Family Name: ----------

Given *Name:* ----------

Student ID: ----------

University of Alberta
Faculty of Science

[redacted] sample

CMPUT 291 – A1
File Structures and Data Management

Duration: 2 Hours
No Aids Allowed

QUESTION	***VALUE***	***SCORE***
1	***14***	
2	***27***	
3	***10***	
4	***17***	
5	***16***	
6	***16***	
TOTAL	***100***	

Your examination booklet must have **8 pages** (including this one).

Question 1
[14 marks in total] TRUE or FALSE: 2 marks for each correct answer; -2 marks for each incorrect answer; 0 mark if no choice is selected.

a) In an ER diagram, the relationship between an owner entity set and a weak entity set can only be one-to-many with the total participation of the weak entity set.

( ) TRUE ( ) FALSE

b) Integrity constraints can be inferred for a given relational schema by examining its instances.

( ) TRUE ( ) FALSE

c) The result of a SQL statement cannot have duplicates.

( ) TRUE ( ) FALSE

d) The SQL query "SELECT name FROM customers WHERE city <> 'Ottawa'" will not list any customer whose city field is NULL.

( ) TRUE ( ) FALSE

e) Armstrong axioms are complete meaning that for a given set F of FD's the axioms can only generate functional dependencies that are logically implied from F.

( ) TRUE ( ) FALSE

f) Every BCNF relation is in 3NF.

( ) TRUE ( ) FALSE

g) For equality queries, B+ trees are faster than hash-based indexes in the average case.

( ) TRUE ( ) FALSE

Question 2

[27 marks in total] The following schema describes information about service histories of vehicles (for example in a garage). A tuple *(v, t, s, d, c)* in ***services*** means that the vehicle with VIN *v* of type *t* is serviced with service type *s* on day *d* and the service is charged *c* dollars and cents. The ***vehicles*** relation gives for each vehicle of type *t*, its make (e.g. Honda), model (e.g. Accord) and the year of the vehicle.

services (vin, vtype, srv-type, date, charge)
vehicles (vtype, make, model, year)

a) [6 marks] Give a SQL statement that creates view ***Service-History***(*make, model, srv-freq, avg-charge*) which contains for every make and model the number of services and the average service charge.

b) [5 marks] Using view Service-History, give a SQL statement that lists the make and the model of vehicles with the fewest number of services.

c) [5 marks] Using view Service-History, give a SQL statement that lists the number of services for every make of vehicles.

d) [5 marks] Give a SQL statement that lists service types that have never been charged over $100.

e) [6 marks] Give a SQL statement that lists for every make and model of vehicles the most common service type.

Question 3
[10 marks in total] Using the schema given in Question 2, explain in plain English what the following relational algebra queries compute.

a) [5 marks] $\pi_{srv-type}(\sigma_{date \geq 1/12/1999 \ \wedge \ date \leq 31/12/1999} services)$

b) [5 marks] $\pi_{make,model,year}(vehicles \triangleright\triangleleft (\pi_{vtype} vehicles - \pi_{vtype}(\sigma_{date \geq 1/1/2000} services))$

Question 4
[17 marks in total] Consider relation R with attributes ABCDE and functional dependencies {AB→D, BC→E}.

a) [3 marks] Show that ABC is a key.

b) [3 marks] How many keys does the relation have? Justify.

c) [3 marks] Is the relation in BCNF? Explain.

d) [3 marks] Is the relation in 3NF? Explain.

e) [5 marks] Give a BCNF decomposition of the relation.

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Question 5

[16 marks in total] Consider a B+ tree in which an internal node can hold up to 3 keys and a leaf can hold up to 2 records. Starting from an empty tree, perform the following operations in the given order (show the final tree in each part).

a) [3 marks] Insert 33*, 44*.

b) [3 marks] Insert 65*, 25*.

c) [3 marks] Insert 100*, 50*.

d) [3 marks] Insert 60*.

e) [4 marks] Delete 25*, 35*.

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Question 6

[16 marks in total] Starting from an empty extendible hash file, perform the following operations in the given order. Show the result including all indicators after each part. Assume a page can hold up to 3 records.

a) [3 marks] Insert 10*, 18*, 25*.

b) [3 marks] Insert 36*, 9*.

c) [3 marks] Insert 8*, 7*.

d) [3 marks] Insert 26*, 3*.

e) [4 marks] Delete 8*, 36*.