BCS The Chartered Institute for IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 4 Certificate in IT

SOFTWARE DEVELOPMENT

Tuesday 28th September 2010 - Afternoon
Time: TWO hours

Section A and Section B each carry 50% of the marks. You are advised to spend about 1 hour on Section A (30 minutes per question) and 1 hour on Section B (12 minutes per question).

Answer the Section A questions you attempt in Answer Book A
Answer the Section B questions you attempt in Answer Book B

The marks given in brackets are **indicative** of the weight given to each part of the question.

Calculators are **NOT** allowed in this examination

SECTION A

Answer TWO questions out of FOUR in Answer Book A. Each question carries 30 marks.

A1 Write an algorithm to implement the following word game for 2 players:

Each of the players in turn enters a word where all the letters are different, starting with 4 letters. The word is then checked to see if it has any letters the same; if it has that player is eliminated. There must be no duplicated words. The next round has words with 5 letters. This continues until only one player remains; he/she is declared the winner.

a) Specify the following record named '**oneplayer**' in a language of your choice, to use in the program. State which language you are using.

(3 marks)

name, word (10 characters)
Playerout _indicator (in, eliminated)

b) Write a procedure **checkword** with appropriate parameters, which checks if the letters in 'theword' are all different. If they are it returns FALSE otherwise it returns TRUE.

(6 marks)

c) Develop an algorithm to implement the word game. It must show at least two stages of development, and reach a stage where coding would be straightforward.

(Algorithm 11 marks)
(Development 10 marks)

A2 The following code uses Newton's Method to improve the roots of a quadratic equation

$$Ax^2 + Bx + C = 0$$

The roots are approximately known.

Line No.	Code	Version B
10	FNX(X) = A*X↑2 + B*X + C	float FNX(X){ return(A*X*X+B*X+C);}
11	FND(X) = 2*A*X + B	float FND(X){return(2*A*X+B);}
12	PRINT "EXECUTION STARTS	printf("EXECUTION STARTS HERE");
13	HERE"	K = 0;
14	K = 0	loop: R2 = R1 - FNX(R1) / FND(R1);
15	R2 = R1 - FNX(R1) / FND(R1)	K = K + 1;
16	K = K + 1	printf("count = %d root = %f", K, R2);
17	PRINT "count = ",K," root = ", R2	if(K == 2) goto end;
18	IF K = 2 THEN GO TO 20	R1 = R2;
19	R1 = R2	goto loop;
20	GO TO 15	end: printf("final root = %f", R2);
21	WRITE(" final root = ", R2)	}
	END	

a) Dry run this code with the values A = 1, B = -3, C = -10 and R1 = 6. Give two cycles of the loop which show that the root R1 is converging to a value of 2.6.

(20 marks)

b) Re-write the code as a function with parameters A, B and C and which reads in the first value of R1.
Use better names for the variables and avoid the use of 'GO TO' statements.

(10 marks)

A3 The arrays **x, y** have been initialised as follows

index	0	1	2	3	4	5	6	7	8	9
x	41	19	55	90	80	76	13	55	1	0
y	42	20	57	90	81	76	12	49	0	1
z										

The subroutine ***r*** in the code below is going to be executed with parameter ***s*** set to 2 and parameter ***t*** set to 7. [*You can choose to follow either version of the code*]

a) Trace the call of the subroutine ***r(2,7)*** and show clearly the results of the call.

(8 marks)

	Version A	Version B
1	void r(int s, int t){	PROCEDURE r(s, t : INTEGER);
2	int v, w;	VAR v, w : INTEGER;
3	/* begin function */	BEGIN
4	for(w=s; w<=t; w++)	FOR w := s TO t DO
5	{	BEGIN
6	v = x[w] + y[w];	v := x[w] + y[w];
7	z[w] = v / 2;	z[w] := v / 2;
8	}	END
9	}	END;

b) Write a brief summary of what the subroutine does.

(6 marks)

c) Decide on better names for the identifiers (the subroutine name, its parameters and the variables) and rewrite the code [either version A or version B] using your new names and including suitable comments.

(10 marks)

d) Rewrite lines 4 to 8 [of either version A or version B] using a while-loop instead of a for-loop.

(6 marks)

A4

program A	program B

/* program A */
int res;
int convert(char c){
  int val;
  /* begin function */
  val = 0;
  if(c=='I' || c=='i')
  val = 1;
  else if (c=='V' || c== 'v')
  val = 5;
  else if (c=='X' || c=='x')
  val=10;
  return(val);
}
void main(){
  res = convert('X') + convert('i');
}
	PROGRAM B;
	VAR res : INTEGER;
	FUNCTION convert(c : CHAR) : INTEGER;
	VAR val : INTEGER;
	BEGIN
	  val := 0;
	  IF (c='I') OR (c='i') THEN
	  val := 1
	  ELSE IF (c='V') OR (c= 'v') THEN
	  val := 5
	  ELSE IF (c='X') OR (c='x') THEN
	  val :=10;
	  convert := val;
	END;
	BEGIN
	  res := convert('X') + convert('i')
	END.

a) Choose either program A or program B and then find and copy out an example of each of the following.
[*Take care to copy out only what is requested, nothing more*]

(1 mark each, 12 total)

a.1) a reserved word	a.7) an arithmetic operator
a.2) a variable identifier	a.8) a logical operator
a.3) a type identifier	a.9) a formal parameter
a.4) a function identifier	a.10) an actual parameter
a.5) a character constant	a.11) a local variable
a.6) an integer constant	a.12) an assignment symbol

b) Continuing with either program A or program B as in part (a), find and copy out an example of each of the following.
[*Take care to copy out only what is requested, nothing more*]

(3 marks each, 18 total)

b.1) a function call	b.4) an assignment statement
b.2) a function declaration	b.5) an expression with a boolean (logical) value
b.3) a variable declaration	b.6) a conditional statement

SECTION B

Answer FIVE questions out of EIGHT in Answer Book B. All questions carry 12 marks.

B5 A serial file 'datafile' has a sequence of records R_1, R_2, …, R_N, which follow each other in the file. A file pointer is used to manage operations with this file.

a) Draw a diagram showing how the records are laid out on the file. Include the file pointer's position before any records are read from the file.

(4 marks)

b) Describe how the END-OF-FILE (datafile) condition is detected.

(3 marks)

c) Write a program loop which opens the file, counts how many records are on it, then closes it. State which language you use.

(5 marks)

B6 The following data is stored for cricketers:

Family Name	20 characters
Given names	20 characters
Nationality	10 characters
Type of player	batsman or bowler or keeper
batting average	real number
bowling average	real number
played in more than 10 matches	yes/no

a) Devise a record structure named **player** to hold this data.

(3 marks)

b) Write a program which reads the serial file **cricketers** and which prints in a table those who have not played in any test matches, have a bowling average less than 20 and a batting average greater than 40. A count of these players is also made and printed at the end.

(9 marks)

B7 Values for the hyperbolic cosine function are obtained from the power series

$\text{Cosh}(x) = 1 + x^2 / \text{fac}(2) + x^4 / \text{fac}(4) + x^6 / \text{fac}(6) + \ldots$

where fac(n) = factorial n = 1*2*3*4*…n

a) Write code for fac(n); any method may be used.

(4 marks)

b) Incorporate your function into another function Cosh(x) which calculates Cosh(x) using the power series given earlier. Show how to terminate the calculation when the difference between successive terms is less than 0.00005.

(8 marks)

B8 Bank account details are stored in a linked list and are such that each entry takes the following form:

Name (20 characters)
Account number (integer)
Balance of account (real number)
Negative balances indicate overdrawn accounts.

a) Provide suitable definitions for such a linked list. State which language you are using.

(3 marks)

b) Write a program which will print a table detailing all accounts from the linked list that are overdrawn. The name, account number and amount in debt should be printed under a suitable caption. Afterwards, a count of how many accounts were overdrawn must be printed.

Make appropriate variable declarations for part (b). Do NOT repeat the record declaration made in part (a) but show where it would be placed.

(9 marks)

B9 One of the common operations required of a computer program is to sort items into ascending (or descending) according to the value of a key. Describe (either in words, or by pseudo code or by actual program code) one algorithm for sorting.

(12 marks)

B10 Compare the following pairs of terms. [*You are advised that three well chosen sentences per pair will be sufficient - one sentence describing the first term, one sentence describing the second term and a final sentence highlighting the difference between the terms.*]

a) Compile-time error and run-time error

b) Sequential access file and direct access file

c) High-level language and low-level language

d) Sequential and parallel programming

(12 marks)

B11 One particular software development method is named the waterfall method.

a) Write out the names of all the phases in the method

(3 marks)

b) Choose THREE phases and write a short description of each of the three phases you have chosen

(9 marks)

B12 Describe the general concept of black box testing and illustrate your answer using the subroutine reverse() whose task is to reverse the elements of array **v** as shown below.

index	0	1	2	3	4	5
v (initial values)	2	4	6	8	10	12
v (after reversal)	12	10	8	6	4	2

(12 marks)