Name _____ Section _____

Mathematica Problem Set
Problem Set 1
Due January 22, 1999 by 5:00 p.m.

Professors Gray & Costanzo Spring 1999

Problem 1

Begin define the following two equations in Mathematica:

$$2p + g - q^2 = 3\sin\left(\frac{\omega t}{2}\right), \tag{1}$$

$$p - 4g + 13q^2 = 20\cos(3\omega t). \tag{2}$$

After doing so, solve these two equations for p and q. Once you have obtained the solution, create a list of replacement rules for the parameters called `plist` in which you define g to be 9.81 and ω to be 5. Finally, use the solution you have obtained and the list of replacement rules to plot the solutions for p and q versus time, t, for $0 < t < 5$.

Problem 2

Define the following second-order differential equation in Mathematica:

$$\ddot{x} + \gamma\dot{x} - x + \beta x^3 = A\sin(\omega t), \tag{3}$$

along with the initial conditions $x(0) = 0.5$ and $\dot{x}(0) = 0.8$. After doing so, define a list of replacement rules called `params` that assigns values to the constants in the problem. In that list, let γ be 0.15, β be 0.5, and A be 0.3. Now, solve the differential equations, subject to the initial conditions and the list of constants,[1] for $x(t)$ for the time interval $0 < t < 200$. After obtaining the solution (remember, it will be given as an `InterpolatingFunction`), plot the solution $x(t)$ versus t for the full 200 seconds. In addition, plot the *phase space* for the system for 200 seconds. That is, do a `ParametricPlot` of $\dot{x}$ versus x for $0 < t < 200$.

[1] The ordinary differential equation along with the initial conditions is called an *initial value problem*.