Integrity Constraints – Practice Questions Solution

1. Consider the schema:

   employee(employee-name, street, city)
   works(employee-name, company-name, salary)
   company(company-name, city)
   manages(employee-name, manager-name)

   Give an SQL DDL definition for the tables of this database. Identify referential-integrity constraints that should hold and include them in the DDL definition.

```
create table employee
(person-name    char(20) not null,
 street         char(30),
 city           char(30),
 primary key(person-name))

create table works
(person-name    char(20) not null,
 company-name   char(15) not null,
 salary         integer,
foreign key (person-name) references employee,
foreign key (company-name) references company)

create table company
(company-name   char(15) not null,
 city           char(30))

create table manages
(person-name    char(20) not null,
 manager-name   char(20) not null,
foreign key (person-name) references employee,
foreign key (manager-name) references employee)
```

   Note that your domain selections can be different, as long as they are compatible where one column is a foreign key of another.

2. Given the following *relation*, list all of the nontrivial functional dependencies satisfied in it:

A	B	C
a_1	b_1	c_1
a_1	b_1	c_2
a_2	b_1	c_1
a_2	b_1	c_3

The nontrivial functional dependencies are:

A → B
C → B
AC → B

Note that the last functional dependency is actually logically implied by the first two (which axiom(s)?). There are also 19 trivial functional dependencies of the form $\alpha \rightarrow \beta$, where $\beta \subseteq \alpha$.

3. Given the relation schema R = (A, B, C, D, E) and the set of functional dependencies:

F = { E → AB
BC → D
D → E
AB → BC
BC → E }

Compute the canonical cover F_c. Show your steps clearly!

Using the algorithm for computing a canonical cover in text 6.5.4:

1. Use the union rule to replace

BC → D
BC → E

With

BC → DE

The left side of each functional dependency in F is now unique, so there are no more functional dependencies to replace using the union

rule.

2. The attribute B in BC of $AB \rightarrow BC$ is extraneous because from the algorithm from page 209 of the text, $AB \rightarrow C$ logically implies $AB \rightarrow BC$, so replace $AB \rightarrow BC$ with $AB \rightarrow C$.

3. The attribute E in $BC \rightarrow DE$ is extraneous because $E \in DE$ and $(F - \{BC \rightarrow DE\}) \cup \{BC \rightarrow (DE - E)\}$ logically implies F.

   This is true because $BC \rightarrow D$ is one of the given functional dependencies, so replace $BC \rightarrow DE$ with $BC \rightarrow D$.

4. There are no more extraneous attributes, since none of the attributes on the left side or right side of any remaining functional dependency is extraneous. Therefore, the canonical cover is:

$$F_c = \{ \quad E \rightarrow AB, \quad BC \rightarrow D, \quad D \rightarrow E, \quad AB \rightarrow C \quad \}$$