Quiz 3: Relational DB Design Theory

1) Consider the following functional dependencies: \( AB \rightarrow C, BC \rightarrow D, EA \rightarrow B \). On which of the following is \( D \) functionally dependent?
   (a) \( AB \)  
   (b) \( EA \)  
   (c) \( AC \)  
   (d) \( ED \)

2) Suppose that we have the following three tuples in a legal instance of a relation schema \( S \) with three attributes \( ABC \) (listed in order): \( (1,2,3), (4,2,3), \) and \( (5,3,3) \).
   2-1) Which of the following dependencies can you infer does not hold over schema \( S \)?
       (a) \( A \rightarrow B \)
       (b) \( BC \rightarrow A \)
       (c) \( B \rightarrow C \)
   2-2) Can you identify any dependencies that hold over \( S \)?

3) Suppose you are given a relation \( R \) with four attributes, \( ABCD \). For each of the following sets of FDs, assuming those are the only dependencies that hold for \( R \), do the following: (a) Identify the candidate key(s) for \( R \). (b) Identify the best normal form that \( R \) satisfies (1NF, 2NF, 3NF, or BCNF). (c) If \( R \) is not in BCNF, decompose it into a set of lossless and dependency preserving BCNF relations, if possible.
   3-1) \( C \rightarrow D, C \rightarrow A, B \rightarrow C \)

   3-2) \( B \rightarrow C, D \rightarrow A \)

   3-3) \( ABC \rightarrow D, D \rightarrow A \)