

Name: _____

This quiz is **open book**, **open notes**, but there can be no sharing of any material, and no communication except with me. You can use the Internet, but only as a library. If you are not sure if something is allowed, check with me.

Some questions in this quiz use the database schema and sample instance depicted below. [The following details are identical to those in quiz 1 and the midterm exam.] 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 Beerl	15	24	13	16

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

2. (4 pts.) Write a SQL statement that creates the table Boxes, introduced earlier. Include a declaration for the primary key.

3. (5 pts.) Suppose the table Products, introduced earlier, has already been created and populated with some data, such as the data in the sample instance. Write a SQL statement that declares the primary key of Products without dropping the table or otherwise losing its contents.

4. (5 pts.) Suppose the database introduced earlier includes a table `NewCustomers` with a single column, `name`, of type `varchar(20)`. Whenever a product with a new customer (one whose name is not in the `Products` table) is added to the database, we wish to add that customer's name to the `NewCustomers` table. Write a SQL trigger that implements this behavior.

5. (5 pts.) We say a box b_1 *dominates* a box b_2 if b_1 is not more expensive than b_2 , b_1 's load rating is at least as high as b_2 's, and each of b_1 's linear dimensions (width, depth, height) is no smaller than the corresponding linear dimension of b_2 . We say b_1 *strictly dominates* b_2 if b_1 dominates b_2 and at least one of the inequalities in the above definition is strict. Write a SQL query to find all pairs of boxes (b_1, b_2) such that b_1 strictly dominates b_2 . (Each box is identified by listing its name and supplier.) The output is a set of tuples (n_1, s_1, n_2, s_2) such that the box (n_1, s_1) strictly dominates (n_2, s_2) .

6. (5 pts.) Suppose we wish to disallow insertions of boxes that are strictly dominated by some existing box. Write a SQL trigger on the Boxes table that enforces this requirement.

7. (5 pts.) A *project group* has a name, a letter grade, a contact phone number, and consists of zero or more students. Write an ODL declaration of a class that models project groups. (Chose appropriate types.) You may assume the existence of a class, **Student**, that models students.

8. (5 pts.) Suppose all transactions in a database system are running at SQL isolation level L . If the following history is observed, what are the possible values of L ? Justify your answer briefly. (The history follows the notational conventions used in class.)

$r^1(x) \ r^2(x) \ c^2 \ r^1(x) \ r^3(y) \ w^1(y) \ a^1 \ r^3(x) \ w^3(x) \ c^3$

9. (5 pts.) Write a SQL statement to create a table `Customers` with attributes `name`, `phone`, and `balance`, where `balance` refers to an account balance for the customer, and may be a credit or debit balance. Declare a foreign-key constraint that requires every customer name in `Products` to also occur in `Customers`.

10. (5 pts.) Suppose our sample database has users Alice, Bob, and Cathy, with user-IDs `alice`, `bob`, and `cathy`. Suppose Alice has just created the `Boxes` and `Products` tables. Suppose the following sequence of SQL statements is executed. (The user who executes each statement is noted in parentheses to the left of each statement below.) What SQL privileges do Bob and Cathy have on `Boxes`? List the privileges for each, and justify your answer briefly.

```
(Alice)    grant insert on Boxes to bob with grant option;
(Alice)    grant delete on Boxes to bob with grant option;
(Alice)    grant delete on Boxes to cathy;
(Alice)    grant insert on Boxes to cathy with grant option;
(Bob)      grant insert, delete on Boxes to cathy with grant option;
(Alice)    revoke insert on Boxes to bob cascade;
(Alice)    revoke insert on Boxes to bob restrict;
```

11. (5 pts.) Write a SQL statement that Alice may execute in order to permit Bob to run SQL *queries* on, as well as to update the `num` attribute of, `Boxes`. (Bob should not be permitted to perform other operations on `Boxes`.)

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