TEMPLE UNIVERSITY

Dept. of Computer and Information Sciences

CIS 616 – Principles of Data Management

SAMPLE Midterm Exam – 2 Hours

Name:

Grade (out of 100pts):

Problem Set	Points
1. (18 points)	
2. (20 points)	
3. (25 points)	
4. (20 points)	
5. (7 points)	
6. (10 points)	

Instructions:

1. Put your name and student number on your exam *now*.
2. Give your answer in the provided space. If you need more space, use the back of the pages and make a note of it, BUT it should not be necessary.
3. **Show all your work!** Partial credit is possible for a wrong answer but *only* if you show the intermediate steps in obtaining an answer.
4. The number of points for each part of each question is given in parentheses. There is a total of 100 points.
5. Good Luck!

Problem Set 1: General Concepts (18 points)

1. (4 pts) What is a data model?

2. (4 pts) What is the difference between a relational table, a file of records, and a spreadsheet?

3. (5 pts) Why is referential integrity not necessary in the ER model, although it is important in the relational model?

4. (5 pts) What is (a) the degree of relation $r(R)$, (b) the cardinality of relation $s(S)$, and (c) the degree and cardinality of $r(R)$ * $s(S)$, where $R = (A, B, C), S = (D, E)$?

Problem Set 2: Relational Algebra & SQL (20 points)

1. (9 pts) Given relations r and s below,

r:

ename	project	dept
Kasper	Forecast	Accounting
Kasper	Audit	Accounting
Kasper	Spreadsheet	Admin
Mohan	Forecast	Admin
Mohan	Audit	Admin
Mohan	Spreadsheet	Accounting
Lin	Forecast	Admin
Lin	Audit	Admin
Lin	Spreadsheet	Admin

s:

ename	dept
Kasper	Accounting
Mohan	Admin
Lin	Admin

compute:

(a) (3 pts) $r \div s$

(b) (3 pts) $\sigma_{dept='admin' \ AND \ project<>'Audit'}(r)$

(c) (3 pts) $r \cup s$

2. (11 points) In the following relation schemas all three attributes form the primary key:

R=(A,B,C) S= (D,E,F)

Let relations $r(R)$ and $s(S)$ be given. Give an expression in SQL that is equivalent to each of the three queries below:

(a) (4 pts) $\sigma_{B=13}(rXs)$

(b) (7 pts) $\sigma_{B=13}(\pi_{B,D,F}(r \sqsupset\bowtie\sqsubset_{A=D \wedge C=D} s))$

Problem Set 3: SQL (25 points)

1. (25 pts) Given the populated relations `r`, `s` below, what would the following SQL queries return:

`r`:

A	B
0	1
1	1
3	1
4	1
2	2
3	2
4	2
1	4

`s`:

B	C
1	0
1	0
1	2
1	3
2	1
3	4
4	2
4	3

   a. (7 pts)

```
select A from r where not A = any (select C from s)
```

   b. (9 pts)

```
select avg(A) as A_AVG, r.B as B
from (r natural join s)
where s.C > 0
group by r.B
having count(*) > 3;
```

   c. (9 pts)

```
select avg(A), r.B
from r, s
where r.B = s.B and C > 20
group by r.B
having avg(A) >= (select avg(C) from s);
```

Problem Set 4: SQL (20 points)

1. (20 points) Consider the following schema: (SSN stands for social security number and is the key of EMPLOYEE. SUPERSSN is the social security number of a person's supervisor. DNUMBER is the key of DEPARTMENT and MGRSSN is the social security number of the department manager. Both attributes of DEPTLOCATIONS form a key.)

   ```
   EMPLOYEE (SSN,FName,LName,Address,City,Salary,SuperSSN,DNO)
   DEPARTMENT(DNUMBER,DName,MGRSSN)
   DEPTLOCATIONS(DNUMBER,DLocation)
   ```

   Translate to SQL the two queries below:

   Query 1: List the full names and the departments of all employees whose salary is between 50000 and 75000 and who live and work in Phg.

   Query 2: List the full names of all employees who are directly supervised by their department manager.

Problem Set 5: Functional Dependencies (7 points)

- Consider the following set F of functional dependencies for relational schema R = (A, B, C, D, E):

  1. A $\rightarrow$ BC
  2. CD $\rightarrow$ E
  3. B $\rightarrow$ D
  4. E $\rightarrow$ A

  Compute B+.

Problem Set 6: Indexing (10 points)

- Construct a B-tree for the following set of key values: (2,5,7,10,14,16,30,38). Assume that the tree is initially empty, the values are added in ascending order and the number of pointers that fit in one node is four. Show the form of the tree after each of the following series of operations:

    1. Insert 8
    2. Insert 11
    3. Delete 16
    4. Delete 30
    5. Delete 38