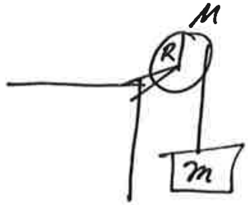
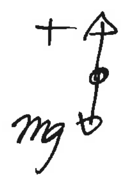
Sum 2012
Exam 3

1.



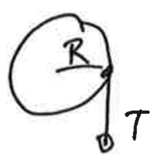
m



$\sum F = T - mg = -ma$

$a = g - T/m$

M



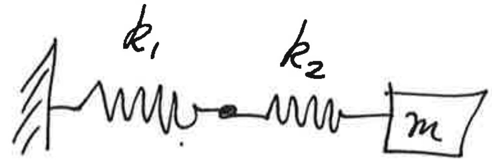
$\sum \tau = RT = I\alpha = I\frac{a}{R}$ $\qquad \alpha = a/R$ if no slip

$a = \frac{R^2 T}{I} = g - T/m$

$\frac{T}{m} + \frac{R^2}{I}T = g = T\left(\frac{1}{m} + \frac{R^2}{I}\right)$

- $T = \frac{mg}{1 + \frac{mR^2}{I}} = \frac{mg}{1 + 1/c}$
- $a = g - \frac{T}{m} = g - \frac{g}{1+\frac{1}{c}} = g\left(1 - \frac{1}{1+c}\right) = g\left(\frac{c}{1+c}\right)$
- $\alpha = a/R$

4.



at joint: $F = -k_1 x_1 = -k_2 x_2$ if springs are displaced by x_1, x_2

$\Rightarrow x_1 = \frac{k_2}{k_1} x_2$ identical springs, $k_1 = k_2$

total displacement is $x_1 + x_2 = \Delta x$

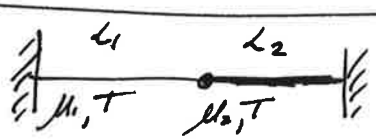
effective spring const would obey

$$F = -k_{eff}\,\Delta x = -k_{eff}(x_1 + x_2) = -k_{eff}(x_1 + x_1) = -k_{eff}(2x_1)$$

for this to work, need $k_{eff} = k_1/2 = k_2/2$

$$\Rightarrow T = 2\pi\sqrt{\frac{m}{k_{eff}}} = 2\pi\sqrt{\frac{m}{k_1 + k_2}}$$

5.



$t = \frac{\Delta x}{v}$ = same for both

$$t_1 = \frac{L_1}{v_1} = \frac{L_1}{\sqrt{T/\mu_1}}$$

$$t_2 = \frac{L_2}{\sqrt{T/\mu_2}}$$

$$t_1 = t_2 \Rightarrow \frac{L_1}{\sqrt{T/\mu_1}} = \frac{L_2}{\sqrt{T/\mu_2}}$$

$$\Rightarrow \frac{L_1}{L_2} = \sqrt{\frac{\mu_2}{\mu_1}}$$