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CANDIDATE NAME

CENTRE NUMBER

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COMPUTER SCIENCE **9618/12**

Paper 1 Theory Fundamentals **May/June 2021**

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. Any blank pages are indicated.

1 Raj owns houses that other people rent from him. He has a database that stores details about the people who rent houses, and the houses they rent. The database, HOUSE_RENTALS, has the following structure:

CUSTOMER(<u>CustomerID</u>, FirstName, LastName, DateOfBirth, Email)

HOUSE(<u>HouseID</u>, HouseNumber, Road, Town, Bedrooms, Bathrooms)

RENTAL(<u>RentalID</u>, CustomerID, HouseID, MonthlyCost, DepositPaid)

(a) Give the definition of the following database terms, using an example from the database HOUSE_RENTALS for each definition.

Term	Definition and example
Field	A column/attribute in a table e.g. CustomerID in the table CUSTOMER
Entity	Anything that data can be stored about e.g. A customer or a house
Foreign key	A field in one table that is linked to a Primary Key in another table e.g. CustomerID / HouseID in table RENTAL

[6]

(b) Tick (✓) **one** box to identify whether the database HOUSE_RENTALS is in Third Normal Form (3NF) or not in 3NF.
Justify your choice using one or more examples from the database HOUSE_RENTALS.

In 3NF	
Not in 3NF	

Justification ......
• All fields in all tables are dependant fully on the PK and on no other fields

• for example all fields in Customer table are fully dependent on CustomerID
[2]

(c) Example data from the table RENTAL are given:

RentalID	CustomerID	HouseID	MonthlyCost	DepositPaid
1	22	15B5L	1000.00	Yes
2	13	3F	687.00	No
3	1	12AB	550.00	Yes
4	3	37	444.50	Yes

(i) Complete the following Data Definition Language (DDL) statement to define the table RENTAL.

CREATE ....**TABLE**....... ....**RENTAL**....... (

       RentalID INTEGER NOT NULL,

       CustomerID INTEGER NOT NULL,

       HouseID ....**VARCHAR**....... (5) NOT NULL,

       MonthlyCost ....**REAL/CURRENCY**....... NOT NULL,

       DepositPaid BOOLEAN NOT NULL,

       ....**PRIMARY KEY**....... (RentalID)

);

[4]

(ii) Write a Data Manipulation Language (DML) script to return the first name and last name of all customers who have **not** paid their deposit.

- Select FirstName and LastName
- From both tables
- Where DepositPaid = No
- Joining tables (either AND, or INNER JOIN)

Example script:
SELECT FirstName, LastName
FROM CUSTOMER, RENTAL
WHERE DepositPaid = No
AND RENTAL.CustomerID = CUSTOMER.CustomerID;

[4]

2 Aisha manages a team of software developers.

(a) Explain the reasons why it is important that Aisha acts ethically in relation to her team members.

- To make sure the team members feel valued
- To get the best work out of the team
- To enable them to work well together
- To enable them to create the best product for the client

[2]

(b) The team are developing a computer game where the user plays a board game (such as chess) against the computer.

Describe how the computer would use Artificial Intelligence (AI) to play the board game.

- The rules / past moves / decision making algorithms of the game will be stored
- The AI program is trained, by playing many times
- AI will look (ahead) at possible moves and/or analyse the pattern of past choices … and choose the move most likely to be successful
- Computer could learn how to improve // learn from previous mistakes
    - … by storing the positive/negative result of choices
    - ... and changing its future choices

[3]

(c) The final game will be released under a licence.

Tick (✓) **one or more** boxes in each row to identify the licence(s) each statement describes.

Statement	Free Software Foundation	Open Source Initiative	Shareware	Commercial Software
The user can edit the source code	●	●		
The user **must** always pay before being able to use the software				●
The user can redistribute the software	●	●	●	
The user always gets a trial period			●	

[4]

3 A logic expression is given:

S = (**A** AND **B** AND **C**) OR (**B** XOR **C**)

(a) Draw the logic circuit for the given expression.
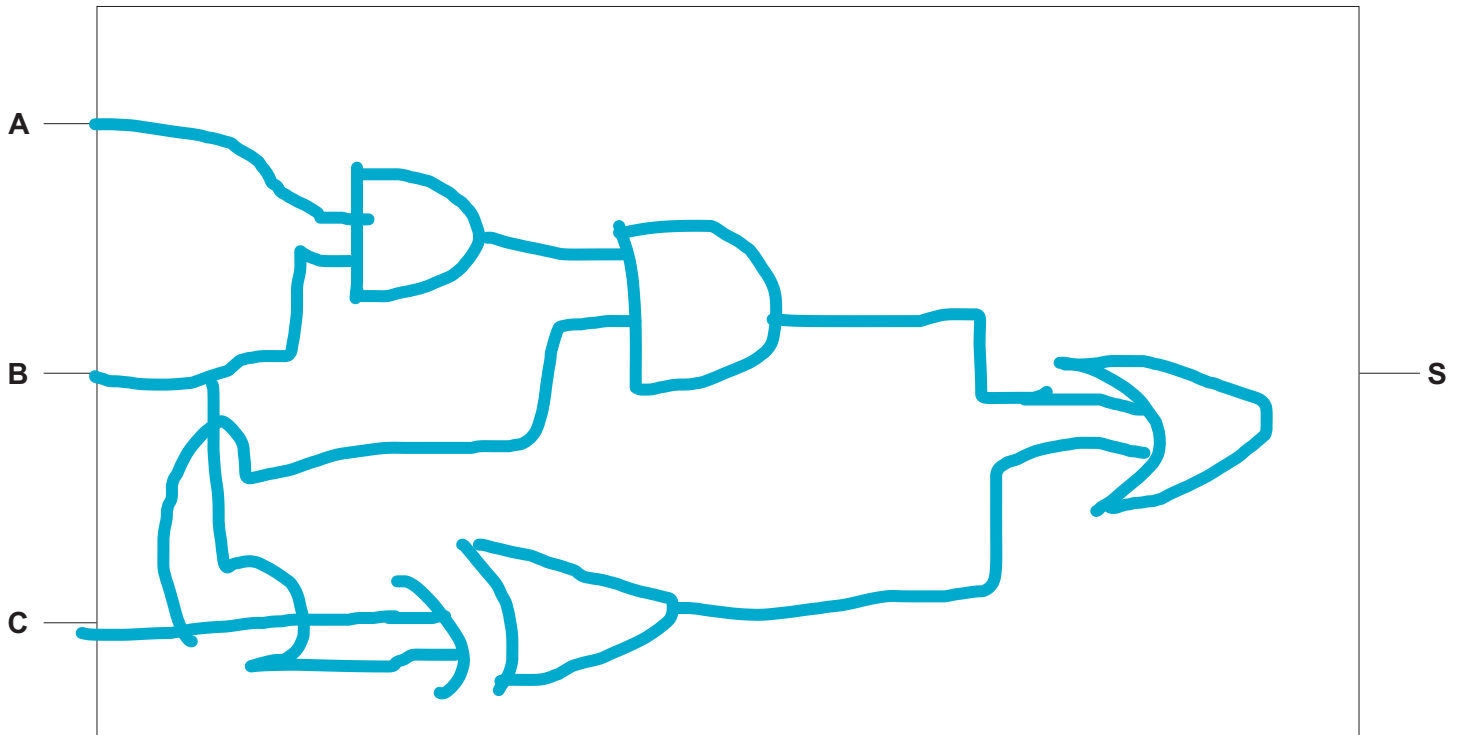
[4]

(b) Complete the truth table for the logic expression:

S = (**A** AND **B** AND **C**) OR (**B** XOR **C**)

A	B	C	Working space	S
0	0	0		0
0	0	1		1
0	1	0		1
0	1	1		0
1	0	0		0
1	0	1		1
1	1	0		1
1	1	1		1

[2]

4 The table shows part of the instruction set for a processor. The processor has one general purpose register, 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
STO	<address>	Store contents of ACC at the given address
ADD	<address>	Add the contents of the given address to 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)
CMP	<address>	Compare the contents of ACC with the contents of <address>
JPE	<address>	Following a compare instruction, jump to <address> if the compare was True
JPN	<address>	Following a compare instruction, jump to <address> if the compare was False
JMP	<address>	Jump to the given address
IN		Key in a character and store its ASCII value in ACC
OUT		Output to the screen the character whose ASCII value is stored in ACC
END		Return control to the operating system
# denotes a denary number, e.g. #123		

The current contents of the main memory and selected values from the ASCII character set are:

Address **Instruction**

Address	Instruction
70	IN
71	CMP 100
72	JPE 80
73	CMP 101
74	JPE 76
75	JMP 80
76	LDD 102
77	INC ACC
78	STO 102
79	JMP 70
80	LDD 102
81	DEC ACC
82	STO 102
83	JMP 70
...	
100	68
101	65
102	100

ASCII code table (selected codes only)

ASCII code	Character
65	A
66	B
67	C
68	D

(a) Complete the trace table for the program currently in main memory when the following characters are input:

A D

Do not trace the program any further when the third input is required.

Instruction address	ACC	Memory address		
		100	**101**	**102**
		68	65	100

[4]

(b) Some bit manipulation instructions are shown in the table:

Instruction		Explanation
Opcode	**Operand**	
AND	#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	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	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 address or a symbolic address # denotes a denary number, e.g. #123		

The contents of the memory address 300 are shown:

Bit Number	7	6	5	4	3	2	1	0
300	0	1	1	0	0	1	1	0

(i) The contents of memory address 300 represent an unsigned binary integer.

Write the denary value of the unsigned binary integer in memory address 300.

102

.... [1]

(ii) An assembly language program needs to test if bit number 2 in memory address 300 is a 1.

Complete the assembly language instruction to perform this test.

AND

.... #4

[1]

(iii) An assembly language program needs to set bit numbers 4, 5, 6 and 7 to 0, but keep bits 0 to 3 with their existing values.

Write the assembly language instruction to perform this action.

AND # 15

....

.... [2]

5 Seth uses a computer for work.

(a) Complete the following descriptions of internal components of a computer by writing the missing terms.

The ....control unit/bus.................... transmits the signals to coordinate events based

on the electronic pulses of the ....system clock.................... .

The ....data bus.................... carries data to the components, while the

.....................address bus.................... carries the address where data needs to be written to

or read from.

The ...arithmetic and logic unit.. performs mathematical operations and

logical comparisons.

[5]

(b) Describe the ways in which the following factors can affect the performance of his laptop computer.

Number of cores:
• Each core processes one instruction per clock pulse
• More/multiple cores mean that sequences of instructions can be split between them
• … and so more than one instruction is executed per clock pulse // more sequences of instructions can be run at the same time
• More cores decreases the time taken to complete task

Clock speed:
• Each instruction is executed on a clock pulse // one F-E cycle is run on each clock pulse
• ... so the clock speed dictates the number of instructions that can be run per second
• The faster the clock speed the more instructions can be run per second

[4]

(c) Seth accesses both software and data using cloud computing.

(i) Give **two** benefits of storing data using cloud computing.

• Cloud storage can be free (for small quantities)
• No need for separate (high capacity) storage devices/saves storage on existing devices
• Can access data from any computer with internet access
• Most cloud data services will have in-built backup/disaster recovery   • Security could be better
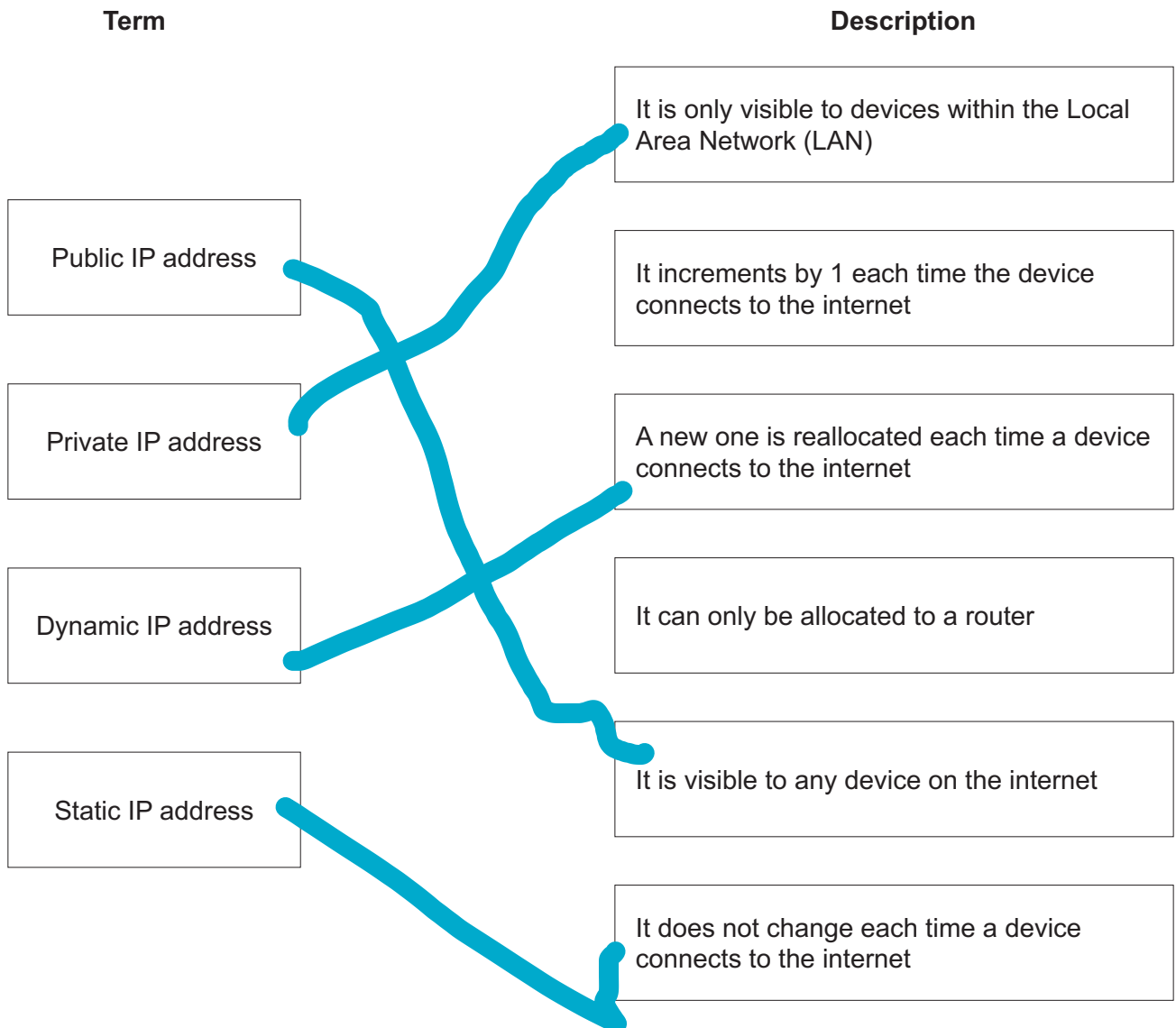• Can easily increase capacity • Data can be easily shared

[2]

(ii) Give **two** drawbacks of Seth using cloud computing.

• Can only access (the cloud) with internet access
• Security may not be strong // no control over security
• There may not be any backups // no control over backups
• It can take a long time to upload/download the data
• It can be more expensive in the long term
• There could be a limit to the amount of storage unless paid for
• There could be compatibility/access issues
• There could be issues with the company offering cloud services

[2]

(d) Draw **one** line from each term to its **most appropriate** description.

Term	Description

Term

Description

Public IP address

Private IP address

Dynamic IP address

Static IP address

It is only visible to devices within the Local Area Network (LAN)

It increments by 1 each time the device connects to the internet

A new one is reallocated each time a device connects to the internet

It can only be allocated to a router

It is visible to any device on the internet

It does not change each time a device connects to the internet

[4]

6 A computer uses the ASCII character set.

(a) State the number of characters that can be represented by the ASCII character set and the extended ASCII character set.

ASCII ....128...

Extended ASCII ....256...

[2]

(b) Explain how a word such as 'HOUSE' is represented by the ASCII character set.
 • Can only access (the cloud) with internet access
 • Security may not be strong // no control over security
 • There may not be any backups // no control over backups
 • It can take a long time to upload/download the data
 • It can be more expensive in the long term
 • There could be a limit to the amount of storage unless paid for
 • There could be compatibility/access issues   [2]
 • There could be issues with the company offering cloud services

(c) Unicode is a different character set.

The Unicode value for the character '1' is denary value 49.

(i) Write the hexadecimal value for the Unicode character '1'.

.......31.. [1]

(ii) Write the denary value for the Unicode character '5'.

.......53.. [1]

7 Jennifer is writing a computer program for her A Level homework.

(a) Jennifer uses a program library to help her write her computer program.

Describe how a program library can be used while writing a computer program.

• Program libraries store pre-written functions and routines

• The program library can be referenced/imported

• the functions/routines can be called in her own program

.... [2]

(b) Jennifer uses an Integrated Development Environment (IDE) to write her computer program.

(i) The IDE allows Jennifer to use both an interpreter and a compiler while creating her computer program.

Describe the ways in which Jennifer can use **both** a compiler **and** an interpreter while developing the program.

Interpreter:
• Use an interpreter while writing the program
• … to test/debug the partially completed program
• … because errors can be corrected and processing continue from where the execution stopped // errors can be corrected in real time // errors are identified one at a time

Compiler:
• Use the compiler after the program is complete to create an executable file
• Use the compiler to repeatedly test the same (completed) section
• … without having to re-interpret every time // compiler not needed at run-time

....

.... [4]

(ii) Identify **two** debugging tools that a typical IDE can provide.

1 Breakpoints ....

....

2 Single stepping ....

....

[2]

Report windows

8 A company has several security measures in place to prevent unauthorised access to the data on its computers.

(a) Describe the difference between the security and privacy of data.

Security protects data against loss

....

Privacy protects data against unauthorised access

....

.... [2]

(b) Each employee has a username and password to allow them to log onto a computer. An employee's access rights to the data on the computers is set to either read-only, or read and write.

Identify **one** other software-based measure that could be used to restrict the access to the data on the computers.

• Two factor authentication   • Biometric passwords

• Key Card Access   • Firewall [1]

(c) The company is also concerned about threats posed by networks and the internet.

Identify **two** threats to the data that are posed by networks and the internet.

Threat 1 • Malware // viruses // spyware // by example

....

Threat 2 • Hacking   • Phishing   • Pharming

....

[2]

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