Name: _____

Student ID number: _____

105A - Midterm 1

Please read the following very carefully

- This is a closed book exam. You may **not** use a calculator. All other electronic devices should **not** be around!
- You have 50 minutes to complete the exam.
- Grades are out of 150
- Answer all **three** questions, i.e., (1), (2), and (3).
- Make sure to write your name at the top of each page of this exam. Use the space provided on the exam pages to do your work. You may use the back of the pages also, but please mark clearly which problem you are working on (and also state underneath that problem that you have done work on the back of the page).
- Partial credit will be given. Show as much work/justification as possible (diagrams where appropriate). If you can not figure out how to complete a particular computation, a written statement of the concepts involved and qualitative comments on what you think the answer should be may be assigned partial credit.
- Mistakes in grading: If you find a mistake in the grading of your exam, alert the instructor within one week of the exams being returned DO NOT write on the returned graded exam you may make a note of the problems you thought were misgraded on a separate page.

A surfer on a surfboard with mass M floats near the edge of the pier. The surfer is given a push so its initial speed at $t = 0$ is v_0. The drag by the water on the surfboard depends on the speed v of the surfboard as $-bv$, where $b = \text{Const.}$.

1. (40pt) Find an expression for the speed $v(t)$ of the surfer as a function of time.

2. (40pt) How far can the surfer travel given the initial velocity?

3. (70pt) Examining the situation in reality you find that the surfboard is in fact bobbing back and front with a restoring force that scales as $-17b^2x/(4M)$.
(i) Write the equation of motion.
(ii) Find the frequency of oscillations.
(iii) Find the expression for the distance of the surfboard as a function of time $x(t)$. Express your answer as, only, a function of b, M and the initial conditions (note that at $t = 0$ the surfboard is at $x = 0$).

you may continue your answer here...