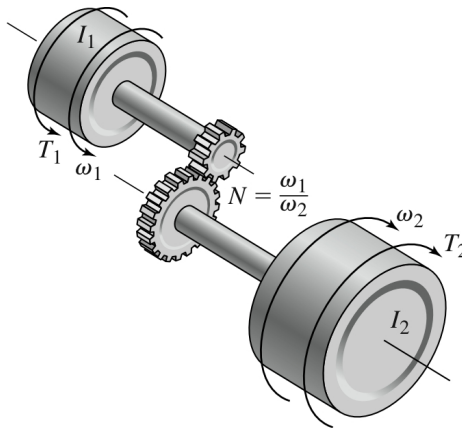
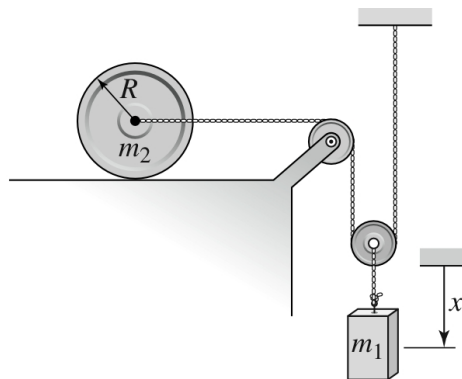


The FE reference book and 1 formula sheet may be used during this exam. 10 points each.

1. A particular function has the form $y(t) = Ae^{-t/\tau}$, and has values $y(1) = 4.912$ and $y(3) = 3.293$. Compute values for A and τ .
2. For the geared system shown below, proper selection of the gear ratio N can maximize the load acceleration $\dot{\omega}_2$ for a given motor and load. Note that the gear ratio is defined such that $\omega_1 = N\omega_2$. Assuming that the inertias and torques are given (and constant):
 - (a) Derive the expression for the load acceleration $\dot{\omega}_2$.
 - (b) Determine the value of N that maximizes $\dot{\omega}_2$. *Hint: This does get a little ugly. Be careful with your math, and trust it. The final step is to solve a quadratic equation in N .*



3. Assume the cylinder below rolls without slipping. Neglect the mass of the pulleys and derive the equation of motion of the system in terms of the displacement x .



Bonus (2 points, all-or-nothing): Write the mass moments of inertia for a) a solid rod, length l and mass m , about its center, b) the same rod about its end, c) a hoop, mass m , radius r , about its symmetric axis and d) a uniform disk about its symmetric axis, mass m , radius r .