

COMPUTER SCIENCE

HIGHER LEVEL (questions 1-17) - 2 hours 10 minutes

STANDARD LEVEL (questions 1-14) - 1 hour 30 minutes

PAPER 1

MOCK EXAM

INSTRUCTIONS TO CANDIDATES

- Do not turn over this examination paper until instructed to do so.
- **Answer all questions.**

Answer all questions. Write all answers on the lined paper provided.

1. Outline how **backups** can prevent data **loss**. [2 marks]

2. Explain how data is exchanged between **RAM**, the **CPU**, and **cache memory**. [2 marks]

3. Outline what happens in RAM when the **Operating System** starts an **application**. [2 marks]

4. (a) Convert the **decimal** number **56** to **binary**. [1 mark]
(b) Convert the **binary** number **01011100** to **hexadecimal** (base 16). [1 mark]

5. Outline **two** essential functions of a **compiler**. [2 marks]

6. Outline a **software** solution that can reduce the amount of time required to transmit data in a **Wide Area Network**. [2 marks]

7. Explain what a **truncation error** is, including an **example** of when it might occur. [2 marks]

8. Outline **one** advantage of creating a prototype before **designing** a computer system. [2 mark]

9. An **external hard-disk** is considerably slower than an **internal hard-disk**. [2 marks]
Explain **two reasons** that an external hard-disk is better than an internal hard-disk for making backup copies, despite the slower speed.

#10

The GOOD STUFF company has a web-site, where **anybody** can place orders for products.

To place an order, the customer must:

- choose a product
- enter customer name
- enter customer's address
- enter a credit card number

The order is then **printed on paper** and sent to a warehouse, where the products are packaged and delivered. Orders are shipped without any **verification**.

- (a) Outline how **data validation** might be used during the **ordering** process. *[1 mark]*
- (b) Explain the difference between **data validation** and **data verification**. *[2 marks]*
- (c) Outline how the **web-server** can **securely store** the user's private data, preventing GOOD STUFF employees from stealing and misusing bank information. *[2 marks]*

The web-site must maintain a list of all the items they sell, with prices, as well as all the customer data (name, address, credit card). The web-server must also communicate with the customers and print a paper order that is sent to the GOOD STUFF warehouse.

- (d) Draw a diagram showing how data moves between the following modules: *[5 marks]*

Customer's PC
Web server
Product and Prices Database
Printing paper order

#11

- (a) Outline how a Bubble Sort algorithm functions. [2 marks]
- (b) Assume that a Bubble Sort algorithm requires 10 seconds to sort an array containing 1 million numbers. State approximately how long the same algorithm would require to sort 4 million numbers. [2 marks]
- (c) Using pseudocode, construct an algorithm that finds the LARGEST value in an array that contains 1 million numbers. Assume that the numbers are already stored in an array named DATA. Do NOT assume that the numbers are sorted – they are in a random order. [4 marks]
- (d) Assume that your algorithm in part (c) requires 2 seconds to find the largest value in an array of 1 million numbers. State how long the same algorithm would require to find the largest number in an array containing 4 million numbers. [2 marks]
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-
-
-
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#12

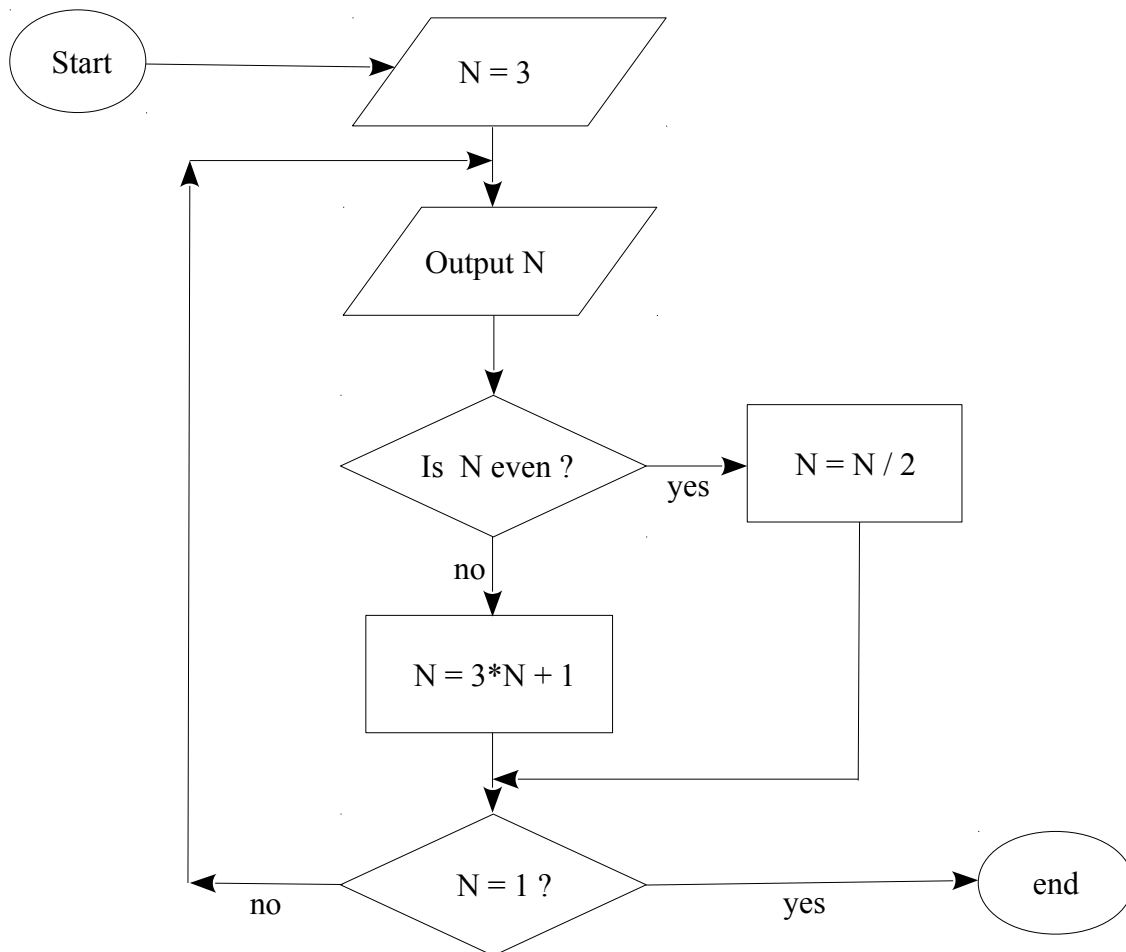
A college occupies a building on three levels. A computer network, **using wires**, is in place but needs to be extended. It is suggested that the current system be replaced by a wireless network which provides connection to a file server and a separate gateway out to the Internet.

- (a) State 3 groups of **stakeholders** who should be involved in the problem **investigation and analysis**. [3 marks]
- (b) Outline one method for obtaining needs and requests from a large group of stakeholders (say 1000 people). [1 mark]
- (c) Assuming that the network software will NOT include a GUI interface, describe two **usability issues** that should be considered carefully during the design phase. [4 marks]
- (d) Describe **one ethical problem** that might result from a lack of clear and thorough **user documentation**. [2 marks]

#13

The flowchart below represents an algorithm that displays a sequence of numbers.

The word “even” means that a number is evenly divisible by 2, for example 4 , 6, 8, 10.



(a) Read the algorithm and state the sequence of numbers that it produces. [4 marks]

(b) Draw a flowchart for an algorithm that ADDS UP the following numbers and outputs the total.
 $2 + 4 + 8 + 16 + 32 + 64 + \dots + 65536$ [6 marks]

#14

An airport uses a computer system to **check in** passengers for flights. An airline employee **scans** each passenger's **passport** to identify the passenger. Then a **central computer** searches for a corresponding **reservation**. Finally, the clerk can select a seat for the passenger and record this in the **database**. Then a **paper boarding card** is printed and given to the passenger, who walks to the boarding gate.

When passengers **board the plane**, a stewardess **scans** each passenger's passport again, as well as scanning the **boarding card**. The passport and boarding card are checked against the central database, to make sure that the passenger is boarding the correct plane.

- (a) Explain the role of **optical character recognition** in this system. *[2 marks]*
- (b) Explain why **automatic facial recognition** is not needed in this system. *[2 marks]*
- (c) Describe the need for a **network** in this system. *[2 marks]*
- (d) Discuss **one advantage** and **one disadvantage** of using a **wired network** as opposed to using a **wireless network** for this system. *[4 marks]*
- (e) Describe one advantage of using **RFID** chips in the boarding cards rather than just using simple paper cards. *[2 marks]*

#15

There are many possible ways to store a **list** of data in a computer.

One possibility is to use an **array**. Another possibility is to use a **collection**.

An array is a **static** data structure, whereas a **collection** is a **dynamic** data structure.

(a) Explain the major difference between **static** and **dynamic** data structures.

[2 marks]

A **stack** is a list with specific access methods:

- **push(DATA)** is used to put a value into a stack

- **pop()** is used to remove an item from a stack

Study the following algorithm.

```
// Assume INFO is a stack that is empty
// Assume NAMES is an array containing 5 names
NAMES = ["Al", "Betty", "Carl", "Deb", "Ed"]
loop C from 0 to 4
    DATA = NAMES[C]
    INFO.push( DATA )
end loop
loop while not INFO.isEmpty()
    DATA = INFO.pop()
    output DATA
end loop
```

(b) State what will be displayed by the algorithm above -
be sure to write your solution in the correct order.

[3 marks]

(c) Explain the essential difference between a **stack** and a **queue**.

[2 marks]

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It is possible to use **parallel arrays** to store various types of data, for example the NAME and AGE and PHONE of a list of students.

(d) Explain how the same data could be stored in a COLLECTION of OBJECTS.

[3 marks]

**#16**

A candy company is designing a new **automated vending machine**, where customers can buy candy. These machines will be available in airports, shopping malls, on street corners, etc.

The goal is to make the machines work without using cash. They intend to create a system so that customers can pay by using their mobile phone. They will place a call to a phone number printed on the front of the machine and place their order. Then the candy will slide out of a slot in the machine. The candy company will collect money from the customer's telephone account.

The vending machines should be further automated. By using facial recognition technology, the vending machine will display advertisements chosen according to gender and age. For example, the machine might advertise chewing gum for girls, chocolate for boys, mints for men, etc.

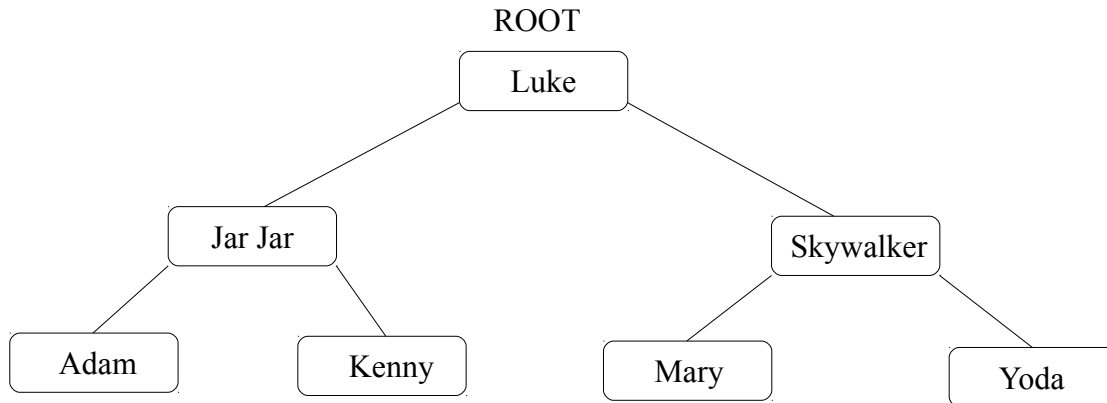
The advertising choices will be based on the items that have actually been purchased by customers in the past. A large database will collect data on all the transactions over a long period of time, and analyze popularity according to age and gender. For this to be useful, the vending machines must have a permanent connection to the central database.

- (a) Describe a type of **sensor** that could be used to activate the advertising screen whenever a pedestrian comes close to the machine. [2 marks]
- (b) The **processing** for the facial recognition could be performed directly inside the vending machine, or it could be performed by a central computer. Describe **one advantage** and **one disadvantage** of using a central computer for doing the facial recognition processing. [3 marks]
- (c) Assuming that the facial recognition is performed by a central computer, outline **three other needs** for **three different microprocessors** in the vending machine. [3 marks]
- (d) The vending machine might require a **secondary storage device**.  
Explain how the vending machine could display graphical advertisements if it does NOT contain a secondary storage device. [2 marks]



#17

Below is a **balanced binary search tree** .



- (a) State what would be printed by a **PRE-ORDER traversal** of this tree. *[2 marks]*
- (b) Explain where a new node containing "Louise" would be added to this tree. *[1 mark]*
- (c) Explain why **deleting** a node from a binary-search tree could be significantly more complex than adding a new node. *[2 marks]*
- (d) Draw a binary tree which correctly represents this formula:  

$$(a + b) / (c - d * e)$$
*[3 marks]*
- (e) Look at your answer to (d). State what would be printed by a **POST-ORDER traversal** of the formula tree. *[2 marks]*