Math 23 Diff Eq: Homework 1

due Wed Oct 3 ... but best if do relevant questions after each lecture

Please write clearly, don't be scared of using lots of space on the page, and staple your work.

Some of your homework time this week is devoted to getting started with Matlab, a versatile and powerful package which I promise will bring you joy and success in your future careers! For help, always start with our resources `http://math.dartmouth.edu/~m23f07/res.html`, then ask friends or myself. Let me know of other good tutorials.

A. Install Matlab on your personal machine, *e.g.* from `http://caligari.dartmouth.edu/downloads/matlab`

   Susan Schwarz can help with installation. Instead you could work at computer labs where Matlab is already installed. Try out a couple of commands from the Matlab introductions linked on our course site (don't worry about matrices yet). Try `t=-2:.01:2; y=exp(t); plot(t,y);` What dimensions, *i.e.* size of array, is the `y` object you just created?

B. Exploring direction fields and solution families.

   Download `dfield7` to your desktop or working directory and run it from Matlab. (Failing that, use the Java version).

   Use it to plot the direction field superposed on some solutions to $y' = 3 - y$ with different initial conditions $y(0) = y_0$. Hand in printout of this.

   i) Describe in words the relationship between the direction field and a solution passing through a given point (t, y).

   ii) Describe the behavior as $t \to \infty$ (stable/unstable, growth/decay ?). Is this true for all y_0?

Problems from Boyce & DiPrima: (remember to show your working/reasoning—answers without explanation will not receive a high score!)

1.1: 2 (Note in `dfield7` you'll need to enter $2y$ as `2*y`. You can change the name of the variable `x` to `y`),

20 (don't use computer). Use this to state a conjecture on what property of the rate function $f(t, y)$ leads to stable vs unstable equilibrium.

22. [Hint: how is radius related to volume?]

1.2: 7, 12.

1.3: 2, 13 (really to get you back in to taking derivatives), 16.

2.1: 1 [Hint: write as y' =something. For `dfield7` you'll need to know that e^t is entered as `exp(t)`],

15, 20.

2.2: 2, 6 (look for constant solutions too), 21 [Hint: where does y' blow up? Convert this to x values which define the domain where solution is valid. Finally, use `dfield7` to check—you may need to `Stop` the solver yourself for each curve!].

2.4: 1 [First check: linear or nonlinear?)], 10 (so now what does applying the theorem tell you?)