

## 2005 Paper 5 Question 8

### Databases

(a) Define the core operators of the relational algebra. [5 marks]

(b) Describe *two* differences and *two* similarities between the relational algebra and SQL. [4 marks]

(c) Suppose that  $S(a, b, \dots)$  and  $R(a, \dots)$  are relations (the notation indicates that attribute  $a$  is in the schema of both  $S$  and  $R$ , while attribute  $b$  is only in the schema of  $S$ ). Suppose that  $v$  is a value; is the following equation always valid?

$$\sigma_{(a=v \text{ or } b=v)}(R \bowtie S) = (\sigma_{a=v}(R)) \bowtie (\sigma_{b=v}(S))$$

If yes, provide a short proof. If no, provide a counter-example. [2 marks]

(d) Various *normal forms* are important in relational schema design.

(i) Define Third Normal Form (3NF). [3 marks]

(ii) Define Boyce-Codd Normal Form (BCNF). [3 marks]

(iii) For databases with many concurrent update transactions, explain why schemas in normal form are important for good performance. [3 marks]