = f_r (x+d)$

$W_{fr} = \mu_c W \cos\theta (x+d)$

$\underbrace{mg}_{W} h_A = \frac{1}{2} k x^2 + \mu_c W \cos\theta (x+d)$

$\hookrightarrow W h_A - \frac{1}{2} k x^2 = \mu_c W \cos\theta (x+d)$

$\sin\theta = \frac{h_A}{(x+d)}$

$h_A = (x+d)\sin\theta$

$\mu_c = \frac{h_A}{\cos\theta (x+d)} - \frac{k x^2}{2W \cos\theta (x+d)}$

$\mu_c = \frac{(x+d)\sin\theta}{(x+d)\cos\theta} - \frac{k x^2}{2W(x+d)\cos\theta}$

$\mu_c = \tan\theta - \frac{k x^2}{2W(x+d)\cos\theta}$

$x = 1,5\,in = 0,125\,ft$

$(x+d) = 1,5 + 3 = 34,5\,in$

$(x+d) = 2,875\,ft$

$k = 5\,\frac{lb}{in}$

$\mu_c = \tan 10 - \frac{5 \cdot 1,5^2}{2 \cdot 4 \cdot 34,5 \cdot \cos 10} \Rightarrow \boxed{\mu_c = 0,13}$

Por dinamica

$\mu_c = \tan\theta - \frac{a}{g\cos\theta}$

?

$\mu_c = \tan\theta - \frac{k x^2}{2W(x+d)\cos\theta}$

Por Energías

Por comparación

$\left[\frac{a}{g}\right] = \left[\frac{k x^2}{2W(x+d)}\right] \Rightarrow a = \frac{g k x^2}{2W(x+d)} = \frac{32,2 \cdot 5 \cdot 1,5^2}{2 \cdot 4 \cdot 34,5} = \boxed{a = 1,31\,ft/s^2}$

$\left[\frac{k x^2}{2W(x+d)}\right] = \frac{(lb/in) \cdot in^2}{lb\,in} = [\,/\,]$