Tutorial Sheet 4: Relational Data Modelling

1. Define, in the context of the Relational Data Model, referencing the ER model where appropriate:
    a. Relation
    b. Tuple
    c. Attribute
    d. Domain
    e. Degree
    f. Cardinality
2. Describe, giving examples:
    a. Entity Integrity
    b. Domain Integrity
    c. Referential Integrity
3. Define, giving examples:
    a. Candidate Key
    b. Primary Key
    c. Alternate Key
    d. Foreign Key
4. For the two relations below, evaluate the following expressions (a) to (e):

R	A	B
	1	1
	2	1
	3	2

S	B	C
	1	1
	2	2

    a. Cartesian Product RXS
    b. (Equi) Join R $\bowtie_{R.B=S.B}$ S
    c. (Natural) Join R $*_{R.B=S.B}$ S
    d. Show that (b) above equals $\sigma_{R.B=S.B}(RXS)$
    e. Show that (c) above equals $\pi_{R.A,R.B,S.C}(\sigma_{R.B=S.B}(RXS))$

5. For the three relations below **R, S, T** , show the commutativity and associativity properties of Equi-Join ($\bowtie$) and Natural Join (*)

R	A	B
	1	0
	0	1

S	A	C
	1	1
	0	0

T	C	D
	0	1
	0	1

7. [2008 Q2]
   a) Assume the following relations:

S	A	B
	1	0
	0	1

T	C	D
	0	0
	0	1
	1	1

Evaluate the following relational algebra expression. Give the result of each step (i.e. the result of each subexpression).

$R = \pi_{D}(\sigma_{(D=1)AND(A<=D)}(R \bowtie_{B=C} T))$

[9 Marks]

   b) Describe the integrity constraints primary key, referential integrity, and entity integrity in the relational data model.

[8 marks]

   c) What is relational algebra, what are the relational algebra operators and what is the role of relational algebra in the context of the relational data model?

[8 marks]

7. [2008 Q2]
   a) Assume the following relations:

R	X	Y
	A	C
	A	B

S	Y	Z
	A	B
	B	C
	A	C

Evaluate the following relational algebra expression. Give the result of each step (i.e. the result of each subexpression).

$T = \pi_{R.X,S.Y}(\sigma_{(R.Y=S.Z)AND(S.Y=A)}(RXS))$

[9 Marks]

   b) Describe the relational model's integrity constraints

[8 marks]

   c) Explain the underlined words in the following paragraph:
   The relational model is a type of data model which consists of relations. A relation consists of tuples and attributes. Each attribute is associated with some domain. Relations also have assorted degrees and cardinalities.

[7 marks]