Prelims Solutions

Problem J10M3

Valentin Skoutnev

1

The x component of Newton's equation on the slab gives $M\ddot{x} = F_L - F_R$ with $F_L = \mu_k N_L$, $F_R = \mu_k N_R$. The y component gives $0 = Mg - N_L - N_R$. Torque balance around the left contact point gives $Mg(d/2 + x) = N_R d$. Now we can solve for $N_R = Mg(1/2 - x/d)$, $N_L = Mg(1/2 - x/d)$. Hence, $M\ddot{x} = -\frac{2\mu_k Mg}{d}x$ and $x(t) = x_o cos(\sqrt{\frac{2\mu_k g}{d}}t)$ for the initial conditions $x(0) = x_0$, $\dot{x}(0) = 0$.

2

Only difference is that now $M\ddot{x} = F_R - F_L = -(F_L - F_R) = \frac{2\mu_k Mg}{d}x \rightarrow x(t) = x_o cosh(\sqrt{\frac{2\mu_k g}{d}}t)$.