Databases

(a) The Entity/Relationship model is based around the concepts of *entity*, *attribute*, and *relationship*. Describe how these can be represented in the relational model. [6 marks]

(b) Data normalisation is often an important component in database design. Discuss why this is so, and give examples of situations where normalisation is *not* important. [6 marks]

(c) Let \( A \) and \( B \) be disjoint non-empty sets of attributes. Let \( R \) be a relation over attributes \( A \cup B \) and let \( S \) be a relation over attributes \( B \).

Suppose that we want to introduce a new relational operation called *division*, denoted \( R \div S \), that will return a relation over attributes \( A \). The relation \( R \div S \) is made up of all tuples \( t \) such that for all \( s \in S \) we have \( ts \in R \) (\( ts \) is the concatenation of \( t \) and \( s \)).

Note that in the special case that \( R = T \times S \) for some relation \( T \), then \((R \div S) = T \) and \((R \div T) = S \).

In other words, \( \div \) can be treated as an inverse to the Cartesian product.

Can we define \( R \div S \) in the relational algebra? Prove that your answer is correct. [8 marks]