Section 1.2

Problem 1.A: Do problem 1.10, except use the initial condition that the particle is on the y axis at time $t = 0$, and show that the particle's position is given by

$$\mathbf{r}(t) = -\hat{\mathbf{x}}R\sin(\omega t) + \hat{\mathbf{y}}R\cos(\omega t).$$

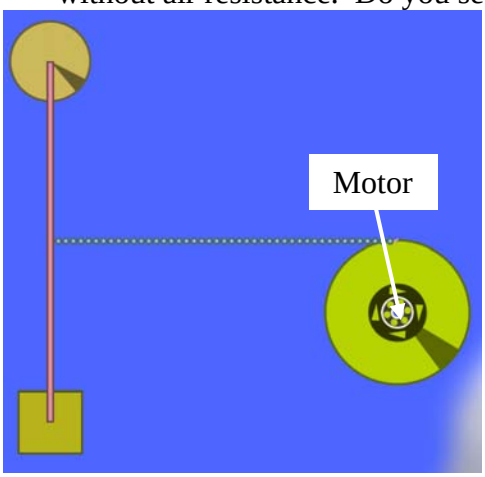
Answer the other parts of the problem starting with the above expression.

Problem 1.B: Phun exercise. Try to create an inertial balance like the one shown in class, and email your scene file to dgary@njit.edu. On your turned-in homework, answer the following questions:

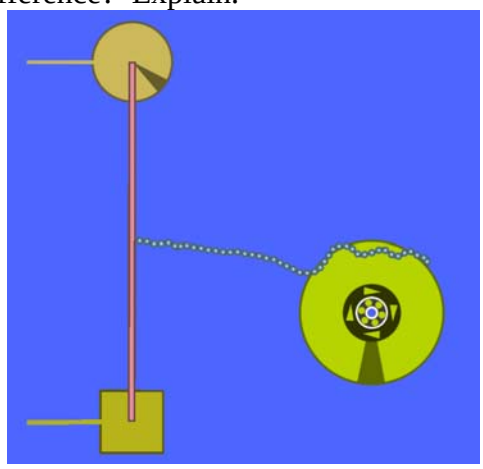
a) Referring to tests with your Phun scene, what is the approximate mass ratio m_u:m_l for the trial shown in 1c, below, where m_u is the upper mass, and m_l is the lower mass?

b) To get your scene to work properly, where did you have to attach the bar to the masses? How did you get the alignment right?

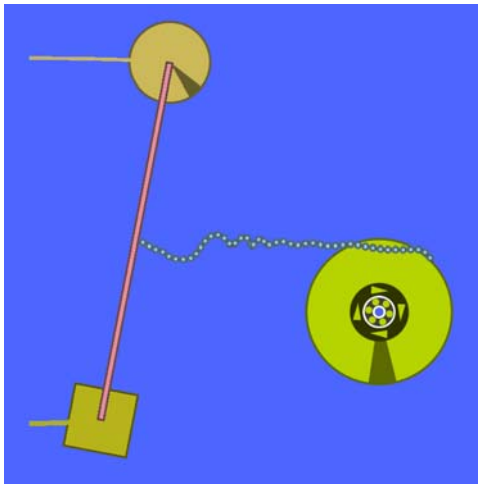
c) You had to turn gravity off. What about air resistance? In your simulation, set the masses each to 0.05, the bar mass to 0.01, and run the simulation with and without air resistance. Do you see any difference? Explain.



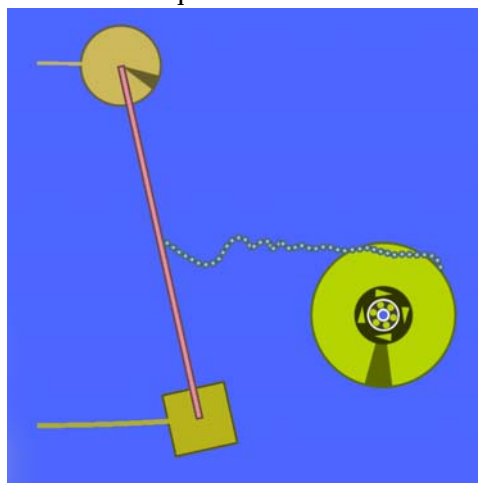
1a) Inertial balance at start of simulation.



1b) Inertial balance during simulation, with equal masses.



1c) Inertial balance during simulation with lower mass more massive than upper mass.



1d) Inertial balance during simulation, with upper mass more massive than lower mass.

Problem 1.C: Write the polar coordinate unit vectors $\hat{\mathbf{r}}$ and $\hat{\phi}$ in terms of Cartesian coordinate unit vectors $\hat{\mathbf{x}}$ and $\hat{\mathbf{y}}$. Differentiate your expressions with respect to time and show that $\frac{d}{dt}\hat{\mathbf{r}} = \dot{\phi}\hat{\phi}$ and $\frac{d}{dt}\hat{\phi} = -\dot{\phi}\hat{\mathbf{r}}$, as before.