

Name: _____

1. (1 pt.)

- **Read all material carefully.**
- *If in doubt whether something is allowed, ask, don't assume.*
- You may refer to your books, papers, and notes during this test.
- E-books may be used *subject to the restrictions* noted in class.
- Computers are not permitted, except when used strictly as ebooks.
- Network access of any kind (cell, voice, text, data, ...) is not permitted.
- Write, and draw, carefully. Ambiguous or cryptic answers receive zero credit.
- Use class and textbook conventions for notation, algorithmic options, etc.

Write your name in the space provided above.

WAIT UNTIL INSTRUCTED TO CONTINUE TO REMAINING QUESTIONS.

Do not write on this page below this point.

Q	Full Score
1	1
2	9
3	10
4	20
5	20
total	60

2. (9 pts.) Consider a relation $R(A, B, C, D, E, F, G)$ with the following basis of dependencies:

$$\begin{aligned}AB &\rightarrow C \\B &\rightarrow D \\DC &\rightarrow A \\CEF &\rightarrow AB \\FG &\rightarrow C\end{aligned}$$

Provide a smallest (cardinality) instance of R that *violates* the dependency $CEF \rightarrow AB$ without violating any of the other dependencies. Briefly explain why your answer is correct (including why no smaller instance suffices).

3. (10 pts.) Indicate which of the following dependencies are *logically implied* by those in the basis of Question 2. *Justify* your answers briefly.

(a) $AF \rightarrow B$.

(b) $BCF \rightarrow A$.

(c) $EFG \rightarrow C$.

4. (20 pts.) For the relation R of Question 2 (dependencies repeated here):

$$\begin{aligned}AB &\rightarrow C \\B &\rightarrow D \\DC &\rightarrow A \\CEF &\rightarrow AB \\FG &\rightarrow C\end{aligned}$$

- (a) List **all** keys of R .
- (b) Explain your answer, noting why the keys you list are valid and also why there are no other keys.
- (c) How many *superkeys* does R have? Explain your answer. (You need not list all superkeys.)

[additional space for answering the earlier question]

5. (20 pts.) Decompose the schema of Question 2 to BCNF. **Show all intermediate steps and details**, such as keys, projected dependencies, and decomposed relations, for each (recursive) normalization invocation.

$$\begin{aligned} AB &\rightarrow C \\ B &\rightarrow D \\ DC &\rightarrow A \\ CEF &\rightarrow AB \\ FG &\rightarrow C \end{aligned}$$

[additional space for answering the earlier question]

[additional space for answering the earlier question]