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 2017

3 hours

Additional Materials: Answer Paper

2940599144

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.

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

Singapore Examinations and Assessment Board

CAMBRIDGE International Examinations

Answer **all** questions.

1 The principal of a college decides to improve security access. Currently, the staff use keys to enter classrooms and laboratories. One of the principal's suggested improvements is to replace the existing locks and keys with a swipe card system. The principal plans to purchase swipe card readers for every room, and staff will be issued with their own swipe card. If a valid card is swiped through a particular reader, the corresponding door will be unlocked.

Software for controlling the system is required to:

- define the rooms that can be entered by each card. The office staff will make any changes.
- produce a pop-up screen on the office staff's computer if an unauthorised card is used to attempt an entry into a room.
- produce reports. Some of the reports will be confidential and can only be viewed by the principal.

A local software company is selected to produce the software. The company assigns a development team to the project.

(a) A systems analyst from the team makes an initial visit to the college.

State **two** groups of staff that the systems analyst would need to interview.
Justify your answer. [4]

(b) As a result of the analysis carried out, a diagram is used to show entities and data flow.

Draw a suitable diagram. [6]

(c) The next stage of system development is software design.

(i) Describe the checks that the team needs to make at the end of this stage. [2]

(ii) Describe **two** methods that could be used to check this design. For each method, identify the members of the development team involved other than the systems analyst. [6]

(d) The swipe card system will need to be fully tested. The company carries out white box and black box testing.

Explain **three** differences between black box and white box testing. [6]

(e) User documentation will be produced during the development process.

Describe **three** sections that should be included in the user guide for this system. [6]

(f) After the system is implemented, maintenance will be required.

Name and describe **two** types of maintenance. For each type, give an example for the swipe card system. [6]

(g) Describe a method that can be used to ensure that only the office staff can change the system and only the principal can view confidential reports. [2]

(h) The principal is considering expanding the use of the swipe card system to record attendance in classes.

Describe **one** disadvantage of this proposal and suggest a more reliable method. [2]

2 A multinational company has many local branches in various parts of the country that are linked using a wide area network (WAN).

(a) The company's network transfers data using asynchronous data transmission.

(i) State which of the following diagrams represents asynchronous data transmission. Explain your answer. [2]

Diagram A

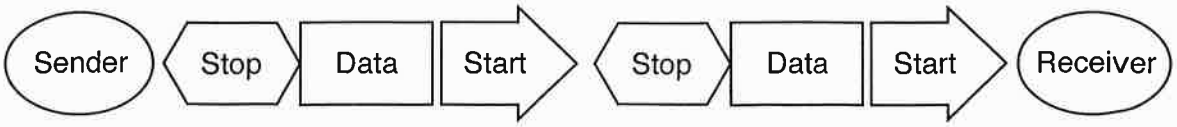
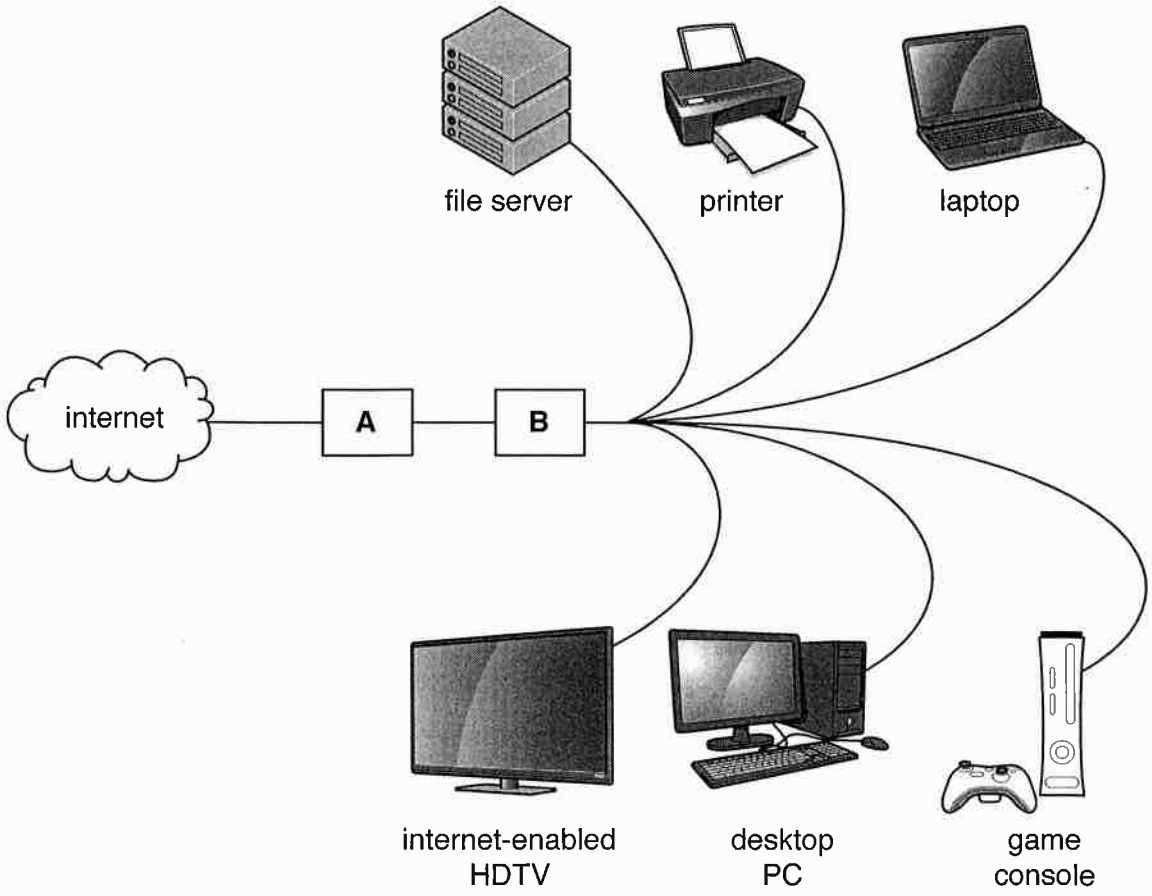


Diagram B

(ii) Explain why asynchronous data transmission affects network performance. [2]

An employee works from home on her wireless laptop. The following diagram shows the configuration of the employee's home network.



(b) This network uses both a switch and a router to transfer data. State which of the pieces of equipment labelled **A** and **B** is the switch. Explain your answer. [2]

(c) Describe **two** features of a router. [2]

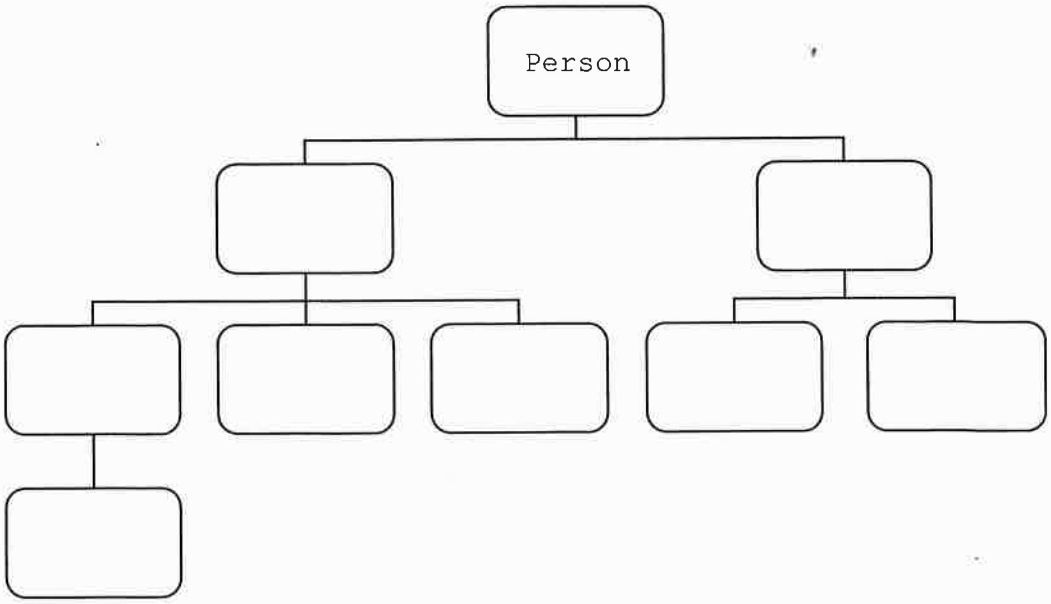
(d) Describe **one** advantage and **one** disadvantage, for the employee, of working from home. [2]

3 **(a)** Explain what is meant by an object in object-oriented programming. [2]

(b) **(i)** A student is writing a program to represent people in a university. Tutors, office workers, lecturers and professors are all employed by the university. A professor is a senior lecturer. The university educates both undergraduate and graduate students.

The student's program contains a class with the identifier `Person`. Sub-classes share the characteristics of this class.

Copy and complete the following inheritance diagram by adding sub-classes `Professor`, `OfficeWorker`, `Lecturer`, `Undergraduate`, `Staff`, `Graduate`, `Student` and `Tutor`. [2]



(ii) Explain why inheritance is an important feature of object-oriented programming. [2]

(c) A stack is a data structure that can be implemented in object-oriented programming. The implementation of a stack requires an integer variable and an array.

(i) Describe the purpose of the integer variable in the implementation of a stack class. [1]

(ii) Describe the purpose of the array in the implementation of a stack class. [1]

(iii) Explain how to use the stack data structure to compute the following expression:

$(A + B) \times (C + D)$ [2]

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

(i) State where data are stored on a client-server network. [1]

(ii) State where data are stored on a peer-to-peer network. [1]

(iii) Describe **one** benefit of a client-server network over a peer-to-peer network. [2]

(iv) Describe **one** drawback of a client-server network compared to a peer-to-peer network. [2]

(b) A college has five IT rooms. Each room has 20 computers which can only print to a single printer in the room. At busy times in the year, there can be up to 100 students printing their coursework at the same time.

Explain how all these print jobs are controlled and sent to the printer. [2]

(c) A 30 megabyte file is transferred over a network to a printer in 5 seconds.

Calculate the transfer rate, in megabits per second, used to transfer this file. Show all of your working. [2]

5 The following grid shows the initial state of a popular puzzle.

	8		9					
						7	8	9
2				(4)	5	6		
		1	2	3				
6								4
				1	9	8		
		4	3	2				8
7	6	5						
					7		1	

The aim of the puzzle is to fill the whole grid so that every row, every column and every 3 × 3 mini-grid contains a number between 1 and 9. No number should be repeated in any row, column or 3 × 3 mini-grid.

A software company is creating an online version of the puzzle. A programmer is asked to create the puzzle software.

(a) The programmer decides to use a 2D array to store the puzzle.

(i) Copy and complete the following line of pseudocode.

```
DECLARE Puzzle ARRAY[1 : ...., .... : ....] OF .....
```
[2]

The circled value in the diagram above needs to be assigned to the appropriate array element.

(ii) Copy and complete the following line of pseudocode.

```
Puzzle[....,....] ← .....
```
[2]

(iii) Explain why a 2D array is more suitable than a single 1D array to represent this puzzle.
[2]

(b) The puzzle grid can be saved by writing the array `Puzzle` to a file.

Design an algorithm, using pseudocode, to write the array to the file. [5]

(c) During the testing of the puzzle software, several errors are discovered.

Describe **two** debugging techniques that could be used to locate these errors. [4]

6 A computer company has several offices throughout the country, each with several salespersons. A record of the sales made by each salesperson has been set up using a relational database. There is a minimum amount of $150 for each sale.

The following tables hold the data.

CUSTOMER (CustomerID, CustomerName, CustomerEmail, CustomerTelephone)

OFFICE (OfficeID, Address, Telephone)

SALE (CustomerID*, SalesPersonID*, SaleDate, Amount)

SALESPERSON (SalesPersonID, SalespersonName, OfficeID*)

Note: underline indicates primary key. An asterisk (*) indicates a foreign key.

(a) Draw an Entity-Relationship (E-R) diagram to represent the data model. [3]

(b) The following is a section of the data dictionary for the data model. It has three missing entries labelled **A**, **B** and **C**.

Table	Field	Data type	Validation
CUSTOMER	CustomerID	Integer	Unique
SALE	CustomerID	Integer	**A**
SALE	SaleDate	Date	
SALE	Amount	**B**	**C**

State a suitable entry for **A**, **B** and **C**. [3]

(c) There is an address field in this database.

Explain why storing the address as a single field is not good database design. [3]

Each month, a report is produced to show the sales for each salesperson. The following is a report for salesperson, B Chin.

B Chin

Date	Customer	Amount
3/12/2016	R Tan	$219.00
6/12/2016	D Bin	$889.00
8/12/2016	A Yeo	$479.00
11/12/2016	W Ong	$1449.00
...	...	...
...	...	...
31/12/2016	G Lim	$259.00
	Total	**$9675.00**

(d) (i) To produce the report, the database uses the `SaleDate` and `Amount` fields in the `SALE` table.

Name **four** other fields that the database uses to produce this report. [4]

(ii) State **two** features of a relational database management system which would be used to calculate and display the total for this salesperson. [2]