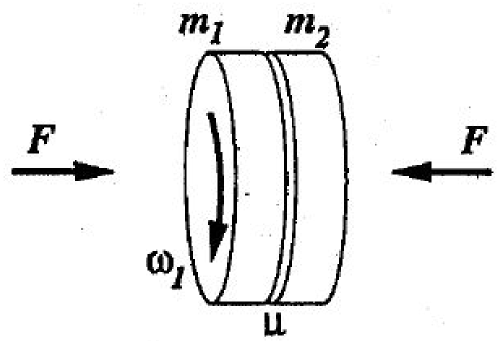
FP7



A rudimentary transmission can be made by forcing two uniform cylindrical wheels with frictional coefficient μ together. The wheels have masses m_1 and m_2, and both have radius R. Initially, wheel 1 is rotating with angular velocity ω_1 and wheel 2 is at rest. The wheels are being forced together with a constant force F, uniformly distributed across each wheel's face.

a) (3 points) When the wheels are first brought together, what is the magnitude of the torque that wheel 1 applies to wheel 2 via friction? Hint: split wheel 1 up into infinitesimal concentric rings of radius r and width dr, and calculate the torque exerted by them.

   If you could not answer part (a) use $r = \mu F R$ in what follows.

b) (2 points) What is the final angular velocity, ω_f, of the two wheels (in terms of constants and ω_1)?

c) (3 points) How long does it take to reach ω_f?

d) (2 points) What was the change in energy of the system as a fraction of the initial energy? Where did this energy go?