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

COMPUTING 9597/02

Paper 2

October/November 2016

3 hours

Additional Materials: Answer Paper

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams, graphs, tables or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

At the end of the examination, fasten your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Singapore Examinations and Assessment Board

CAMBRIDGE
International Examinations

[Turn over

Answer **all** questions.

1   Many elderly people spend later life in a nursing home. The Ministry of Health (MOH) requires each nursing home to keep detailed care records for each resident. Care staff make daily entries in the care records about all aspects of resident care. These care records are currently paper-based documents. There is no common format for the documents that different nursing homes use.

Care staff do not have computer access to medical records that each resident's doctor holds. Nurses at a nursing home need to keep their own medical records and to consult with residents' doctors.

The MOH is planning an initiative to computerise all care records and would like all nursing homes to use a common design for care records.

The MOH will send a project proposal which is to be circulated to all nursing homes. This is to find out which homes would consider taking part in a pilot project. The MOH's aim is to introduce a pilot system into a single nursing home.

The MOH needs to find a software house to design and implement the computerised care record system. It will send the project proposal to software houses.

At a later date, all nursing homes will use the new computer system.

(a)   (i)   State **four** topics you would expect to find in this project proposal.   [4]

   (ii)   Describe the purpose of this project proposal.   [2]

   Following production of the project proposal, the initial activities with their expected times are as follows:

Label	Activity	Time (weeks)
A	Send the project proposal document to all nursing homes.	5
B	Circulate the project proposal document to a number of software houses.	6
C	Review the feedback. Note which nursing homes and software houses have expressed interest.	2
D	Identify doctors who look after residents in homes that have expressed interest. Hold a presentation meeting to explain the proposed project to these doctors.	5
E	Presentation event for the chosen nursing home.	2

The Program Evaluation and Review Technique (PERT) chart for these initial activities is shown below.
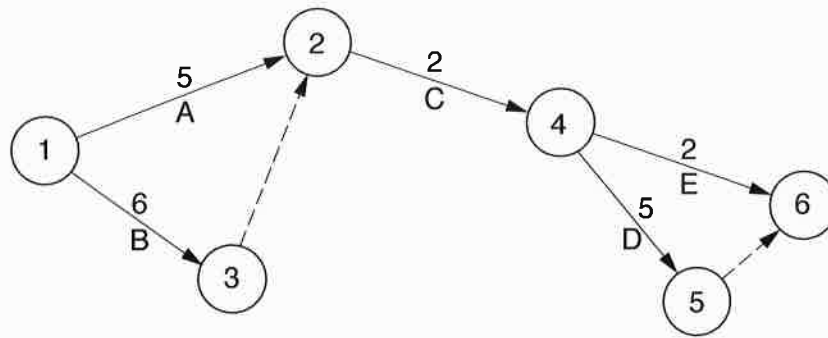
(b) (i) State the critical path for the initial activities. [1]

(ii) Calculate the minimum time these initial activities will take. [1]

(c) In activity E, the MOH presented more details about the project to the manager and care staff of the chosen nursing home. The manager and care staff raised a number of points about both social and ethical issues associated with the project.

Describe **three** points that could have been raised. [6]

Following activity E, the MOH decided the software house to which it would award the contract.

Following the initial project proposal, activities which make up the system development cycle are shown below:

Label	Activity	Time (weeks)
F	Analysis	12
G	Design	15
H	Data entry of current care record data	4
I	Initial testing	10
J	Program development	14
K	Install new hardware in nursing home	3
L	Alpha testing	2
M	Beta testing	1
N	Implementation	3
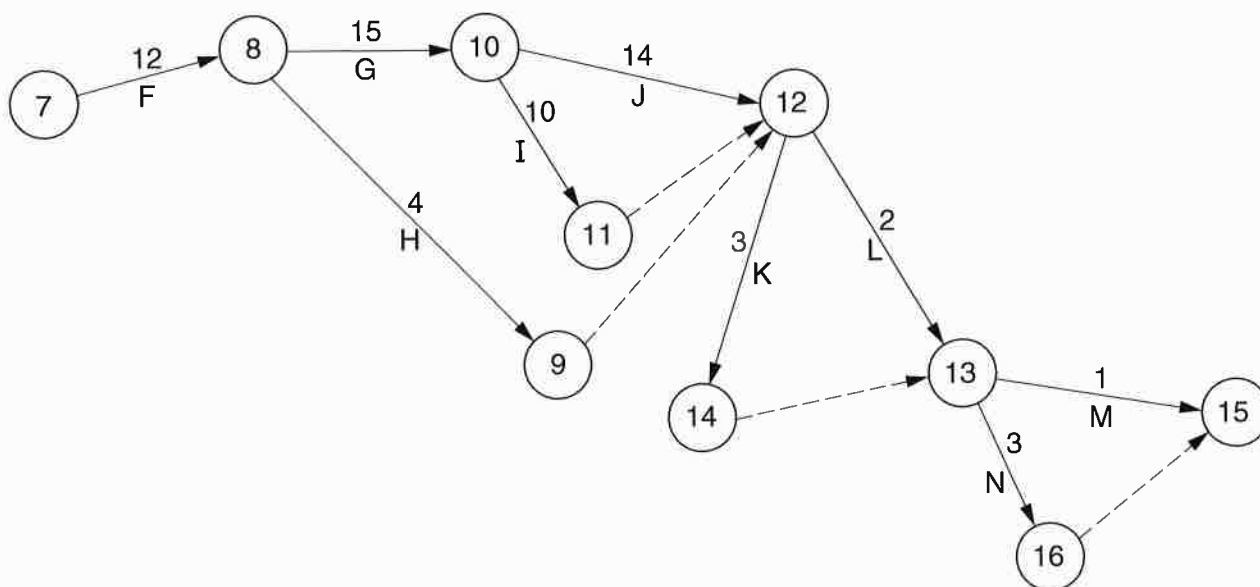
(d) The system development cycle starts at node (time point) 7.

(i) The PERT chart shows four activities with dashed lines. Explain the significance of the dashed lines. [1]

(ii) Explain the meanings of a dependent stage and concurrent stages in a PERT chart. Give an example of each for this project. [4]

(iii) The table describes activity I as 'Initial testing'. One category of initial testing is white-box testing.
Name and describe **two** other categories of initial testing. [4]

(iv) The PERT chart indicates that some testing can commence almost as soon as program development does. Describe the type of program development that would allow for this. [2]

(e) An analyst from the software house carried out the analysis for the project.

Describe **three** examples of people whom the analyst consulted. For each example, state:

- the fact finding technique used
- the nature of the information that the analyst obtained.

Each fact finding technique should be different. [6]

(f) When the analysis stage was completed, the following decisions were taken:

- Each nursing home will store and manage its own care records data.
- Each nursing home will be provided with a local area network (LAN).
- The care record system on each LAN will use a client-server model with a web interface for client computers.

  (i) Explain the meaning of the term client-server model. [3]

  (ii) State the **two** items of software that the LAN will use to implement this client-server design. [2]

During the presentation event to doctors (part of activity D), the doctors gave feedback. They said that they would like to have access to the new computerised care records from their own offices.

(g) A second phase of the project is to allow each nursing home access to the medical data stored by doctors. This will involve connecting the LAN for each nursing home to a number of doctors' surgery LANs.

  (i) State **two** methods for ensuring the security of access to the care record network application. [2]

  (ii) Give **two** methods for protecting the security of the LAN. [2]

2   A firm hires vehicles to customers. A customer usually makes a booking a number of weeks before the start of the hire period. The customer pays a deposit at the time of the booking and the balance when they return the vehicle from hire.

At the time of the booking, the firm records the following data:

- customer data, including a customer reference code
- booking date
- hire start date
- hire return date
- type of vehicle
- deposit taken

Vehicle types are coded as follows:

- Small car – SC
- Large car – LC
- Utility vehicle – UV

Each vehicle type has its own daily charge, for each day of the hire period.

Each vehicle has a unique registration.

Customers may make more than one booking. The software will not allow a customer to make more than one booking for the same start date.

The document below is an example of an invoice printed for the customer when they return the vehicle and pay the balance due.

INVOICE

Yi Ling Tan
12 The Street
The District
753352

Customer Reference: TAN60876

Booking Date: 13/06/2016
Vehicle registration: 5BFE3571H
Vehicle type: UV

Start date	Return date	Days charged	Vehicle rate	
21/07/2016	28/07/2016	8	$ 85.50	$ 684.00
			Deposit Paid:	$ 100.00
			Amount Due:	$ 584.00

(a) The firm wants to model this application using a relational database.

    (i) A database needs a number of tables to store the data for this application.

        Draw the Entity-Relationship (E-R) diagram showing the tables and the relationships between them. [6]

    (ii) 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 tables you identified in **part (i)**. [6]

(b) The firm implements the relational database using a Database Management System (DBMS). It writes programs to access the data using a Graphical User Interface (GUI).

One program is for recording a new booking.

The firm uses different types of components in a GUI for the display and entry of data.

Name **three** types of component that the booking form could use and give the types of data it is used to capture. [3]

3 The recursive procedure X has two parameters, `Value` and `Index`. The procedure processes the contents of an array, `T`.

```
01  PROCEDURE X(Value, Index)
02    IF T[Index] > 0
03      THEN
04        IF T[Index] > Value
05          THEN
06            X(Value, Index * 2)
07        ENDIF
08        IF T[Index] < Value
09          THEN
10            X(Value, Index * 2 + 1)
11        ENDIF
12        IF T[Index] = Value
13          THEN
14            OUTPUT "True"
15        ENDIF
16    ENDIF
17  ENDPROCEDURE
```

(a) (i) State what is meant by a recursive procedure. [1]

(ii) Give the **two** line numbers which indicate that procedure X is recursive. [1]

(b) An array `T` is used to store the data for a binary tree. A program places items in the array in the order in which they joined the tree structure.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
T	17	11	19	9	12	18	23	0	4	0	0	0	0	0	0

(i) Draw the binary tree for the array `T` dataset. [3]

(ii) Copy and then complete the trace table for the procedure call X(18, 1).

Procedure call	Value	Index	Output
1	18	1	

[3]

(iii) Describe the purpose of procedure X. [2]

4 Data is to be transmitted in packets between two computers.

Each packet message can consist of:

- upper case letters
- the <Space> character.

Each packet has a start character (#) and an end character (#).

A typical packet would be:

```
#ETA FROM SRE#
```

(a) Describe **two** checks that the receiving computer should make for the integrity of:

- the individual bytes which make up a packet
- the collection of bytes which makes up the packet. [4]

(b) Describe **three** validation checks that the receiving computer should perform on the packet.

[6]

5 A programmer implements a linked list of surnames with a start pointer, StartPtr and two one-dimensional arrays:

- Array Data stores the surnames.
- Array Ptr stores the link pointers.
- Both arrays have lower bound 1 and upper bound 3000.

The purpose of procedure InsertListItem is to insert a new surname to the linked list.

Assume a function NextFree() is available and returns:

- the index position for the array Data at which the new surname is to be inserted
- −1 when the Data array is full.

The programmer designs the algorithm as follows:

```
01   PROCEDURE InsertListItem(NewSurname : STRING)
02     IF NextFree() = -1
03       THEN
04         OUTPUT "List is full"
05       ELSE
06         // input the surname
07         IF StartPtr = 0
08           THEN
09             StartPtr ← NextFree()
10             Data[StartPtr] ← NewSurname
11           ELSE
12             // traverse the linked list to find the position
13             // at which to insert NewSurname



         ENDIF
       ENDIF
     ENDPROCEDURE
```

(a) Describe the state of the linked list, if the condition StartPtr = 0 in line 07 is True. [1]

(b) It is now necessary to complete the design for procedure InsertListItem.

   (i) The pseudocode already uses some variables.

   Copy the table below and complete it to show any extra variables that you will need to use.

Variable	Data Type	Description

[3]

   (ii) Write the pseudocode for line 14 onwards to complete the procedure. [6]

6 A real-estate management company owns a number of residential and business units. When the company first acquires a unit, it often requires renovation work. The company records the renovation cost.

A residential unit will be a house or an individual flat within a building. A business unit will be either an office building, a storage unit or a factory.

A residential unit is either advertised for sale, with the company looking to make a profit, or retained for rental. If the unit is sold, the sale price is recorded. If the unit is retained, the monthly rental charged, the start date and length of the rental (in months) are recorded.

A business unit has a long term lease, which is usually 10 years or longer. The company records the nature of the business. It does not offer any of its business units for sale.

Other data recorded for a unit include: purchase price, purchase date, number of rooms, floor space, whether or not a lift is present. The company records whether the house has a garage and whether it has a garden.

A programmer will develop an application, using object-oriented programming to store and process the company's data.

(a) Draw a class diagram, with base class UNIT, showing:

- appropriate sub-class(es)
- inheritance
- the properties required
- appropriate methods, including **one** pair of 'get' and 'set' methods for **one** of the properties. [8]

(b) The company has recently purchased a number of units that they want to renovate as a 'block of flats' (a number of self-contained flats in the same building). Once the renovation is complete, the company may offer a block of flats for sale. Alternatively, it may retain the unit and advertise each individual flat for rental.

Explain how this would affect the design in **part (a)**. [3]

(c) (i) Explain the meaning of the term encapsulation. [2]

(ii) Explain the meaning of the term polymorphism. [2]