Cambridge Assessment International Education

Done

Cambridge International AS & A Level

CANDIDATE NAME: Farzan Ahmed

CENTRE NUMBER:

CANDIDATE NUMBER:

8172456601

COMPUTER SCIENCE **9618/12**

Paper 1 Theory Fundamentals **October/November 2024**

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.

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1 **(a)** Complete the truth table for the logic expression:

X = (**A** XOR **B**) NAND (**A** AND (**B** XOR **C**))

A	B	C	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[2]

(b) Draw the logic circuit for the logic expression:

W = **P** NAND ((**Q** OR NOT **R**) XOR (**P** XOR **Q**))



[2]

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2 Embedded systems are used in many electronic devices.

(a) Describe the drawbacks of embedded systems.

It is difficult to change and the errors cannot be fixed easily. It cannot be easily adapted for other task.

[3]

(b) An embedded system has Dynamic RAM (DRAM).

Identify **one** benefit of using DRAM instead of Static RAM (SRAM) in an embedded system.

DRAM is less expensive to purchase

[1]

(c) Give **two** differences between Erasable Programmable ROM (EPROM) and Electrically Erasable Programmable ROM (EEPROM).

Difference 1 EPROM use ultraviolet light to erase data, EEPROM uses an electrical signal to do this.

Difference 2 EPROM erases all data, EEPROM can erase parts of the data.

[2]

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3 A student has a computer.

(a) The computer is designed using the Von Neumann model for a computer system.

Complete the table by describing the purpose of each of the given registers.

Register	Purpose
Program Counter (PC)	Stores the address of the next instruction to be fetched.
Memory Address Register (MAR)	stores the address of the memory location where the data will read.
Memory Data Register (MDR)	Stores the data to be written to the address in MAR
Index Register (IX)	stores the number that will be added to the oprand.

[4]

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(b) The student needs to connect the computer to a monitor that has a screen resolution of 2560 × 1600 pixels. The monitor also has built-in speakers.

The computer has a Video Graphics Array (VGA) port and a High Definition Multimedia Interface (HDMI) port.

Explain the benefits of connecting the monitor to the computer using the HDMI port instead of the VGA port.

HDMI has faster transfer rates than VGA because of large number of pixels of monitor HDMI supports the high resolution of the monitor. HDMI supports video and audio transfer between computer and monitor speakers so no seperate sound cable is needed unlike VGA.

[4]

(c) The computer has an Operating System (OS). One of the key management tasks of the OS is process management.

Describe the process management tasks performed by an OS.

OS manages the scheduling of processes. It allocates which resources the processes require. Allow multi tasking. Handles the interupts.

[4]

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4 A program is written in a high-level language by a team of three programmers using an Integrated Development Environment (IDE).

(a) Describe how the programmers can use the debugging features of a typical IDE during the development of the program.

•Single Stepping :- Run the program one line at a time and check the variable contents.
•set Breakpoint :- Run the code upto a set line and then check the status.
• Report Or Watch Window: view how the data changes as the programm is running.

[4]

(b) The programmers created a new program library whilst developing the program.

Describe the benefits to the programmers of creating a program library.

The sub-routines can be shared without having to re-write or re-test which saves the programmer time. Individual programmers can contribute their speciliams to the library.

[3]

(c) The file containing the final program code will be sent by email for beta testing.

Identify **one** security method that can be used to protect the program code from unauthorised access during email transfer.

Explain how your chosen method protects the program code.

Security method Encrytion

Explanation The file contents are coverted into cypher text. If intercepted the data cannot be understood without decrytion key.

[3]

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5 A computer programmer is learning about the importance of acting ethically at work.

(a) Explain the reasons why the computer programmer needs to act ethically towards colleagues and the public.

Colleagues The programmer should treat colleagues fairly and avoid act of discrimination. The programmer should help to train colleagues.

The public The programmer should be honest in making claims about the software. Programmer should maintain the security of public data.

[4]

(b) The programmer writes a program to be used in a business. The source code of the program can be modified by the business. The business pays the programmer for the maintenance and security updates.

(i) Identify **one** suitable type of software licence for the program **and** describe the reasons for your choice.

Type of software licence Open source initiative

Reasons for choice Allows program source code to be examined so that the business can modify program to meet their needs.

[3]

(ii) Explain the reasons why the programmer should copyright their program.

To identify themselves as the owner. To allow legal consequences if anyone copies it.

[2]

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6 A company uses a relational database to store data about its customers, employees and the individual repair jobs that customers have booked.

(a) Explain the benefits of using a relational database instead of a file-based approach.

There is less repeated data since each item of data is only stored once. Data consistency is maintained since the changes in one table will automatically update in another

[3]

(b) The company decides which employees will work on each repair job. An employee can log into the database to access information about their repair jobs.

The database is normalised and includes these tables:

- `CUSTOMER` stores personal data about each customer
- `EMPLOYEE` stores personal data about each employee
- `LOGIN_DATA` stores the username and password for each employee
- `JOB` stores the data about each repair job
- `JOB_EMPLOYEE` stores the employees that are working on each repair job.

(i) Identify each relationship between the database tables **and** explain how each relationship can be implemented in the normalised database.

CUSTOMER to JOB is one to many relationship, implemented by Primary key in CUSTOMER is Foreign key in JOB.
EMPLOYEE to LOGIN_DATA is one to one relationship implemented by Primary key in JOB is Foreign key in JOB_EMPLOYEE.
EMPLOYEE To JOB_EMPLOYEE is one to many relationship, implemented by Primary key in EMPLOYEE is Foreign key in JOB_EMPLOYEE.

[6]

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(ii) The database also has the table `INVOICE` that stores data about each invoice that is sent to a customer.

Example data from the table `INVOICE` is given.

InvoiceID	DateSent	Amount	Paid	JobID
29262	12/12/2023	105.20	Y	221
26765	11/11/2023	200.00	Y	315
13290	02/01/2024	50.00	Y	315
34090	05/02/2024	25.95	N	569

Write a Structured Query Language (SQL) script to return the total amount of all the invoices sent in the year 2023 that have been paid.

```
SELECT SUM (Amount)
FROM INVOICE
WHERE Paid = "Y"
AND Date Sent >= 01/01/2023 AND
Date Sent <= 31/12/2023
```

[3]

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7 A student takes a photograph of a science experiment.

(a) The photograph is saved as a bitmapped image.

(i) Define the following bitmap terms.

Colour depth The number of bits used to represent the colour.

File header Stores the data about the image file.

[2]

(ii) Explain why changing the image resolution will affect the image quality and file size.

Image quality Increasing resolution means the image is more detailed because there are more pixels.

File size Increasing resolution will increase the file size because there are more pixels therefore more data.

[2]

(iii) Identify **one** lossless method of compressing an image.

Run-Length Encoding [1]

(b) The student draws a picture on paper that is scanned into the computer and saved as a vector graphic.

Define the vector graphic terms property and drawing list.

Property An attribute of drawing object

Drawing list All drawing objects.

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8 The following table shows part of the instruction set for a processor. The processor has two registers, the Accumulator (ACC) and the 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)
DEC	<register>	Subtract 1 from 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

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(a) The current contents of memory are shown:

Address	Data
19	25
20	23
21	2
22	4
23	15
24	50
25	22

The current contents of the ACC and IX are shown:

ACC	50
IX	20

Complete the table by writing the content of the ACC and the IX after each set of instructions has run.

	Instructions	ACC content	IX content
1	LDM #19 DEC ACC	18	20
2	LDD 23 ADD 19	15+25 40	20
3	LDI 25 INC ACC	~~4~~ 5	20
4	LDR #21 LDX 2	15	21

[5]

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(b) The instruction set also 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>
LSL	#n	Bits in ACC are shifted logically n places to the left. Zeros are introduced on the right-hand end
LSR	#n	Bits in ACC are shifted logically n places to the right. Zeros are introduced on the left-hand end.
<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 content of the ACC is shown:

ACC	1	0	0	1	1	0	1	0

(i) The table has three sets of instructions. The binary number 10011010 is reloaded into the ACC before each set of instructions is run.

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

	Instructions	ACC content
1	LSL #2	0 110 1000
2	ADD #5 AND #30	0001 1110
3	OR B11110010 INC ACC	1111 1011

[3]

1001 1111 AND 0001 1110

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(ii) Explain how bit manipulation can be used to test whether the binary number stored in the ACC represents an odd denary number.

Write the bit manipulation instruction that will be used.

Explanation An odd binary number will have a 1 in the least signaficant Bits (LSB) compare the results of masking with denary 1, the result of comparison will be true if number is odd.

Instruction AND #1

[3]

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9 A road bridge has a weight limit and a height limit for vehicles. For example, a vehicle must weigh less than 10 000 kg and must have a height of less than 3 m.

The bridge has a warning system. If a vehicle is approaching the bridge and it exceeds one or both limits, a sign displays a warning telling the driver of the vehicle to stop.

(a) The bridge warning system uses sensors to detect if a vehicle exceeds the limits.

Complete the table by identifying **two** different sensors that could be used by the system **and** describe how each sensor is used by the system.

Sensor	Use in bridge warning system
Infra-red sensor	Measure or check the height of the vehicle
Pressure-sensor	measure or check the weight of the vehicle

[2]

(b) Explain whether the bridge warning system is an example of a monitoring system or of a control system.

Monitoring system because there is no use of feedback. The system does not have any acutators.

[2]

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