Sample Exam II      M242 Fall 2018
SHOW ALL WORK!
Give relevant inputs/commands when using the TI

1. A spring-mass system has spring constant $k = 9$ newtons/m, and a mass of 1 kg. Let $x$ represent the displacement of the mass from its rest position. The damping constant is $c = 6$ newton-sec/meter. There is no driving force. The mass is put into motion from rest position by displacing it 1 meter in the positive direction and releasing it.
   a) Write the differential equation for this mass-system, and give the initial conditions.
   b) Find the general solution to the differential equation.
   c) Find the solution that also satisfies the initial conditions.
   d) What type of damping is present?
   e) Sketch a phase plot for $0 \leq t \leq 5$. Pick appropriate values for $x$-$y$ ranges for your graph.

2. A spring-mass system has spring constant $k = 64$ newtons/m, a mass of 1 kg, and no damping. There is a driving force of $f(t) = 5\sin(7t)$. Initial conditions are both zero (no initial displacement or velocity).
   a) Write the differential equation for this mass-system.
   b) Sketch an accurate time plot of the position of the mass for $0 \leq t \leq 10$. Explain what is happening.
   c) Find the position of the mass after 2 seconds accurate to 3 decimal places using a numerical method on the TI (either Euler or RK).

3. Find general solutions to each second order equation. Describe the long-term behavior for each.
   a) $y'' + 7y' + 10y = e^{-x}$
   b) $y'' + 4y = \sin(2t) - \cos(2t)$. 