Instructions: The homework is due BEFORE CLASS on Tue Oct 06. Please hand in paper copies (either typeset or hand-written copies are fine, as long as the hand writing is clear).

Question 1 (25 points)

Consider a database schema with three relations:

Customers(cid:integer, cname:string, age:integer, zipcode:integer)
Vehicles(vin:integer, manufacturer:string, year:integer, seats:integer)
Sales(cid:integer, vin:integer, price:integer)

The database contains customer and vehicle information for a car dealership. The description is as follows: customers are uniquely identified by cid and they have as attributes name, age and zipcode of residence. Vehicles are uniquely identified by vin. Each vehicle has a manufacturer company (assume no two companies have the same name), production year and number of seats (how many persons fit in the car). The Sales relation provides information about car purchases, including price of purchase for each sale.

Write relational algebra expressions for the following queries (points shown for 430/630):

(a) Find the ages of customers in zipcode 02125. (2|2)
(b) Find the manufacturers of vehicles that sold for more than $30,000. (2|2)
(c) Find the ages of customers who bought a ‘Honda’ vehicle. (2|2)
(d) Find the zipcodes of customers who paid at most $20,000 for a Honda vehicle with at least 6 seats. (2|2)
(e) Find the zipcodes of customers who bought a vehicle with 2 seats, or who paid at least $50,000 for a vehicle. (3|3)
(f) Find the ages of customers who bought only vehicles manufactured by Ford. Consider only customers that bought at least one vehicle. (4|3)
(g) Find the manufacturers which had vehicles purchased from zipcode ‘02125’, but also never had a vehicle purchased by a customer more than 40 years old. (4|3)
(h) Find the manufacturer and year of the most expensive vehicle sold. (5|3)
(i) [630 students only] Find the manufacturer(s) of the most expensive vehicle(s) bought by the youngest customer(s). Note that there may be multiple such manufacturers, due to age and/or price ties. (0|5)
Question 2 (25 points)

Consider a database schema with three relations:

Students (sid:integer, sname:string, age:integer)
Enrolled (sid:integer, cid:integer, grade:integer)
Courses(cid:integer, cname:string, credits:integer)

The keys are underlined in each relation. Students are identified uniquely by sid, and courses by cid. Students enroll to take courses, and for each course they obtain a grade which is an integer. sname is the student name (string), age represents the student age and is an integer. cname is the course name (string), and credits is the number of credits for a particular course (integer).

Write relational algebra expressions for the following queries (points shown for 430|630):

(a) Find the names of students who got grade 10 in some course. (2|2)
(b) Find the ages of students who take some course with 3 credits. (2|2)
(c) Find the names of students who take a course named 'Calculus'. (2|2)
(d) Find the names of students who obtained grade at least 8 in some course that has less than 4 credits. (3|2)
(e) Find the names of students who obtained only grades of 10 (implies that they took at least one course). (3|3)
(f) Find the names of students who took a course with three credits or who obtained grade 10 in some course. (4|3)
(g) Find the ages of students who attend ‘Calculus’ but never took any 4-credit course (assume there is a course ‘Calculus’ with 3 credits). (4|3)
(h) Find the names of students who are enrolled in a single course. (5|3)
(i) [630 only] Find the grades of students who are enrolled in course(s) with the highest number of credits. (0|5)