BCS THE CHARTERED INSTITUTE FOR IT

BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 4 Certificate in IT

SOFTWARE DEVELOPMENT

Friday 28th March 2014 - 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 2 questions (out of 4) in Answer Book A. Each question carries 30 marks

A1 Three speed tests are run on six different computers and the times (in seconds) taken are recorded in a two-dimensional array called *TIMES* so the entry where T=2 and C=3 records the time for test 2 run on computer 3.

TIMES	C=1	C=2	C=3	C=4	C=5	C=6
T=1						
T=2						
T=3						

The *MAX*imum and *MIN*imum times for each test are to be computed and stored in arrays of size 3. Then a *SCORES* table (with the same shape as *TIMES*) is to be computed with each entry calculated by the formula

$$SCORES_{TC} = (TIMES_{TC} - MIN_{T})/(MAX_{T} - MIN_{T})$$

Finally an array *TOTALS* of total scores for each computer is to be calculated and the winning score (lowest score) found.

Write a program to perform the above calculations given the *TIMES* array.

You are advised that a structured program using well-chosen functions will obtain the most marks.

(30 marks)

A2 A number sort using an insertion algorithm is to be programmed as follows. The numbers to be sorted are made available in an array called *UNSORTED*.

	1	2	3	4	...	100
UNSORTED	55	11	44	33	...	...

The numbers are copied from *UNSORTED*, one at a time, and placed in their correct place in *SORTED* by moving existing numbers where necessary. So after the first 3 numbers have been inserted and the number 33 is to be inserted, the sorted array will look like this:

	1	2	3	4	...	100
SORTED	11	44	55			

The position to insert the new number is found, the larger numbers are moved along and the new number inserted. So for example 33 needs to go in place 2, so the numbers 44 and 55 are moved along (that is, to places 3 and 4) to make room.

Solve this problem by writing the functions

a) findPosition(v) – find the right position in *SORTED* for value *v*

(9 marks)

b) makeSpace(p) – move numbers in *SORTED* along one place starting at position *p*

(9 marks)

c) insert1(v) – using a) and b), inserts a single value *v* in its correct place in *SORTED*

(6 marks)

d) insertionSort() – inserts every value from *UNSORTED* into *SORTED*

(6 marks)

A3 The array *a* has been initialized as follows

	0	1	2	3	4	5
a	A	B	C	D	E	F

The function *f*(b) has been declared as follows

```
void f(b){
  int c,d;
  for(c=0;c<=b;c++){
        d=a[c]; a[c]=a[b-c]; a[b-c]=d;
  }
}
```

Given the situation described above,

a) Trace the call of *f*(5)

(10 marks)

b) State what the function achieves overall

(6 marks)

c) From your trace, state the significant result that it achieves half way through

(6 marks)

d) Re-write the declaration of *f* with well-chosen identifiers and comments to achieve the result noted in part c)

(8 marks)

A4 a) Consider the code below and write it out again formatting it in a more familiar human-readable form.

```
int f(int i,char c){int j=i;if(c>='A'&&c<='Z')j++;return j;}
```

(6 marks)

b) What is meant by white space when discussing computer programs?

(5 marks)

c) The code above is expressed in the minimum number of characters. What happens if any of the FIVE spaces are removed from the program?

(5 marks)

d) Referring to the code in part a), find and write out ONLY the following:

i) all the different identifiers
ii) all the different constants
iii) all the different operators
iv) the longest conditional (logical, boolean) expression
v) a conditional statement

[*Note that you should copy out exactly what is requested and no more*]

(5 x 2 marks)

e) The language C has a conditional expression of the form (e1?e2:e3) which evaluates to e2 if e1 is true, otherwise it evaluates to e3. Rewrite your answer to part a) using the style {return (e1?e2:e3);}

(4 marks)

Section B

Answer 5 questions (out of 8) in Answer Book B. Each question carries 12 marks.

B5 A health care company is planning to create a mobile application to indicate Body Mass Index (BMI), so that their patients can work out if they are a healthy weight for their height. The formula used for this calculation is:

$$\mathbf{BMI = W / H^2}$$

Where:
BMI = Body Mass Index
H = Height (measured in metres)
W = Weight (measured in kg)

a) Write an expression in pseudocode to calculate the BMI using the formula above.

(2 marks)

b) Incorporate your expression into pseudocode or a program in a language of your choice in which the input variables are H and W, and the outputs are BMI and Category; the following data is used to determine Category.

BMI	**Health Category**
Less than or equal to 18.5	Underweight
Greater than 18.5 to 25.0	Normal
Greater than 25.0 to 30.0	Overweight
Greater than 30.0	Obese

(10 marks)

B6 It is often necessary for programmers to search through an array of data to find a particular element.

a) Specify a linear search method to find an item of data from the unsorted 15 element integer array shown below:

Data {1, 54, 4, 76, 32, 12, 14, 3, 31, 52, 65, 45, 13, 89, 17}

The solution can be written in either pseudocode or a programming language of your choice. The output must indicate the array location of the data item.

(8 marks)

b) Briefly describe how a binary search operates and state why it would NOT be a suitable method to use for this particular data.

(4 marks)

B7 a) Define what is meant in programming by the terms

i) Conditional execution
ii) Looping

(6 marks)

b) Define the structure of the following statements in a language known to you. (If there are multiple statements of a particular kind in the language you have chosen then just pick one of each.)

i) Conditional statement
ii) Loop statement

(6 marks)

B8 A computer maintenance company employs 390 field service engineers and an address list is maintained using a sequential file with the name of each employee being the key field. Assume (for simplicity) that no names are duplicated and that the names are evenly distributed over the alphabet.

a) Give (or estimate) the minimum, maximum and average number of keys that will need to be accessed to find the address of a particular employee from the sequential file.

(4 marks)

b) Now suppose that the file is made into an indexed sequential file with a single level index. The index groups are defined by the initial letter of the name, with 2 initial letters per group, i.e. A-B, C-D, E-F, G-H, I-J, K-L etc.

i) Give (or estimate) the minimum, maximum and average number of keys that will need to be accessed to find the correct group in the index.

(4 marks)

ii) Give (or estimate) the minimum, maximum and average number of keys that will need to be accessed to find the address in the main file once the index has been consulted.

(4 marks)

B9 A typical web page is divided into five parts. That is, a narrow strip at the top and bottom and a strip at each side leaving a large area in the middle.

a) Sketch this layout and describe one way that it can be achieved.

(5 marks)

b) Give a typical use for each of the five parts of the page by considering the homepage of an e-commerce site selling to the general public.

(5 marks)

c) State briefly another way in which the same layout effect can be achieved and give a reason why this method might not be favoured.

(2 marks)

B10 Define the following terms:

a) Algorithm
b) Iteration
c) GUI
d) Code generator

(4 x 3 marks)

Turn Over]

B11 Use the program code below to find occurrences of the following SIX errors listed below. For each error, you should give the line number and an explanation of the error. In addition, you should state whether each error will be discovered at compile time or run-time.

a) identifier not declared **(2 marks)**
b) type error - index not allowed **(2 marks)**
c) array index out of bounds **(2 marks)**
d) syntax error **(2 marks)**
e) variable required **(2 marks)**
f) type error - invalid type **(2 marks)**

Line	C Program
1	void main();
2	{
3	float a[10];
4	int b, c;
5	b = 1;
6	2 = b;
7	c = b[1];
8	d = i+j;
9	if (b > 1 b = b - 1 ;
10	a[0]=b;
11	if (a[0]) c = 1;
12	for(b=0; b<=9; b++)
13	a[b+1] = b;
14	}

B12 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 chosen.

(9 marks)