

Family Name: -----

Given Name: -----

Student ID: -----

University of Alberta
Faculty of Science

Fall 2000

CMPUT 291 – A1
File Structures and Data Management

Duration: 2 Hours
No Aids Allowed

<i>QUESTION</i>	<i>VALUE</i>	<i>SCORE</i>
<i>1</i>	<i>14</i>	
<i>2</i>	<i>27</i>	
<i>3</i>	<i>10</i>	
<i>4</i>	<i>17</i>	
<i>5</i>	<i>16</i>	
<i>6</i>	<i>16</i>	
<i>TOTAL</i>	<i>100</i>	

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

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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

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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.

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- 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.

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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] $\rho_{\text{srv-type}}(\sigma_{\text{date} \geq 1/12/1999 \wedge \text{date} \leq 31/12/1999} \text{services})$

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

Question 4

[17 marks in total] Consider relation R with attributes ABCDE and functional dependencies $\{AB \rightarrow D, BC \rightarrow E\}$.

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

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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*.