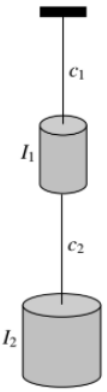
17.4: Double Torsion Pendulum

Here we have two cylinders of rotational inertias I_1 and I_2 hanging from two wires of torsion constants c_1 and c_2.

FIGURE XVII.3



At any instant, the top cylinder is turned through an angle θ_1 from the equilibrium position and the lower cylinder by an angle θ_2 from the equilibrium position (so that, relative to the upper cylinder, it is turned by). The equations and the description of the motion are just the same as in the previous example, except that $x_1, x_2, m_1, m_2, k_1, k_2$ are replaced by $\theta_1, \theta_2, I_1, I_2, c_1, c_2$. The kinetic and potential energies are

$$T = \frac{1}{2} I_1 \dot{\theta}_1^2 + \frac{1}{2} I_2 \dot{\theta}_2^2, \tag{17.4.1}$$

$$T = \frac{1}{2} c_1 \theta_1^2 + \frac{1}{2} c_2 (\theta_2 - \theta_1)^2. \tag{17.4.2}$$

The equations for ω and the displacement ratios are just the same, and there is an in-phase and an out-of-phase mode.