Instructions: Answer all questions concisely. Write your name on every answer sheet.

1. (Total: 4pts.) Given two relations $R_1$ and $R_2$, where $R_1$ contains $N_1$ tuples and $R_2$ contains $N_2$ tuples, and $0 < N_1 < N_2$, give the minimum and maximum possible sizes (in tuples) for the resulting relation produced by each of the following relational algebra expressions.
   
   (a) $R_1 \cup R_2$ (assume $R_1$ and $R_2$ are union-compatible)
   (b) $R_1 \cap R_2$ (assume $R_1$ and $R_2$ are union-compatible)
   (c) $R_1 - R_2$ (assume $R_1$ and $R_2$ are union-compatible)
   (d) $R_1 \times R_2$

2. (Total: 2pts.) Given two relations $R_1(A, B)$ and $R_2(B, C)$, where $R_1$ contains $N_1$ tuples and $R_2$ contains $N_2$ tuples, and $0 < N_1 < N_2$, give the minimum and maximum possible sizes (in tuples) for the resulting relation produced by the relational algebra expression $R_1 \bowtie R_2$.

3. (Total: 5 pts.) Answer questions (1), (6), and (10) of exercise 4.3 (page 127) in the textbook.

4. (This question will not be graded.) Go through the rest of the questions in Exercise 4.3 and Exercise 4.5 on your own. Write the queries in both relational algebra and relational calculus (TRC or DRC).