Chemistry 5850 Summer 2004 Assignment 8

Due: Thursday, July 8

Weight of this assignment: 28 marks

The equation of motion for a frictionless pendulum subjected to an additional periodic driving force is

$$mL\ddot{\theta} = -mg\sin\theta + A\sin(\omega t),$$

where m is the mass, L is the length of the pendulum, g is the standard acceleration due to gravity, θ is the angular displacement from equilibrium, and $A\sin(\omega t)$ is the added periodic force.

1. Rewrite this second-order differential equation as a pair of first-order equations. [2 marks]
2. Reduce your equations to dimensionless form. [5 marks]
3. Rewrite your dimensionless equations as an autonomous system by adding a simple differential equation for the dimensionless time. [1 mark]
4. Suppose that your pendulum has a mass of 80 g and a length of 25 cm. Obtain Poincaré sections of the motion using `xpp` for at least two different sets of the remaining parameters (including the initial conditions as parameters) leading to qualitatively different behaviors. (Don't forget to allow for the decay of transients before collecting the data.) Based on your Poincaré sections, indicate whether you think the motions observed are periodic, quasiperiodic, or chaotic. [20 marks]