

BCS The Chartered Institute for IT  
THE BCS PROFESIONAL EXAMINATIONS  
BCS Level 4 Certificate in IT

**SOFTWARE DEVELOPMENT**

Wednesday 21<sup>st</sup> April 2010 - Morning  
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 <b>NOT</b> allowed in this examination
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**SECTION A**

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

- A1 The volume of a cylinder with outer radius ( $r_1$ ), the inner radius ( $r_2$ ) and height ( $h$ ) is given by the formula:

$$volume = \pi * (r_1^2 - r_2^2) * h$$

The weight of a cylinder depends on the density of the material from which it is made:

$$weight = density * volume$$

Cylinders are to be made from melted-down silver coins, each weighing 3.9 grams.

$$Density\ of\ silver = 10.5\ g\ cm^{-3}$$

A program is to print a table of the various sizes of cylinder possible by varying  $r_1$ ,  $r_2$  and  $h$  all between appropriate input limits. Also the weight is to have a maximum value ( $maxwt$ ).

- a) Sketch the envisaged cylinder and state what limits must be applied to the calculations of its size and weight.

**(4 marks)**

- b) Develop an **algorithm** to print a table of the various sizes of cylinder that can be made and how many coins are required. Each cylinder must not weigh more than 1 kilogram or be greater than 10 cm in height. The cylinder dimensions are to be input as maximum and minimum values for both ( $r_1$ ) and ( $r_2$ ). The increment between successive calculations ( $incr$ ) is also input.

The algorithm must have at least two stages of development and need not be developed beyond the point at which coding / testing would be straightforward.

**(12 marks algorithm)  
(14 marks development)**

A2 a) Define recursion.

(5 marks)

- b) The following definition of function *sub* uses recursion. Dry run the call of *sub(a,b)* with values *a* = 5 and *b* = 2 using either version A or version B. All the variables contain integer values.

(20 marks)

line	Version A	Version B
1	FUNCTION sub(a,b)	int sub(int a, int b){
2	IF b > 0 THEN	if(b > 0)
3	sub := sub(a-1, b-1)	return( sub(a-1, b-1) );
4	ELSE	else
5	IF b = 0 THEN sub := a	if(b == 0) return( a );
6	ELSE	else
7	sub := sub(a+1, b+1)	return( sub(a+1, b+1) );
8	END	}

- c) Which line in the function code is not tested in this dry run?  
Give, with reasons, different values for *a* and *b* which would cause this line to be tested. Do NOT carry out another dry run.

(5 marks)

A3 The array *z* has been initialised as follows

index	0	1	2	3	4	5	6	7	8	9
z	42	19	55	90	81	76	12	49	0	0

The function *u* in the code below is going to be executed with parameter *v* set to 7 and parameter *w* set to 70. [You can choose to follow either version of the code]

- a) Trace the call of the function *u(7,70)* and state the value that is returned from the call.

(8 marks)

	Version A	Version B
1	int u(int v, int w){	FUNCTION u(v, w : INTEGER):INTEGER;
2	int x, y;	VAR x, y : INTEGER;
3	/* begin function */	BEGIN
4	y = 0;	y := 0;
5	for(x=0; x<=v; x++)	FOR x := 0 TO v DO
6	{	BEGIN
7	if( z[x] > w ) y++;	IF z[x] > w THEN y := y + 1;
8	}	END;
9	return(y);	u := y
10	}	END;

- b) Write a brief summary of what the function does.

(6 marks)

- c) Decide on better names for the identifiers (the function 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 5 to 8 [of either version A or version B] using a while-loop instead of a for-loop.

(6 marks)

A4

<pre> program A /* PROGRAM A */ char near; float sq(float p){return(p*p);} float dist(float x1, float y1, float x2, float y2){     float res;     /* begin function */     res = sqrt( sq(y2-y1) + sq(x2-x1) );     return(res); } void main(){     if( dist(8.0, 4.5, 9.0, 3.3) &lt; 10 )         near = 'Y';     else         near = 'N'; } </pre>	<pre> program B PROGRAM B; VAR near : CHAR; FUNCTION sq(p:REAL):REAL;BEGIN sq:= p*p END; FUNCTION dist(x1,y1,x2,y2:REAL):REAL;     VAR res : REAL;     BEGIN         res := sqrt( sq(y2-y1) + sq(x2-x1) );         dist := res;     END; BEGIN {main program}     IF dist(8.0, 4.5, 9.0, 3.3) &lt; 10 THEN         near := 'Y'     ELSE         near := 'N'; END. </pre>
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- 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)**

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

<p>b.1) a function call  b.2) a function declaration  b.3) a variable declaration</p>	<p>b.4) an assignment statement  b.5) an expression with a boolean (logical) value  b.6) a conditional statement</p>
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## SECTION B

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

- B5 Write a program to input a value *limit* and print a table of all the odd numbers  $n$  between 3 and *limit* where  $(n^2 - 1)$  is divisible by 8.

(12 marks)

- B6 Data associated with each of the chemical elements is as follows:

Element name	Up to 12 characters
Symbol	one or two letters
Metal/ non-metal	Boolean
Atomic number	integer
Atomic mass	real number
Density	real number
Melting point	real number
Boiling point	real number

- (a) A serial file **atomdata** contains records for all the elements. Write a record description named **elements** for this data and file declaration.

(3 marks)

- (b) Write a program which searches the file for the first five metals with a density greater than  $8.0 \text{ g.cm}^{-3}$  and a liquid range (Boiling point - Melting point) greater than  $500^\circ\text{C}$ . Print the name, and atomic mass of the five elements.

(9 marks)

- B7 Values for the sine function are obtained from the power series

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

where  $\text{fac}(n) = \text{factorial } n = 1*2*3*4*\dots n$

- (a) Write code for  $\text{fac}(n)$ ; any method may be used.

(4 marks)

- (b) Incorporate your function into another function  $\text{asine}(x)$  which calculates  $\sin(x)$  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 Write a program to merge two distinct lists into a single linked list. Both of the initial lists contain integers and both are in ascending integer order. This order must be preserved in the merged list. The two lists are of the same length. They are set up by the procedure **setuplist(head)** which returns a pointer to the head of the list. *You must not write code for the procedure setuplist but indicate where appropriate calls to it would be made in your code*

(12 marks)

B9 One of the common operations required of a computer program is to search for a specific item in a collection of items. Describe (either in words, or by pseudo code or by actual program code) one efficient algorithm for searching, taking care to explain what arrangements should be made to make the search efficient.

**(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) A compiler and an interpreter
- b) Internal and external memory
- c) Design and implementation
- d) System software and application software

**(12 marks)**

B11 A business selling to the general public via a web site will require that site to have good user-interface design.

- a) What are the basic elements that appear on the page with which the user can interact?

**(6 marks)**

- b) Briefly describe what you consider to be the basic concepts of good user-interface design?

**(6 marks)**

B12 Describe the general concept of white box testing and illustrate your answer using the function printed in question 4 or a similar sized function of your own choosing.

**(12 marks)**