HOMEWORK 23
DIFFERENTIAL EQUATIONS
DUE 10-31

Show your work!
(1) Two objects, one at 50 °C and one at 100 °C, are placed in a room together. The rate of change of the temperature of each object is proportional, but opposite, to the amount by which its temperature exceeds the temperature of the other object.
  (a) Suppose that the temperature of the initially cooler object is initially increasing at 2 °C/s, whereas the temperature of the initially warmer object is initially decreasing at 1 °C/s. Model this situation with differential equations. Your equations should involve no undetermined constants.
  (b) What are the limits of the temperatures of the initially cooler object, and the initially warmer object, as $t \to \infty$? (Don't just guess; you should solve your differential equations from (a).)

(2) Consider the overdamped harmonic oscillator from class, with mass $m = 1$ kg, spring constant $k = 10 \ \dfrac{\text{N}}{\text{m}}$, and damping coefficient $b = 7 \ \dfrac{\text{N}}{\text{m/s}}$.
  (a) Is it possible for a solution to *never* cross the rest position $x = 0$ for *any* t-value (positive or negative)? Give an example (with no undetermined constants), or explain why not.
  (b) Is it possible for a solution to cross the rest position $x = 0$ for *exactly one* t-value (positive or negative)? Give an example (with no undetermined constants), or explain why not.
  (c) Is it possible for a non-0 solution to cross the rest position $x = 0$ for *more than one* t-value (positive or negative)? Give an example (with no undetermined constants), or explain why not.

• **Three** book problems: #3.5.19; #3.6.10, 32.