UNIVERSITY OF LONDON

IMPERIAL COLLEGE OF SCIENCE, TECHNOLOGY AND MEDICINE

EXAMINATIONS 1999

BEng Honours Degree in Computing Part II
MEng Honours Degrees in Computing Part II
BSc Honours Degree in Mathematics and Computer Science Part II
MSci Honours Degree in Mathematics and Computer Science Part II
for Internal Students of the Imperial College of Science, Technology and Medicine

This paper is also taken for the relevant examinations for the
Associateship of the Royal College of Science
Associateship of the City and Guilds of London Institute

PAPER 2.2 / MC 2.2

DATABASES I

Wednesday, May 5th 1999, 4.00 – 5.30

Answer THREE questions

For admin. only:
paper contains 4 questions

1a The set of dependencies

$$F_C = \{ A \rightarrow B, B \rightarrow C, A \rightarrow D \}$$

is said to be an *irreducible cover* for the set of dependencies

$$F = \{ A \rightarrow BC, B \rightarrow C, A \rightarrow B, AB \rightarrow C, AC \rightarrow D \}$$

i) What are the properties of F_C that make it an irreducible cover for F ?
ii) Using only Armstrong's axioms, derive from F_C each of the three dependencies that appears in F but not in F_C.

b A certain 1NF database consists initially of a single relation R whose schema is

R (A, B, C, D, E, F, G)

and whose primary key K is given as {A, B, C}. Four further dependencies are also asserted:

$F \rightarrow AE$
$AD \rightarrow E$
$AC \rightarrow D$
$AE \rightarrow G$

Transform the database first to 2NF and then to 3NF, explaining clearly the principles and operations involved.

c Two separate update requests are issued to the database considered in part b:

- add the new information that E=5 when A=C=1
- delete all records for which G=2

Discuss these updates as applied both to the database given initially and to the database after transforming to 3NF.

The three parts carry, respectively, 40%, 45% and 15% of the marks.

2 ***For this question you will need to refer to the Supplementary Sheet showing the Suppliers-and-Parts database.***

a Let R1 be a relation with attributes X∪Y, and R2 a relation with attributes Y.

i) Explain precisely what is meant by the relational algebra expression

$$R1 \div R2$$

ii) Using the data supplied, evaluate SP[S*, P*] ÷ P[P*]

iii) Construct an expression which is equivalent to R1 ÷ R2 but uses only the operations of product (x), projection ([]) and difference (−). Explain your answer in words.

b Formulate in relational algebra the following queries, outlining their evaluations and stating the answers obtained:

i) Find the status of every supplier who supplies a quantity (QTY) of at least 300 of parts made in a city (PCITY) other than the city (SCITY) in which that supplier is based.

ii) Find the weights of those parts not made in cities where screws are made.

Note—this algebra allows just the following nine operations on relations A, B:

$A \cup B$	$A[\ldots]$
$A \cap B$	A *where condition*
$A \times B$	$A \rhd\lhd B$
$A \div B$	$A - B$
	rename A *as* B

The two parts carry, respectively, 45% and 55% of the marks.

Turn over ...

3 Consider the ER diagram on the supplementary sheet.

a i) What are the strong entity sets in the ER diagram? For each one give the primary key.

ii) Is there a weak entity set? If so, give its name, partial key and identifying relationship.

iii) For each relationship in the diagram give the participation constraints on the entity sets involved in the relationship.

b Translate the ER diagram into the relational model. Give the relation schema, identifying the primary and foreign keys of each relation and stating which entity set and/or relation of the ER diagram each relation represents. You do not need to give the foreign key rules but you must identify the foreign keys of each relation and state whether or not it can have NULL values and if not, why not.

c Indicate how you would modify the ER diagram if it became necessary to distinguish two special types of Accounts, Savings Accounts and Checking Accounts. How would you modify your relational representation, given in answer to part b, to represent the modified ER diagram?

The three parts carry, respectively, 40%, 45%, 15% of the marks.

4a i) How can foreign keys be declared in an SQL relation schema?

ii) What is the default policy in an SQL database for dealing with an update that violates a foreign key contraint? What are the two alternative policies that can be specified when the foreign key is declared? Give examples to illustrate these two alternative policies.

b i) Explain, using examples, how constraints on the values of individual attribute values, or on combinations of attribute values, can be specified in an SQL schema definition.

ii) What is a trigger? Give an example to show how a trigger definition can be used to maintain a database constraint involving more than one relation.

c Re-express the ER diagram on the supplementary sheet as a UML diagram.

The three parts carry, respectively, 30%, 40%, 30% of the marks.

End of Paper

Supplementary Sheet for Question 2 on Paper 2.2=MC2.2: 1998-99

Relation S

S#	SNAME	SCITY	STATUS
S1	Smith	London	20
S2	Jones	Paris	10
S3	Blake	Paris	10
S4	Clark	London	20
S5	Adams	Athens	30

For each supplier, gives their name, status and the city in which they are based

Relation P

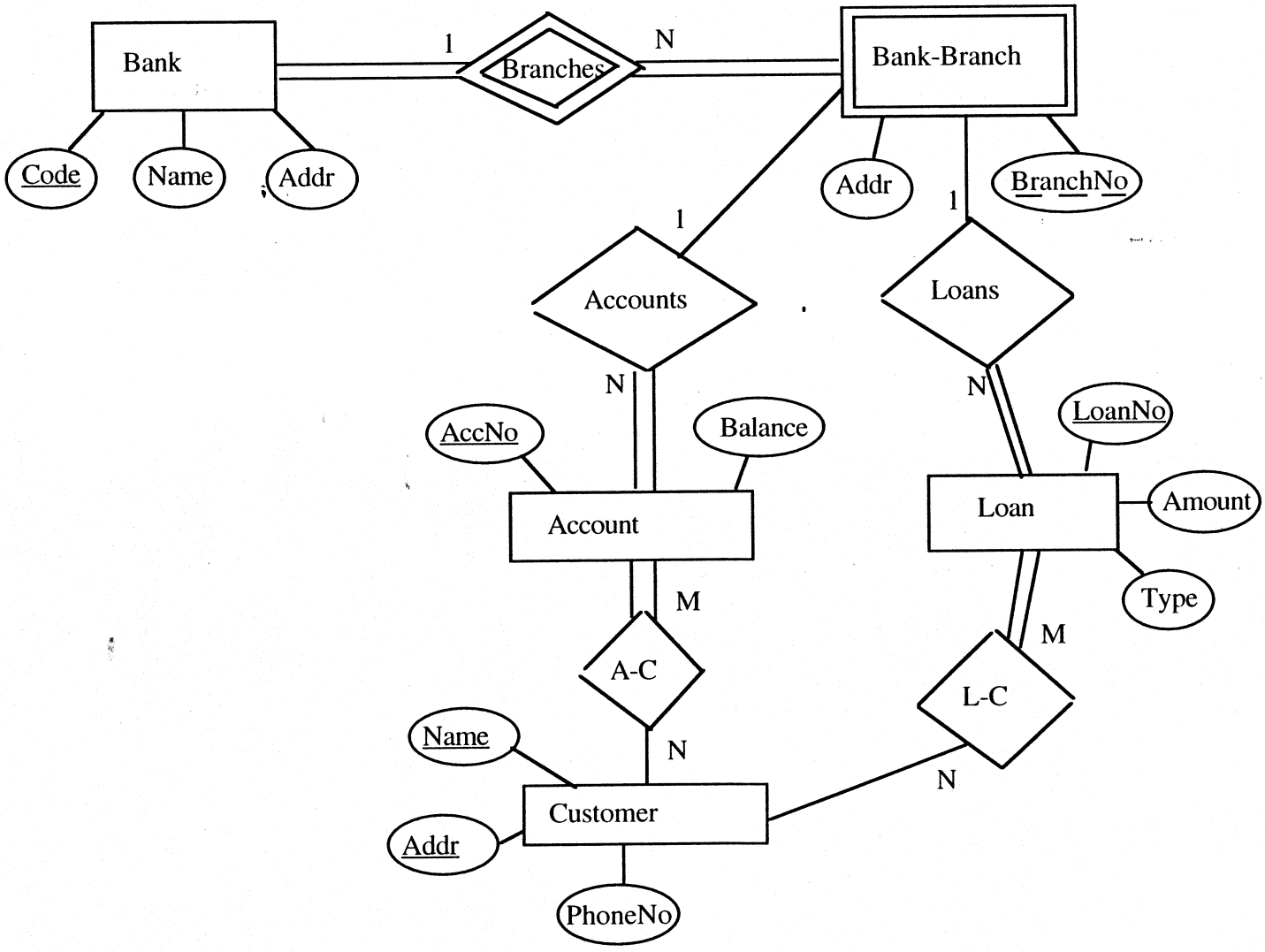
P#	PNAME	PCITY	COLOUR	WEIGHT
P1	Nut	London	Red	12
P2	Bolt	Paris	Green	17
P3	Screw	Rome	Blue	17
P4	Screw	London	Red	14
P5	Pin	Paris	Blue	12
P6	Brace	London	Red	19

For each part, gives its physical properties and the city in which it is made

Relation SP

S#	P#	QTY
S1	P1	300
S1	P2	200
S1	P3	400
S1	P4	200
S1	P5	100
S1	P6	100
S2	P1	300
S2	P2	400
S3	P2	200
S4	P2	200
S4	P4	300
S4	P5	400

For each supplier and part, gives the quantity of that part supplied by that supplier



Supplementary sheet for questions 3,4 of Paper 2.2/MC2.2