UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

Foundation Year Examination 2007

COMPUTING

IS50001A (FY01)
Foundation Mathematics for Computing

Duration: 3 hours

Date and Time:

You should answer four questions in this paper. All questions are worth 25 marks. The marks for each part of a question are indicated at the end of the part in [.] brackets.

There are a total of 100 marks available on this paper.

No calculators should be used.

THIS PAPER MUST NOT BE REMOVED FROM THE EXAMINATION ROOM

1. **This question is about fractions, percentages and ratios.**

   (a) Convert the following into decimals

      i. $\frac{1}{5}$ [1]

      ii. $\frac{1}{20}$ [2]

   (b) Calculate the following

      i. $\frac{3}{5} + \frac{3}{10}$ [2]

      ii. $\frac{3}{5} * \frac{3}{10}$ [2]

   (c) Calculate the following

      i. 20% *of* 360 [2]

      ii. 42% *of* 400 [2]

   (d) Calculate how much A and B receive when the money is split into the following ratios.

      i. £400 ratio 3:1 [2]

      ii. £200 ratio 7:3 [2]

   (e) Evaluate the following

      i. $(7 * -7) + (-7 * -7)$ [1]

      ii. $(7 * -7) - (-7 * -7)$ [1]

   (f) Binary and decimal number systems

      i. write 11_2 as a decimal [2]

      ii. write 1101_2 as a decimal [2]

      iii. express 9 as a binary number [2]

      iv. express 23 as a binary number [2]

2. **This question is about simultaneous equations and drawing graphs.**

(a) Using the substitution or elimination method to solve the following equations [8]

i.

$$\begin{aligned} y &= 3x + 2 \\ y &= 4x + 1 \end{aligned}$$

ii.

$$\begin{aligned} y &= x + 3 \\ 2y &= 4x + 8 \end{aligned}$$

(b) Plot each pair of equations from part(a) on separate graphs.

How can these graphs be used to check your answers in part(a)?

(You may wish to copy and complete the following table to help you sketch each of the graphs. Your final answer should consist of 2 graphs each with a pair of straight lines. One graph for part (i) and another for part (ii).) [8]

$x - value$	-2	-1	0	1	2
$y - value$					

(c) Copy and complete the following table and then sketch the equation in your answer books. [6]

$$y = x^2 + x - 2$$

$x - value$	-4	-3	-2	-1	0	1	2	3	4
$y - value$									

(d) Using a graph or otherwise, solve the following pair of simultaneous equations. [3]

$$\begin{aligned} y &= x^2 + x - 2 \\ y &= 0 \end{aligned}$$

3. **This question is about sets and logic**

(a) Complete the following tables and hence decide whether each of the logical formula is a contingency, tautology or inconsistency.

i. [4]

$(P \wedge Q) \vee Q$

P	Q	$P \wedge Q$	$(P \wedge Q) \vee Q$

- $(P \wedge Q) \vee Q$ is a ...

ii. [4]

$(P \wedge Q) \Rightarrow Q$

P	Q	$P \wedge Q$	$(P \wedge Q) \Rightarrow Q$

- $(P \wedge Q) \Rightarrow Q$ is a ...

(b) Evaluate the following expressions

i. $\{1,2,3,9\} \cup \{1,7,9\} =$ [1]

ii. $\{4,8,9\} \cap \{1,7,9\} =$ [1]

iii. $\{1,4,8,9\} \cap \{1,4,6,7\} =$ [1]

iv. $\#\{1,2,3\} =$ [1]

v. $\#\{\{\},\{a\},\{b\}\} =$ [1]

vi. $\bigcup\{\{yellow\},\{yellow,pink\},\{yellow,red\}\} =$ [2]

vii. $\bigcap\{\{\},\{0,6,9\},\{1,4,5\},\{7,8\}\} =$ [2]

viii. $\bigcup\{\{0,1,5\},\{0,1,3,5\},\{0,5,6\}\} =$ [2]

ix. $\bigcap\{\{0,3,5\},\{0,1,3,5\},\{0,5,6\}\} =$ [2]

x. $\mathbb{P}\{1,2,3\}$ [2]

xi. $\#\,\mathbb{P}\{1,2,3,4,5\}$ [2]

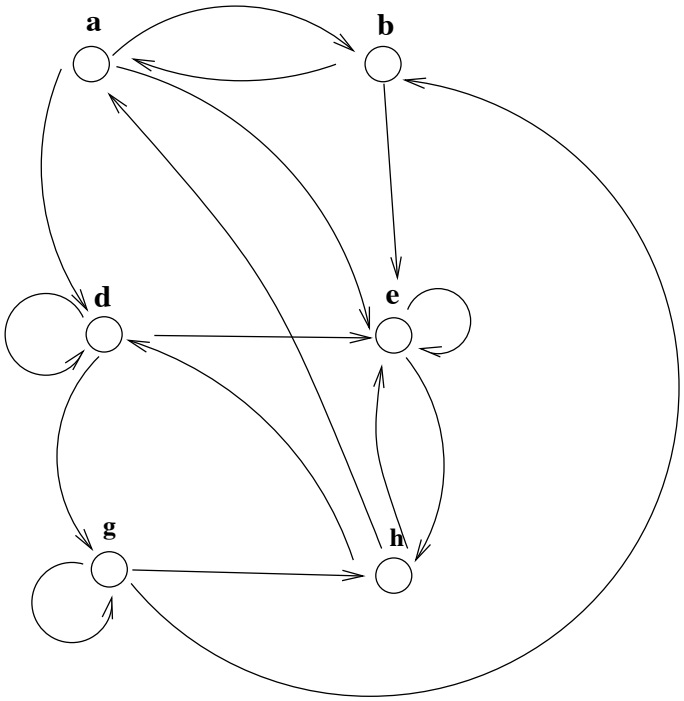

Figure 1: An Example Graph

4. **This question is about relations, functions and graphs**

(a) You are given the following

$$\textit{relation}1 = \{\ (0,1), (1,2), (1,3), (1,4), (2,5), (3,5)\ \}$$

$$\textit{relation}2 = \{\ (0,1), (1,2), (2,3), (3,4)\ \}$$

Calculate the following

i. dom *relation*1 [2]

ii. dom *relation*2 [2]

iii. ran *relation*1 = [2]

iv. ran *relation*2 = [2]

v. *relation*1 $\fatsemi$ *relation*2 = [2]

vi. $(\textit{relation}1 \fatsemi \textit{relation}2)^{\sim} =$ [2]

(b) This question is about the graph in Figure 1.

i. Complete the following table and give the indegree and outdegree for each node. [3]

Node	Indegree	Outdegree
a		
b		
d		
e		
g		
h		

ii. Categorise the following paths as one of the following

- simple directed path
- simple undirected path
- directed path
- undirected path
- simple directed cycle
- simple undirected cycle
- directed cycle
- undirected cycle

A. $\langle a, b \rangle$ is a ... [1]

B. $\langle b, a \rangle$ is a ... [1]

C. $\langle a, e, h, d \rangle$ is a ... [1]

D. $\langle a, e, b, a, d \rangle$ is a ... [1]

E. $\langle b, c, b \rangle$ is a ... [1]

iii. List all the loops. [1]

iv. Are there any Hamiltonian Cycles? If there are then write one down. [4]

5. **This question is about algorithms**

(a) Consider the following procedure.

procedure *BubbleSort*$\{a_1, a_2 \ldots a_n$:natural numbers$\}$
  for $i := 1$ *to* n
    for $j := 1$ *to* $n - i$
      if $a_j > a_{j+1}$ **then** *swapvalues*(a_j, a_{j+1})
return $(a_1, a_2, \ldots a_n)$
end

Suppose we were to call this program as follows.

BubbleSort $\{8, 5, 7, 4, 1\}$

Copy and complete the following table to show how the variables change and thus how the algorithm works. What will the algorithm return on its completion? [12]

variable	i	j	a_1	a_2	a_3	a_4	a_5
initial values	1	2	8	5	7	4	1

(b) Consider the following procedure

procedure *BinarySearch*$\{x$:natural number, $a_1, a_2, \ldots, a_n$:increasing natural numbers$\}$
$i := 1$;
$j := n$;
while $i < j$
begin
  $m := (i + j)$ *DIV* 2
  If $x > a_m$ **then** $i := m + 1$
  else $j := m$
end
if $x = a_i$ **then** *location* $:= i$
else *location* $:= 0$
end

i. Write down the constants $x, n, a_1, a_2, \ldots a_n$ for this procedure when it is called with [3]

$$\mathit{BinarySearch}\{11, (1, 3, 5, 8, 11, 13, 15, 17)\}$$

ii. Copy and complete the following table to show how the variables change and thus how the algorithm works. What information does the final value of the variable *location* tell us? [10]

variable	*i*	*j*	*m*	*location*
initial values				

6. **This question is about probability**

(a) If you roll a die, calculate the probabilities for the following outcomes. [6]

i. you roll a six

ii. you roll an even number

iii. you roll a number which is greater than 1

(b) If you role two dice, calculate probabilities for each of the following. [6]

i. you role a score equal to 2

ii. you role a score equal to 7

iii. you role an odd score

(c) Suppose I had a drawer with 10 socks of which 5 were red 3 were blue and 2 were green. Calculate the following.

i. The probability of picking a red sock [1]

ii. The probability of picking a red sock or a blue sock [2]

iii. The probability of picking two red socks (That is I pick one red sock, do not return it, and then I pick another red sock. The rest of the questions have the same behaviour.) [2]

iv. The probability of picking two green socks [2]

v. The probability of picking two blue socks [2]

vi. The probability of picking a pair of matching socks [2]

vii. The probability of picking a pair of odd socks [2]