

# THE BRITISH COMPUTER SOCIETY

## THE BCS PROFESSIONAL EXAMINATIONS BCS Level 4 Certificate in IT

### SOFTWARE DEVELOPMENT

21<sup>st</sup> April 2008, 2.30 p.m.-4.30 p.m.  
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).

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

Calculators are <b>NOT</b> allowed in this examination.
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#### SECTION A

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

1. The ATBASH cipher dates back to 500BC and operates by substitution of any letter by the corresponding letter from the opposite end of the alphabet. Thus A → Z, B→Y and so on.
  - a) Assuming that the letters are ASCII-coded, how would you convert any capital letter to its ATBASH equivalent? Write a suitable data structure to hold every capital letter and its ATBASH equivalent.

**(4 marks)**
  - b) Derive a relationship between the capital letters and their ATBASH equivalents. [Marks will be awarded for working as well as the relationship]

**(10 marks)**
  - c) Develop the algorithm below which encodes capital letters from a text file <testtext> to ATBASH equivalents. Spaces, punctuation are not coded.

**(16 marks)**

#### Algorithm

```
Set up Data Structure as defined in part a)
Set up <testtext> file for reading
WHILE NOT end-of-file <testtext>
    READ <testtext>, character
    IF character is a capital letter THEN
        CONVERT character to ATBASH code
        PRINT character, ATBASH code
    ELSE PRINT character
    ENDIF
ENDWHILE
```

**Turn over]**

2. The simplest Fibonacci series Fib(N) is where each term after the two is the sum of the preceding two as shown in the table below:

Fib(N)	1	1	2	3	5	8	13	21
N	1	2	3	4	5	6	7	8

The following function code is **intended** to return the Fibonacci series term corresponding to the input parameter<N>:

```

line      code
1      INTEGER FUNCTION itfib (N : INTEGER)
        VARIABLES  p, term, prev1, prev2 : INTEGER
        BEGIN
2          p = 3  prev1 = 1  prev2 = 1  term = 1
3          WHILE p is LESS THAN N DO
4              term = prev1 + prev2
5              prev2 = prev1
6              prev1 = term
7              ADD 1 TO p
            ENDWHILE
8          iterfib = term
        END
        ENDFUNCT

```

- a) Dry run the function code with N = 5. **(20 marks)**
- b) Does the variable <term> contain the correct Fibonacci term when the code has executed for N = 5? If not, suggest reasons why not. **(4 marks)**
- c) The code also contains an error so that a function call such as PRINT itfib(5) receives no return value to print. Explain why and make an appropriate correction. **(3 marks)**
- d) The code also contains an error relating to N. What is this error? **(3 marks)**
3. a) Name, and briefly explain, the operations usually applied to the data structure called a queue. **(5 marks)**
- b) Write an implementation of a queue (data structure and operations) in a programming language that you know. The values to be stored in the queue will be integers. You may assume that there will never need to be more than 20 values queued at any one time. **(15 marks)**
- c) Using your implementation as in (b), create a program which processes a queue (MIX) of integers until it is empty, passing even numbers to a second queue (EVEN) and odd numbers to a third queue (ODD). **(10 marks)**

4.

	program A	program B
	<pre>int abs(int x){   int a;   if(x &lt; 0)     a = - x;   else     a = x;   return(a); } int z = abs("hello");</pre>	<pre>FUNCTION abs(x AS integer)   VAR a : integer   IF x LESS THAN 0     a &lt;- - x   ELSE     a &lt;- x   RETURN(a) ENDFUNC VAR z = abs("hello")</pre>

You may elect to answer this question using either program A or program B.

- a) Choose either program A or program B and then find and copy out an example of the following:

**(1 mark each, total of 15)**

- i) a reserved word
- ii) a variable identifier
- iii) an integer constant
- iv) a monadic operator (operator with one operand)
- v) a type identifier
- vi) a diadic operator (operator with two operands)
- vii) an assignment symbol
- viii) a relational operator
- ix) a punctuation symbol
- x) a formal parameter
- xi) a local variable
- xii) a function identifier
- xiii) a string constant
- xiv) an arithmetic operator
- xv) an actual parameter

- b) Continuing with either program A or program B as in part (a), find and copy out an example of the following:

**(3 marks each, total of 15)**

- i) a function call
- ii) a function declaration
- iii) an assignment statement
- iv) a variable declaration
- v) a conditional statement

Turn over]

## SECTION B

Answer FIVE questions out of eight. All questions carry equal marks.

5. The time  $t$  taken by an athlete to complete a lap of a track increases by a constant ratio  $f$  such that the time for the  $n^{\text{th}}$  lap is given by  $t(n) = f * t(n-1)$ .
- a) IF the time for the first lap is  $\text{inputtime}$  write a recursive function which works out the time taken for any number of laps  $\text{num}$  given the values  $\text{inputtime}$ ,  $\text{num}$  and  $f$ .
- (4 marks)**
- b) Write a program (or pseudocode) incorporating the recursive function based on the expression derived in part (a). The program requests the time for the first lap  $\text{inputtime}$ , the ratio of the times for successive laps  $f$  and how many laps  $\text{num}$ . It prints the total time taken for all the laps.
- (8 marks)**
6. a) An inter date is given in the form  $\text{ddmmyy}$  where  $\text{dd}$  = day digits,  $\text{mm}$  = month digits,  $\text{yy}$  = last two digits of the year. Thus 251207 is 25<sup>th</sup> December 2007. Write code or pseudocode to re-arrange the date into the form  $\text{yyymmdd}$  using the MOD and DIV operators where MOD gives the modulus and DIV is the integer division operator; e.g.  $10 \text{ MOD } 3 = 1$ ;  $10 \text{ DIV } 3 = 3$
- (4 marks)**
- b) Write code to sort a sequence of these modified dates held in the array  $\text{LONGDAT}[1..99]$  into descending order of year.
- (8 marks)**
7. a) Write a suitable data structure to hold a node of a linked list with one pointer and 5 data items relevant to the stock of a garden centre. These are:  
name (20 characters)  
plant\_type (indoor OR outdoor)  
season (one from spring, summer, autumn, winter)  
price (pounds and pence)  
date stock received  
State which language you are using.
- (4 marks)**
- b) Write a procedure or function called 'onend' to add a new item at the end of the list, opposite to the head. Assume the parameters for "onend" consist of the head pointer, and the item to be added to the end.
- (8 marks)**

8. a) Letters to candidates containing the results of intermediate examinations were produced by a PC system taking its data from a candidates results file <results> and a name file <names>. Draw and label a schematic diagram showing what devices/components are needed to produce these letters.  
**(6 marks)**
- b) For failed candidates, the program produces the sentence *You have FAILED in the following subjects....* This must now be altered to *You have NOT YET PASSED the following subjects...* What system documentation should be available in order to under take this alteration?  
**(6 marks)**
9. a) What is normally meant by the term 'debugging'?  
**(4 marks)**
- b) How is debugging approached in a simple programming environment where the programmer has only the standard output facilities of the programming language to use for this purpose?  
**(4 marks)**
- c) What extra facilities to assist in debugging might be provided in a more extensive development environment?  
**(4 marks)**
10. A new electronic device that stores music and connects to the domestic television is being developed. It is to be controlled solely by a remote control which has only 5 buttons labelled *up, down, left, right, select*.
- a) Consider each of the five main interactive screen interface elements found on web pages (and elsewhere) and describe which elements can be used easily with this restricted remote control.  
**(8 marks)**
- b) Describe one way of implementing textual input using this interface.  
**(4 marks)**

11. A prospective buyer has come into a computer shop to discuss which computer to buy on the basis of the software provided. The buyer has started asking questions about virus checking, maintaining an address book, doing backups and storing digital photos.

As the shop assistant, what would your advice be to the customer? For each of these four areas you should state whether you consider system or application software to be applicable and what features of the software you would consider important.

**(12 marks)**

12. Because of a company takeover a new team of software engineers have taken over a package that had been written by the previous team. Amongst the team there is

- i) a group charged with running the package for the next few months
- ii) a group who are looking at recoding the package line-by-line from the existing programming language to the company's preferred coding language
- iii) a third group looking at rewriting the package from scratch.

Explain with reasons what kind of documentation each group would be looking for in order to do their respective tasks.

**(12 marks)**