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 8 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]

Consider the following schema. SIN stands for Social Insurance Number.

Relations
- Person(SIN, name)
- Doctor(SIN, specialty)
- Caresfor(doctor, patient)

Integrity constraints
- Doctor[SIN] ⊆ Person[SIN]
- Caresfor[doctor] ⊆ Doctor[SIN]
- Caresfor[patient] ⊆ Person[SIN]
- (σ_{doctor(patient)} Caresfor) = ∅

Part (a) [3 marks]

Suppose relation Caresfor has 4 tuples. What can you say about the minimum number of tuples in relation Person?

Give a valid instance of the database that demonstrates your answer.

<table>
<thead>
<tr>
<th>Person:</th>
<th>Doctor:</th>
<th>Caresfor:</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIN</td>
<td>name</td>
<td>SIN</td>
</tr>
</tbody>
</table>

Part (b) [3 marks]

Use the notation $R = ∅$ to express the following new constraint: A doctor’s patient can’t be his or her doctor.
Question 2.  [14 marks]

Here is part of the schema from assignment 1:

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]

For each staff member who has catalogued at least one object, find the first object that he or she catalogued. If there are ties, report them all. Report the SID and CN, as well as the DID of the donor who donated the item.
Part (b) [7 marks]

Find donations that meet the following conditions: they contain no items whose type is “couch”, and no items that were catalogued by a temp (i.e., a staff member whose type is “temp”). Report the donation’s NID and the donor’s email address.
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, show the output of the following query.

```sql
SELECT eid
FROM Sales s1
WHERE EXISTS
  (SELECT eid
   FROM Sales s2
   WHERE s1.eid <> s2.eid AND s1.day = s2.day AND s1.amount = s2.amount);
```
Part (b)  [2 MARKS]

Complete each of the following two queries so that they will run without error:

```sql
SELECT eid, min(amount), count(day) FROM Sales
SELECT count(eid), day, sum(amount) FROM Sales
```

Part (c)  [2 MARKS]

Complete this query so that it will report the eid of employees whose total sales in the Sales table exceeds 1,000. Do not use subqueries.

```sql
SELECT eid
FROM Sales
```

Part (d)  [5 MARKS]

Write a query in SQL to find the eid of employees whose department name is “Widgets” and who have never made a sale.