

GENERAL CERTIFICATE OF EDUCATION BOARD

General Certificate of Education Examination

Computer Science 2

0795

JUNE 2022

ADVANCED LEVEL

Subject Title	Computer Science
Paper No.	2
Subject Code No.	0795

Two and a Half 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.

1. (i) (a) Describe each of the following CPU characteristics: *clock speed*, *word size*, and *core*. (3 marks)
 (b) Explain how the word size can affect the performance of the CPU. (2 marks)
- (ii) (a) How many 128 by 8 RAM chips are required to provide a memory capacity of 2048 bytes? (2 marks)
 (b) How many lines of address bus must be used to access 2048 bytes of memory? (2 marks)
 (c) How many address lines will be common to each 128 x 8 chip? (2 marks)
- (iii) In the fetch-execute cycle of a machine, a number of registers are used.
 (a) Briefly describe **two** special purpose registers used in the fetch-execute cycle. (2 marks)
 (b) With the use of registers and register contents describe the steps of the fetch phase of the fetch-execute cycle. (4 marks)

2. (i) A logic circuit is designed to have two 2-bit binary numbers AB and CD, with outputs E, L and G.
- L is high when AB is less than CD.
 - G is high when AB is greater than CD.
 - E is high when AB is equal to CD.
- (a) Draw a truth table for the above circuit. (3 marks)
 (b) Determine the Boolean expression for the logic circuit L, G, and E. (3 marks)
 (c) Hence, draw the circuit diagram of L, G, and E. (3 marks)
- (ii) Using an 8-bit 2's complement notation, perform the following computations:
 (a) $-35 + (-11)$ and the $19 - (-4)$. (3 marks)
 (b) Add $(93)_{16}$ and $(DE)_{16}$. (2 marks)
 (c) Using NAND gates **ONLY**, generate the NOT and OR gates. (3 marks)

3. (i) (a) What is the importance of the operating system to a user? (2 marks)
 (b) Why is process management necessary in operating systems? (2 marks)
- (ii) The processes P_1 to P_4 have attributes as shown below.

PROCESSES	BURST TIME/sec	PRIORITY
P_1	10	1
P_2	6	2
P_3	9	4
P_4	17	3

- (iii) Draw a Gantt chart for each of the 4 processes using the following scheduling algorithms:
 (a) Round-Robin with a time quantum of 4 seconds. (2 marks)
 (b) Priority-based scheduling with pre-emption. (2 marks)
 (c) First come first serve (FCFS). (2 marks)
 (d) Calculate the average waiting time of the above scheduling algorithms. (6 marks)
 (e) State which of them is best to implement and why. (1 mark)

4. (i) (a) What is a medium in data communication? (2 marks)
 (b) Explain the difference between bounded and unbounded media. Give an example in each case. (4 marks)
- (ii) Five computers are connected together to form a network such that each computer has a direct link with every other computer in the network.
 (a) Describe the network topology used in this network? (2 marks)
 (b) Given that each link in the network operates in full duplex mode, how many separate links have been used to connect the computers together? (2 marks)
 (c) What is fault tolerance? Why is this type of network said to be the most fault tolerant? (3 marks)
- (iii) Explain the difference between verification and validation. Hence, give an example of how each might apply to a website registration form. (4 marks)

5. (i) A database is to be created to store data about students and the subjects they are studying. Some of the data to be stored in the database is given in the table below.

Student Number	Student Name	DateOf Birth	Subject Code	Subject Name	Lecturer Number	Lecturer Name
N343	K Bakari	02-04-85	765	Maths	T1003	G Dionda
N343	K Bakari	02-04-85	795	Comp. Science	T1001	M Etame
N343	K Bakari	02-04-85	780	Physics	T1002	S Marion
U339	H Jaika	22-07-84	795	Comp. Science	T1001	M Etame
U339	H Jaika	22-07-84	715	Chemistry	T1005	N Agbor

- (a) Define the following terms used to describe the components in a database table using examples from this table.
 (1) Field (2) Record (4 marks)
- (b) Is this table in first normal form (1NF)? Justify your answer. (3 marks)

- (ii) A student tries to improve the database in 5(i) above by splitting the table into the following two relations.

Student(StudentName, DateOfBirth, SubjectCode)

StudentSubject(SubjectCode, SubjectName, LecturerNumber, LecturerName)

- (a) Explain why the use of StudentName as key field is a potential problem. Suggest a suitable replacement. (3 marks)
- (b) Explain why the Student relation is not in third normal form (3NF). (2 marks)
- (c) Convert the design to third normal form (3NF). Show table designs in 3NF with primary keys underlined. (5 marks)

6. (i) An important part of any software development project is testing. Three testing techniques are white box testing, black box testing and dry run testing.
- (a) You are asked to test a given software. You are not given a copy of the program code, only the systems objectives that outline the proposed functionality of the software. Which type of testing can you perform? Justify. (2 marks)
- (b) After writing a program, you use your test plan to check whether your program runs correctly. One test does not give the expected results. What would you do to locate the errors in your program code? (2 marks)

- (ii) Study the algorithm below and answer the questions that follow.

```

Count ← 0
Total ← 0
Input (Number)
While Number >= 0 Do
    Count ← Count + 1
    Total ← Total + Number
    Input (Number)
EndWhile
Average ← Total/Count

```

Count	Total	Number	Average

Trace table

- (a) Dry-run the above algorithm and complete the trace table. Use the values 5, 7, 23 and -1 as input. (4 marks)
- (b) Does the dry run in (ii) (a) above show any error in the algorithm? Explain (2 marks)
- (c) Describe **two** types of test data that can be used to do white-box testing of the above algorithm. (4 marks)
- (d) Explain the difference between a count-controlled loop and a condition-controlled loop, and state which of them has been used in the above algorithm. (3 marks)

7. (i) (a) What is a data structure? (2 marks)
- (b) State **two** main factors that determine the choice of a data structure for a program. (2 marks)
- (c) Explain the difference between a linear data structure and a non-linear data structure, giving an Example in each case. (4 marks)

- (ii) Euclid's algorithm for finding the *greatest common divisor* of two positive integers, m and n , is described by the following properties.

- If $m = 0$, then $\gcd(m, n) = n$
- If $n = 0$, then $\gcd(m, n) = m$
- Otherwise, $\gcd(m, n) = \gcd(n, r)$; where r is the remainder when m is divided by n .

- (a) What name is given to the algorithm design (problem solving) technique used by Euclid's algorithm? What are the first **two** properties called? (2 marks)
- (b) Find the greatest common divisor of 243 and 171 using Euclid's algorithm. Show all the steps in your solution. (3 marks)
- (c) Write in pseudo code, a function named $\gcd$ that takes as parameters two positive integers m and n , computes and returns their greatest common divisor based on the three properties above. (4 marks)

8. (i) (a) Explain why an information system is important to an organization. (2 marks)
- (b) State and describe four components of an information system. (6 marks)
- (c) Describe three alternative ways of collecting information for a given system. (3 marks)

- (ii) All computerised systems implement certain security measures to fight against piracy and unauthorised use.

- (a) Explain the terms piracy and unauthorised use. (2 marks)
- (b) State and explain **two** security measures used to fight against piracy. (4 marks)

GO BACK AND CHECK YOUR WORK