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0478/12

February/March 2024

1 hour 45 minutes

You must answer on the question paper.

No additional materials are needed.

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- 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.
- Calculators must **not** be used in this paper.

- 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 Computers represent different types of data in binary.

(a) Tick (✓) **one** box to show the reason why computers use binary to represent data.

A Computers only allow 1s and 0s to be entered.

☐

B Computers are made of switches and gates that can only be on or off.

☐

C Binary does **not** need to be converted into other forms of data to be displayed.

☐

D Both computers and humans can quickly process binary data.

☐

[1]

(b) One form of data is characters.

The American standard code for information interchange (ASCII) denary number for the character 'N' is 78.

(i) Tick (✓) **one** box to identify the ASCII denary number for the character 'Q'.

A 81

☐

B 80

☐

C 79

☐

D 77

☐

[1]

(ii) Give the binary number for the ASCII denary number for 'N'.

..... [1]

Working space

.....

(iii) Explain how the word 'RED' is represented using a character set.

.....

 [2]

(c) Sound can be represented as binary.

- (i) Explain why recording sound with a higher sampling resolution creates a more accurate recording.

.....

.....

.....

..... [2]

- (ii) Give **one** other way that the accuracy of a sound recording can be improved.

.....

..... [1]

2 A computer has a central processing unit (CPU).

The CPU includes the registers:

- Program counter (PC)
- Memory address register (MAR)
- Memory data register (MDR)
- Accumulator (ACC)
- Current instruction register (CIR).

(a) The table contains **five** statements about the role of registers in the fetch–decode–execute cycle of a CPU.

Letter	Statement
A	PC stores the address of the next instruction to be accessed
B	MAR stores the instructions of the program that is running
C	MDR stores the data passed to it from the PC
D	ACC stores the result of each calculation
E	CIR stores the instruction currently being executed

Two of the statements are **not** correct.

Identify the letter of each incorrect statement.

Suggest a corrected statement for each.

Incorrect statement 1

Corrected statement

.....

.....

Incorrect statement 2

Corrected statement

.....

.....

[4]

(b) The computer has a single core 3.5 GHz processor and an 8 kB cache.

(i) State what is meant by a 3.5 GHz processor.

.....

..... [1]

- (ii) The CPU is changed to a dual-core 3.5 GHz processor.

Explain how the number of cores affects the performance of a CPU.

.....

.....

.....

..... [2]

- (iii) The amount of cache is increased to 64 kB.

Explain how the amount of cache affects the performance of a computer.

.....

.....

.....

..... [2]

- (c) The computer has both primary and secondary storage.

- (i) Random access memory (RAM) is one example of primary storage.

Describe what is meant by RAM.

.....

.....

.....

..... [2]

- (ii) Read only memory (ROM) is another example of primary storage. ROM often stores the start-up instructions for a computer.

Identify **one** other item of data that is commonly stored in ROM.

.....

..... [1]

- (iii) Some computers make use of virtual memory.

State the purpose of virtual memory.

.....

..... [1]

3 A computer has an operating system (OS).

(a) Complete the table by writing each missing OS function name and description.

Function name	Description
managing memory	<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>
<p>.....</p> <p>.....</p>	allows application software to run on the computer
managing peripherals	<p>.....</p> <p>.....</p> <p>.....</p> <p>.....</p>

[3]

(b) The OS handles interrupts.

(i) State the purpose of an interrupt.

.....

..... [1]

(ii) Identify **one** input device and **one** example of an interrupt that it can generate.

Input device

Interrupt

[1]

- (iii) A processor is currently executing a program. The processor receives an interrupt.

Explain how the processor manages the current program and the interrupt.

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..... [5]

- 4 A student enters a uniform resource locator (URL) into their web browser.

Draw and annotate a diagram to show the process from the user entering the URL to the web browser displaying the web page.

[5]

5 Complete the description of digital currencies using the terms provided.

blockchains changed datachains decentralised
deleted encryption passport physical address
physically records time-stamp traced
transaction-chains virtually

A digital currency does **not** exist , it can only be accessed electronically.

Some digital currencies have digital ledgers called

These are decentralised databases where each transaction is stored as a new set of data with a and is linked to the previous set of data. This means that transactions cannot be altered, only new transactions added, which allows the location of the data to be

[4]

- 6 A self-driving tractor sows seeds and harvests crops for a farmer. The self-driving tractor moves automatically through the field, turning at each end and stopping when it has finished.

- (a) One reason the self-driving tractor is a robot is because it has a mechanical structure that includes wheels, an engine, and a framework.

Give **one** other reason why the self-driving tractor is an example of a robot.

.....
 [1]

- (b) If a person is detected within 3 metres whilst the tractor is moving, the self-driving tractor must stop.

- (i) Explain how an infra-red sensor, microprocessor and actuator can be used to stop the self-driving tractor if a person is detected within 3 metres.

.....

 [5]

- (ii) Identify **one** other sensor that the self-driving tractor might use and how it will use the sensor.

Sensor

Use

..... [2]

- (c) Explain the drawbacks of a farmer using a self-driving tractor to sow seeds and harvest crops.

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..... [3]

- (d) The self-driving tractor has an in-built expert system that the farmer can use to solve any errors with the tractor.

Identify **three** components of an expert system.

1

2

3 [3]

- (e) At the end of each day the self-driving tractor transmits the data it has collected to the farmer's computer in their house.

The transmission uses an echo check.

- (i) Describe the role of the self-driving tractor and the farmer's computer in the echo check.

.....

.....

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.....

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..... [3]

- (ii) Another method of error checking is a parity block check.

The table shows 7 bytes that are transmitted using odd parity. The parity bit has been completed for each byte.

Complete the parity byte for the data.

	parity bit	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1
byte 1	1	1	0	0	1	1	1	0
byte 2	1	0	0	0	0	1	1	0
byte 3	0	1	0	0	0	0	0	0
byte 4	0	1	0	0	1	1	1	1
byte 5	1	0	0	0	0	0	0	0
byte 6	0	1	1	1	1	1	1	1
byte 7	1	1	0	0	1	1	0	1
parity byte								

[3]

7 Data is transmitted using the internet.

(a) The data is encrypted before transmission.

(i) State the purpose of encrypting data.

.....
 [1]

(ii) Describe the differences between symmetric and asymmetric encryption.

.....

 [4]

(b) The data is transmitted using packet switching.

(i) Identify **two** items of data contained in a packet header.

1
 2 [2]

(ii) Give the purpose of a router in the packet-switching process.

.....
 [1]

8 (a) Hexadecimal can be used to represent binary numbers.

(i) Convert the denary number 236 into hexadecimal.

.....
 [1]

Working space

.....

(ii) Give **one** benefit of using hexadecimal instead of binary to represent data.

.....
 [1]

(b) Two's complement can be used to represent positive and negative binary integers.

(i) Convert the two's complement integer 10110111 into denary.

Show all your working.

.....

 [2]

(ii) Convert the denary number 45 into an 8-bit two's complement integer.

.....
 [1]

Working space

.....

(c) Logical shifts are performed on binary integers.

State the mathematical effect of a right shift of **four** places on a positive binary integer.

.....

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..... [2]

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