Two hours - online hybrid

This paper version is made available as a backup
In this event, only MCQ answers written in the boxes on the exam paper will be marked.

EXAM PAPER MUST NOT BE REMOVED FROM THE EXAM ROOM

UNIVERSITY OF MANCHESTER
SCHOOL OF COMPUTER SCIENCE

Fundamentals of Databases

Date: Monday 21st January 2019
Time: 14:00 - 16:00

This is a hybrid examination with sections to be answered online and questions to be answered on paper.

Please answer All Questions in Section A and Section C online and All Questions in Section B in a separate answerbook

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This is a CLOSED book examination

The use of electronic calculators is NOT permitted
Section A contains Multiple Choice Questions and is restricted
Section B

Answer the single question in this section.
Use a SEPARATE answer book for this question.

1. Consider the following database and its requirements:
   
   Customer (id, name, first_visit)
   Pizza (id, name, size)
   Topping (id, name)

   R1 – A customer may order many pizzas and a pizza be ordered by many customers.
   R2 – A pizza must have toppings and a topping may go on many pizzas.

   Give an expression in the relational algebra for each of the following queries over the above database:

   a. Find all pizza ordered by at least one person under the age of 18. (1 mark)
   b. Find the names of all females who eats both the veggie_supreme and chicken_delight pizzas. (1 mark)
   c. Find all pizzas that are 10inches and have pepperoni on them. (1 mark)
   d. Draw an entity-relationship diagram that, when mapped into a relational schema, would have produced the relation schemas given for the database and requirements above. You may need to invent names for some of the relationship types. (7 marks)
Section C

Answer the single question in this section.
Use your computer to answer this question.

1. Normalize the relation in **Section-A question number 20** to 3NF (or BCNF, if possible) showing the process step-by-step. For your convenience, the relation has been provided below. Note that you will need to answer the question as to whether or not this relation can be normalized to BCNF, and if so, normalize it to this normal form.

```sql
CREATE TABLE sensor_recording (  
site_id SMALLINT NOT NULL,  
site_name VARCHAR(15),  
lane_id SMALLINT NOT NULL,  
lane_name VARCHAR(15),  
direction_id SMALLINT,  
direction_name VARCHAR(15),  
vehicle_id SMALLINT NOT NULL,  
vehicle_class_id SMALLINT,  
vehicle_length DECIMAL(2,1),  
vehicle_class_name VARCHAR(15),  
year_month_day DATE NOT NULL,  
time_day TIME NOT NULL,  
vehicle_speed DECIMAL(2,1),  
date_flag SMALLINT,  
date_flag_text VARCHAR(15),  
traffic_volume INT,  
PRIMARY KEY (site_id, lane_id, vehicle_id, year_month_day,  
time_day)
);
```

(10 marks)