

Caribbean Examinations Council



Computer Science



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CAPE® Computer Science Past Papers

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FORM TP 2008175



TEST CODE **02115020**

MAY/JUNE 2008

**CARIBBEAN EXAMINATIONS COUNCIL
ADVANCED PROFICIENCY EXAMINATION**

COMPUTER SCIENCE

UNIT 1 – INFORMATION SYSTEMS

PAPER 02

$1\frac{1}{2}$ hours

16 MAY 2008 (a.m.)

INSTRUCTIONS TO CANDIDATES

1. This paper consists of **THREE** sections.
2. Answer **ONE** question from **EACH** section.

SECTION A

MODULE 1: COMPONENTS OF COMPUTER SYSTEMS

Answer ONE question from this section.

1. (a) Explain why extranets are generally more insecure than intranets. [4 marks]
- (b) Describe ONE example of software that can be stored in
 - (i) ROM
 - (ii) RAM.[4 marks]
- (c) While John was in the USA, he decided to purchase an external CD-ROM drive for his friend, Peter. When he returned and gave Peter the drive, it would not work on Peter's computer. Explain TWO reasons why the drive may not have worked.
[4 marks]
- (d) Describe and give ONE example of
 - (i) systems software
 - (ii) application software.[6 marks]
- (e) (i) What are deadlocks? Describe an example where a deadlock can occur in an operating system.
[4 marks]
- (ii) Explain how an interrupt is handled in the operating system of a computer.
[4 marks]
- (iii) Describe TWO functions that a typical disk management utility should be able to perform.
[4 marks]

Total 30 marks

2. (a) Discuss what happens at the sending computer when the OSI model for networking is involved in the transmission of a text file from one computer to another computer. Use a diagram in your response, clearly showing the direction of flow of data using the OSI model.
[12 marks]
- (b) Differentiate between 'HTTP' and 'FTP'.
[6 marks]
- (c) Explain how EACH of the following approaches can be used to share files over the Internet.
 - (i) Client/server
 - (ii) Peer-to-peer[6 marks]
- (d) Explain THREE reasons why a distributed network configuration may be preferred rather than a centralised configuration.
[6 marks]

Total 30 marks

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SECTION B

MODULE 2: APPLICATIONS OF COMPUTERS

Answer ONE question from this section.

3. (a) Management at a certain cafeteria has decided to install vending machines for customers to purchase snacks and drinks. The vending machines contain small computer applications that are responsible for dispensing the item requested to the customer and returning change, if necessary.
- (i) Discuss TWO economic implications of installing the vending machines. [4 marks]
- (ii) Discuss TWO social implications of installing the vending machines. [4 marks]
- (b) In a certain business, the clerical assistants keep track of customer records using manual paper files. The manager of the company recently became aware of the benefits of computer technology and quickly introduced computers in her business. She also instructed the clerical assistants to use ONLY computer applications for storing customers' data from now on.
- (i) Discuss ONE reason why the manager may have made a mistake in her decision to use only computer applications to store the customers' records. [3 marks]
- (ii) Suggest TWO advantages of using computer applications to store the customers' records. [4 marks]
- (c) At a certain university, the principal ruled that the university's management has the right to view the emails of all lecturers. Some lecturers did not agree.
- Briefly discuss ONE reason to support the principal's ruling and ONE reason why the lecturers may have disagreed with the principal's ruling. [6 marks]
- (d) (i) Discuss TWO ways to help prevent or control the unauthorized disclosure of data in an organization. [6 marks]
- (ii) An organization may employ passwords to prevent unauthorized access to files on its Web site.
- Describe ONE other strategy that can be used to prevent unauthorized access to files on its Web site. [3 marks]

Total 30 marks

4. (a) Explain what is meant by ‘real-time updating of files’ in a computer application and outline ONE situation where this approach to updating files is necessary. [3 marks]
- (b) Kiran, the manager of a retail store, recently had some problems with the computer system being used at the store. A computer consultant examined the system and told Kiran, ‘You have data loss and data corruption in your computer system. There has also been unauthorized access.’
- (i) Explain the meaning of EACH of the underlined terms. [3 marks]
- (ii) For EACH of the underlined problems, suggest ONE way in which the computer consultant may have determined the existence of that problem. [6 marks]
- (c) (i) Describe TWO strategies that can be used to back-up critical data in a government organization located in a country lying in a region prone to hurricanes. [6 marks]
- (ii) Suppose a hurricane occurs and destroys all the computer systems and associated data in the organization mentioned in (c) (i) above. Describe the steps that can be taken to restore the computer systems and data, for ONE of the strategies described in (c) (i) above. [4 marks]
- (d) Suggest TWO ways in which computer applications designed for the *strategic* level of an organization differ from computer applications designed for the *operational* level. [4 marks]
- (e) State TWO advantages of videoconferencing over email as a means of communicating information. [4 marks]

Total 30 marks

SECTION C

MODULE 3: COMPUTER-BASED PROBLEM SOLVING

Answer ONE question from this section.

5. (a) Professional organizations that publish scholarly articles are increasingly making these articles available online to readers who subscribe to their digital libraries. Previously, these readers may have obtained the articles through paper subscriptions or through a traditional library.
- (i) Describe TWO benefits of a digital library to **readers who subscribe** to the service. [4 marks]
- (ii) Describe TWO benefits of a digital library to **organizations that publish** the scholarly articles. [4 marks]
- (b) Explain how EACH of the following characteristics affects the usefulness and value of information:
- (i) Accuracy [3 marks]
- (ii) Depth of coverage [3 marks]
- (iii) Bias [3 marks]
- (c) Diana lives on a hilltop that is visible from several surrounding communities. A local cellular phone provider has approached Diana to rent part of her property to install a cellular tower. Diana is very happy with the amount of rental income that she will receive. However, she is worried about the negative remarks she recently heard on television about the health risks of cellular towers.
- Discuss THREE sources of information that Diana can use to get more reliable information on the health risks of cellular towers. [9 marks]
- (d) Briefly discuss the validity of the following statements:
- (i) Information on the Internet is reliable since it must be refereed before it is placed on the Internet. [2 marks]
- (ii) Information on the Internet is always current since it is available to users as soon as it is placed on the Internet. [2 marks]

Total 30 marks

6. (a) A local foreign-used car dealership sells five different types of cars. At the end of each month, salespersons are required to submit to management the amount of each type of car sold. Management would like to use this information to generate summaries of the cars sold such as:
- the total number of cars sold per month
 - the average number of cars of each type sold per month
 - the total number of cars sold per year
 - the number of cars sold in each type per year
 - the average monthly sales of each type of car
- (i) Design the **layout** of a spreadsheet to generate the required summary information, CLEARLY specifying the formulae that you will use in the spreadsheet. [10 marks]
- (ii) Describe TWO types of graphs that can be generated from the spreadsheet to make it easier for management to grasp trends in the sales information. [4 marks]
- (b) Management at a certain private hospital needs to keep information on its patients such as personal information, appointments, attending doctors, diagnoses and treatment administered. Several thousand patients have visited the hospital since its inception.
- (i) What is the BEST computer-based tool that can be used to store the information specified above? [1 mark]
- (ii) Discuss FIVE features of the tool that make it appropriate for managing patient information in a hospital context. [15 marks]

Total 30 marks

END OF TEST

FORM TP 2008175



TEST CODE **22115020**

MAY/JUNE 2008

**CARIBBEAN EXAMINATIONS COUNCIL
ADVANCED PROFICIENCY EXAMINATION
COMPUTER SCIENCE**

UNIT 1 – INFORMATION SYSTEMS

PAPER 02

1½ hours

17 JULY 2008 (p.m.)

INSTRUCTIONS TO CANDIDATES

1. This paper consists of **THREE** sections.
2. Answer **ONE** question from **EACH** section.

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SECTION A

MODULE 1: COMPONENTS OF COMPUTER SYSTEMS

Answer ONE question from this section.

1. (a) (i) State TWO characteristics of ROM. [2 marks]
- (ii) Distinguish between ROM and PROM [2 marks]
- (b) You are using a friend's computer to type your school-based assessment. When you have finished, you realize that your friend's printer is not working. Your friend finds a floppy diskette in a drawer, and as she is about to insert the diskette to save the file, you stop her from doing so.
- (i) Describe TWO of your concerns regarding the use of the floppy diskette. [4 marks]
- (ii) Explain how you would address EACH concern that you have identified. [4 marks]
- (iii) Suggest ONE other secondary storage device that would be appropriate in this case. Justify your response. [4 marks]
- (iv) Your friend had Internet access. Explain ONE other way that you could have saved your file to print later. [2 marks]
- (c) You have received the latest computer racing game on a CD as a gift. The game runs properly on your neighbour's new computer, but does NOT run at all on your computer.
- (i) Give TWO likely reasons why the game works on your neighbour's computer, but does not work on your computer. [4 marks]
- (ii) For EACH of the reasons, given at (c) (i) explain what you may need to do, so that the game works on your computer [2 marks]
- (d) Name and briefly describe TWO types of user interfaces. [6 marks]

Total 30 marks

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2. (a) The Accounting Department of a company has 12 computers. Eleven of the computers can only exchange messages with each other via the twelfth computer.
- (i) State the type of network that this department is using. [1 mark]
 - (ii) State the term used to describe the twelfth computer. [1 mark]
 - (iii) Sketch and label the network identified in (a) (i), clearly illustrating the connections of the workstations or nodes. [4 marks]
 - (iv) Explain TWO situations that would cause the network to fail. [3 marks]
 - (v) Sketch TWO other network topologies and discuss ONE advantage and ONE disadvantage of EACH. [8 marks]
- (b) One of your colleagues in another country has completed her part of a project and you need to download the file to your computer using communications hardware and a suitable networking protocol.
- (i) Define the term 'networking protocol'. [2 marks]
 - (ii) Identify the networking protocol that can be used to retrieve the file. [1 mark]
 - (iii) Explain how the protocol you identified in (b) (ii) above works to retrieve the file. [8 marks]
- (c) Explain the role of a router. [2 marks]

Total 30 marks

SECTION B

MODULE 2: APPLICATIONS OF COMPUTERS

Answer ONE question from this section.

3. (a) Twenty years ago, customers would form long lines in banks to conduct their business of deposits and withdrawals of funds. Recently, many banks have introduced banking machines in public areas, such as supermarkets and shopping malls, to service these routine tasks.

Describe TWO benefits and TWO challenges of introducing the banking machine to customers [8 marks]

- (b) Telecommuting is an option that some employees consider, and there are some advantages and challenges.

(i) Explain what is meant by 'telecommuting'. [2 marks]

(ii) Describe TWO benefits and TWO challenges of telecommuting for the employer. [8 marks]

(iii) Describe TWO **conditions** that are required for telecommuting to be successful. [4 marks]

- (c) Identity theft has become a big social issue world wide. A common attack method is to create a website that appears to be authentic and prompt users for their Identity and password details. Another technique is to create an email which appears to come from an authentic organization like a bank or credit card issuer, requesting the confirmation of account numbers and other personal information. This information is later used by hackers to make large purchases or even completely take over a person's identity.

(i) Discuss TWO ways in which Internet users can protect themselves from identity theft. [4 marks]

(ii) Discuss TWO precautions that one can take when making purchases on the Internet, using a credit card. [4 marks]

Total 30 marks

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4. Ten years ago, Mrs McIntosh opened a small department store in Jamaica, selling a range of small and large household appliances. Her business has grown steadily and now she has 11 outlets across the island, as well as an outlet each in St. Lucia and Dominica.

- (a) Discuss THREE application areas of the business where the data processing needs would have changed. [9 marks]
- (b) For TWO of the application areas discussed in (a), describe how innovations in information technology would have facilitated the changing needs of the business over the ten years. [6 marks]
- (c) (i) Discuss TWO kinds of information processing activities that would take place at the operational and strategic levels of Mrs McIntosh's business. [6 marks]
- (ii) Identify THREE types of information systems that could be used at the business and describe the nature of the processing that would be performed by EACH one. [9 marks]

Total 30 marks

SECTION C

MODULE 3: COMPUTER-BASED PROBLEM SOLVING

Answer ONE question from this section.

5. (a) You have been asked to collect medical data on persons who live in a certain part of a Caribbean country. The data to be collected should include name, age, marital status and illnesses suffered in the previous five years.
- (i) Identify FOUR techniques that can be used to gather the required data. [4 marks]
- (ii) Describe TWO of the techniques that you identified in 5 (a) (i), clearly stating how EACH is administered or used. [8 marks]
- (iii) For EACH of the techniques identified in 5 (a) (i), state ONE problem that may be encountered when using that approach for gathering data. [4 marks]
- (iv) For TWO of the techniques identified in 5 (a) (i), describe ONE advantage of using EACH technique. [4 marks]
- (b) Explain, with the aid of an example, what is meant by the term 'breadth of coverage', as it pertains to an information source. [3 marks]
- (c) What is the relationship between a 'digital library' and an 'electronic database'? [2 marks]
- (d) List FIVE reasons why information derived from an electoral manifesto may be misleading. [5 marks]

Total 30 marks

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6. At a certain university, the staff members need to access information on students (for example, name, address, marital status and courses). The university's governing council requires summary information on the number of students in the university, their country of origin, the courses being offered, and the fees paid.
- (a) (i) Identify the MOST appropriate software tool for storing and retrieving information on students and their courses of study. [1 mark]
- (ii) Describe THREE features of the software tool chosen in 6 (a) (i), that make it suitable for this task. [9 marks]
- (b) (i) Identify the MOST appropriate software tool for analysing and generating summary information on students. [1 mark]
- (ii) Discuss TWO features of the software tool chosen in 6 (b) (i), that make it MOST appropriate for this task. [6 marks]
- (c) The Chancellor of the university is required to make a presentation to a group of regional leaders on students registered for each graduate and post-graduate programme. Describe how the presentation should be put together using appropriate software tools. [6 marks]
- (d) The university periodically sends newsletters to its former students, and often sends brochures on new programmes offered at the post-graduate level.
- (i) Identify the MOST appropriate software tool for producing the newsletters and brochures. [1 mark]
- (ii) Justify your selection of the software tool in d (i) by discussing TWO reasons for the choice. [6 marks]

Total 30 marks

END OF TEST

FORM TP 2009166



TEST CODE **02115020**

MAY/JUNE 2009

**CARIBBEAN EXAMINATIONS COUNCIL
ADVANCED PROFICIENCY EXAMINATION
COMPUTER SCIENCE**

UNIT 1 – FUNDAMENTALS OF COMPUTER SCIENCE

PAPER 02

$2 \frac{1}{2}$ hours

15 MAY 2009 (a.m.)

INSTRUCTIONS TO CANDIDATES

1. Do NOT open this examination paper until instructed to do so.
2. Answer **ALL** questions from the **THREE** sections.

SECTION A

COMPUTER ARCHITECTURE AND ORGANISATION

Answer BOTH questions.

1. (a) Draw the symbol and give the corresponding truth table for THREE primary logic gates.
[6 marks]

- (b) The following is the truth table for an exclusive-OR gate:

X	Y	Z
0	0	0
0	1	1
1	0	1
1	1	0

Using the primary logic gates from (a) above, design and draw a circuit which behaves exactly like an exclusive-OR gate.
[6 marks]

- (c) Draw a clearly labelled block diagram of a 4×1 multiplexer (4 inputs, 1 output).
[6 marks]

- (d) (i) Calculate the decimal equivalent of 00011011_2 .
[1 mark]

- (ii) Determine if the result of $0111 + 1110$ can be stored as a 4 bit binary number.
[2 marks]

- (iii) Showing all working, find the largest and smallest integers that can be represented using 4 bits signed magnitude.

Hint: the leftmost bit is to be used for the sign and the other bits are used for representing the integer itself.
[2 marks]

- (iv) Find the 4 bit two's complement of -5 .
[2 marks]

Total 25 marks

2. (a) Explain what is meant by EACH of the following terms:

- (i) Word size
- (ii) Cache memory
- (iii) Clock speed

[6 marks]

(b) Distinguish between EACH of the following pairs of terms as they pertain to computer memory:

- (i) ROM and RAM
- (ii) Access speed and access method
- (iii) Volatility and capacity

[6 marks]

(c) (i) Define the terms, 'instruction set' and 'instruction format'. [2 marks]

(ii) State THREE types of instructions that are typically included in an instruction set. [3 marks]

(iii) Suppose 16 bits are used for representing instructions in a certain computer. Using a diagram, explain how a 2-address instruction can be formatted using the 16 bits available. [3 marks]

(iv) Describe what happens in a typical instruction cycle, assuming that direct addressing is used. [5 marks]

Total 25 marks

SECTION B

PROBLEM SOLVING WITH COMPUTERS

Answer BOTH questions.

3. (a) What is an algorithm? [2 marks]
- (b) Name THREE basic control constructs used in structured programming. [3 marks]
- (c) The algorithm below is designed to generate, print and count the odd numbers between 1(inclusive) to 99 (inclusive). However there are errors.

```
1. begin
2. j = 2
3. c = 1
4. while (j < 99)
5.     print j
6.     j = j + 2
7.     c = c + 1
8. endwhile
9. print ('c = ', c)
10. print ('j = ', j)
11. end
```

- (i) What are the final values in the variables c and j when the algorithm terminates? [2 marks]
- (ii) By referring to the specific line numbers:

Identify and correct the errors in the algorithm. [6 marks]

- (iii) Using the corrected algorithm, give the value of variable c at the end of execution. [1 mark]

- (d) Construct a flowchart to represent the following algorithm.

```
begin
    read name
    if name = 'enddata'
        print 'no data supplied'
    else
        while name <> 'enddata'
            read amount
            read quantity
            sale = amount * quantity
            print 'This sale = ', sale
            read name
        endwhile
    endif
end
```

[11 marks]

Total 25 marks

4. (a) BuyLo is a grocery. Management has decided that it needs to track all the goods that are sold on a daily basis by using a computer-based solution.

Discuss what the ‘Identifying and evaluating possible solutions’ stage of problem solving would involve for BuyLo. [6 marks]

- (b) Trace through the execution of the following algorithm and draw the output in your answer booklet exactly as it would be generated by the algorithm. You should carefully note the following:

- *printSpaces(n)* prints *n* spaces from the current cursor position, use a dash ‘ – ’ to indicate a space
- *print* continues output on the current line from the current cursor position
- *println* continues output on the current line from the current cursor position but any subsequent output begins on a new line

```
SIZE = 10
begin
    printSpaces ( SIZE )
    println ('*')
    j = SIZE - 2
    while j >= 0
        begin
            printSpaces ( j + 1 )
            print ( '*' )
            printSpaces ( 8 - j )
            println ( '*' )
            j = j - 1
        endwhile
    for j = 1 to (SIZE + 1) do
        print ( '*' )
    end for
    println ( )
end
```

[11 marks]

- (c) Write an algorithm that uses repetition to find the sum of all multiples of 7 between 14 (inclusive) and 126 (inclusive). [8 marks]

Total 25 marks

SECTION C

PROGRAMMING

Answer BOTH questions.

5. (a) Describe the 'lexical analysis' and 'semantic analysis' stages of the translation process.
[6 marks]
- (b) Write a C function which accepts two integer parameters, a and b , and returns the larger of the two. Assume the integers are different.
[4 marks]
- (c) Write a C program with the following functionality. The steps MUST be followed exactly as stated.

Accept 10 integers from the user and place them in a text file 'in.dat', one integer per line. Assume all integers are valid.

Close the file 'in.dat', reopen it, read the data and find and print the average of the integers stored in the file.

Print an appropriate message if the file cannot be found.

[Note: You cannot use arrays to solve this problem.]

[15 marks]

Total 25 marks

6. (a) Briefly describe EACH of the following classifications of programming languages:

- (i) Declarative
- (ii) Imperative (procedural)
- (iii) Scripting

[6 marks]

(b) Distinguish between ‘syntax’ and ‘semantics’ as used in computer programming.

[3 marks]

(c) You are given the following declarations in a C program:

```
struct payRec {  
    long int id;  
    float totalPay;  
    int numDays;  
};  
  
void main () // start of main function  
{ int empId;  
    float pay, rate;  
    int hrs;  
    struct payRec Smith, Jones, Singh;  
    .  
    .  
    .  
}
```

The declaration is used to create records to manipulate data on three employees Smith, Jones and Singh, working for a small company. ‘id’ represent the identification number of the employee, ‘totalPay’ the amount of money he earns, ‘numDays’ the number of days worked and ‘rate’ the hourly rate of pay. Assume that Smith’s id is 1000, Jones’ id is 1001 and Singh’s id is 1002 and all numDays fields are set to 0 initially.

Using the C program declaration, complete the main program by

- reading input data (explained later) and updating the totalPay and numDays fields for each employee.
- prompting the user for id, hrs and rate. Calculate the salary by multiplying hrs by rate for the employee and adding that result to the totalPay.

NOTE:

An employee can have more than one set of data, where each set corresponds to a day worked by the employee.

Data are terminated by the sentinel id of 999.

At the end, print each employee id, total pay and number of days worked.

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Sample screen:

Please enter ID: 1000
Enter hours worked: 10
Enter rate of pay: 10.50

Please enter ID: 1000
Enter hours worked: 3
Enter rate of pay: 10.50

Please enter ID: 1001
Enter hours worked: 5
Enter rate of pay: 5.50

Please enter ID: 1002
Enter hours worked: 10
Enter rate of pay: 10.50

Please enter ID: 999

NAME	ID	TOTAL PAY	DAYS WORKED.
Smith	1000	136.50	2
Jones	1001	27.50	1
Singh	1002	105.00	1

[16 marks]

Total 25 marks

END OF TEST

FORM TP 2009168



TEST CODE **02215020**

MAY/JUNE 2009

**CARIBBEAN EXAMINATIONS COUNCIL
ADVANCED PROFICIENCY EXAMINATION**

COMPUTER SCIENCE

UNIT 2 – FURTHER TOPICS IN COMPUTER SCIENCE

PAPER 02

$2 \frac{1}{2}$ hours

18 MAY 2009 (p.m.)

INSTRUCTIONS TO CANDIDATES

1. DO NOT open this examination paper until instructed to do so.
2. Answer **ALL** questions from the **THREE** sections.

SECTION A

DATA STRUCTURES

Answer BOTH questions.

1. (a) The Stack Abstract Data Type (ADT) provides a *pop (Stack)* operation, a *push (Stack, data)* operation, and an *isEmpty (Stack)* operation.
- (i) Suppose that you need to implement a Stack for storing integers. Describe how you will implement the THREE stack operations above using static computer storage. [4 marks]
- (ii) Write the C code for a function that implements the *push (Stack, data)* operation assuming that *data* is an integer value. Your function must deal with stack overflow conditions. [5 marks]
- (b) Consider the following algorithm where *expr* is a string containing a postfix expression (that is, an expression containing '+', '−', '*', and '/' characters as well as digits) and *n* is the number of characters in *expr*.

```
char ch
int digit, x, y

for (i = 1 to n) begin
    ch = expr [i]
    if (isdigit (ch)) begin      // isDigit returns true if ch is a digit
        digit = value (ch)       // value returns the integer value of ch
        push (stk, digit)        // stk is the name of the stack
    end
    else begin
        y = pop (stk)
        x = pop (stk)
        if (ch = '+') newval = x + y
        else if (ch = '-') newval = x - y
        else if (ch = '*') newval = x * y
        else newval = x / y
        push (stk, newval)
    end
end
x = pop (stk)
print ("The value of expr is " + x)
```

Assume that *stk* is initially empty. Determine the output of the above algorithm if *n* is 9 and *expr* is 923*−82/+ .

Draw the stack on EACH iteration of the *for* loop.

[10 marks]

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- (c) A string is a palindrome if it spells the same way forwards and backwards (for example, "madam"). Explain how a stack can be used to determine if a string is a palindrome.

[6 marks]

Total 25 marks

2. (a) (i) Write a function, *lsearch*, which accepts the following parameters

arr, an array of integers,
n, the amount of elements in *arr*, and
key, the integer being searched for

and performs a linear search on *arr* for *key*. If *key* is found, your function should return the **location in the array arr, where it was found**. Otherwise, it should return **-1**.

[10 marks]

- (ii) Assume that *key* is not present in *arr*. How many elements in *arr* will be checked before **-1** is returned? [1 mark]

- (b) (i) A function is required that accepts the same parameters and returns the same values as stated in (a) (i) above. The function however, performs the binary search on *arr*.

Using an algorithm or otherwise, describe the steps that will be performed during the binary search of *arr*.

[10 marks]

- (ii) Assume that *arr* contains the following elements (in the order given) and *key* is **40**:

7 10 15 17 18 25 35 37 40 45 50 55 56 57 58 62 63 71 75 78 81

How many elements of *arr* will be checked before the correct location is returned?
Show your working.

[4 marks]

Total 25 marks

SECTION B
SOFTWARE ENGINEERING

Answer BOTH questions.

3. (a) (i) Briefly explain what is involved in the evolutionary development of software. [3 marks]
- (ii) State TWO problems of using the evolutionary development approach. [2 marks]
- (b) In a typical visit to a doctor, when the doctor consults with the patient, the patient tells the doctor the symptoms of his/her problem. The doctor uses his/her medical knowledge and experience together with any historical information available on the patient (from a patient file) and makes a diagnosis. This diagnosis is reported to the patient and recorded in the patient file. Based on the diagnosis, the doctor prescribes a course of medication for the patient. In order to bill the patient, the doctor submits the list of tests and services performed to the accounting section. The prices for the tests and services are obtained from an accounting file and the cost of the visit is calculated and recorded in the file. A bill is then given to the patient.
- Draw a Level-0 data flow diagram for the above scenario. [14 marks]
- (c) (i) Describe TWO ways in which a CASE tool can be used in a software development process. [4 marks]
- (ii) State ONE advantage and ONE disadvantage of using a CASE tool. [2 marks]
- Total 25 marks**
4. (a) (i) What are functional requirements? [2 marks]
- (ii) Discuss how functional requirements are obtained during analysis of a software system. [3 marks]
- (b) A certain private hospital has a number of wards. Several doctors are hired by the hospital to treat patients who seek medical services. A patient may be seen by one or more doctors but is assigned to one ward. When a patient is assigned to a ward, the patient is prescribed one or more drugs for a certain period. The patient's first name, last name, and address are recorded and a patient id is used to uniquely identify each patient at the hospital.
- Draw an entity-relationship model for the above scenario. [14 marks]
- (c) A one-dimensional array **num** consists of 20 integers. The integers are NOT sorted. Consider C programming code that is written to accept an integer, **target**, from the user and determines if **target** is present in **num**. If **target** is found in **num**, the location in which it was found is printed. If **target** is not present in **num**, an appropriate error message is printed.
- Briefly describe THREE tests which can be used to determine if the code is working correctly. [6 marks]

Total 25 marks

GO ON TO THE NEXT PAGE

SECTION C

OPERATING SYSTEMS AND COMPUTER NETWORKS

Answer BOTH questions.

5. (a) Briefly explain how EACH of the following features can aid in network management:
- (i) User accounts
 - (ii) Access logs [6 marks]
- (b) (i) State the first FOUR layers (that is, layers 1 to 4) of the OSI model for computer communication. [2 marks]
- (ii) Explain how EACH of the layers stated in 5(b)(i) above are involved in the transmission of a large file. [8 marks]
- (c) Explain how data are communicated in an IEEE802.11b network? Use a diagram in your response. [7 marks]
- (d) Distinguish between the CDMA and TDMA access methods for mobile networks. [2 marks]

Total 25 marks

6. (a) Describe the function of a device driver. [3 marks]
- (b) What is a hybrid network? [2 marks]
- (c) A user is working on a document in a word processor and then selects the “Print” option of the word processor. The document then begins to **spool**.
 - (i) Explain what happens during spooling. [3 marks]
 - (ii) Discuss ONE advantage of spooling. [2 marks]
- (d) (i) Give ONE reason why a menu interface may be preferred over a command interface. [2 marks]
- (ii) Give ONE reason why a command interface may be preferred over a menu interface. [2 marks]
- (e) Describe TWO possible interrupts that can occur while a user is running a game on a computer. [6 marks]
- (f) A user is running an application that requires more RAM (Random Access Memory) than that which is physically installed in the computer. Briefly discuss how the concept of paging can be used to solve the memory problem experienced by the user. [5 marks]

Total 25 marks

END OF TEST

FORM TP 2010159



TEST CODE **02115020**

MAY/JUNE 2010

**CARIBBEAN EXAMINATIONS COUNCIL
ADVANCED PROFICIENCY EXAMINATION**

COMPUTER SCIENCE

UNIT 1 – FUNDAMENTALS OF COMPUTER SCIENCE

PAPER 02

2½ hours

14 MAY 2010 (a.m.)

INSTRUCTIONS TO CANDIDATES

1. DO NOT open this examination paper until instructed to do so.
2. Answer **ALL** questions from the **THREE** sections.

SECTION A

COMPUTER ARCHITECTURE AND ORGANISATION

Answer BOTH questions.

1. (a) Give the truth tables of the THREE primary logic gates. Your truth tables should be appropriately labelled. [3 marks]
- (b) Explain how a 4-bit binary counter works, clearly specifying the range of values counted. [4 marks]
- (c) (i) Draw a clearly labelled **block** diagram of a 2-to-4 line decoder. [3 marks]
(ii) Give the truth table of a 2-to-4 line decoder. [2 marks]
(iii) Draw a clearly labelled **circuit** of a 2-to-4 line decoder constructed from one or more of the primary logic gates. [6 marks]
- (d) (i) Calculate the decimal equivalent of 00101001_2 . [1 mark]
(ii) Determine if the result of $0110 + 0101$ can be stored as a 4-bit binary number. [2 marks]
(iii) Showing all working, find the largest and smallest integers that can be represented using 6 bits if signed magnitude is used.

Hint: the leftmost bit is to be used for the sign and the other bits are used for representing the integer itself. [2 marks]

- (iv) Find the 4-bit two's complement representation of -4 . [2 marks]

Total 25 marks

2. (a) Consider the following four devices used for storing data in a computer: ROM, RAM, hard disk and CD-RW. Compare these four devices in terms of *storage capacity* and *access speed*. **[6 marks]**
- (b) (i) Explain how cache memory works. **[2 marks]**
- (ii) Explain ONE benefit of cache memory. **[2 marks]**
- (c) (i) Explain what is meant by the ‘instruction set’ of a central processing unit. **[2 marks]**
- (ii) State THREE types of instructions that are typically included in an instruction set. **[3 marks]**
- (iii) Instruction formats differ in the number of addresses contained in an instruction. Using a diagram in EACH case, describe THREE typical instruction formats. **[6 marks]**
- (iv) Describe the MAIN activities that take place in an instruction cycle. **[4 marks]**

Total 25 marks

SECTION B

PROBLEM SOLVING WITH COMPUTERS

Answer BOTH questions.

3. (a) State THREE basic control structures. **[3 marks]**
- (b) Figure 1 shows an algorithm using pseudocode.

```
pcount = 0 : counter for pineapples  
bcount = 0 : counter for bananas  
for j = 1 to 100 do  
    input choice  
    if choice = 'banana' then  
        bcount = bcount + 1  
    else  
        pcount = pcount + 1  
    end if  
end for  
print 'pineapples =', pcount  
print 'bananas =', bcount
```

Figure 1

Using the algorithm in Figure 1 above, give an explanation of EACH control structure stated in (a). **[6 marks]**

- (c) Some programmers prefer to use a graphical form to represent algorithms. Provide a graphical representation of the algorithm in Figure 1. **[7 marks]**
- (d) The algorithm in Figure 1 assumes that the choice can only be banana or pineapple. Amend the algorithm for an additional choice – cherry. In addition, the algorithm should keep a count of errors made, such as, when a choice is incorrectly spelt or is not one of the three choices. The counter should be displayed just before the algorithm terminates. **[9 marks]**

Total 25 marks

4. (a) Trace through the execution of the following algorithm and draw the output in your answer booklet, exactly as it would be generated by the algorithm. You should carefully note the following:

- *printSpaces(n)* prints *n* spaces from the current cursor position
- *print* continues output on the current line from the current cursor position
- *println* terminates output on the current line at the current cursor position. Any subsequent output begins on a new line (e.g. line 21)
- *println (output-list)* outputs ‘output-list’ on the current line and then places the cursor at beginning of the following line (e.g. line 4)

```
1. begin
2.     SIZE = 10
3.     printSpaces ( SIZE )
4.     println ( '*' )
5.     j = SIZE - 2
6.     r = 1
7.     while ( j >= 5 ) do
8.         begin
9.             printSpaces ( j + 1 )
10.            print ( '*' )
11.            printSpaces ( r )
12.            println ( '*' )
13.            j = j - 1
14.            r = r + 2
15.        end
16.        for j = 1 to 5 do
17.            begin
18.                printSpaces ( SIZE )
19.                println ( '*' )
20.            end
21.            println
22.        end
```

[11 marks]

- (b) Write an algorithm that uses iteration to find the sum of all multiples of 3 and all multiples of 4 between 3 (inclusive) and 150 (exclusive). **[8 marks]**

- (c) A video club has just purchased software that can be used for tracking DVD rentals, number in stock, new titles and other system management functions. The software is to be used at one site only. The company has two computers.

Briefly explain what the ‘Implementation and Review’ stage of the problem solving process would involve for the video club. **[6 marks]**

Total 25 marks

SECTION C

PROGRAMMING

Answer BOTH questions.

5. (a) Explain TWO ways in which a programming language for a mobile device (for example, a cellular phone) would differ from a programming language for a desktop computer.

[4 marks]

- (b) How does a *character* variable differ from a *string* variable? [2 marks]

- (c) A text file “salary.dat” contains employee records for a company. Each line contains an employee name 30 characters in length (only surname is stored), hours worked, hourly rate and deductions. For employee *Smith* below, hours worked is 100, hourly rate is \$10.50 and deduction is \$34.75. The number of records is unknown beforehand, but the last line of the file contains the fictitious name “ENDDATA” only.

A sample *salary.dat* file containing three records is given below:

Smith	100	10.50	34.75
Jones	20	12	5
Janet	50	30	10
ENDDATA			

Write a C program which reads the data and:

- calculates and prints the *gross salary* for each employee; gross salary is calculated as hours worked multiplied by hourly rate
- calculates and prints the *net pay* for each employee (gross pay minus deductions)
- calculates and prints the total overall net pay (the sum of EACH employee’s net pay)

Marks will be awarded for the overall degree of accuracy of your program.

[19 marks]

Total 25 marks

6. (a) The program below demonstrates poor programming **style**. Describe THREE different ways in which the programming **style** can be improved. Use line numbers in your response.

```
1. # include <stdio.h>
2. void main ()
3. { int arr [10];
4.
5. int test;
6. float Val;
7. for (J = 0; J < 10; J++) {
8.     printf( Please enter integer number %d: ", J);
9.     scanf (" %d ", &arr [J]);
10.    } //for
11. }
```

[6 marks]

- (b) What is the purpose of a ‘struct’ in C? [2 marks]

- (c) (i) Write a function which accepts two integers, **x** and **y**, and returns the larger of the two. Assume that the integers are unique. Show how your function would be called. [6 marks]

- (ii) Write a function which accepts a character, **ch**, and returns **1** if the character is a letter of the alphabet or **0** otherwise. Show how your function would be called. [6 marks]

- (iii) Write a function which accepts a character, **ch**, and returns **1** if the character is present in the string “CAPECOMPUTERSCIENCE”. The function should return **0** if **ch** is not present in the string. [5 marks]

Total 25 marks

END OF TEST

FORM TP 2010161



TEST CODE **02215020**

MAY/JUNE 2010

CARIBBEAN EXAMINATIONS COUNCIL
ADVANCED PROFICIENCY EXAMINATION

COMPUTER SCIENCE

UNIT 2 – FURTHER TOPICS IN COMPUTER SCIENCE

PAPER 02

2½ hours

17 MAY 2010 (p.m.)

INSTRUCTIONS TO CANDIDATES

1. DO NOT open this examination paper until instructed to do so.
2. Answer **ALL** questions from the **THREE** sections.

SECTION A

DATA STRUCTURES

Answer BOTH questions.

1. (a) Define the term *abstract data type* (ADT). **[2 marks]**

- (b) (i) Give an ADT operation that can be used to store an element in a singly linked list. **[1 mark]**

- (ii) A singly linked list is created and the following elements are placed in the linked list in the order given:

25, 50, 75

Draw the list after all three elements have been placed in the list using the ADT operation at (i) above, clearly indicating the beginning and end of the list.

[3 marks]

- (c) The Queue ADT provides an *enqueue* (*Queue, data*) operation and a *dequeue* (*Queue*) operation.

- (i) Suppose that you need to implement a Queue for storing a set of integer values. Describe the computer storage that you will use for implementing the queue operations. **[4 marks]**

- (ii) Write the C code for a function that implements the *enqueue* (*Queue, data*) operation assuming that *data* is an integer value. Your function must deal with queue overflow conditions. **[5 marks]**

- (d) The Stack Abstract Data Type (ADT) provides a *pop* (*Stack*) operation, a *push* (*Stack, data*) operation, and an *isEmpty* (*Stack*) operation.

You are given a queue, *q*, with a set of elements. Using a stack, *stk*, write an algorithm to reverse the order of all the elements in *q*. Your algorithm must only use Stack and Queue ADT operations. **[6 marks]**

- (e) A stack can be implemented using a singly linked list.

Explain how the Stack ADT operations will be implemented if a singly linked list is used. **[4 marks]**

Total 25 marks

2. (a) A set of 10 integers is stored in a one-dimensional array as follows:

location	0	1	2	3	4	5	6	7	8	9
data	10	3	2	15	6	5	8	11	20	19

A selection sort algorithm must be used to sort the 10 integers in ascending order (i.e. smaller values must come before bigger values).

- (i) Describe how the selection sort algorithm works to sort a set of 10 integers in ascending order.

[10 marks]

- (ii) Draw the array after the first, second, and third passes of the selection sort algorithm (i.e. three diagrams in all).

[3 marks]

- (b) A one-dimensional array **num** consists of 20 integers. The integers are **not** sorted.

Write C programming code to accept an integer, **target**, from the user and determine if **target** is present in **num**. If **target** is found in **num**, print the location in which it was found. If **target** is not present in **num**, print an appropriate error message.

[10 marks]

- (c) When should binary search be used on an array?

[2 marks]

Total 25 marks

SECTION B

SOFTWARE ENGINEERING

Answer BOTH questions.

3. (a) A critical attribute of a well-engineered software product is maintainability. Briefly discuss TWO **other** attributes of well-engineered software. **[4 marks]**

- (b) Explain, giving TWO reasons, why it is important to involve end users and management in the development of a software product. **[4 marks]**

- (c) Explain why a software system that is used in a real-world environment must be upgraded or become progressively less useful. **[3 marks]**

- (d) The hiring process of a certain organisation after a vacancy is advertised is as follows:

Applications are accepted from interested persons and stored in a file. An acknowledgement letter is sent to each applicant indicating that his/her application has been received. At a later date, the applications are retrieved from the file, examined and eligible applicants are selected for an interview. The selected applicants are informed of the date and time of their interviews. After the interviews are held, the successful applicant's data is moved to the personnel file since this person will now be an employee of the organisation. Finally, letters are sent to each applicant informing him or her of the outcome of the application.

Draw a Level-0 data flow diagram to represent the above scenario. **[14 marks]**

Total 25 marks

4. (a) Two deliverables of the analysis phase of software engineering are a *feasibility study* and a *requirements specification document*.
- (i) State TWO reasons why the feasibility study is undertaken. [2 marks]
- (ii) Describe the contents of the requirements specification document. [3 marks]
- (b) A certain organisation consists of a number of departments. Each department employs one or more employees but an employee is employed in only one department. The organisation stores the first name, last name, address, and telephone number of each employee, as well as an employee number to uniquely identify each employee. Employees have one or more skills. A department undertakes various kinds of projects. Employees may be assigned to one or more projects being undertaken. A project consists of a set of tasks and employees use one or more of their skills when performing tasks on projects.
- Draw an entity-relationship model for the above scenario. [14 marks]
- (c) Consider a function, *lsearch*, which accepts the following parameters:
- arr*, an array of integers as a parameter,
n, the amount of elements in *arr*, and
key, an integer being searched for
- and performs a linear search on *arr* for *key*. If *key* is found, the function returns **the location where the key was found**, otherwise, it returns **-1**.
- Briefly describe THREE tests which can be used to determine if *lsearch* is working correctly. [6 marks]

Total 25 marks

SECTION C

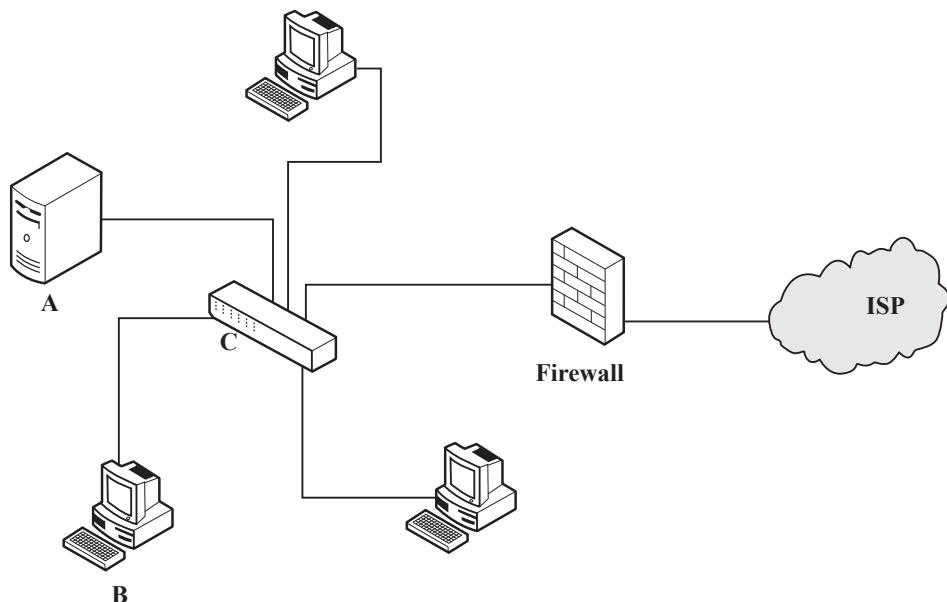
OPERATING SYSTEMS AND COMPUTER NETWORKS

Answer BOTH questions.

5. (a) (i) Draw a diagram to show the layers of the OSI model for computer communication. [6 marks]
- (ii) Describe the role of EACH of the top THREE layers of the model drawn in 5 (a) above. [6 marks]
- (b) What is meant by a ‘page fault’, in an operating system that uses paging? How is it handled? [4 marks]
- (c) State and describe TWO applications that use or can use GPRS. [6 marks]
- (d) In an operating system, explain what can cause a process to move from the running state to the ready state. [3 marks]

Total 25 marks

6. The diagram below shows the network design of a company which utilizes a client-server model for its data and applications.



- (a) Complete the labelling of the diagram, giving the names of **A**, **B** and **C**. [3 marks]
- (b) State, giving a reason, which network topology is being employed. [2 marks]
- (c) Give ONE disadvantage of the topology identified in (b). [2 marks]
- (d) List ONE device which is NOT shown in the diagram that may also be found on the network. [1 mark]
- (e) Briefly describe the function of the firewall. [3 marks]
- (f) What is the meaning of the abbreviation ISP? [1 mark]
- (g) What service would the company likely use from the ISP? [1 mark]
- (h) If the company had an Intranet, on what protocol would it be running? [1 mark]
- (i) Differentiate between a peer-to-peer and a client server configuration. [3 marks]
- (j) Give ONE disadvantage of a client server configuration. [2 marks]
- (k) Both devices labelled **A** and **B** are running computer programs classified as operating systems.
- (i) Describe ONE function of modern operating systems. [2 marks]
- (ii) What is the difference between the type of operating system running on **A** and that running on **B**? [2 marks]
- (iii) Give ONE method used to secure files. [2 marks]

Total 25 marks

END OF TEST

TEST CODE **02115020**



FORM TP 2011163

MAY/JUNE 2011

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

COMPUTER SCIENCE

UNIT 1: FUNDAMENTALS OF COMPUTER SCIENCE

PAPER 02

2½ hours

13 MAY 2011 (a.m.)

This examination paper consists of **THREE** sections: Computer Architecture and Organisation, Problem Solving with Computers and Programming.

Each section consists of 2 questions

The maximum mark for each section is 50.

The maximum mark for this examination is 150.

This examination consists of 7 printed pages.

INSTRUCTIONS TO CANDIDATES

1. Do NOT open this examination paper until instructed to do so.
2. Answer **ALL** questions from the **THREE** sections.

SECTION A

COMPUTER ARCHITECTURE AND ORGANISATION

Answer BOTH questions.

1. (a) The following is the truth table of a certain circuit:

x	y	z
0	0	1
0	1	1
1	0	0
1	1	0

Using only primary logic gates, design and draw the circuit.

[6 marks]

- (b) Write down the truth table (i.e. list all possible input bit patterns and their corresponding outputs) for the circuit in Figure 1.

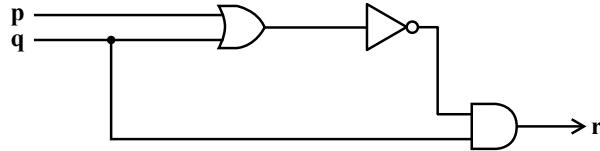


Figure 1

[4 marks]

- (c) Explain what is meant by the terms:

(i) Flip-flop

[2 marks]

(ii) Multiplexor

[2 marks]

- (d) (i) Draw a clearly labelled **block** diagram of a 2-to-4 line decoder. [3 marks]
- (ii) A circuit is required for a television game show. The circuit must control four light bulbs, B1, B2, B3, and B4. Only ONE of the light bulbs can be on at any time.
State how a 2-to-4 line decoder can be used in the circuit and explain how the bulbs are switched on. [3 marks]
- (e) Find the 4-bit two's complement of – 6. [2 marks]
- (f) Consider the following floating point representation:
1-bit sign, 3-bit exponent, 5-mantissa.
Calculate the decimal representation of 001000101.
(Show all working.) [3 marks]

Total 25 marks

2. (a) Name and state the function of THREE registers found in the Central Processing Unit (CPU). [6 marks]
- (b) Compare main memory and TWO storage devices in terms of capacity and access speed. [6 marks]
- (c) Besides registers, name TWO other components in the CPU and state the function of EACH. [4 marks]
- (d) Define the term ‘cache memory’ and explain how it increases the efficiency of data retrieval. [4 marks]
- (e) (i) State what is an ‘instruction format’. [1 mark]
(ii) Name and describe TWO addressing modes. [4 marks]

Total 25 marks

SECTION B

PROBLEM SOLVING WITH COMPUTERS

Answer BOTH questions.

3. (a) Describe any THREE stages in the problem solving process. [6 marks]
- (b) The algorithm below finds the average age of a set of students. Construct a flowchart to represent the algorithm.

Algorithm
AverageAge Sum = 0 Counter = 0 Read Age While Age != 0 Sum = Sum + Age Counter = Counter + 1 Read Age End while Average = Sum/Counter Print Average End

[11 marks]

- (c) The algorithm below is designed to print a table of squares of all the **even** numbers between 1 and 100 (inclusive). However, there are errors in the algorithm.

```
1.      j = 1
2.      while j < 100
3.          print "Even Number Square"
4.          print "===== ====="
5.          j * j = square
6.          print j, square
7.      end while
```

By referring to the specific line number, **identify and correct** the errors in the algorithm so that it will achieve its objective. [8 marks]

Total 25 marks

4. (a) State THREE properties of a well-designed algorithm. [3 marks]

(b) Trace through the execution of the following algorithm and draw the output in your answer booklet exactly as it would be generated by the algorithm. You should carefully note the following:

- *printSpaces(n)* prints n spaces from the current cursor position; use a dash ‘-’ to indicate a space in your answer booklet.
- *print()* continues output on the current line from the current cursor position.
- *println()* continues output on the current line from the current cursor position but any subsequent output begins on a new line

```
SIZE = 10
begin

    i = SIZE - 1
    while (i > 0) {
        printSpaces (i)
        print ("*")
        y = (SIZE - i - 1) * 2
        printSpaces (y)
        println ("*")
        i = i - 1
    }

    for (i=1; i<=2*SIZE; i=i+1)
        print ("*")

    println()
}

end
```

[11 marks]

(c) (i) Write an algorithm that uses iteration to print the sum of ALL multiples of 11 (integers) between 0 and 5 000, inclusive. [8 marks]

(ii) Indicate whether ‘bounded’ or ‘unbounded’ iteration was used in your response for 4 (c) (i) and state ONE reason for its use. [3 marks]

Total 25 marks

SECTION C

PROGRAMMING

Answer BOTH questions.

5. (a) Apart from intermediate code generation, list TWO other stages of the translation process. [2 marks]
- (b) Give TWO advantages of using a modular approach in programming. [2 marks]
- (c) Write a C function which accepts an integer array and an integer variable indicating the size of the array. The function should return the sum of all the numbers in the array that are NOT greater than 100. [6 marks]
- (d) A gym is having a contest. Members are asked to guess the number of jellybeans in a jar. The winner is the member who accurately guesses the number of jellybeans or whose guess is closest to this value without going over.

All the information related to the contest is stored in a file ‘contest.txt’. The first line of the file gives that actual number of jellybeans in the jar. Each line thereafter contains the guess of a member followed by his/her member identification code (which is a four digit integer). Data is terminated by – 1 (which appears on a line by itself).

Write a C program that determines and outputs to a file, “winner.txt”, the winning guess and the winner’s identification code.

You may assume all guesses are unique and a winner exists. **You may not use arrays in your solution.** [15 marks]

Total 25 marks

6. (a) Explain the term ‘white space’. [2 marks]
- (b) Define the term ‘debugging’. [2 marks]
- (c) Explain why programmers should practise proper indentation. [2 marks]
- (d) For any THREE integer values the following rules apply:
- The values cannot be the sides of a triangle if any value is 0 or negative and, if any value is greater than the sum of the other two.
 - The values can represent the sides of an equilateral triangle if all the values are equal.
 - The values can represent the sides of an isosceles triangle if two values are equal.
 - The values can represent the sides of a scalene triangle if all the values are different.

Write a C program that prompts the user for THREE integers and prints to the standard output what triangle is represented. If no triangle is represented print “No triangle is represented.” [11 marks]

- (e) (i) In your answer booklet show the output generated by the following segment of code.

```
int i, j;  
  
for (i = 1 ; i < 5; i++)  
{  
    for (j = 1 ; j <= 5 ; j++)  
    {  
        print ("%d", i);  
    }  
    print ("\n");  
}
```

[4 marks]

- (ii) Modify the code in e (i) so that the following output is generated.

```
1 2 3 4 5  
2 3 4 5  
3 4 5  
4 5
```

5 [4 marks]

Total 25 marks

END OF TEST

TEST CODE **02215020**

FORM TP 2011165



MAY/JUNE 2011

C A R I B B E A N E X A M I N A T I O N S C O U N C I L

ADVANCED PROFICIENCY EXAMINATION

COMPUTER SCIENCE

UNIT 2: FURTHER TOPICS IN COMPUTER SCIENCE

PAPER 02

2½ hours

16 MAY 2011 (p.m.)

This examination paper consists of **THREE** sections: Data Structures, Software Engineering and Operating Systems and Computer Networks.

Each section consists of 2 questions

The maximum mark for each section is 50.

The maximum mark for this examination is 150.

This examination consists of 5 printed pages.

INSTRUCTIONS TO CANDIDATES

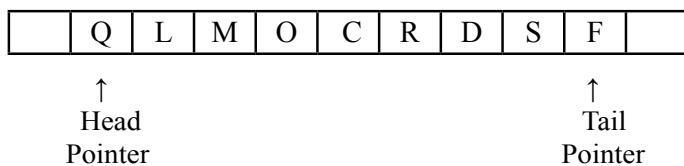
1. Do NOT open this examination paper until instructed to do so.
2. Answer **ALL** questions from the **THREE** sections.

SECTION A

DATA STRUCTURES

Answer BOTH questions.

1. (a) (i) Define the term ‘Abstract Data Type’ (ADT). [2 marks]
(ii) Explain how a stack ADT is implemented. [3 marks]
- (b) A certain element is at the bottom of a stack. Write an algorithm to remove the element from the stack, leaving the other elements in their same relative positions. (You may use an appropriate auxiliary structure in your solution.) [8 marks]
- (c) Assume that a queue implemented in a circular fashion is in the state indicated in the diagram below.

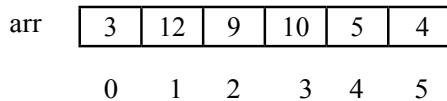


Draw a diagram showing the queue after the letters L and Y are inserted, three letters are removed, and the letters E and Z are then inserted. [7 marks]

- (d) Describe how you would sort an array of n items using a bubble sort. [5 marks]

Total 25 marks

2. (a) Using a labelled diagram, explain what is a linked list. [6 marks]
(b) Consider the following array arr.



Write a C program to store and then sort the values in the array arr, using simple selection sort. [12 marks]

- (c) Explain what is involved in EACH of the following search techniques:

- (i) linear search [3 marks]
(ii) binary search [4 marks]

Total 25 marks

SECTION B

SOFTWARE ENGINEERING

Answer BOTH questions.

3. (a) Explain the ‘waterfall approach’ to systems development. [3 marks]
- (b) Describe FOUR tasks which must be performed during the design phase of systems development. [8 marks]
- (c) A mail order company receives orders from customers at its sales department. The sales department prepares an internal order form which it dispatches to the warehouse and sends an acknowledgement to the customer. The warehouse checks for the availability of the item. If the item is in stock the order is prepared and dispatch instructions are sent to the dispatch department which sends a copy to the sales department and the accounting department. The sales department receives a copy of the invoice from accounts and sends summary financial statements of the customer to accounts and to the customer. Accounts also sends an invoice to the customer.

Draw a Level-0 data flow diagram that shows the flow of information between the customer, the company and the various departments within the firm. [14 marks]

Total 25 marks

4. (a) In undertaking the development of a new software system, the systems analyst is required to undertake a fact-finding exercise.
- (i) Identify THREE methods of fact-finding available to the analyst. [3 marks]
- (ii) Outline TWO deliverables from the analysis phase of the systems development life cycle. [4 marks]
- (b) (i) Describe TWO ways in which a CASE tool can be used in a software development process. [4 marks]
- (ii) State ONE advantage and ONE disadvantage of using CASE tools in a project. [2 marks]
- (c) A certain university has a number of colleges. Each college has one or more departments. A lecturer is hired by one or more departments. A department can teach many courses and a course can be taught by one or more lecturers. The following information is stored on a course: code (primary key), name, and credit hours.

Draw an entity-relationship model for the above scenario. [12 marks]

Total 25 marks

SECTION C

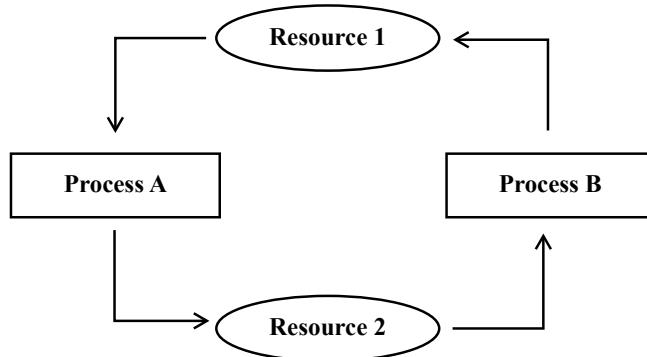
OPERATING SYSTEMS AND COMPUTER NETWORKS

Answer BOTH questions.

5. (a) Explain ONE difference between an analog signal and a digital signal. [2 marks]
- (b) State TWO examples of EACH of the following:
- (i) wired transmission media [2 marks]
- (ii) wireless transmission [2 marks]
- (c) Using examples, explain the client-server model of computing. [4 marks]
- (d) The College of Enquiry has decided to install a Local Area Network (LAN) to be used by both staff and students. It is expected that both groups will connect to the Internet to do research and communicate with stakeholders external to the College from different points within the campus. It is also expected that the college will connect its LAN to other LANs.
- (i) Describe FOUR network devices that may be used by the college. [8 marks]
- (ii) Describe how TWO types of transmission media can be used by the college LAN. [4 marks]
- (iii) State THREE ways in which different users may be granted access to the various data and resources on the network. [3 marks]

Total 25 marks

6. (a) (i) Distinguish between a ‘batch processing system’ and a ‘multi-user system’. [4 marks]
- (ii) Name ONE application for which a batch processing system is used. [1 mark]
- (iii) Name ONE application for which a multi-user system would be appropriate. [1 mark]
- (b) Describe TWO ways in which files can be protected. [4 marks]
- (c) Program A is currently running. It needs to retrieve data from a disk, so an interrupt is generated.
- (i) What is an interrupt? [1 mark]
- (ii) Briefly explain how an interrupt is handled by the processor. [3 marks]
- (d) The diagram below depicts a difficulty that can occur in a multiprogramming system.



- (i) What is the term used to describe the difficulty that has occurred? [1 mark]
- (ii) Outline the conditions under which such an event would occur. [3 marks]
- (iii) Explain TWO ways in which the difficulty outlined in d (i) could be resolved. [4 marks]
- (e) Briefly explain how the round-robin scheduling algorithm works. [3 marks]

Total 25 marks

END OF TEST

TEST CODE **02115020**



FORM TP 2012163

MAY/JUNE 2012

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

COMPUTER SCIENCE

FUNDAMENTALS OF COMPUTER SCIENCE

UNIT 1 – Paper 02

2 hours 30 minutes

15 MAY 2012 (a.m.)

This examination paper consists of **THREE** sections: Computer Architecture and Organisation, Problem Solving with Computers and Programming.

Each section consists of 2 questions

The maximum mark for each section is 50.

The maximum mark for this examination is 150.

This examination consists of 6 printed pages.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

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02115020/CAPE 2012

SECTION A

COMPUTER ARCHITECTURE AND ORGANIZATION

Answer BOTH questions.

1. (a) A certain circuit has two inputs, x and y. Its output is given by the boolean function, F, where

$$F = xy' + x'y$$

- (i) Give the truth table of the circuit. [4 marks]
(ii) Using only the primary logic gates, design and draw the circuit. [6 marks]
- (b) (i) Draw a clearly labelled block diagram of a 4-to-1 line multiplexer. [4 marks]
(ii) In a security system, four sensors must transmit data to a single line for alarm notification. Each sensor transmits data for 1 second.

Explain how a multiplexer can be used for the purpose described above and discuss how data from each sensor is transmitted through the alarm notification line. [6 marks]

- (c) (i) Showing all working, find the largest and smallest integers that can be stored in four bits when signed magnitude representation is used. [2 marks]
(ii) Consider the following floating point representation:
1-bit sign, 3-bit exponent, 5-bit mantissa
Calculate the decimal equivalent of 101100011. [3 marks]

Total 25 marks

2. (a) (i) Explain what is meant by the ‘instruction set’ of a central processing unit (CPU). [2 marks]
(ii) Briefly describe THREE types of instructions that are typically included in an instruction set. [6 marks]
(iii) Explain how cache memory can increase the efficiency of data retrieval. [3 marks]

- (b) (i) Distinguish between the opcode and the operands of an instruction. [2 marks]
- (ii) Two typical instruction formats are one-address and two-address. Describe how the operands are obtained in EACH case and specify where the results are stored. [6 marks]
- (c) (i) Explain how a hard disk differs from RAM in terms of access method and access speed. [3 marks]
- (ii) Explain how RAM differs from a CD-R device in terms of volatility and storage capacity. [3 marks]

Total 25 marks

SECTION B

PROBLEM SOLVING WITH COMPUTERS

Answer BOTH questions.

3. (a) Explain the role of an algorithm in the problem-solving process. [2 marks]
- (b) Examine the TWO algorithms below (labelled Algorithm 1 and Algorithm 2) and answer the questions that follow.

Algorithm 1

```
FOR X = 0 TO 15 DO
    PRINT X
END FOR
```

Algorithm 2

```
READ X
WHILE X != 999 DO {Note that != means "not equal to"}
    SUM = SUM + X
    READ X
END WHILE
```

- (i) Which of the algorithms above illustrates **bounded iteration**? Justify your answer. [3 marks]
- (ii) Which of the algorithms above illustrates **unbounded iteration**? Justify your answer. [3 marks]

- (c) A primary school is conducting a survey on the popularity of certain colours. Students are asked to vote for any of four choices: red, blue, green, none. If red, blue or green is not the favourite, students vote for ‘none’.

Write an algorithm to find and print the

- (i) number of students that voted for EACH of the colours: red, blue, green.
- (ii) TOTAL number of students that voted for red, blue or green.

Assume that on the day of the survey, 150 students are present. Also assume that all votes are valid. [10 marks]

- (d) Write an algorithm that uses iteration to find the sum of all multiples of 4 and all multiples of 7 between m (inclusive) and n (inclusive) where m and n are two positive integers entered via the keyboard. Assume that $n > m$. [7 marks]

Total 25 marks

4. (a) Construct a flow chart to represent the following algorithm.

```
begin
    Prompt for numDays
    Read numDays
    Set day to 1
    Set totalComm to 0
    While day <= numDays do
        read numItemsSold
        if numItemsSold < 500 then
            comm = numItemsSold * 4
        else comm = numItemsSold * 5
        endif
        totalComm = totalComm + comm
        Print comm
        Add 1 to day
    Endwhile
    Print numDays, totalComm
stop
```

[12 marks]

- (b) An algorithm is shown below.

```
read j
sum = 0
while j < 5 do
    sum = sum + j
    print j
    read j
endwhile
print 'sum =', sum
```

What would the algorithm print given the line of input data below? Show your working.

3 2 1 5 7 4

[3 marks]

GO ON TO THE NEXT PAGE

- (c) Trace through the execution of the following algorithm and draw the output in your answer booklet, exactly as it would be generated by the algorithm. You should carefully note the following:

- *printSpaces (n)* prints n spaces from the current cursor position
- *print* continues output on the current line from the current cursor position
- *println* terminates output on the current line at the current cursor position.
Any subsequent output begins on a new line (e.g., line 18)
- *println (output-list)* outputs ‘output-list’ on the current line and then places the cursor at the beginning of the following line (e.g., line 4).

```
1. begin
2.     SIZE = 10
3.     printSpaces ( SIZE + 1 )
4.     println ( '*' )
5.     j = SIZE - 2
6.     while j >= 0
7.         begin
8.             printSpaces ( j + 1 )
9.             print ( '$' )
10.            printSpaces ( SIZE - j )
11.            println ( '&' )
12.            j = j - 2
13.        endwhile
14.        printSpaces ( 1 )
15.        for j = 1 to (SIZE + 1) do
16.            print ( '+' )
17.        endfor
18.        println
19.    end
```

[10 marks]

Total 25 marks

SECTION C

PROGRAMMING

Answer BOTH questions

5. (a) Briefly describe THREE stages of the program translation process. [6 marks]
- (b) Write a C function which accepts a positive integer, n , and returns 2^n . State any assumptions made. [7 marks]
- (c) (i) Write C code to store the even numbers from 2 (inclusive) to 40 (inclusive) in a file called “num.dat”. [7 marks]
- (ii) Write C code to read the integers from the file “num.dat” created in c (i), add 5 to each integer and then print the result on the screen. [5 marks]

Total 25 marks

6. (a) Explain THREE ways in which good programming style can be maintained. [6 marks]
- (b) A grocer needs to store data about some products using a C application. Each product has an ID (integer), a quantity in stock (integer) and a price (floating point).
- (i) Write a declaration for a C struct **productRec** that can store the record for each product. [2 marks]
 - (ii) Declare TWO variables, *item1* and *item2*, that have the record structure declared in b (i) above. [1 mark]
 - (iii) Write C code to put data in the *item1* struct from b (ii) above. You can use any values you like. [2 marks]
 - (iv) Assume that two **productRec** structs, *item3* and *item4*, are already loaded with data. Write C code to exchange the values in *item3* and *item4*. [3 marks]
- (c) Write C code to read a string entered by the user at the keyboard, store it in a character array and print the vowels that are present in the string. If no vowels are present, print “NO VOWELS”. Assume that the string is entered in upper case letters and that the string is exactly 7 characters in length. Also, count and print the number of occurrences of the letter ‘A’ in the string.

Example:

Please enter name: MICHAEL

Vowel I present. Vowel A present. Vowel E present.
Number of As = 1

[11 marks]

Total 25 marks

END OF TEST

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FORM TP 2012165



MAY/JUNE 2012

CARIBBEAN EXAMINATIONS COUNCIL

ADVANCED PROFICIENCY EXAMINATION

COMPUTER SCIENCE

FURTHER TOPICS IN COMPUTER SCIENCE

UNIT 2 – Paper 02

2 hours 30 minutes

16 MAY 2012 (p.m.)

This examination paper consists of **THREE** sections: Data Structures, Software Engineering and Operating Systems and Computer Networks.

Each section consists of 2 questions

The maximum mark for each section is 50.

The maximum mark for this examination is 150.

This examination consists of 6 printed pages.

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02215020/CAPE 2012

SECTION A

DATA STRUCTURES

Answer BOTH questions.

1. (a) A Stack abstract data type (ADT) is implemented in C using appropriate variables and functions.
- (i) Explain the difference between the Stack ADT and the C implementation of the stack. [3 marks]
- (ii) Declare the variables that are needed for the implementation of the stack in C and describe the purpose of EACH. Assume that the stack will store at most 100 integer elements. [4 marks]
- (iii) Write the C code for the *push (element)* and *pop ()* operations. You must cater for stack overflow and underflow conditions. [8 marks]

- (b) The linked list ADT provides an insert operation which inserts new elements at the beginning of the list.

A certain linked list is initially empty. Draw the linked list after the following elements are inserted in the order given (from left to right):

43 38 25

[You must clearly indicate the beginning and ending of the list.] [4 marks]

- (c) The Queue ADT provides an *enqueue (element)* operation and a *dequeue ()* operation. You are given a queue, *q*, with an unknown number of elements. Using a stack, *stk*, write an algorithm to reverse the order of the elements in *q*. Your algorithm must use Stack and Queue ADT operations **only**. [6 marks]

Total 25 marks

2. (a) A one-dimensional array contains the marks of 100 students in a certain subject. The marks are not sorted.

Write the C programming code which inputs two integers, *lower* and *upper* (where *lower* is less than *upper*), and finds and prints the number of marks in the array between *lower* and *upper* (inclusive). If no mark is found in the range, print an appropriate error message.

[You do NOT have to input the marks in the array.] [10 marks]

- (b) The following 10 integers are stored in a sorted array, *arr*.

location	0	1	2	3	4	5	6	7	8	9
data	7	9	16	22	27	45	50	51	80	91

Describe how a binary search algorithm will search *arr* for the following keys:

- (i) 16 [6 marks]
(ii) 63 [6 marks]

You must show the portion of the array being searched each time in the loop until the key is found or until it is determined that the key is not present.

- (c) The following 10 integers are stored in an array, *arr*.

location	0	1	2	3	4	5	6	7	8	9
data	80	91	50	22	27	45	16	51	7	9

Draw the array after the first, second, and third passes of the selection sort algorithm (i.e., three diagrams in all). [3 marks]

Total 25 marks

SECTION B

SOFTWARE ENGINEERING

Answer BOTH questions

3. (a) In a university registration system, a student sends an application form containing his/her personal details and the course he/she would like to register for. The university checks a course file to find out if the course is available. If the course is available, the student is enrolled in the course by updating the student file and course file. The university confirms the enrolment by sending a confirmation letter to the student. If the course is unavailable, the student is sent a rejection letter.

Draw a level-0 data flow diagram (first level of decomposition) that depicts the above scenario. [14 marks]

- (b) Describe ONE advantage and ONE disadvantage of the evolutionary approach to software development. [4 marks]
- (c) Describe FOUR phases in the waterfall approach for software development and state the order in which they will be undertaken. [5 marks]
- (d) Discuss ONE reason why it is important to involve end users in the development of a software product. [2 marks]

Total 25 marks

4. (a) A conceptual data model is a representation of an organization's data. During analysis, it is common to obtain a conceptual data model using a technique known as entity-relationship modelling.

- (i) Describe the main components of an entity-relationship model. [6 marks]
- (ii) A certain company undertakes software development projects. A project consists of a set of tasks and each task requires various skills such as coding and testing. The company stores the first name, last name, address and telephone number of each employee as well as an employee number to uniquely identify the employee. Each employee has a number of competencies; however, other employees could have similar competencies. Employees may be assigned to only one project being undertaken. However, they can be assigned to one or more tasks based on their competencies.

Draw an entity-relationship model for the above scenario. [13 marks]

GO ON TO THE NEXT PAGE

- (b) A function, *binarySearch*, performs a binary search on an integer array, *arr*; to determine if a certain *key* is present. If *key* is found, *binarySearch* returns **the location where the key was found**. Otherwise, it returns **-1**. Its parameters are as follows:

arr, an array of integers
n, the amount of elements in arr, and
key, the integer being searched for.

Describe THREE tests which can be used to determine if *binarySearch* is working correctly. [6 marks]

Total 25 marks

SECTION C

OPERATING SYSTEMS AND COMPUTER NETWORKS

Answer BOTH questions.

5. (a) Describe the characteristics of EACH of the following transmission media:
- (i) twisted pair [2 marks]
(ii) fibre optic cables [2 marks]
- (b) A ring network has four computers, but one of the computers has failed. Explain ONE modification to the ring network that will allow the three remaining computers to still transmit data. **Use a diagram in your response.** [4 marks]
- (c) With the aid of a diagram, explain the role of a hub in a local area network. [3 marks]
- (d) With the aid of a diagram, explain how is data communicated in an IEEE802.11a network. [6 marks]
- (e) Outline the role of a firewall on a computer network. [3 marks]
- (f) State the role of EACH of layers 1 – 5 of the OSI model for network communication. [5 marks]

Total 25 marks

6. (a) Using a diagram, explain how a deadlock can occur in an operating system. [4 marks]
- (b) Briefly explain how a software interrupt is handled in a system that contains one processor. [4 marks]
- (c) List and describe THREE states that a process may be in during execution. [9 marks]
- (d) Describe THREE components of a process control block (PCB). [6 marks]
- (e) State ONE advantage of a menu interface over a command interface. [2 marks]

Total 25 marks

END OF TEST

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FORM TP 2013163

MAY/JUNE 2013

C A R I B B E A N E X A M I N A T I O N S C O U N C I L
CARIBBEAN ADVANCED PROFICIENCY EXAMINATION®
COMPUTER SCIENCE
FUNDAMENTALS OF COMPUTER SCIENCE

UNIT 1 – Paper 02

2 hours 30 minutes

17 MAY 2013 (a.m.)

This examination paper consists of **THREE** sections: Computer Architecture and Organization, Problem Solving with Computers, and Programming.

Each section consists of 2 questions

The maximum mark for each section is 50.

The maximum mark for this examination is 150.

This examination consists of 7 printed pages.

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02115020/CAPE 2013

SECTION A

COMPUTER ARCHITECTURE AND ORGANIZATION

Answer BOTH questions.

1. (a) (i) Draw a clearly labelled block diagram of a 4 to 1 line multiplexer. [4 marks]
- (ii) Four lines, I_0, I_1, I_2, I_3 , are connected to the input lines of a 4 to 1 line multiplexer. Explain how the multiplexer can send the signal in I_1 as output for one second followed by the signal in I_3 . [4 marks]
- (iii) Give TWO properties of a flip-flop and state ONE use of this device. [3 marks]
- (b) (i) Find the 4-bit signed magnitude representation of -5 . [2 marks]
- (ii) Find the 4-bit one's complement representation of -5 . [1 mark]
- (iii) Find the 4-bit two's complement representation of -5 . [2 marks]
- (c) A certain system represents decimal numbers by storing sign (S), mantissa (M) and exponent (E).

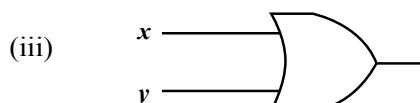
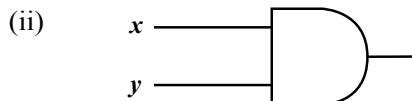
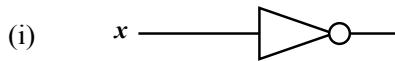
One bit is used for the sign, 3 bits for the exponent and 4 bits for the mantissa.

What decimal number is represented below?

S E M
1 010 0101

[3 marks]

- (d) Draw the truth tables for the following logic gates.



Total 25 marks

2. (a) A student wishes to keep a computer system for 10 years. His teacher said that ‘port connectivity’ could be a problem in a few years.

Explain, with ONE example, the term ‘port connectivity’ . [3 marks]

- (b) Differentiate between the following items as they pertain to computer systems:

(i) ROM and EPROM [2 marks]

(ii) EPROM and EEPROM [2 marks]

- (c) Arrange the following in order of size **from smallest to largest**:

supercomputer, pda, laptop, microcomputer [2 marks]

- (d) (i) Explain what is meant by the ‘instruction set’ of a computer. [2 marks]

(ii) State THREE types of instructions that are typically present in an instruction set and give ONE example of EACH type. [6 marks]

(iii) Briefly explain the term ‘direct addressing’. [2 marks]

- (e) Explain how the ‘fetch’, ‘decode’, ‘execute’ cycle works in a computer. [6 marks]

Total 25 marks

SECTION B

PROBLEM SOLVING WITH COMPUTERS

Answer BOTH questions.

3. (a) A company called DVDR sells used DVD movies and wishes to acquire software to track purchases, customer information and the quantities of movies in stock. The company has contracted the services of a software company called SoftSol which writes software applications.

Briefly describe any THREE stages that SoftSol would generally follow when creating the software for DVDR. **[6 marks]**

- (b) A certain cellular company provides the following rates for voice calls.

First 10 minutes \$1.50 per minute

Any additional minutes \$0.50 per minute

Write an algorithm that reads an integer value representing the number of minutes used for voice calls, calculates and prints the cost of calls. **[6 marks]**

- (c) Construct a flow chart to represent a solution to the following problem.

A set of data exists for students in a class. Each line contains a student ID number followed by the scores in 3 subjects. Data is terminated by the fictitious student ID: 9999.

Sample data

1111 34 56 78
4444 67 98 99
2654 88 89 90
9999

Requirements

- (i) Read the data and for each student, calculate and print the average scored in the 3 subjects.
- (ii) Print the number of students in the class; for example, the message '*There are 3 students in the class*' is printed. **[13 marks]**

Total 25 marks

4. (a) Trace through the execution of the following algorithm and draw the output in your answer booklet exactly as it would be generated by the algorithm. You should carefully note the following:

- *printSym(n)* prints n ‘^’ from the current cursor position
for example, *printSym(5)* would print:
~~~~~
- *write (output-list)* continues output on the current line from the current cursor position
- *writeln (output-list)* continues output on the current line and then terminates output on that line. Subsequent output would therefore begin on a new line

```
begin
    SIZE = 10
    j = 6
    printSym ( j + 1 )
    writeln ( '*' )
    while j > -1
        begin
            printSym ( j )
            write ( '@' )
            printSym ( SIZE - j - 4 )
            writeln ('*')
            j = j - 1
        endwhile
    end
```

**[11 marks]**

- (b) Write an algorithm to find the product of all multiples of 6 between 12 (inclusive) and 600 (exclusive). **[8 marks]**
- (c) Explain THREE properties of well-designed algorithms, using an example in EACH case. **[6 marks]**

**Total 25 marks**

## SECTION C

### PROGRAMMING

**Answer BOTH questions**

5. (a) Explain TWO differences between compilers and interpreters. [6 marks]
- (b) Write a function swap that accepts an integer array and two integers  $pos1$ ,  $pos2$ , representing two locations in the array. The function should swap the contents of the two locations. Assume that  $pos1$  and  $pos2$  are valid. [4 marks]
- (c) Write a C program that reads a text file ‘in.dat’ and obtains two integers. Assume the file contains two integers separated by a space. Next, print out the integers in reverse order, followed by their sum and product.

#### Example

Given: 5 10

The program outputs 10 5 15 50

[7 marks]

- (d) Write a program that prompts the user to enter an integer r and prints  $r!$   
where  
 $0! = 1$   
 $r! = r(r-1)(r-2)\dots1$  for  $r > 0$

For example  $4! = 4(3)(2)(1) = 24$

[8 marks]

**Total 25 marks**

6. (a) Identify and briefly describe any TWO programming paradigms. [4 marks]
- (b) Explain ONE reason why programming languages implementations used on mobile devices are different from those for desktop computers. [2 marks]
- (c) What output would the following C program produce when executed?

```
#include <stdio.h>

int main ()
{ int i, j, final = 1;
  for (j = 6; j > 0; j = j - 2)
    {
      i = j / 2;
      while (i <= j)
        {
          printf("i is %d j is %d\n", i, j);
          j--;
          final = final + i * j;
        } //while
      printf("New i = %d", i);
    } //for
  printf("\nFinal Output: %d\n", final);
  return 0;
} //main
```

[6 marks]

- (d) (i) Write a C declaration for a struct in C that can hold the record of a customer. Each record contains a customer ID (integer) and a customer balance (float). Note that balance represents the amount of money a customer has for making purchases. [3 marks]
- (ii) Declare two variables to represent two customers, Andrew and Jamie. Next, set their record values as follows:

|        | ID   | Balance |
|--------|------|---------|
| Andrew | 1200 | 1000    |
| Jamie  | 1500 | 3000    |

[4 marks]

- (iii) Assume that Andrew pays full price for any purchases made and Jamie gets a 10% discount on all purchases.

Write C code to read two values representing the purchases of Andrew and Jamie respectively, from the keyboard. Next, adjust each customer's balance based on the purchases. [3 marks]

- (iv) Write C code to interchange the records of Andrew and Jamie. [3 marks]

**Total 25 marks**

**END OF TEST**

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MAY/JUNE 2013

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COMPUTER SCIENCE  
FURTHER TOPICS IN COMPUTER SCIENCE

**UNIT 2 – Paper 02**

***2 hours 30 minutes***

**20 MAY 2013 (p.m.)**

This examination paper consists of **THREE** sections: Data Structures, Software Engineering, and Operating Systems and Computer Networks.

Each section consists of 2 questions

The maximum mark for each section is 50.

The maximum mark for this examination is 150.

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02215020/CAPE 2013

## SECTION A

### DATA STRUCTURES

**Answer BOTH questions.**

1. (a) A stack is required to store a set of characters.
- (i) Write code to declare the variables that will be needed by the stack.  
Assume that the stack size is 1000 characters. [ 2 marks]
- (ii) Write the function that pushes a character,  $c$ , onto the stack. You must cater for stack overflow. [ 4 marks]
- (iii) Write the function that pops a character from the stack. You must cater for stack underflow. [ 6 marks]
- (b) (i) Using a labelled diagram, explain what is a ‘linked list’. [ 7 marks]
- (ii) A linked list contains two nodes. With the aid of a diagram in EACH case, explain how a new node can be inserted at the
- a) top of the linked list [ 3 marks]
- b) bottom of the linked list. [ 3 marks]

**Total 25 marks**

2. (a) The following bubbleSort() function implements the bubble sort algorithm on an array of integers.

```
void bubbleSort (int a[ ], int numItems)
{
    int i, j, temp;

    for (i=0; i<numItems-1; i++) {
        for (j=0; j<numItems-i; j++) {
            if (a [j] > a [j+1]) {
                temp = a [j];
                a [j] = a [j+1];
                a [j+1] = temp;
            }
        }
    }
}
```

- (i) Explain the purpose of the outer ‘for’ loop. [ 2 marks]
- (ii) Explain carefully the process that occurs in the inner ‘for’ loop. [ 3 marks]
- (iii) State why the upper limit for j in the inner ‘for’ loop is (numitems – i) and not (numitems). [ 1 mark ]
- (iv) The array  $a$  contains the following five values:

Location 0 1 2 3 4

|       |   |   |   |   |   |
|-------|---|---|---|---|---|
| Value | 5 | 1 | 4 | 8 | 2 |
|-------|---|---|---|---|---|

- a) Show the contents of the array after **each stage** during the FIRST pass of the **bubble sort**. [ 4 marks]
- b) Show the contents of the array at the end of the SECOND and THIRD passes of the **bubble sort**. [ 2 marks]

- (b) The following 7 integers are stored in an array.

Location 0 1 2 3 4 5 6

|       |    |   |    |   |   |    |    |
|-------|----|---|----|---|---|----|----|
| Value | 34 | 5 | 10 | 1 | 9 | 23 | 14 |
|-------|----|---|----|---|---|----|----|

Using the **selection sort** algorithm, show the contents of the array after **each** of the first four passes of the sort. [ 4 marks]

- (c) Describe the principles behind the **binary search** when searching for an item in an array. [ 6 marks]
- (d) The following 16 integers are stored in an array:

|          |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |
|----------|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Location | 0 | 1 | 2 | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | 15 |
| Value    | 1 | 5 | 7 | 15 | 19 | 23 | 24 | 28 | 31 | 36 | 54 | 57 | 67 | 72 | 79 | 80 |

- (i) How many comparisons does a **linear search** make before it determines that the value 50 is not present in the array? [ 1 mark ]
- (ii) How many comparisons does a **binary search** make before it determines that the value 50 is not present in the array? Show your working. [ 2 marks]

**Total 25 marks**

**SECTION B**  
**SOFTWARE ENGINEERING**

**Answer BOTH questions.**

3. (a) (i) Explain what is meant by the term ‘prototyping’. [4 marks]
- (ii) Explain how prototyping can be used during the development of a software product. [4 marks]
- (iii) State TWO weaknesses of the prototyping approach (that is, evolutionary development). [2 marks]
- (b) In a certain hospital, patients are assigned to a single ward where they are treated by one doctor. A ward may have one or more doctors and a doctor can work in one or more wards. There are a number of healthcare assistants who work on each ward and each one may take care of one or more patients in that ward. A patient can also be taken care of by one or more of the healthcare assistants. Each patient has a unique patient ID (primary key). The hospital keeps track of the name of each patient, his/her address, and an emergency contact number. Each patient is administered one or more treatments to deal with his/her specific condition.

Draw an entity-relationship model for the above scenario. Relationships should be named and the cardinality of each relationship should be clearly specified. [9 marks]

- (c) Consider the function `binarySearch()` with the following prototype:

```
int binarySearch (in[] items, int numItems, int key)
```

The function searches for an integer *key* in the *items* array. There are *numItems* items in the array. If *key* is found, *binarySearch()* returns the position where it is found. Otherwise, it returns  $-1$ .

Describe THREE tests that should be part of the test plan to unit test the *binarySearch()* function. [ 6 marks]

**Total 25 marks**

4. (a) State THREE traditional methods of determining requirements of a new software system and identify ONE advantage and ONE disadvantage of each method. [ 9 marks]
- (b) A data flow diagram (DFD) typically contains symbols representing external entities, data stores, and processes.
- (i) State the purpose of EACH of those symbols when it is used in a DFD. [ 3 marks]
  - (ii) For EACH symbol, give a diagram showing how it is used in a DFD. [ 3 marks]
  - (iii) A customer sends an order to the order processing system. The system checks if the items ordered are in the inventory. If the items are available, a shipping notice is sent to the warehouse which dispatches the items to the customer and updates the number of items in the inventory. If the items are **not** available, the order is rejected and returned to the customer.
- Draw a level-0 data flow diagram for the scenario above. [ 6 marks]
- (c) Distintuish between ‘functional requirements’ and ‘non-functional requirements’ and give ONE example of EACH type of requirement. [ 4 marks]

**Total 25 marks**

## SECTION C

### OPERATING SYSTEMS AND COMPUTER NETWORKS

**Answer BOTH questions.**

5. (a) Explain why a peer-to-peer network is generally considered a special case of a client/server network. [ 4 marks]
- (b) Briefly discuss the following THREE issues that should be considered when developing a computer network:
- (i) Network security
  - (ii) Expandability
  - (iii) Interconnectivity [ 6 marks]
- (c) (i) List, in the correct order, the LAST FIVE layers of the open system interconnection (OSI) model for computer communication. [ 5 marks]
- (ii) For any THREE of the layers listed in (c) (i), describe the role EACH plays in data communication. [ 6 marks]
- (d) A company has FOUR desktop computers and ONE server and wishes to network them. The company has a twisted pair cable as well as a switch. Draw a diagram to illustrate how the devices can be connected. **Carefully label all components.** [ 4 marks]

**Total 25 marks**

6. (a) A user is running a game on a computer. Indicate what situation would cause the game process to move from
- (i) ready to running
  - (ii) ready to blocked. [ 4 marks]
- (b) (i) Outline the function of the process control block (PCB) in an operating system. [ 1 mark ]
- (ii) Briefly describe FOUR components of a PCB. [ 8 marks]
- (c) (i) Explain how device drivers function in an operating system. [ 3 marks]
- (ii) State THREE reasons why device drivers may need to be updated. [ 3 marks]
- (d) Batch systems, multi-programming systems, and multi-user systems were significant developments in the history of operating systems. Briefly describe EACH type of operating system. [ 6 marks]

**Total 25 marks**

**END OF TEST**

**IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.**