



MINISTRY OF EDUCATION, SINGAPORE
in collaboration with
UNIVERSITY OF CAMBRIDGE LOCAL EXAMINATIONS SYNDICATE
General Certificate of Education Advanced Level
Higher 2



COMPUTING

Paper 2

9597/02

October/November 2019

3 hours

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

An answer booklet will be provided with this question paper. You should follow the instructions on the front cover of the answer booklet. If you need additional answer paper ask the invigilator for a continuation booklet.

Answer **all** questions.

The number of marks is given in brackets [] at the end of each question or part question.

This document consists of **8** printed pages.



Singapore Examinations and Assessment Board



CAMBRIDGE
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Answer **all** questions.

- 1 Pharmacists working in a group of pharmacies, dispense medicine to patients who present to them a prescription written by a doctor. A new system is to be built to allow a doctor to send prescription data electronically to a pharmacy of the patient's choice. Patients will either collect the medicine, or have the pharmacy deliver it to them.

A project proposal is written and sent to doctors and pharmacy staff, inviting each to respond within a given time.

(a) Give a reason why the project proposal is sent to:

(i) Doctors [1]

(ii) Pharmacy staff [1]

The responses from the doctors and pharmacy staff are reviewed. Invitations are sent to doctors to find out whether they are willing to take part in a pilot scheme. The project proposal is sent to prospective software developers. Some of the activities involved in the project are listed in the following table.

Label	Activity	Duration (weeks)
A	Send project proposal to doctors	4
B	Send project proposal to pharmacy staff	2
C	Discuss all the responses from A and B, and revise the proposal if required	2
D	Send project proposal to prospective software developers	3
E	Invite doctors to be part of a pilot scheme	2
F	Request quotations of cost and development time from software developers	3
G	Select a software developer	1

(b) (i) Draw a Gantt chart for the activities labelled **A** to **G**. [6]

(ii) State the estimated time taken to complete activities **A** to **G**. [1]

In activities **A** and **B**, doctors and pharmacy staff identified ethical and security issues that would need to be addressed.

(c) (i) Describe **one** security issue. [2]

(ii) Describe **one** ethical issue. [2]

In activity **F**, quotations are received from software developers. The lowest cost is from a developer who works alone, but demonstrates a number of successful projects. Other software developers that employ many staff submit more expensive quotations.

(d) Explain why the group of pharmacies may decide against the single developer. [2]



An analyst from the chosen software developer reviews the current system.

- (e) Give **four** methods available to the analyst to find out how a system operates. [4]

The analyst proposes that the doctors and pharmacy staff interact with a web-based system.

- (f) State the software that will be needed on the devices used by the doctors and pharmacy staff, other than the operating system. [1]

The alternative to a web-based system would be to write and install purpose-built application software for each computer used by a doctor or member of the pharmacy staff.

- (g) Describe **two** advantages to the software developer of a web-based solution over purpose-built software running on each user's computer. [4]

Doctors may wish to write prescriptions when they visit patients in their own home.

- (h) Explain **one** benefit of a web-based solution in this situation. [2]

The computers used by the doctors and pharmacy staff are clients of the server operated by the pharmacy. Some validation is provided by client-side scripting.

- (i) Give **two** advantages of using this type of scripting. [2]

The new system is designed, coded and tested as a number of modules. A tester performing black-box testing on a module would need its specification.

- (j) Explain why the tester would not need access to the source code. [2]

- (k) Explain why someone designing a test strategy for white box testing would need access to the source code. [2]

- (l) Alpha testing is performed on the system.

Explain the purpose of alpha testing. [2]

- (m) The group of pharmacies is responsible for the security and integrity of the stored data.

- (i) Give **two** methods that could be used to ensure security of the stored data. [2]

- (ii) Give **two** methods that could be used to ensure the integrity of the stored data. [2]

- (n) The group considers using either the cloud or its own server to store data needed by the proposed system.

Give **one** advantage and **one** disadvantage of storing the data in the cloud. [2]



- 2 A bakery bakes bread and cakes to sell in its own shop and to other shops throughout a city. Its drivers visit every shop each day, delivering that day's order and collecting the order for the next day.

Order forms are pre-printed with the name of each shop and every item that the bakery bakes.

The manager of each shop writes onto the form the quantity of each item required.

When the drivers return to the bakery, the data from the order forms are collated to give the bakers the total of each item to bake.

Copies of the order forms are made and used as delivery notes for the next day's deliveries.

The accounts department use the original order forms to prepare a weekly invoice for each shop.

The bakery wants the shops to submit their orders online.

A program is needed to determine the number of each item needed and produce the weekly invoice for each shop.

The new program will use a relational database with three tables: Product, Shop and Order.

Each product has a description, price, and a unique product ID number.

Each shop has a name, an address, telephone number, manager's name, and a unique shop ID number.

Each order has a product ID, a quantity, a shop ID and a date for delivery.

- (a) Draw an Entity-Relationship (E-R) diagram showing the three tables and the relationships between them. [5]

- (b) A table description can be expressed as:

TableName (Attribute1, Attribute2, Attribute3, ...)

The primary key is indicated by underlining one or more attributes.

Write table descriptions for the three tables. [4]

The bakery can change the price of an item at any time. Validation ensures that the new price is within specified limits and is more likely to be correct.

- (c) (i) Explain why this could still result in incorrect weekly invoices, assuming that the new price input is correct. [2]
- (ii) Describe changes to the database **and** draw a modified E-R diagram to ensure correct invoices are created. [4]



- 3 A programmer is asked to write a program to store names in alphabetical order.

The program needs to:

- add and remove names
- search for the presence of a specific name
- output all the names in alphabetical order.

The programmer considers two options: an array and a linked list.

- (a) (i) Explain why an array allows for more efficient searching. [2]
- (ii) State why this advantage becomes more significant as the number of names becomes much larger. [1]
- (b) (i) Give **one** disadvantage of using an **array** to store the names in alphabetical order. [2]
- (ii) Give **one** advantage of using a **linked list** to store the names in alphabetical order. [2]

A third option is to store the names in a binary tree.

- (c) Explain how a binary tree provides some of the advantages of both an array and a linked list when storing sorted data. [2]
- (d) State why a binary tree may need to be re-created with exactly the same data items. [1]



- 4 A company operates a multi-storey car park. All parking bays are identified by a letter, indicating the floor, and a number indicating the position of the bay on that floor (for example, C34 indicates bay 34 on floor C).

The entrance to the car park is controlled by a barrier. Before the barrier lifts to allow a car to enter, the driver must press a button to indicate if they need a standard bay or a special bay.

Special bay users must present a card to a card reader at the barrier.

The car park has an additional third type of bay that has a charging point for electric vehicles. The hourly rate for these bays is not the same as standard bays. The cost of using this type of bay additionally depends on the cost of the electricity used. This is monitored by the charging device and stored.

A camera captures the vehicle registration number. A ticket is printed showing:

- current time
- vehicle registration number
- floor letter
- position number of a suitable bay where the car must be parked
- the card number for the special bay, if a card had been presented at the barrier.

When the driver takes the ticket from the printer, the entrance barrier lifts.

Before a car is allowed to leave, the ticket must be presented and a charge paid. The charge is determined by the length of stay and type of bay. The hourly rate for a standard bay is not the same as that for a special bay. As a car approaches the exit barrier a camera captures the vehicle registration. The barrier only lifts if the charge for this vehicle has been paid.

This system is to be implemented using object-oriented programming (OOP).

The base class PARKING_BAY has a property to store whether or not a bay is occupied.

(a) Draw a class diagram, showing:

- any derived classes and inheritance from the base class
 - the properties needed in the base, and any derived classes
 - suitable methods to support the system with at least one getter and one setter method.
- [8]

(b) Add a class, CAR_PARK, that has properties to store:

- a list of all bays
 - the number of unoccupied bays.
- [3]

(c) Explain why polymorphism is useful in object-oriented programming. [2]

(d) Explain the purpose of making the attributes of an object private. [2]



- 5 The function `Z` takes three integer parameters, `low`, `high`, `seek` and returns an integer value. It operates on the values in the elements of the array `A`.

```

01 FUNCTION Z(low, high, seek, A) RETURNS INTEGER
02     IF low > high THEN
03         RETURN -1
04     ENDIF
05     mid ← low + INT((high - low)/2)
06     IF seek = A[mid] THEN
07         RETURN mid
08     ELSE
09         IF seek < A[mid] THEN
10             RETURN Z(low, mid - 1, seek, A)
11         ELSE
12             RETURN Z(mid + 1, high, seek, A)
13         ENDIF
14     ENDIF
15 ENDFUNCTION

```

- (a) (i) State what lines 10 and 12 tell you about the function. [1]

- (ii) State the purpose for the `RETURN` statements in lines 03 and 07 of function `Z`. [1]

The values in each of the eight elements of the array `A` are:

Element	0	1	2	3	4	5	6	7
Value	-3	8	14	15	96	101	412	500

- (b) Copy and then complete the trace table for the instruction:

OUTPUT `Z(0, 7, 103, A)`

Function call	low	high	seek	mid	A[mid]	OUTPUT
1	0	7	103			

[4]

- (c) Function `Z` can return **two** different types of value.

Explain what these represent.

[2]

- (d) The number of elements in array `A` may be very large.

Explain why a programmer might prefer to use an iterative approach rather than the one used in function `Z`.

[2]



6 Data communication networks can use circuit switching or packet switching.

(a) (i) Give **two** advantages of packet switching over circuit switching. [2]

(ii) Give **one** advantage of circuit switching over packet switching. [1]

(b) (i) State **one** reason for using either a parity check or a checksum. [1]

(ii) Give **one** example of an error that a parity check cannot detect. [1]

(c) Switches and routers are common devices used in networking.

Explain the most significant differences between a switch and a router. [2]

(d) Explain the purpose of a bridge in a network. [1]

(e) A local area network (LAN) can be set up as either client-server or peer-to-peer.

Give **two** advantages in storing shared data on a client-server network rather than on a peer-to-peer network. [2]

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