Exam I  March 28, 2008  Name________________
ComS 561  100 pts  SSN_________________

1. Given the relations R(\text{A B C}) and S(\text{B D E})
\begin{align*}
&\text{a e c} & \text{b} & \text{1} & \text{3} \\
&\text{d e f} & \text{e} & \text{5} & \text{6} \\
&\text{g e h} & \text{i} & \text{8} & \text{3} \\
&\text{j k l} & \text{b} & \text{6} & \text{7} \\
&\text{l b c} & & & \\
\end{align*}
provide a) R natural join S  b) Project S over E.

2. Describe the components needed for a web database application using struts, the flow
of control in the web application using struts, and the flow of data in the web application
using struts. Use an example as part of your answer.

3. Given a relational scheme \( R = \text{ABCDEFGHIJK} \) and the set of functional
dependencies \( \mathcal{F} = \{ \text{AB} \rightarrow \text{K}, \text{CE} \rightarrow \text{D}, \text{CE} \rightarrow \text{F}, \text{F} \rightarrow \text{G}, \text{H} \rightarrow \text{JI} \} \) determine the key of any
relation \( r \) over scheme \( R \) and in \( \text{SAT}(\mathcal{F}) \) using the RAP sequence(Show your work).

4. Given the relations \( r(R), s(S) \), the relation schemes \( R(\text{A,B,C}) \) and \( S(\text{C,D,E}) \) and the
relational algebra query \( \sigma_{\text{A}=10}(r \text{ join } s) \), provide the equivalent SQL statement.

5. Provide an example of a relational database scheme that is in 2NF, but not in 3NF.

6. Briefly explain what is meant by a lossless join. Can we determine whether a join is
lossless before we see the data that will be joined? Why or why not? Provide an
example as part of your answer.

7. Given the relation \( r \) below, explain why or why not the dependencies a) \( \text{AB} \rightarrow \text{C} \) b)
\( \text{CD} \rightarrow \text{F} \), c) \( \text{BC} \rightarrow \text{E} \) hold in \( r \).
\[
\begin{array}{cccccc}
\hline
\text{r} & \text{A} & \text{B} & \text{C} & \text{D} & \text{E} & \text{F} & \text{G} \\
\hline
2 & 3 & 4 & 5 & 5 & 5 & 8 \\
2 & 3 & 4 & 6 & 7 & 7 & 9 \\
\hline
\end{array}
\]

8. Briefly explain what Java Data Objects (JDO) are and why they are useful in an
application that uses Java to define the model classes. Your answer should contain an
example to illustrate the points that you are making.

9. Given the classes Employee, Department, and Customers classes provide the relation
mappings necessary to store instances of the classes in relations using the mapping
strategy discussed in class. You need to list the relation schemes for each resulting relation and indicate places where attribute names represent the same value.

```java
public class Employee{
    String name;
    String streetAddress;
    String city;
    String state;
    String zip;
    String phoneNumber;
    Collection<Customer> currentCustomersAssigned;
    Collection<Department> assignedDepartments;
    ...
}

public class Department{
    String deptName;
    String division;
    String deptNumber;
    String deptAddress;
    String phoneNumber;
    Collection<Employee> currentEmployees;
    ...
}

public class Customer{
    String customerNumber;
    String customerName;
    String customerAddress;
    ...
}
```