This test is open notes and text. You have 50 minutes and the test is worth 50 points.

1. **[20 points]** Consider the following relational schema. Primary keys are underlined and foreign keys are in *italics* (you may infer what they refer to).

   PERSON: $ssn$, fname, lname, address, phone, bdate  
   EMPLOYEE: $ssn$, job_title, date_hired  
   SAILOR: $ssn$, rating  
   BOATMODEL: $model\#$, model_name, manufacturer  
   BOAT: $reg\#$, bname, color, $model\#$  
   RESERVATION: $sailor\_ssn$, date_reserved_for, $boat\_reg\#$, $emp\_ssn$

Provide SQL answering the following queries:

a) List the boat names and model names of all boats that have no reservations.

b) Determine if there are two different boats with the same name (list all such names and two registration numbers in each row returned).

c) List the first and last name of all customers and the model name and color of the boat they have reserved, for all reservations in February 2013.

d) List the names of all sailors who have reserved any of the three most popular boats (a boat is more popular than another if it has more reservations). You may assume that all boats have different numbers of reservations.

e) **[551 only]** List the names of all maximal reservers. A sailor is a maximal reserver if the set of boats (s)he has reserved is not a proper subset of any other sailors. (*This may be turned in by midnight.*)
2. **[15 points]** Design an ER diagram for a library as described below. Show relevant constraints.

- Each **employee** has an ssn, fname, lname, and address.
- An employee is classified into one of three categories: **managerial**, **research**, and **floor**. Floor employees are paid by the hour and have an hourly wage rate. The other two categories have a salary. Research workers have a specialty, while managerial workers have a job title.
- **Customers** are identified by their card number, and also have a fname, lname, and address.
- Each **book** is identified by its LCN (Library of Congress Number). It has a title, and one or more **authors**.
- An **author** has as a key an author code, since (fname, lname) does not suffice. We also keep track of their birth date and date of death.
- Customers may check out books. We keep track of the date it was checked out, as well as the date of return, if it has been returned.
- Each time a book is checked out, we want to track which employee was involved in that transaction. Checking out a book can be handled by floor or research staff, *but not managerial staff*.
- Each member of the floor staff has exactly one member of the managerial staff as a supervisor.
3. [**15 points**] Derive a relational schema based on the attached ER diagram. Indicate all foreign keys and NOT NULL constraints.