Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

9196178439

COMPUTER SCIENCE **9608/32**

Paper 3 Advanced Theory **October/November 2020**

1 hour 30 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use an HB pencil for any diagrams, graphs or rough working.
- Calculators must **not** be used in this paper.

INFORMATION

- The total mark for this paper is 75.
- The number of marks for each question or part question is shown in brackets [ ].
- No marks will be awarded for using brand names of software packages or hardware.

This document has **16** pages. Blank pages are indicated.

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1 In a particular computer system, real numbers are stored using floating-point representation, with:

- 12 bits for the mantissa
- 4 bits for the exponent
- two's complement form for both mantissa and exponent.

(a) Calculate the denary value for the following floating-point number. Show your working.

Mantissa												Exponent			
0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	0

Working .....

.....

.....

.....

Denary value .....

[3]

(b) A new operating system has been installed that has changed the way the floating-point numbers are used. The order of the exponent and the mantissa are reversed.

(i) Calculate the new denary value for the following floating-point number that has the same bit pattern as the number in **part (a)**. Show your working.

Exponent				Mantissa											
0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	0

Working .....

.....

.....

.....

Denary value .....

[3]

(ii) Identify **two** problems that can occur due to the change in the representation of the floating-point number.

Problem 1 .....

.....

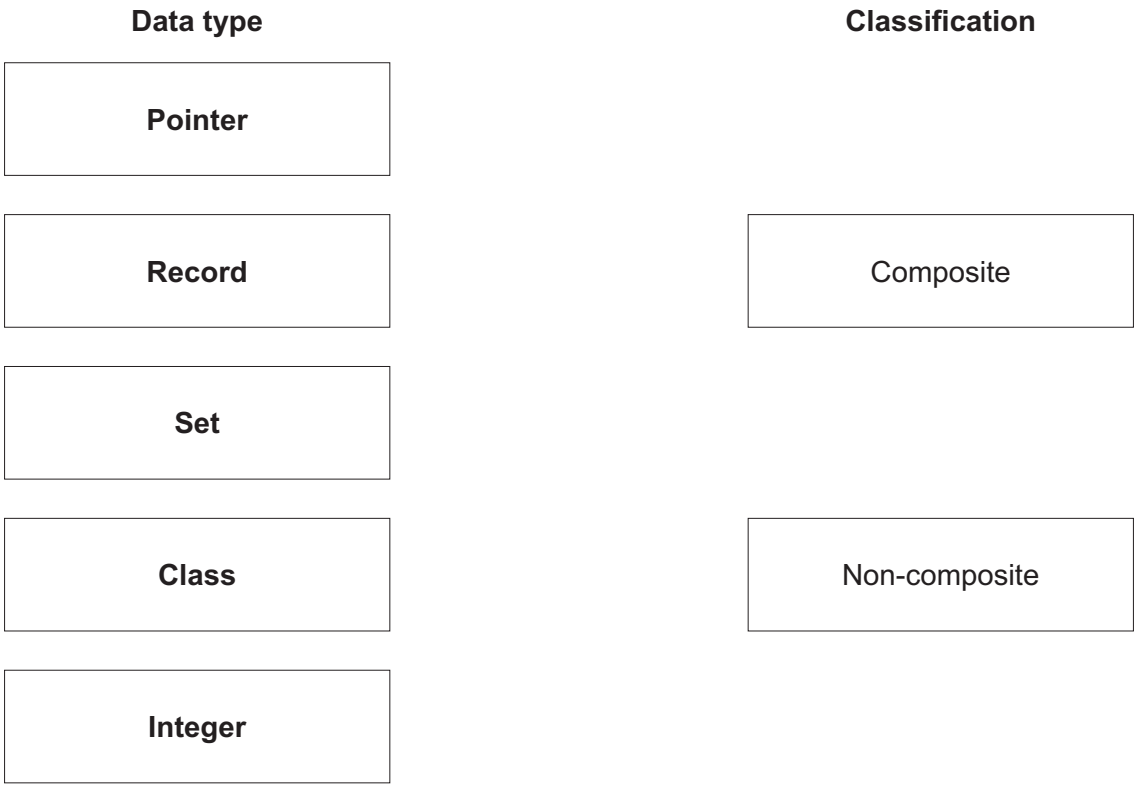
Problem 2 .....

.....

[2]

2 Data types can be classified as composite or non-composite.

(a) Draw **one** line from each data type to its correct classification.



[2]

(b) A user-defined data type, `timeOfDay`, is declared using the following pseudocode.

```
TYPE timeOfDay = (morning, afternoon, evening, night)
```

(i) Identify the type of user-defined data type declared **and** state its classification.

Type .....

Classification .....

[2]

(ii) Write pseudocode to declare the variable `session` of type `timeOfDay`.
Assign the value `afternoon` to the variable `session`.

.....

.....

.....

..... [2]

3 The use of protocols is essential for successful communication between computers.

(a) Define the term **communication protocol**.

.....

.....

..... [2]

(b) Identify **two** protocols that are used in the transfer of emails **and** state the purpose of each protocol.

Protocol 1 .....

Purpose .....

.....

Protocol 2 .....

Purpose .....

.....

[4]

(c) Manav and Miora want to have a video conversation over the Internet using a dedicated connection.

(i) Identify **and** describe the switching method used to implement this connection.

Method .....

Description .....

.....

.....

.....

.....

[3]

(ii) State **one** benefit and **one** drawback of the method you identified in **part (c)(i)**.

Benefit .....

.....

Drawback .....

.....

[2]

4 The following truth table represents a logic circuit with three inputs and two outputs.

INPUT			OUTPUT	
A	**B**	**C**	**X**	**Y**
0	0	0	1	0
0	0	1	0	0
0	1	0	0	0
0	1	1	0	1
1	0	0	0	0
1	0	1	0	1
1	1	0	0	0
1	1	1	1	1

(a) Write the Boolean expressions for the truth table as sum-of-products.

X = ...

Y = ...
[3]

(b) Complete the Karnaugh Maps (K-maps) for the truth table.

OUTPUT X

C \ AB	**00**	**01**	**11**	**10**
0				
1				

OUTPUT Y

C \ AB	**00**	**01**	**11**	**10**
0				
1				

[2]

(c) The K-maps can be used to simplify **one** of the expressions in **part (a)**.

(i) Draw loop(s) around appropriate group(s) of 1s to produce an optimal sum-of-products for the single output table that can be simplified in **part (b)**. [2]

(ii) Write the simplified sum-of-products expressions for this output from **part (c)(i)**.

..... [2]

5 Complete these statements about flip-flops.

A flip-flop is a ..... .

It has ..... stable states.

A flip-flop is used for ..... .

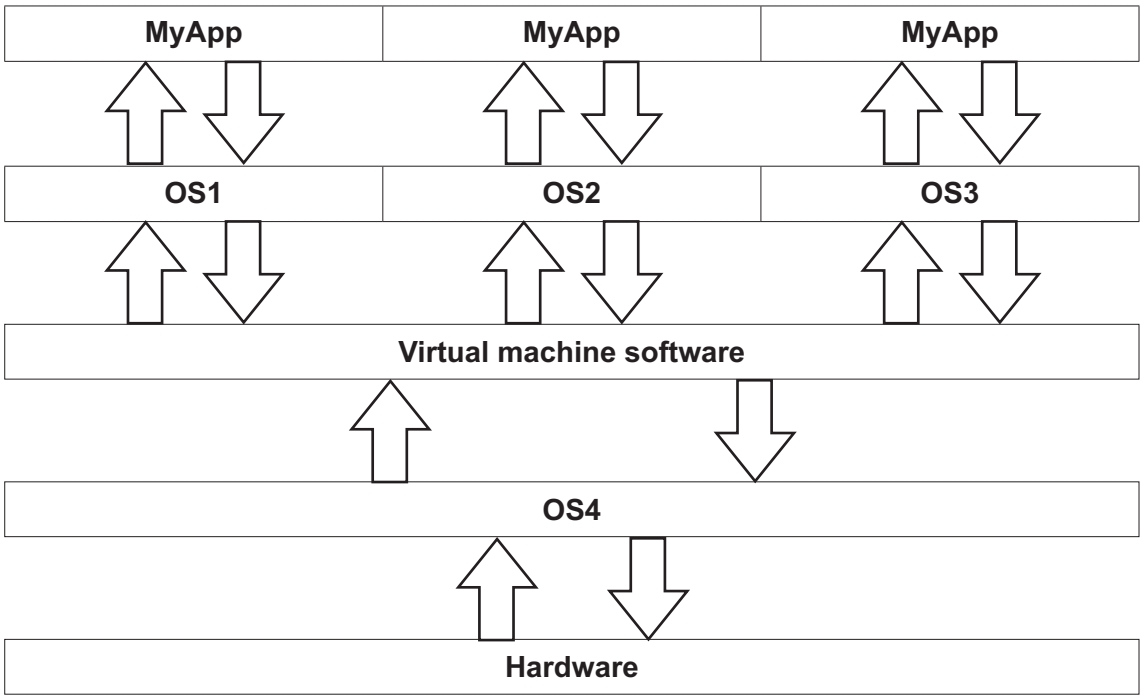
There are different types of flip-flop, for example ..... and ..... .

[5]

6 Mahmoud is developing a new application, MyApp, that needs to work with three different operating systems (OS1, OS2 and OS3).

He has decided to use virtual machine software to test MyApp with these three different operating systems.

The diagram shows MyApp running on three virtual machines.



(a) Describe the roles of the **four** operating systems (OS1, OS2, OS3 and OS4) shown in the diagram.

.....

.....

.....

.....

..... [3]

(b) Describe the role of the virtual machine software in the testing of MyApp.

.....

.....

.....

.....

.....

..... [3]

(c) Explain **one** benefit and **one** drawback of this approach to testing MyApp.

Benefit .....

.....

.....

.....

Drawback .....

.....

.....

.....

[4]

7 Sam wants to send confidential data to an organisation. He has already received the organisation's digital certificate. The organisation has asked him to make sure that the message containing the confidential data is encrypted and is sent with a digital signature.

(a) Explain the process the organisation followed to obtain its digital certificate.

.....

.....

.....

.....

.....

..... [3]

(b) Identify **two** items included in the organisation's digital certificate that will be used when sending the message. Give a reason why each item is required.

Item 1 .....

Reason .....

.....

Item 2 .....

Reason .....

.....

[4]

(c) Identify **two** other items included in the organisation's digital certificate.

.....

.....

.....

..... [2]

(d) Explain how the digital signature for Sam's message is produced.

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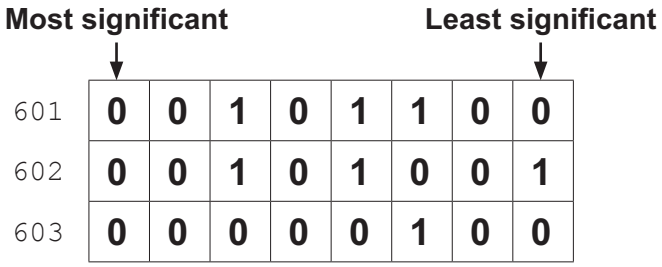
.....

..... [4]

8 A car monitoring system provides information to the driver about the car's performance and alerts the driver to possible problems.

- Data about the car's performance is stored in three memory locations with addresses `601` to `603`.
- Location `601` contains the distance travelled in kilometres for the current trip as a binary integer.
- Location `602` contains the quantity of fuel used in litres for the current trip, as a fixed-point binary number with 5 places before the binary point and three places after the binary point.
- The four least significant bits of location `603` are flags used to identify problems with the car, for example, the fuel is low. A flag is set to 1 if there is a problem, or 0 if not. These problems are:
    - Bit 0 - high engine temperature
    - Bit 1 - low oil pressure
    - Bit 2 - low battery
    - Bit 3 - low fuel
    - Bits 4 to 7 are not used

(a) The current contents of addresses `601` to `603` are:



State the information that the current contents of addresses `601` to `603` will provide to the driver.

.....

.....

.....

..... [3]

(b) A car has low oil pressure and low fuel. It has travelled 80 kilometres and used 7.25 litres of fuel.

Complete the contents of the addresses to record this information.

601								
602								
603								

[3]

(c) The following table shows the assembly language instructions for the car performance monitoring system. There is one general purpose register, the Accumulator (ACC).

Table 8.1

Instruction			Explanation
Label	**Op code**	**Operand**	
	LDM	#n	Load the number n to ACC
	LDD	<address>	Load the contents of the location at the given address to ACC
	STO	<address>	Store the contents of ACC at the given address
	AND	#n	Bitwise AND operation of the contents of ACC with the numeric operand
	CMP	#n	Compare the contents of ACC with the number n
	JPE	<address>	Following a compare instruction, jump to <address> or <label> if the compare was True
	JMP	<address>	Jump to <address> or <label>
<label>:	<op code>	<operand>	Labels an instruction
Note: # denotes immediate addressing B denotes a binary number, for example B01001010 & denotes a hexadecimal number, for example &4A			

(i) Write **assembly language** instructions to set the contents of addresses 601 and 602 to zero, and set all four least significant bits of the contents of address 603 to one.
Use the instruction set from **Table 8.1**.

.....

.....

.....

.....

.....

..... [3]

(ii) A program continuously checks the flags. If a flag is set, the program moves to the error-handling routine at the specified label. For example, if the engine temperature is high, the program jumps to the label for the error-handling routine `HIGHTEMP`. The error-handling routine instructions have not been provided.

A programmer has written most of the instructions for the program in the following table. There are four missing operands.

Complete the assembly language program by writing the **four** missing operands.

Label	Op code	Operand
CHECKFLAGS:	LDD	603
	AND	&0F
	STO	TEMP
	AND	&01
	CMP	&01
	JPE	HIGHTEMP
	LDD	TEMP
	AND	&02
	CMP	
	JPE	LOWOIL
	LDD	TEMP
	AND	
	CMP	&04
	JPE	LOWBATT
	LDD	
	AND	&08
	CMP	&08
	JPE	LOWFUEL
	JMP	
TEMP:		

[4]

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