Name: ________________________________

This test is open book, open notes, but there can be no sharing of any material, and no communication except with me. You can use the Internet, but only as a library. If you are not sure if something is allowed, check with me.

1. (1 pt.) Write your name in the space provided above.

2. (4 pts.) Split $S(P, Q, R, S, T)$ using $QS \rightarrow R$.

3. (5 pts.) Consider a schema composed of a relation $R(A, B, C, D, E, F, G)$ with functional dependencies (basis) $ABC \rightarrow D$, $AC \rightarrow E$, $D \rightarrow G$, $G \rightarrow AF$, and $FG \rightarrow AB$. Compute $\{C, G\}^+$. 

4. (5 pts.) For each of the following functional dependencies, determine whether the dependency is true in the schema of Question 3. Justify your answers.

\[
\begin{align*}
BDG & \rightarrow ABF \\
BE & \rightarrow AC \\
ABC & \rightarrow DEFG
\end{align*}
\]
5. (10 pts.) List all keys of $R$ from Question 3. Justify your answer.

6. (5 pts.) Consider the schema of Question 3. Are there any functional dependencies in the given basis that are BCNF violations? List all such violations, if any.

7. (10 pts.) Transform the schema of Question 3 into BCNF. Document and justify the steps of the transformation.
8. (10 pts.) If the following is a valid instance of a relation $T$, which (if any) of the listed multivalued dependencies is definitely false? (List all such dependencies.) Justify your answer.

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$J \rightarrow K$
$K \rightarrow J$
$J \rightarrow LMN$
$K \rightarrow LMN$
$LMN \rightarrow K$
9. (5 pts.) For the schema in Question 3, write a SQL query that produces a nonempty result if and only if the database instance violates the dependency $AC \rightarrow E$.

10. (5 pts.) Write a relational algebra query that is equivalent to the query of Question 9.