1. (2pt) What is a foreign key constraint? Why are such constraints important? What is referential integrity?

2. (2pt)

(a) Convert the ER diagram into relations
(b) Identify the keys and foreign keys of each relation

3. (3pt) Consider two relation instances below, with the following schemas:
Write a relational algebra expression and show its result when the expression is executed with the given instances.

(a) List the names of all European cities with population of more than 600,000.
(b) List the names of all countries for which no cities have been entered into the City table.
(c) List names and continents of countries that are either in Europe or whose capitals have a population of over 1 million.

4. (3pt) Given two relations R1 and R2, where R1 contains N1 tuples, R2 contains N2 tuples, and N2 > N1 > 0, give the minimum and maximum possible sizes (in tuples) for the resulting relation produced by each of the following relational algebra expressions. In each case, state any assumptions about the schemas for R1 and R2 needed to make the expression meaningful:

(1) R1 ∪ R2, (2) R1 ∩ R2, (3) R1 − R2, (4) R1 × R2, (5) σ_{a=5}(R1), (6) \pi_a(R1), and (7) R1/R2

5. (No point counted) Create relations for your ER diagram of the course project. Write the relation algebra for necessary queries, such as “Give an item, show all purchase records of the item”.