You have 24 hours to complete this test, even though it should take much less time than that.

1. **[20 points]** Consider the following relational schema. Primary keys are underlined and foreign keys are in *italics* (also see the ER diagram).

   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

   ![ER Diagram](image)

   Provide SQL answering the following queries:

   a) List the name (first and last) and job title of all employees that have handled no reservations.
b) Count the number of boats made by each manufacturer. List them by manufacturer name, in decreasing order of the number of boats.

c) List the first and last name of all sailors and the model name and name of the boat they have reserved, for all reservations in October 2020.
d) List the names of all sailors who have rented any of the two most popular boats (a boat is considered popular by counting the number of reservations for it). You may assume that all boats have different numbers of reservations (so ties not a concern).

e) [551 only] List the names of all maximal reservers. A sailor is a maximal reserver if the set of boats they have reserved is not a proper subset of any other sailors.
2. **[15 points]** Give an ER diagram for a library as described below. Show relevant constraints. Use Chen notation (as in the text) or Crowsfoot notation (as in MySQLWorkbench).

- 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.
(more space for question 2)
3. **[15 points]** Derive a relational schema based on the attached ER diagram. Indicate all foreign keys and NOT NULL constraints.
Chen ER diagram for question 3