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COMPUTER SCIENCE **0478/12**

Paper 1 Computer Systems **February/March 2024**

1 hour 45 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- 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.

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.

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[Turn over

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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

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

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..... [2]

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(c) Sound can be represented as binary.

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

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..... [2]

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

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..... [1]

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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 .....

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[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.

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..... [1]

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(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.

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..... [2]

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

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

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..... [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.

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..... [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.

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..... [1]

(iii) Some computers make use of virtual memory.

State the purpose of virtual memory.

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..... [1]

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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	…… …… …… ……
…… ……	allows application software to run on the computer
managing peripherals	…… …… …… ……

[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]

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(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]

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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]

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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]

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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.

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..... [5]

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

Sensor .....

Use .....

.....
[2]

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(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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..... [3]

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(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]

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7 Data is transmitted using the internet.

(a) The data is encrypted before transmission.

(i) State the purpose of encrypting data.

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..... [1]

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

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..... [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.

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..... [1]

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

(i) Convert the denary number 236 into hexadecimal.

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..... [1]

Working space

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

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..... [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.

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..... [2]

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

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..... [1]

Working space

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(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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