

BCS THE CHARTERED INSTITUTE FOR IT
BCS HIGHER EDUCATION QUALIFICATIONS
BCS Level 4 Certificate in IT

SOFTWARE DEVELOPMENT

Wednesday 22nd March 2017 - 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 any Section A questions you attempt in Answer Book A
Answer any 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). Each question carries 30 marks.

A1

Imagine data obtained by reading a thermometer every hour for a week. The problem considered here is to find where the temperature peaks and to measure the gaps between the peaks.

- a) Write a function (called findDirection) to go element by element through an array (called TEMPERATURE) and place in a new array (called DIRECTION) a +1 every time that a value in the first array is greater than the previous value, a 0 if it is the same and -1 otherwise.

(8 marks)

TEMPERATURE	21	22	22	23	22	21	21	22	23	24	25	23	21	22	21	22
DIRECTION		+1	0	+1	-1	-1	0	+1	+1	+1	+1	-1	-1	+1	-1	+1

- b) Write a function (called change0) to go through the array called DIRECTION) changing every 0 to a copy of the preceding entry.

(8 marks)

index	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	...
DIRECTION		+1	0	+1	-1	-1	0	+1	+1	+1	+1	-1	-1	+1	-1	+1
			+1				-1									

- c) Write a function (called findPeaks) to record in a new array (called PEAKS) the indexes in DIRECTION where the peaks are [where the temperature changes from going up (+1) to down (-1)].

(8 marks)

index	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	...
DIRECTION		+1	+1	+1	-1	-1	-1	+1	+1	+1	+1	-1	-1	+1	-1	+1
				^							^			^		

PEAKS 3, 10, 13

- d) The data is provided in a 168(=24hrs*7days) element array called TEMPERATURE. Write a program, using the functions of parts a), b) & c) to report the lengths (in hours) of the gaps between peaks.

(6 marks)

A2

There are 6 candidates in an election and the voting paper has been designed as follows:

Mrs Adams [] Mr Bean [] Mr Crab [] Mrs Dean [] Mrs East [] Mr Fish []

The voters have been told to put a number 1 next to their first choice, a number 2 next to their 2nd choice, and so on down to a 6 for their 6th choice. The scoring system is that a candidate is awarded 6 points every time they are chosen in 1st place, 5 points for 2nd, down to 1 point for 6th. You are to write a program to read the choices data, apply the scoring system and report the winning candidate (the candidate with the most points).

The data is available to be read from a file called CHOICES containing one line for each voter. Each line contains just the numbers (always six numbers) from one voting form so

5 4 1 6 3 2

would mean that a voter put Mr Crab in 1st place and Mrs Dean last (in 6th place). The data file contains the choices from 100 voters. You can assume that an array called CANDIDATES exists which contains the candidates' names in alphabetical order.

(30 marks)

[Note: For maximum marks your answer should use functions and should produce a warning message if there is a tie for 1st place.]

A3

- a) Give the final values of the variables a, b, c, d after the following code has executed:

```
i=2; a=++i; b=i;
i=4; c=i++; d=i;
```

(4 marks)

- b) Based on your answer to part a), or otherwise, state the key difference between ++i and i++.

(4 marks)

- c) Given the initial values in the arrays S1 and S2 as follows:

index	0	1	2	3	4	5
S1	11	12	15	16	19	22
S2	13	14	17	18	20	21

trace the execution of the function call $f(3)$, where the function f is defined as follows:

```
void f(int g){
    int i1=0, i2=0, i3=0;
    while(i1<g && i2<g){
        if(S1[i1]<S2[i2]){
            S3[i3++]=S1[i1++];
        }else{
            S3[i3++]=S2[i2++];
        }
    }
}
```

(18 marks)

- d) Describe in your own words the kind of data that function *f* has been given and describe the result that it produces.

(4 marks)

A4

Based on the following program extract, answer the questions below:

```
#include <stdio.h>
#include <math.h>
void f(char c, float y){
    int r; r=0; y=0.0;
    if(c>='0'&&c<='9'){r+=10; y=sqrt(r);}
    printf("%d %f", r, y);
}
```

From the extract

- a) List all the identifiers (5 marks)
- b) List all the operators. (5 marks)
- c) List all the constants. (5 marks)
- d) List the types of each of the constants in c). (5 marks)
- e) Copy out an example of each of the following:
 - i) a declaration,
 - ii) a boolean expression,
 - iii) an assignment statement,
 - iv) a conditional statement.

(10 marks)

SECTION B

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

B5

Values for the hyperbolic sine function are obtained from the power series

$$\text{Sinh}(x) = x + x^3 / \text{fac}(3) + x^5 / \text{fac}(5) + x^7 / \text{fac}(7) + \dots$$

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

Note: - Use pseudocode or actual program code of your choice to answer this question.

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

(4 marks)

- b) Incorporate your function into another function *HSine*(x) which calculates Sinh(x) using the power series given above. The calculation should be terminated when the difference between successive terms is less than 0.00005.

(8 marks)

B6

The following code extracts are written in C.

- a) Write code using a while loop which is equivalent to the following *for* loop.

```
for(i=0;i<=99;i++)  
    v[i]=0;
```

- b) Rewrite the following conditional code without using the logical operators &&(and), ||(or), !(not)

```
if( p && !q )  
    x = 0;  
else  
    x = 1;
```

- c) Write code to find the maximum value in array *v* with the answer in variable *max*.

```
int v[100];  
int max;
```

(3 x 4 marks)

B7

Describe the following file types:

- a) Sequential access file
- b) Direct access file
- c) Indexed sequential file

(3 x 4 marks)

B8

- a) Explain the difference between a syntax error and a run-time error? **(3 marks)**

- b) Write down an example for each of the three errors listed below. In each case examples should be a one line extract from a program with a precise description of the error.

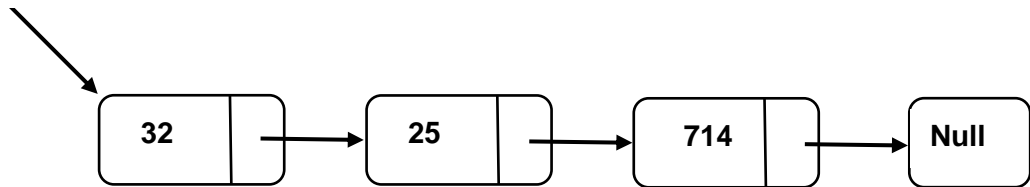
- i) A syntax error in an expression **(3 marks)**
- ii) A syntax error in a statement **(3 marks)**
- iii) A run-time error in an expression **(3 marks)**

B9

A linked list has been set up with one data item and one pointer only in each element of the list as shown in the diagram below.

- a) Draw a diagram of this linked list with a new node inserted containing data element 621 after the node containing data element 25. **(2 marks)**

Head Pointer



- b) Write pseudocode for a function InsertAfter with two integer parameters. The function searches for the node containing the value of the first parameter and then inserts a node after the node found with the value of the second parameter. You can assume a node holding the first value exists. **(6 marks)**
- c) Describe the linked list data structure giving an advantage of using this technique. **(4 marks)**

B10

Write notes to compare and contrast the following pairs of terms

- a) Relational and flat file databases
- b) System software and application software
- c) Black box and white box testing

(3 x 4 marks)

B11

Describe the following stages of compilation:

- a) Lexical analysis **(4 marks)**
- b) Syntax analysis **(4 marks)**
- c) Code generation **(2 marks)**
- d) Code optimisation **(2 marks)**

B12

Briefly describe the operation of the following methods for software development and the particular advantages of using them.

- a) Traditional waterfall method **(6 marks)**
- b) Software prototyping **(6 marks)**