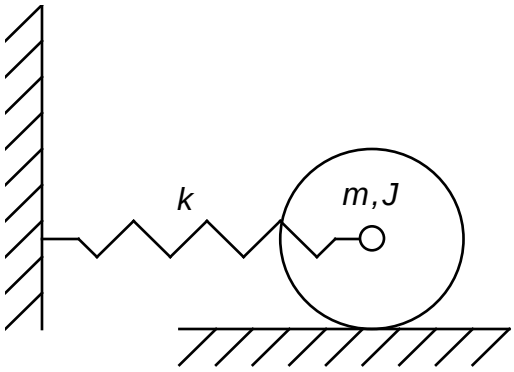
ME 460/660 Exam 1, Spring 1994

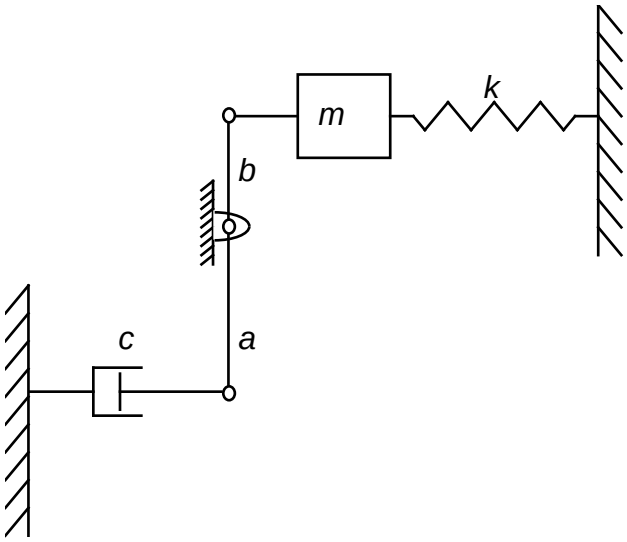
One problem may be skipped.

1) The damping ratio, ζ, and natural frequency, ω, of a single degree of freedom system are identified by examination of the free response to be 0.01 and 10 rad/sec. The spring stiffness is found to be 10 N/m by static analysis. What is the damping coefficient and the mass? Include correct units.

2) A cylinder of mass m and mass moment of inertia $1/2mr^2$ is free to roll without slipping but is restrained by a spring, k, as shown below. Determine the damping ratio and the natural frequency. (Hint: Use the energy method.)



3) Determine the equation of motion for the system below.



One problem may be skipped.

4) Given that the maximum value of A_0 occurs when the maximum of

$(A_0 k)/F_0 = 1/\left(\sqrt{(1-r^2)^2 + (2\zeta r)^2}\right)$ occurs, derive the maximum of A_0 with respect to *r*.

5) a) Shown that for a free decay system, $x_i/x_{i+1} = const$ where x_i is the amplitude after *i* cycles.

b) Given that for a free decay system, $x_i/x_{i+1} = const$, and that the logarithmic decrement is $\delta = \ln x_i/x_{i+1}$, show that $\delta = (1/n)\ln x_0/x_n$. (Hint: $\ln x^n = n\ln x$)

6) The amplitude of motion of a pendulum decreases from 10 mm to 9 mm after 1000 cycles. Determine the damping ratio of the system.