Cambridge Assessment International Education

Cambridge International AS & A Level

CANDIDATE NAME: ZAK

CENTRE NUMBER: H o m e 3

CANDIDATE NUMBER: + 7 8 6

9091517738

COMPUTER SCIENCE **9618/12**

Paper 1 Theory Fundamentals **May/June 2024**

1 hour 30 minutes

Solved

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. Any blank pages are indicated.

© UCLES 2024

1 **(a)** Describe the operation of each of the following logic gates:

NAND .....

- NAND: Outputs 0 only if both inputs are 1; otherwise, it outputs 1.
- NOR: Outputs 1 only if both inputs are 0; otherwise, it outputs 0.
- XOR: Outputs 1 if only one of the inputs is 1; otherwise, it outputs 0.
- OR: Outputs 1 if at least one input is 1; otherwise, it outputs 0.

.....

XOR .....

.....

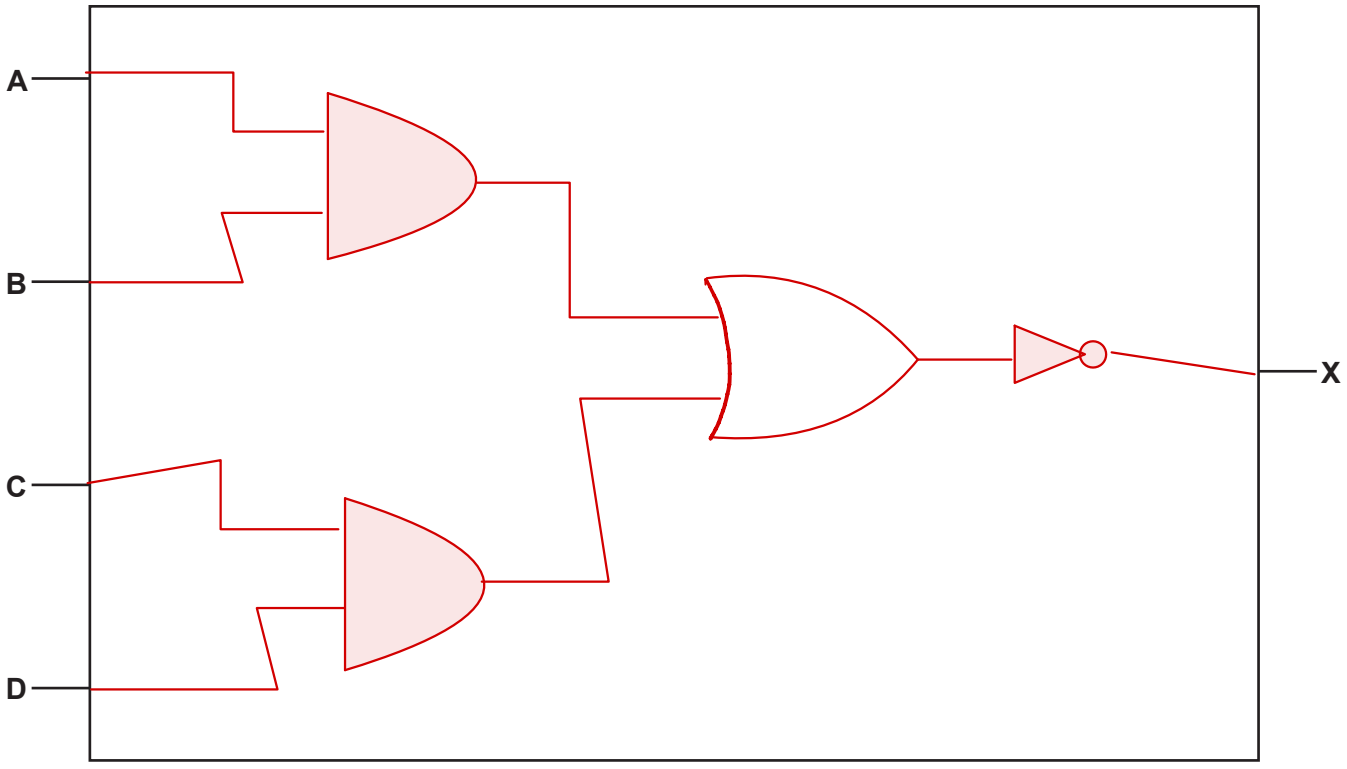
OR .....

.....

[4]

(b) Draw a logic circuit for this logic expression:

X = NOT ((**A** AND **B**) OR (**C** AND **D**))



[2]

2 A computer game is being designed that users will be able to play using a virtual reality (VR) headset.

(a) Complete the description of the principal operation of a VR headset.

A headset can have one or two displays that output the image to the user. The headset has speakers that output surround sound to give a realistic experience.

The user's head movements are detected using a sensor.

This sensor is a gyroscope . The data is transmitted to a microprocessor that analyses the data to identify the direction of movement. Some headsets use cameras that record the user's eye movements for analysis.

[4]

(b) The computer uses a buffer when transmitting data to the VR headset.

Explain how a buffer is used when data is transmitted between the computer and the VR headset.

- A buffer temporarily holds data as headset recives data slow.
- It compensates for speed differences between devices headset & computer.
- Headset recives dat from buffer.
- Ensures smooth data transfer without interruption between them.

[3]

(c) The VR headset has Electrically Erasable Programmable Read Only Memory (EEPROM).

Explain the benefits of using EEPROM instead of other types of Read Only Memory (ROM) in the VR headset.

- Non-volatile memory that retains data without power.
- Can be electrically erased and reprogrammed.
- Allows firmware updates.
- No need for the removal to update.
- Faster than any other type of ROM.

[3]

(d) The computer can transmit a video made from bitmap images and vector graphic animations to the VR headset.

(i) Describe how the data for a bitmapped image is encoded.

- Pixels are stored in a grid that makes up the image.
- Each pixel has a color value.
- Color values are represented in unique binary number.

..... [3]

(ii) Describe the contents of a vector graphic drawing list.

- List of objects (lines, circles, polygons).
- Properties (position, size, color).

..... [2]

(iii) The bitmap video is **not** compressed before transmission to the VR headset.

Give **two** reasons why the video does **not** need to be compressed.

1. Reduces processing time for compression and decompression.
2. Avoids potential quality loss.

..... [2]

3 An assessment board scans exam papers and stores the digitised papers on a server. Exam markers download the digitised papers to mark. The exam markers then upload the mark for each paper.

(a) The assessment board needs to make sure the data stored on the server is secure.

(i) Authentication methods can help to protect the server against hackers.

Identify **one other** security measure that helps to protect the server from hackers.

Describe how the security measure works.

Security measure .....

Description .....

- Firewall: Monitors and controls incoming and outgoing network traffic.
- Prevents unauthorized access to the network.

.....

.....

[3]

(ii) Identify **one** security measure that helps to protect the data when it is being transmitted to its destination. Describe how the security measure works.

Security measure .....

Description .....

- Encryption: Converts data into a coded format.
- Protects data from being accessed during transmission.

.....

[3]

(b) The exam markers use software that operates as a thin-client to mark the exam papers.

Complete the table by identifying **two** characteristics of a thin-client.

Describe how each characteristic will be used in this software.

	Thin-client characteristic	Description of use in this software
1	.....	.....
	1. Centralized processing: Reduces client-side workload. 2. Reduced maintenance: Easier updates and management.	
	.....	.....
	.....	.....
2	.....	.....
	.....	.....
	.....	.....
	.....	.....

[4]

(c) Data transmitted on the internet passes through multiple different systems.

(i) Describe the role of routers in the transmission of data through the internet.

- Direct data packets to their destination.
- Determine the best path for data transmission.

.....

..... [2]

(ii) Describe the role of the PSTN (Public Switched Telephone Network) in the transmission of data through the internet.

- Provides the physical infrastructure for data transmission.
- Connects calls and data packets over long distances.

.....

.....

..... [2]

4 An assessment board wants to store the marks students achieved in exams in a database named RECORDS.

Part of the database design includes these two tables:

EXAM(ExamID, Subject, Level, TotalMarks)

EXAM_QUESTION(ExamQuestionID, ExamID, QuestionNumber, Question, MaxMark)

(a) Identify the relationship between EXAM and EXAM_QUESTION.

One-to-Many relationship

[1]

(b) Sample data for the table EXAM is shown:

ExamID	Subject	Level	TotalMarks
00956124	Computer Science	2	75
00956125	Computer Science	3	120
00956126	Mathematics	2	100
00956127	Mathematics	3	150
00956128	Physics	2	70
00956129	Physics	3	80

Write a Structured Query Language (SQL) script to define the table EXAM.

```
CREATE TABLE EXAM (
    ExamID VARCHAR(8),
    Subject VARCHAR(50),
    Level INT,
    TotalMarks INT,
    PRIMARY KEY (ExamID)
);
```

[3]

(c) The table `EXAM_QUESTION` has been created but the foreign key has not been linked.

Write an SQL script to update `EXAM_QUESTION` **and** link the foreign key to `EXAM`.

```
ALTER TABLE EXAM_QUESTION
ADD CONSTRAINT fk_exam
FOREIGN KEY (ExamID)
REFERENCES EXAM(ExamID);
```

Optional.

[2]

(d) The database also needs to store data about the students, the exams the students have taken and the marks the students achieved in each question of each exam.

Describe the additional tables that will need to be included in the database **and** explain how all the tables in the database will be linked.

- STUDENT (StudentID, Name, DateOfBirth)
- EXAM_TAKEN (StudentID, ExamID, DateTaken)
- MARKS (ExamTakenID, ExamQuestionID, Mark)
- Relationships:
  - STUDENT to EXAM_TAKEN: One-to-many
  - EXAM to EXAM_TAKEN: One-to-many
  - EXAM_QUESTION to MARKS: One-to-many
  - EXAM_TAKEN to MARKS: One-to-many

[5]

© UCLES 2024

BLANK PAGE

5 The following table shows part of the instruction set for a processor. The processor has two registers: the Accumulator (ACC) and an Index Register (IX).

Instruction		Explanation
Opcode	**Operand**	
LDM	#n	Immediate addressing. Load the number n to ACC
LDD	<address>	Direct addressing. Load the contents of the location at the given address to ACC
LDI	<address>	Indirect addressing. The address to be used is at the given address. Load the contents of this second address to ACC
LDX	<address>	Indexed addressing. Form the address from <address> + the contents of the index register. Copy the contents of this calculated address to ACC
LDR	#n	Immediate addressing. Load the number n to IX
ADD	#n/Bn/&n	Add the number n to the ACC
ADD	<address>	Add the contents of the given address to the ACC
SUB	#n/Bn/&n	Subtract the number n from the ACC
SUB	<address>	Subtract the contents of the given address from the ACC
INC	<register>	Add 1 to the contents of the register (ACC or IX)
<address> can be an absolute or a symbolic address # denotes a denary number, e.g. #123 B denotes a binary number, e.g. B01001010 & denotes a hexadecimal number, e.g. &4A		

© UCLES 2024

(a) The current contents of memory are shown:

Address	Data
10	1
11	3
12	5
13	11
14	10
15	16
16	12

The current contents of the ACC and IX are shown:

ACC	10
IX	0

Complete the table by writing the content of the ACC after each program has run.

Program number	Code	ACC content
1	`LDI 15` `SUB #1`	11
2	`LDD 14` `ADD 11`	13

3	`LDM #11`
	`ADD #3`
	`SUB 16`
		2

4	`LDR #2`
	`LDX 14`
	`ADD #2`
		14

[4]

© UCLES 2024

[Turn over

(b) The processor includes these bit manipulation instructions:

Instruction		Explanation
Opcode	**Operand**	
AND	#n/Bn/&n	Bitwise AND operation of the contents of ACC with the operand
AND	<address>	Bitwise AND operation of the contents of ACC with the contents of <address>
XOR	#n/Bn/&n	Bitwise XOR operation of the contents of ACC with the operand
XOR	<address>	Bitwise XOR operation of the contents of ACC with the contents of <address>
OR	#n/Bn/&n	Bitwise OR operation of the contents of ACC with the operand
OR	<address>	Bitwise OR operation of the contents of ACC with the contents of <address>
<address> can be an absolute or a symbolic address # denotes a denary number, e.g. #123 B denotes a binary number, e.g. B01001010 & denotes a hexadecimal number, e.g. &4A		

The current contents of memory are shown:

Address	Data
25	11000110
26	11100001
27	10000001
28	11001101
29	00001111

The current content of the ACC is shown:

0	1	0	0	0	1	1	0

Complete the table by writing the content of the ACC after each program has run.

The binary number 01000110 is reloaded into the ACC before each program is run.

Program number	Code	ACC content
1	XOR 29	01001001
2	AND #29	00000100
3	OR B11111111	11111111

[3]

© UCLES 2024

6 A computer has an Operating System (OS).

Memory management and process management are two OS tasks.

Explain how memory management **and** process management support multi-tasking.

- Memory management: Allocates memory to processes, ensures no conflicts, supports multi-tasking.
- Process management: Schedules processes, manages execution, supports context switching.

..... [4]

7 A computer stores binary data.

(a) Tick (✓) **one** box only to identify the **largest** file size.

- [x] 3300 kibibytes
- [ ] 0.3 megabytes
- [ ] 3 mebibytes
- [ ] 3300 kilobytes

[1]

(b) Subtract the denary number 10 from the denary number 100 using binary subtraction.

Show your working.

Working

$(100)_{10} = (01100100)_2$

$(10)_{10} = (00001010)_2$

$(-10)_{10} = (11110110)_2$

```
 1 1
 01100100
+11110110
100101010
```

Answer 01011010

[3]

(c) Convert the hexadecimal number C0F into denary.

Show your working.

Working

C 0 F

12 0 15

1100 0000 1111

$1100\,0000\,1111$

$2048+1024 + 4+4+2+1$

$= 3087$

Answer $(3087)_{10}$

[2]

8 A programmer uses an Integrated Development Environment (IDE) to write a computer program. The IDE has both a compiler and an interpreter as built-in translators.

(a) The programmer decides to use the compiler when testing the final program.

Describe the benefits of using the compiler during testing.

- Produces faster executable code.
- Easier to distribute and execute.
- Executable file can be tested at user's site.

..... [2]

(b) IDEs have many features other than built-in translators.

Complete the table by identifying **one other** common IDE feature that can be used for each purpose. Describe how each feature helps the user during program development.

Each feature must be different. Do **not** give translator as one of your features.

Purpose	IDE feature	Description
for coding	.....	.....
	.....	.....
for presentation	.....	.....
	.....	.....
for debugging	.....	.....
	.....	.....

1. For coding: Syntax highlighting
   - Helps identify errors.
2. For presentation: Code formatting
   - Improves readability.
3. For debugging: Breakpoints
   - Allows step-by-step execution.

[6]

(c) The programmer uses program libraries when developing the program.

Describe **two** benefits to the programmer of using program libraries.

1. Pre-written code saves development time.
2. Libraries are often optimized and tested, increasing reliability.

2 .....

.....

[2]

Permission to reproduce items where third-party owned material protected by copyright is included has been sought and cleared where possible. Every reasonable effort has been made by the publisher (UCLES) to trace copyright holders, but if any items requiring clearance have unwittingly been included, the publisher will be pleased to make amends at the earliest possible opportunity.

To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced online in the Cambridge Assessment International Education Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download at www.cambridgeinternational.org after the live examination series.

Cambridge Assessment International Education is part of Cambridge Assessment. Cambridge Assessment is the brand name of the University of Cambridge Local Examinations Syndicate (UCLES), which is a department of the University of Cambridge.