Please fill out the identification section above as well as the one on the back page, and read the instructions below.

Good Luck!

This quiz consists of 3 questions on 7 pages (including this one). When you receive the signal to start, please make sure that your copy of the quiz is complete.

If you use any space for rough work or need to scratch out an answer, circle the part that you want us to mark.

# 1: _____/ 6
# 2: _____/14
# 3: _____/11

TOTAL: _____/31
Question 1. [6 marks]
Part (a) [2 marks]

Consider this schema:

A(orange, popcorn)
B(sugar, tea)
A[orange] ⊆ B[sugar]

Suppose relation A has 17 tuples. Circle the one statement below that is the strongest thing we can be certain of.

1. The number of tuples in relation B must be ≥ 17.
2. The number of tuples in relation B must be ≤ 17.
3. The number of tuples in relation B must be 17.
4. The number of tuples in relation B must be ≥ 1.
5. The number of tuples in relation B must be ≥ 0.

Explain your answer:

Part (b) [4 marks]

Consider this schema and dataset:

C(purple, quince, red)
D(saffron, teal)
D[saffron] ⊆ C[quince]

Does the dataset violate the schema? Circle True or False for each aspect of the schema below. 1 mark for each correct answer, -0.5 for each incorrect answer. The minimum grade for this question is 0.

It violates the key constraint for relation C. True False
It violates the key constraint for relation D. True False
It violates a foreign key constraint. True False
It violates another constraint. Specify it below: True False
Question 2. [14 marks]

Here is part of the schema from assignment 1. Recall that CN is an object’s catalogue number, and who is the Staff person who catalogued it.

Relations

- Object(CN, date, name, description, type, length, width, height, who)
- Donor(DID, surname, firstname, address, email)
- Donation(NID, date, DID)
- Contains(NID, CN)
- Staff(SID, surname, firstname, address, email, type, date)

Integrity constraints

- Object[who] ⊆ Staff[SID]
- Contains[NID] ⊆ Donation[NID]
- Contains[CN] ⊆ Object[CN]
- Donation[DID] ⊆ Donor[DID]

Answer the following questions in relational algebra, using only the basic operators Π, σ, ⊥, ⊳, ×, ⋂, ⋃, −, ρ.

Part (a) [7 marks]

Find donations that contain exactly two items. Report the donation’s NID and the donor’s email address.
Part (b)  [7 marks]

Find the SIDs of staff members who have catalogued at least one object out of each donation from the donor whose DID is 9876. Report simply the SIDs.
Question 3. [11 marks]

Here is part of a schema you used for one of your Lecture Prep exercises.

Relations
- Employee(eid, name, salary, dept)
- Department(did, name, division)
- Sales(eid, day, amount)

Integrity constraints
- Employee[dept] ⊆ Department[did]
- Sales[eid] ⊆ Employee[eid]

Part (a) [2 marks]

Suppose table Sales has this content:

<table>
<thead>
<tr>
<th>eid</th>
<th>day</th>
<th>amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2013-11-02</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>2013-11-03</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>2013-11-05</td>
<td>25</td>
</tr>
<tr>
<td>4</td>
<td>2013-11-06</td>
<td>129</td>
</tr>
<tr>
<td>5</td>
<td>2013-11-01</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>2013-11-02</td>
<td>9</td>
</tr>
<tr>
<td>6</td>
<td>2013-11-06</td>
<td>129</td>
</tr>
<tr>
<td>6</td>
<td>2013-11-07</td>
<td>18</td>
</tr>
<tr>
<td>7</td>
<td>2013-11-01</td>
<td>18</td>
</tr>
<tr>
<td>7</td>
<td>2013-11-02</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>2013-11-01</td>
<td>28</td>
</tr>
<tr>
<td>8</td>
<td>2013-11-02</td>
<td>129</td>
</tr>
</tbody>
</table>

Below each of the following two queries, write its output.

(SELECT amount FROM Sales WHERE amount >= 25);    (SELECT amount FROM Sales WHERE amount >= 25)
union
(SELECT amount FROM Sales WHERE eid >= 6);
Part (b) [4 marks]
Complete each of the following queries so that they will find the highest value of amount in the Sales table.

```sql
SELECT *
FROM Sales s
WHERE amount ____________ (SELECT ___________________________ FROM Sales);
```

```sql
SELECT *
FROM Sales s
WHERE NOT EXISTS (____________________________________________________________________);
```

Part (c) [5 marks]
Write a query in SQL to find the departments in which the minimum salary is at least 100. For each, report the department name and the sum of all salaries in the department.