

Name: _____

1. (1 pt.)

- **Read all material carefully.**
- You may refer to your books, papers, and notes during this test.
- No computer or network access of any kind is allowed (or needed).
- Write, and draw, carefully. Ambiguous or cryptic answers receive zero credit.
- Use the conventions used in class and the textbook for all material.
- COS 480 students should answer non-★ questions; ★ questions are for extra credit.
- COS 580 students should answer all questions, including ★ questions.

Write your name in the space provided above.

2. (9 pts.) Consider $R(A, B, C, D, E)$ with dependencies

$$\begin{aligned}A &\rightarrow B \\BC &\rightarrow A \\C &\rightarrow DE \\CE &\rightarrow B \\DE &\rightarrow C\end{aligned}$$

List all keys of R . Justify your answer briefly.

3. (20 pts.) Decompose R as necessary to generate a BCNF schema. For each decomposition used, clearly indicate the dependency used and the relations before and after the decomposition. List the projected dependencies and keys for each decomposed relation.

[additional space for answering the earlier question]

4. ★ (5 pts.) For each of the following, either provide, with explanation, a smallest relation with the stated property or prove that no such relation exists.

(a) $AB \leftrightarrow CD$ is true but $AB \rightarrow CD$ is false.

(b) $AB \rightarrow CD$ is true but $AB \leftrightarrow CD$ is false.

5. ★ (5 pts.) Prove or disprove: If an ER diagram includes an entity set (possibly weak) whose key has eight attributes then there are at least four ovals (representing attributes) in the diagram.