

CAMEROON GENERAL CERTIFICATE OF EDUCATION BOARD  
General Certificate of Education Examination

JUNE 2013

*Sir Abouba*

ADVANCED LEVEL

Subject Title	Computer Science
Paper No.	Paper 2
Subject Code No.	795

Two Hours

Answer any SIX questions.

All questions carry 17 marks each. For your guidance, the approximate mark for each part of a question is indicated in brackets.

You are reminded of the necessity for good English and orderly presentation in your answers.

In calculations, you are advised to show all the steps in your working, giving your answer at each stage.

Calculators may be used.

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AND  
LIBRARY

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Turn Over

1. (i) (a) Explain the term secondary storage. State why it is required. (3 marks)  
 (b) List THREE types of secondary storage. For each, briefly describe an application that uses it. (6 marks)
- (ii) Explain the term embedded system. Give two examples of devices which might have an embedded system. (4 marks)
- (iii) A microprocessor embedded in a plastic card can be used to read or store information on the card using special terminals.  
 (a) Outline one advantage and one disadvantage of such cards. (2 marks)  
 (b) Outline two conditions that need to be met for such cards to be widely used. (2 marks)
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2. (i) (a) What is a physical network topology? (1 mark)  
 (b) Name and illustrate ANY TWO of the three main types of network topologies. For each topology, give one protocol used and one advantage. (6 marks)  
 (c) State the name of any 3 of the 7 layers defined by the OSI 7-layered network model. Also state the main function of the first layer. (4 marks)  
 (d) Differentiate between routers and gateways. (2 marks)
- (ii) (a) What is the difference between internet and extranet? (2 marks)  
 (b) Explain the meaning of the term netiquette. State ONE important rule that can serve as a guideline for cyberspace behavior. (2 marks)
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3. Given a library, you are asked to design a database such that in this library:
- A customer may borrow a book or more.
  - For every book there is just one author.
  - An author could have written many books.
  - When borrowing a book, the code of the book, the borrower's code, the borrow date, and the return date must be recorded as well as the state of the book.
  - When the borrower returns the book, the same information as on the borrow date is recorded.
- Answer the following questions given that the entities Author, Book and Customer have attributes as shown below.
- Author (Aut-code, Name)  
 Book (B-code, title, edition)  
 Customer (Reg-No, Name, address)
- (i) Give an Entity-Relationship model for the library. Clearly show the relationships between entities. (8 marks)
- (ii) (a) What are the primary keys of Author, Book and Customer? (3 marks)  
 (b) Write, using the same notation as that for the entities given above, the following relations of obvious meanings: BorrowBook, WriteBook and ReturnBook. Underline their primary keys. (3 marks)  
 (c) Select any three relations/entities and say whether or not they are in the 3<sup>rd</sup> Normal Form (3NF). (3 marks)
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4. (i) Suppose that vehicle registration numbers in Cameroon have FOUR letters and FOUR digits. The first two letters represent a region of Cameroon and the last two represent a registration series. The four digits represent a number in a series. However, the 4 digits cannot all be zero. There are ten regions in Cameroon, and a series is any two letters of the English alphabet. For example, in NW1024AZ, 1024 is a number in the AZ series for the North West (NW) region of Cameroon. However, NW0000AZ is not a valid registration number.
- (a) How many cars can be registered within a given region for each series? (2 marks)  
 (b) Calculate the total number of cars that can be registered in a given region. (2 marks)  
 (c) Calculate the total number of cars that can be registered in Cameroon. (2 marks)

- (ii) (a) Find the minimum number of bits needed to represent the number section of a vehicle registration number. (The number section is treated as an integer.) (5 marks)
- (b) Using your answer in (a) and given that a character is represented by 8 bits, find the minimum number of bytes that will be used to represent a complete vehicle registration number. (3 marks)
- (iii) Which would you advise the Ministry of Transport of Cameroon to use: an array OR a linked-list as a data structure for vehicle registration? Justify your choice. (3 marks)

5. (i) Consider the following arithmetic operation, P, written in postfix notation:

P: 12, 7, 3, -, 1, 2, 1, 5, +, \*, +.

- (a) Convert P into its equivalent infix expression. (2 marks)
- (b) Give the result of computing P. (1 mark)

(ii) Let a and b denote positive integers. Suppose a function Q is defined recursively as follows:

$$Q(a,b) = \begin{cases} 0 & \text{if } a < b \\ Q(a-b, b) + 1 & \text{if } b \leq a \end{cases}$$

- (a) Find the value of Q(2, 3) and Q(14,3) showing the intermediate steps to your answer. (6 marks)
- (b) What does this function do? (2 marks)
- (iii) Consider the following stack, where STACK is allocated N = 6 memory cells and the dash ( \_ ) represents an empty cell. Initially the STACK contains data as shown below.

STACK: AAA, DDD, EEE, FFF, GGG, \_\_\_\_\_

Give the content of the stack after each of the following operations takes place, in order:

- (a) PUSH (STACK, KKK).  
 (b) POP (STACK, ITEM).  
 (c) PUSH (STACK, LLL).  
 (d) PUSH (STACK, SSS).  
 (e) POP (STACK, ITEM).  
 (f) PUSH (STACK, TTT).

(6 marks)

6. (i) (a) What do you understand by the term *module integration* in software development? (2 marks)
- (b) What is done before module integration? What is done after? (2 marks)
- (c) Is it easy to track errors during system testing when no other tests, prior to system testing, have taken place? Why or why not? (2 marks)
- (d) A software is developed and is working excellently. Some years later one discovers that the software no longer works as desired, or has defects.
- (1) What errors or problems could have arisen?  
 (2) How would you correct for the errors or problems?  
 (3) What is this corrective phase of software development called?  
 (2 marks + 2 marks + 1 mark)

(ii) The algorithm below calculates the roots ( $x_1$  and  $x_2$ ) of a quadratic equation:

$$ax^2 + bx + c = 0$$

where a, b and c are real numbers. In the algorithm, sqrt(y) is the positive square root ( $+\sqrt{y}$ ) of the value y. The symbol ' $\leftarrow$ ' is the assignment operator and all other mathematical operators have their usual meanings.

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Turn Over

Algorithm Roots.

```

begin
  Read (a);
  Read (b);
  Read (c);
  D ← b * b - 4 * a * c;
  If (D = 0) then
    X1 ← -b/(2 * a);
    X2 ← -b/(2 * a);
  else
    X1 ← (-b + sqrt (D))/(2 * a)
    X2 ← (-b - sqrt (D))/(2 * a)
  endif
end

```

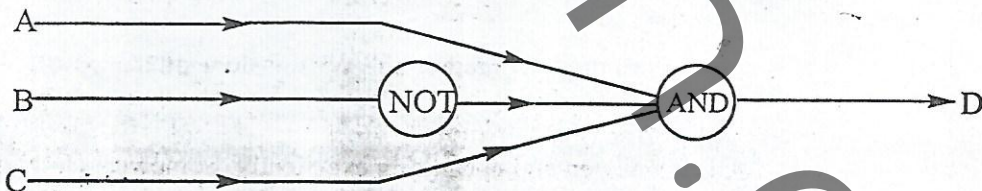
- (a) With respect to good program design and coding practices, state THREE things that are wrong with the algorithm. (3 marks)
- (b) In order to exhibit these problems during testing, what action can you take or what values of a, b and c can you use? (3 marks)

7. (i) Define multi-level and multiple inheritance in the context of object-oriented programming. Use a suitable example to illustrate your definition of multi-level inheritance. (6 marks)

- (ii) (a) Describe what abstraction is and why it is such a powerful and important concept in computer science. (4 marks)
- (b) From your answer in ii(a), briefly state why a procedure name is an abstraction or not. (1 mark)

(iii) What do ANY THREE of the following pieces of software do?  
 (a) Loaders. (b) Linkers (c) Editors. (d) Compilers. (6 marks)

8. (i) (a) Convert  $217_8$  and  $1000.75_{10}$  into binary. (4 marks)
- (b) What is meant by two's complement and why is it important in data representation? Calculate the two's complement of the binary number 000110001. Is 000110001 a positive or a negative number? Why? (4 marks)
- (c) Give the truth table for the following circuit. (3 marks)



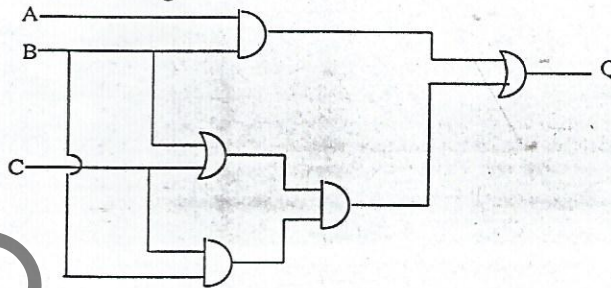
- (ii) Explain briefly the following terms:  
 (a) PROM.  
 (b) EPROM.  
 (c) SRAM.
- (iii) (a) Explain briefly the functions of TWO main components of a CPU (4 marks)
- (b) What is cache memory? (2 marks)

9. (i) (a) State the DeMorgan's laws. Use a truth table with 2 inputs to prove any of the TWO laws. (3 marks)
- (b) Simplify the following boolean expression and draw the resulting logic circuit diagram using only AND and NAND gates. (3 marks)

$$\overline{AB + BC}$$

(3 marks)

- (ii) (a) For the circuit diagram below, determine the output Q. Simplify the resulting boolean expression and then draw its logic circuit. (5 marks)



- (b) Given the simplified logic circuit diagram obtained from ii(a) and the original one, state TWO advantages of the simplified circuit over the original one. (2 marks)

- (iii) (a) Sketch a block diagram of a computer system that is based on the Von Neumann machine architecture and identify all its components. (2 marks)
- (b) How do modern PC Systems implement a Von Neumann machine so that memory can be used more efficiently? (2 marks)

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