

THE BRITISH COMPUTER SOCIETY

THE BCS PROFESSIONAL EXAMINATIONS Certificate

SOFTWARE DEVELOPMENT

18th October 2005, 2.30 p.m.-4.30 p.m.
Time: TWO hours

Both Section A and Section B 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).

SECTION A

Answer TWO questions out of FOUR.
You are advised to spend about 1 hour on Section A (30 minutes per question).

All questions carry equal marks.

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

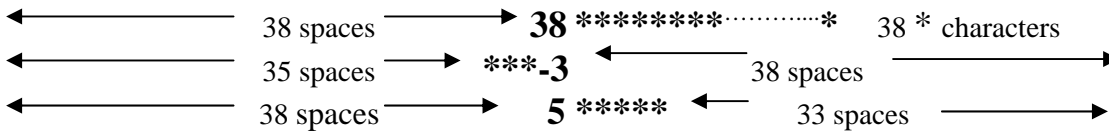
1. The code below affords an approximate value of the square root of a real number (A) from a given initial value (Y)

```
For inner = 1 TO 3 DO
BEGIN
  new = (Y + A / Y) / 2
  Y = new
END
```

- a) Incorporate this code into a fully-coded function *sqroot()* with appropriate parameters. Modify the supplied code so that the iterations cease when successive values differ by less than 0.0005. Use A/2 for the initial value of Y. Incorporate a count of the iterations. Use meaningful names for the identifiers. State which language you use. **(15 marks)**
- b) Write a test harness, which prints a table of square root values (in increments of 1) between integer input values 'lower' and 'upper' which are requested interactively, and using procedure *sqroot*. It must also print the corresponding values obtained by using the standard function (e.g. SQRT in Pascal). These values should be printed to four decimal places in a field width of 8 characters. **(15 marks)**
2. Develop a program from the initial algorithm given on the next page. The program reads a sequence of not more than 120 integers terminated by a zero value. A graphical, scaled representation (bar chart) of the data is to be constructed as follows:

Each integer (N) is to take up 4 character positions and is to be printed in the centre of a line 80 characters wide with a row of asterisk (*) characters on the right hand side of N if N is positive and on the left hand side of N if it is negative. The rows of asterisks are scaled such that the largest value of N produces 38 asterisk characters on its row and the other rows contain a proportionately scaled number of asterisk characters. The asterisk characters are to be grouped on either side of the integer (N) as shown in the diagram on the next page:

(actual printed items shown **bold**)



from input data item	1	38
data item	2	-3
data item	3	5
data item	4	0 (terminator)

Initial Algorithm:

```

LOOP until all data input
  READ data item → data structure
  FIND largest data item from data structure → largest
ENDLOOP
COUNT number of data items → ncal
PRINT "number of data items =" ncal
CALCULATE scalefactor → scale
LOOP to draw diagram
  CALCULATE number of * characters in row → nchar
  IF data item is positive
    THEN LOOP to print spaces
    PRINT data item
    LOOP to print nchar * characters
  ELSE LOOP to print spaces
    LOOP to print nchar * characters
    PRINT data item
  ENDIF
ENDLOOP

```

(30 marks)

3. a) Write a function, in Pseudocode or Structured English or a programming language with which you are familiar, that implements a search as follows:

The function should accept the target for the search, an integer parameter NUM.
 The function should scan an array (name = ASSEMBLY, size = MLEN, both given as global in the context of the function), looking for NUM.
 The result of the function should be the index position in ASSEMBLY if NUM is found, or zero if NUM is not found.

(20 marks)

b) Dry-run your pseudocode from a) above with the following data:

NUM = 11
 MLEN = 10
 ASSEMBLY =

3	5	7	9	11	13	15	117	21	23
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(10 marks)

4. a) Describe the benefits that high-productivity tools bring to software development. In particular, comment on error rates, requirements capture, and user satisfaction. Give full reasons to support your answers. **(30 marks)**

SECTION B

Answer FIVE questions out of EIGHT.

You are advised to spend about 1 hour on Section B (12 minutes per question)

All questions carry equal marks.

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

5. a) Write an algorithm or code for the factorial function fac(n) where

$$\text{fac}(n) = n*(n - 1)*(n - 2)...3*2 *1$$

 (Either an iterative or recursive method may be used.) **(3 marks)**
- b) Using the series $e = 1 + \frac{1}{\text{fac}(1)} + \frac{1}{\text{fac}(2)} + \frac{1}{\text{fac}(3)} + \dots + \frac{1}{\text{fac}(n)}$
- Develop a program to show that the difference between the convergent value for $e = 2.7182818$ and the value accumulated for (n) terms of the above series is less than $1 / [\text{fac}(n - 1) * (n - 1)]$. **(9 marks)**
6. Hill gradient signs at the roadside show the approaching slope either as a percentage (P %) or as a slope of 1 in G, where G is an integer. Thus a slope of 20% could also be shown as 1 in 5.
- a) Derive the general relationship between the percentage P and the nearest integer slope G. **(3 marks)**
- b) Write an interactive program which prints a table of values of P (in increments of 1) between input start and finish values, and the corresponding values of G, rounded to the nearest integer value. **(9 marks)**
7. A school keeps daily meteorological records on a serial file. Each record has the following data items:
 Temperature/deg. C : 2-digit integer
 aspect : (fine or wet)
 rainfall/mm : real number
 wind direction : one of (north, south, east, west)
 wind force/Beaufort scale : 2-digit integer $0 \leq \text{wind} \leq 12$
 observer's initials : (between 1 and 5 characters)
- a) Write an appropriate description for such a record in a suitable programming language. State which Language you are using. **(4 marks)**
- b) Write a program fragment which opens such a file named 'August05' and which counts and prints how many days were wet and windy, i.e. had aspect = 'wet' and wind force greater than 4. **(8 marks)**

Turn over]

8. a) Write a linked list data structure capable of holding one data item and one pointer. How is this shown diagrammatically? **(3 marks)**
- b) Write pseudocode to set up such a linked list using a 'while' or 'repeat' loop. Alongside each instruction show diagrammatically the pointer movement so made or change in memory effected.
- State which programming language you are using. **(9 marks)**
9. a) Describe TWO different ways to use a sequential file. Give reasons for your answer. **(8 marks)**
- b) Make a diagram that shows the detailed sequence of operations for ONE of the ways you describe in part a). **(4 marks)**
10. Design the GUI for a web system to be used by an e-commerce operation that sells electrical goods. Include in your design THREE different types of interface element which make the process of e-commerce easier and more attractive. Explain your design fully, using diagrams. **(12 marks)**
11. Describe the functions of the following software elements. State whether each is 'system software' or 'application software'.
- a) A Spreadsheet. **(4 marks)**
- b) A Project planner. **(4 marks)**
- c) A Disk File Index. **(4 marks)**
12. Briefly describe the type of testing you would use for:
- a) module tests **(6 marks)**
- b) validation testing **(6 marks)**
- Give reasons for your answers.