AQA

AS
COMPUTER SCIENCE

Paper 1

June 2024

Preliminary Material

To be opened and issued to candidates on or after **1 March 2024** subject to the instructions given in the **Teachers' Notes** (7516/1/TN).

Note

- The **Preliminary Material**, **Skeleton Program** and **Data File** are to be seen by candidates and their teachers **only**, for use during preparation for the examination on **Tuesday 14 May 2024**. They **cannot** be used by anyone else for any other purpose, other than that stated in the instructions issued, until after the examination date has passed. They must **not** be provided to third parties.

Information

- A Skeleton Program is provided separately by your teacher and must be read in conjunction with this Preliminary Material.
- You are advised to familiarise yourself with the Preliminary Material and Skeleton Program before the examination.
- A copy of this Preliminary Material and the Skeleton Program will be made available to you in hard copy and electronically at the start of the examination.
- You must **not** take any copy of the Preliminary Material, Skeleton Program and Data Files or any other material into the examination room.

INSTRUCTIONS FOR CANDIDATES

The question paper is divided into **three** sections.

Section A

You will be asked to create a new program and answer questions **not** related to the **Preliminary Material** or **Skeleton Program**.

Section B

Questions will refer to the **Preliminary Material** and the **Skeleton Program**, but will not require programming.

Section C

Questions will use the **Preliminary Material** and the **Skeleton Program** and may require the `SimulationData.txt` **Data File**.

Electronic Answer Document

Answers for **all** questions, for **all** sections, must be entered into the word-processed document made available to you at the start of the examination and referred to in the question paper rubrics as the **Electronic Answer Document**.

Preparation for the Examination

You should ensure that you are familiar with this **Preliminary Material** and the **Skeleton Program** for your programming language.

Queue Simulator

The **Skeleton Program** accompanying this **Preliminary Material** simulates a queue in a shop.

When the simulation runs, buyers arrive at the tills at irregular intervals with a varying number of items in their baskets. There is one queue which is shared by all the tills. The buyer arriving joins the queue and whenever a till becomes free the buyer at the front of the queue leaves the queue and gets served at that till.

The **Skeleton Program** allows the user to choose how long to run the simulation for and how many tills to have in operation.

At the end of each time unit the program outputs the state of the tills and queue.

Running the simulation using the default settings, **Figure 1** shows the output at the end of time unit 0 when the first buyer arrived with 8 items in their basket and, as there were free tills, buyer B1 was served straightaway at till 1 and did not need to queue.

Till 1 has its `Time busy` increased by 1. Till 2 is not serving, so this till's `Time idle` is increased to 1.

The time it takes to serve a buyer's basket is calculated from the number of items in the basket.

Figure 1

```
Settings set for this simulation:
=================================
Simulation time: 10
Tills operating: 2
=================================

Do you wish to change the settings?  Y/N: N

Time Buyer  | Start Till Time  | Till Time Time Time |      Queue
     enters | serve      to    | num- idle busy ser- | Buyer Wait Items
     (items)| buyer      serve | ber            ving | ID    time in
            |                  |                    |            basket
  0  B1(8)
               B1     1     3
                                 1    0    1     2
                                 2    1    0     0
                                                ** Start of queue **
                                                *** End of queue ***
--------------------------------------------------------------------------
```

- `Time idle` is the cumulative time units the till **has not** been serving.
- `Time busy` is the cumulative time units the till **has** been serving.
- `Time serving` is the number of time units remaining to serve the current buyer.
- `Queue wait time` is the number of time units the buyer has been in the queue.

Figure 2

```
------------------------------------------------------------------------
  5  B5(2)
                                    1     0     6     4
                                    2     2     4     3
                                                 ** Start of queue **
                                                    B5      1     2
                                                 *** End of queue ***
------------------------------------------------------------------------
```

Figure 2 shows the output at the end of time unit 5. Buyer B5 arrived, but till 1 is still busy with buyer B3 and till 2 is busy with buyer B4. So buyer B5 joined the queue and at the end of this time unit has waited one time unit with 2 items in their basket.

Figure 3 shows the statistics at the end of the simulation.

Figure 3

```
The simulation statistics are:
==============================
The maximum queue length was: 3 buyers
The maximum waiting time was: 4 time units
8 buyers arrived during 10 time units
The average waiting time was: 1.8 time units
The average queue length was: 1.75 buyers
4 buyers did not need to queue
```

The average queue length is calculated taking into account only the time units when there is a queue of 1 or more buyers.

The simulation program makes use of the data file `SimulationData.txt` which contains rows of data of the format `d:n` where

- `d` is the number of time units to elapse before the next buyer arrives with a basket of items
- `n` is the number of items in the basket.

For example, the first row of the data file contains 1:8
This means at the first time unit the first buyer arrives with 8 items in their basket.

The second row of the data file contains 1:5
This means one time unit later the second buyer arrives with 5 items in their basket.

END OF PRELIMINARY MATERIAL