The aim of this exercise is to calculate **quantitatively** how the period T of a pendulum's oscillation depends on the amplitude of its motion. This tests the model you have built for the pendulum. Include this graph in your lab writeup.

Step I: Short recap (<3 min).
Consider a pendulum like the one used in the lab, which has mass M and moment of inertia I, and whose center of mass is a distance L from the axle. The angle from the vertical is and the amplitude of the oscillation is θ_{max}.

Start with the time differential $dt = d\theta / \dot{\theta}$. The velocity $\dot{\theta}$ is found from energy conservation. Reassure yourselves that you can derive the expression for the period:

$$\frac{T}{2} = \sqrt{\frac{I}{2MgL}} \int_{-\theta_{max}}^{\theta_{max}} \frac{d\theta}{\sqrt{\cos\theta - \cos\theta_{max}}}.$$ (what are the dimensions of the prefactor?)

Step II:

(a) Evaluate the full integral numerically. This will tell you whether you have the functional dependence on amplitude correct (i.e. the shape).
(b) Find the relevant parameters in the prefactor for your system to check absolute values.

Step III:
You should plot, on the same graph, your experimental and calculated results for the period as a function of the amplitude. This same graph will be included in your lab report. At what values of the amplitude does the anharmonic nature of the pendulum become measureable?