

Name: _____

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Many questions in this quiz use the database schema and sample instance depicted below. The **Boxes** table records information about boxes used by a packing store. For each type of box, it stores the box's name and supplier, the maximum weight of its contents (in pounds), its price in dollars, its dimensions (width, depth, and height) in inches, and the number available (inventory). The **Products** table records information about products stocked by the packing store for its customers. For each product, it stores the product name, customer name, weight (in pounds), and dimensions (as in **Boxes**). The type of each attribute appears directly below its name. *Primary key attributes* are underlined.

When asked for queries, you must provide answers that work for all possible database instances, not just the example instance depicted below. For brevity, relational algebra expressions abbreviate the schemas of the **Boxes** and **Products** tables as $B(N, S, L, P, W, D, H, I)$ and $P(N, C, L, W, D, H)$, respectively.

The following tables are repeated on the last page of the quiz. You may detach that page and use it for reference. There is no need to reattach it

Boxes

<u>name</u>	<u>supplier</u>	load	price	width	depth	height	num
varchar(20)	varchar(20)	float	decimal(6,2)	float	float	float	integer
small cube	box-o-rama	10.5	2.99	24	24	24	100
large cube	box-o-rama	20.0	4.99	50	50	50	42
small cube	box world	1.0	1.99	8	8	8	22
economy pack	box world	1.5	0.99	9	12	0.25	9

Products

<u>pname</u>	<u>customer</u>	weight	width	depth	height
varchar(20)	varchar(20)	float	float	float	float
PDR	Alice Armstrong	5	8	10	6
bookshelf speaker	Bob Beerli	15	24	13	16

1. (1 pt.) Write your name in the space provided above.

2. (4 pts.) Given a relation $R(A, B, C, D, E, F)$, which of the following statements is **definitely false**? Justify your answer briefly.

- (a) None of $\{A, B\}$, $\{B, C\}$, and $\{A, B, C\}$ is a key.
- (b) At most one of $\{A, B\}$, $\{B, C\}$, and $\{A, B, C\}$ is a key.
- (c) Each of $\{A, B\}$, $\{B, C\}$, and $\{A, B, C\}$ is a key.
- (d) $\{A, B, C, D, E, F\}$ is a key.

3. (5 pts.) What is the result of the following query on the above database instance?

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select name, supplier from Boxes where price > 3;
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4. (5 pts.) What is the result of the following relational algebra query on the above database instance?

$$\pi_{NSN'C'} \sigma_{I > 25 \wedge L \geq L'} (B \times \rho_{P'(N', C', L', W', D', H')} P)$$

5. (5 pts.) Write a SQL query to find the lowest and highest box-prices for each supplier. The result should consist of tuples of the form (s, l, h) indicating l and h are, respectively, the lowest and the highest prices of boxes from supplier s . The results should be sorted in ascending order of supplier names.

6. (5 pts.) We say a box B_2 is a *recommended substitute* for a box B_1 if B_2 is in stock, costs less than B_1 , has linear dimensions (width, depth, height) no smaller than the corresponding dimensions of B_1 , and has a load rating no smaller than that of B_1 . Write a SQL statement to define a view $\text{RecSub}(N1, S1, P1, N2, S2, P2)$ with tuples $(n_1, s_1, p_1, n_2, s_2, p_2)$, where n_1 and n_2 are box names, s_1 and s_2 are suppliers, and p_1 and p_2 are prices, indicating that the box identified by (n_2, s_2) costs p_2 and is a recommended substitute for the box identified by (n_1, s_1) , which costs p_1 .

7. (5 pts.) Refer to the definition of recommended substitutes in Question 6. We say a box B_2 is a *preferred substitute* for box B_1 if B_2 is a recommended substitute for B_1 and there is no recommended substitute for B_1 that has a price lower than B_2 's price. Write a SQL query for pairs of boxes such the second is a preferred substitute for the first. The desired output consists of tuples of the form (n_1, s_1, n_2, s_2) , where n_1 and n_2 are box names and s_1 and s_2 are suppliers, indicating that the box identified by (n_2, s_2) is a preferred substitute for the box identified by (n_1, s_1) .

8. (5 pts.) Write a SQL query to find all boxes in which *Alice Armstrong's PDR* product can be packed, excluding boxes that are not in stock. A product can be packed in a box if it weighs no more than the box's load rating and if each of its linear dimensions (width, depth, height) is at least two inches smaller than the corresponding dimensions of the box. For each such box, the query should list the name and supplier. Reminder: As always, your query should work for all instances, not just the one depicted earlier.

9. (5 pts.) Write a relational algebra query that is equivalent to the query in Question 8.

10. (5 pts.) Write a SQL query to find the most expensive box from each supplier. The output should consist of tuples of the form (s, n) where n is the name of the most expensive box from supplier s . If there are several most-expensive boxes for a supplier, all should be listed.

11. (5 pts.) Write a relational algebra query that is equivalent to the query in Question 10.

Scratch page

Material here will not be graded. You may detach and discard this page.

Boxes

<u>name</u> varchar(20)	<u>supplier</u> varchar(20)	load float	price decimal(6,2)	width float	depth float	height float	num integer
small cube	box-o-rama	10.5	2.99	24	24	24	100
large cube	box-o-rama	20.0	4.99	50	50	50	42
small cube	box world	1.0	1.99	8	8	8	22
economy pack	box world	1.5	0.99	9	12	0.25	9

Products

<u>pname</u> varchar(20)	<u>customer</u> varchar(20)	weight float	width float	depth float	height float
PDR	Alice Armstrong	5	8	10	6
bookshelf speaker	Bob Beerl	15	24	13	16