

2007 Paper 13 Question 8

Databases

(a) Define the notion of a *functional dependency*. [2 marks]

(b) Consider the following “rule” for functional dependencies.

$$\text{if } A \rightarrow B \text{ and } B, C \rightarrow D, \text{ then } A, C \rightarrow D.$$

Either prove this rule is correct, or present a counter-example showing that the rule is false. [4 marks]

(c) The *union rule for functional dependencies* states that if $F \models X \rightarrow Y$ and $F \models X \rightarrow Z$, then $F \models X \rightarrow Y \cup Z$ (this can also be written as $F \models X \rightarrow Y, Z$).

Prove this rule using only Armstrong’s axioms. [4 marks]

(d) Suppose that $R(A, B, C)$ is a relational schema. Write a relational algebra query that evaluates to the empty set exactly when the functional dependency $B \rightarrow C$ holds on R . [4 marks]

(e) The schema $R(A, B, C, D, E)$ has the following functional dependencies.

$$A \rightarrow B, C$$

$$C, D \rightarrow E$$

$$B \rightarrow D$$

$$E \rightarrow A$$

Is D, E a candidate key for R ? Explain your answer. [6 marks]