CSC 343H1S 2010 Test 1
Duration — 50 minutes
Aids allowed: none

Student Number: |_|_|_|_|_|_|_|_|_|_|

Last Name: _____ **First Name:** _____

Lecture Section: Tuesday evening **Instructor: Horton**

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*Do **not** turn this page until you have received the signal to start.*
(Please fill out the identification section above, **write your name on the back of the test**, and read the instructions below.)
Good Luck!

This midterm consists of 4 questions on 5 pages (including this one). *When you receive the signal to start, please make sure that your copy is complete.* If you use any space for rough work, indicate clearly what you want marked.

1: _____/ 6

2: _____/ 8

3: _____/10

4: _____/ 8

TOTAL: _____/32

[Use the space below for rough work. This page will not be marked unless you clearly indicate the part of your work that you want us to mark.]

Question 1. [6 MARKS]

Part (a) [4 MARKS]

Suppose that

- $R1$ is a relation with $t1$ tuples and $a1$ attributes.
- $R2$ is a relation with $t2$ tuples and $a2$ attributes.
- L is a list of n attributes.
- c is a boolean expression involving the attributes of $R1$.

Assume that the expressions below are legal expressions of relational algebra. Fill in the table to indicate the size of the relation that is the result of each expression.

	Number of tuples		Number of attributes	
Expression	minimum	maximum	minimum	maximum
$\Pi_L R1$				
σ_c R1				
$R1 X R2$				
$R1 \bowtie R2$				

Part (b) [2 MARKS]

Suppose R and S are relations. Which of the following statements are true? Circle one answer for each. **Do not guess.** There is 1 point for each correct answer, -1 for each incorrect answer, and 0 points if you leave the answer blank.

1. If R and S have no attributes in common, $R \times S = R \bowtie S$.

   True False

2. If R and S have at least one attribute in common, it cannot be true that $R \times S = R \bowtie S$.

   True False

Question 2. [8 MARKS]

Consider the following database:

P

A	B	C
1	5	1
4	6	5
2	8	1
3	4	1
1	2	3
3	3	2

Q

C	D
1	5
2	6

Assuming set semantics, give the result (schema and data) returned by the following queries. Use the same tabular format as above; do **not** describe the result in English.

Part (a) [2 MARKS]

$(\Pi_C P - \Pi_C Q) \cap (\Pi_C P - \Pi_C(P \bowtie \sigma_{D=5} Q))$

Part (b) [2 MARKS]

$T := \sigma_{P1.A<P2.A \wedge P1.C=P2.C}(\rho_{P1}(P) \times \rho_{P2}(P))$

$Answer := \Pi_C P - \Pi_{P1.C} T$

Part (c) [2 MARKS]

$T := (\Pi_A P \times \Pi_C Q) - (\Pi_{A,C}(P \bowtie Q))$

$Answer := \Pi_A P - \Pi_A T$

Part (d) [2 MARKS]

$P1(A, B, C) := P$

$P2(A, B, C) := P$

$T := \sigma_{P1.C=P2.C \wedge P1.B>P2.B}(P1 \times P2)$

$Answer := P - \Pi_{P1.A,P1.B,P1.C} T$

Question 3. [10 MARKS]

Consider the following schema for a hair salon. Keys are underlined.

- Clients(CID, name, phone).
  CID is the ID of a client, *name* and *phone* are their name and phone number.
- Staff(SID, name).
  SID is the ID of a staff member and *name* is their name.
- Appointments(CID, date, time, service, SID)
  CID is the ID of the client whose appointment it is, *date* and *time* indicate when the appointment happens, *service* is the name of the service they have at this appointment, and *SID* is the ID of the staff member providing the service for this apppointment. *CID* is a foreign key on Clients and *SID* is a foreign key on Staff. That is, the following inclusion dependencies hold:
  Appointments[CID] $\subseteq$ Clients[CID], and
  Appointments[SID] $\subseteq$ Staff[SID].

Which of the following queries correctly find the name of every client who has not had a haircut in 2010? Circle one answer for each. **Do not guess.** There are 2 points for each correct answer, -1 for each incorrect answer, and 0 points if you leave the answer blank.

1. $A := (\Pi_{CID} Clients) - (\Pi_{CID}(\sigma_{date.year=2010 \wedge service=\text{“}haircut\text{”}} Appointments))$
   $Answer := \Pi_{name}(A \bowtie Clients)$
   Correct Incorrect

2. $A := (\Pi_{CID,name} Clients) - (\Pi_{CID,name}(\sigma_{date.year=2010 \wedge service=\text{“}haircut\text{”}} (Clients \bowtie Appointments)))$
   $Answer := \Pi_{name} A$
   Correct Incorrect

3. $A := (Clients \bowtie Appointments) - (\sigma_{date.year=2010 \wedge service=\text{“}haircut\text{”}} (Clients \bowtie Appointments))$
   $Answer := \Pi_{name} A$
   Correct Incorrect

4. $A := (\Pi_{CID} Clients) - (\Pi_{CID} \sigma_{date.year=2010 \wedge service \neq \text{“}haircut\text{”}} Appointments)$
   $Answer := \Pi_{name}(A \bowtie Clients)$
   Correct Incorrect

5. $A := (\Pi_{CID} \sigma_{date.year=2010 \wedge service \neq \text{“}haircut\text{”}} Appointments)$
   $Answer := \Pi_{name}(A \bowtie Clients)$
   Correct Incorrect

Question 4. [8 MARKS]

This question assumes the same schema as for question 3.

Write the following queries using only the basic Relational Algebra operators $\Pi, \sigma, \bowtie, \times, \cap, \cup, -, \rho$. Assume the set semantics (not bag semantics) for Relational Algebra.

1. CID of all clients who have never had an appointment for both a haircut and another, different, service on the same date.

2. Name and phone number of the client who had staff member Guilano's first appointment.

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[Use the space below for rough work. This page will not be marked unless you clearly indicate the part of your work that you want us to mark.]