1. **ER Diagram (40 pts):** Notown Records has decided to store information about musicians who perform on its albums (as well as other company data) in a database.

   - Each musician that records at Notown has an SSN, a name, an address, and a phone number. Poorly paid musicians often share the same address, and no address has more than one phone.
   - Each instrument used in songs recorded at Notown has a unique identification number, a name (e.g., guitar, synthesizer, flute) and a musical key (e.g., C, B-flat, E-flat).
   - Each album recorded on the Notown label has a unique identification number, a title, a copyright date, a format (e.g., CD or MC), and an album identifier.
   - Each song recorded at Notown has a title and an author.
   - Each musician may play several instruments, and a given instrument may be played by several musicians.
   - Each album has a number of songs on it, but no song may appear on more than one album.
   - Each song is performed by one or more musicians, and a musician may perform a number of songs.
   - Each album has exactly one musician who acts as its producer. A musician may produce several albums, of course.

Design a conceptual schema for Notown and draw an ER diagram for your schema. The preceding information describes the situation that the Notown database must model. Be sure to indicate all key and cardinality constraints and any assumptions you make. Identify any constraints you are unable to capture in the ER diagram and briefly explain why you could not express them.

2. **SQL (30 pts):** Write SQL statements for the following queries using the following database classes:

   `Classes(cclass, type, country, numguns, bore, displacement)`
   `Ships(sname, sclass, launched)`
   `Battles(sname, date)`
   `Outcomes(ship, battle, result)`

Ships are built in classes from the same design, and the class is usually named for the first ship of that class. The relation `Classes` records the name of the class, the type (bb for battleship and bc for battlecruiser), the country that built the ship, the number of main guns, the bore (diameter of the gun barrel, in inches) of the main guns, and the displacement (weight in
tons). Relation Ships records the name of the ship, the name of its class, and the year in which the ship was launched. Relation Battles gives the name and date of battles involving these ships, and relation Outcomes gives the result (sunk, damaged, or ok) for each ship in each battle.

(a) Find the ships heavier than 35,000 tons.

(b) List the name, displacement, and the number of guns of the ships engaged in the battle of Guadalcanal.

(c) Find the ships that were damaged in one battle, but later fought in another.

(d) Find the countries who has the heaviest ships.

(e) Find the number of ships for each country

(f) Find the battle in which the number of ships sunk is highest

3. Relational Algebra (30 pts): Specify the following queries on COMPANY database using relational algebra.

(a) Retrieve the names of all employees in department 5 who work for more than 10 hours per week on the ProductX project.

(b) Retrieve the names of all employees who work on every project.

(c) Retrieve the names of all employees in department 5 who work for more than 10 hours per week on the ProductX project.

(d) For each project, list the project name, and the total hours per week (by all employees) spent on the project.

(e) Retrieve the names of all employees who do not work on any project.

(f) Retrieve the average salary of all female employees.