Computer Science (9-1)

1.1 – Systems architecture
Practice Questions
Antony Gallagher

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:
Additional resources may be supplied with this paper.

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **45**.
- The total number of marks may take into account some 'either/or' question choices.

1 Identify **four** events that take place during the fetch-execute cycle.

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[4]

2 Identify **two** events that take place during the fetch-execute cycle.

1 ---

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2 ---

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[2]

3 Here are some statements about the CPU of a computer.

Tick **one** box in each row to show whether each of the following statements is true or false.

Statement	True	False
CPU stands for Central Processing Unit.		
The CPU fetches and decodes instructions.		
The speed of a CPU is usually measured in GigaHertz (GHz).		
If a CPU has many cores, this slows down the computer.		
The hard disk drive is part of the CPU.		

[5]

4 A CPU has a clock speed of 3.8 GHz. etc.

Describe what is meant by a clock speed of 3.8 GHz.

---

[2]

5 Draw **one** line from each part of the processor to its correct definition.

Part of the processor	Definition
Control Unit (CU)	Performs mathematical operations
Cache	Sends signals to direct the operations
Arithmetic Logic Unit (ALU)	Keeps the clock in sync
Register	A small piece of memory inside the processor that can hold one instruction or address
	High speed memory inside the processor that stores recently used instructions

[4]

6 Quinn's current computer specification is shown in Fig. 4.

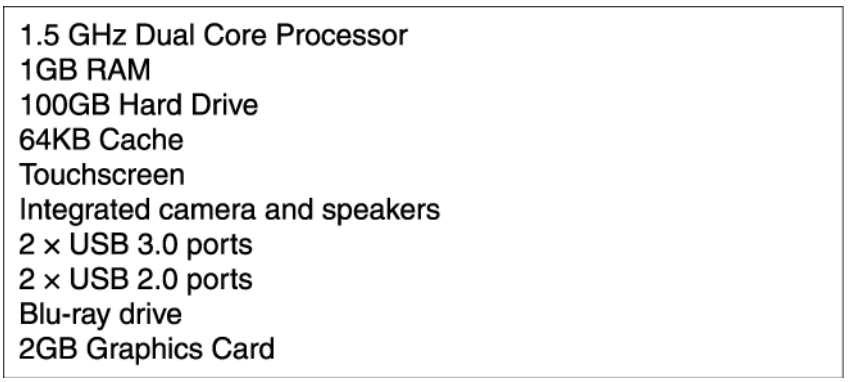

Fig. 4

Describe the benefits of a dual core processor over a single core processor.

--- [2]

7(a) Alicia has designed a computer using Von Neumann architecture.

Describe the purpose of **two** registers that are used by Von Neumann architecture.

1 ---

---

2 ---

---

[4]

(b) Alicia says:

"My computer has a quad-core processor, so it will run twice as fast as a computer with a dual-core processor".

Explain why this statement is not always true.

---

[3]

8 Ann wants to purchase a new computer and is looking at two models. The specification of the CPU in each computer is shown in **Fig. 1**.

Fig. 1

Computer 1	Computer 2
Clock Speed: 1 GHz	Clock Speed: 1.4 GHz
Cache size: 2 MB	Cache size: 2 MB
Number of Cores: 4	Number of Cores: 2

When running a 3D flight simulator, Computer 1 is likely to run faster than Computer 2.

Using the information in **Fig. 1**, identify **one** reason for this.

---

[1]

9 The following paragraph describes embedded systems.

Complete the paragraph by selecting terms from the list and writing them in the correct places. Not all terms are used.

actuator	applications	change	functions	laptop	larger
lights	microprocessor	processor	range	smaller	washing machine

Embedded systems have limited ..... They are often

built into a ..... machine. Two examples of embedded

systems are a ..... and automated

..... in a car.

[4]

10 Xander's tablet computer comes with system software, including an operating system and utility system software.

Xander also has a smart watch.

(i) Tick (✓) **one** box to show whether the smart watch or the laptop is an example of an embedded system.

	Is an example of an embedded system
Smart watch	
Laptop	

[1]

(ii) Justify your choice to **part (i)**.

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[2]

11(a) Dipesh is thinking of buying a tablet computer to replace his old desktop computer.

Describe how the CPU and RAM work together to enable the tablet computer to operate.

[3]

(b) The tablet computer also uses cache memory. Describe the purpose of cache memory.

[2]

(i) The table has **five** components of a computer, and **four** statements.

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

Statement	MAR	MDR	Cache	Program Counter	RAM
It stores a single address					
It stores frequently used instructions					
It is a register					
It stores all currently running data **and** instructions					

[4]

(ii) Identify the name of **one** register **not** given in **part (i)** and describe its purpose.

Register _____

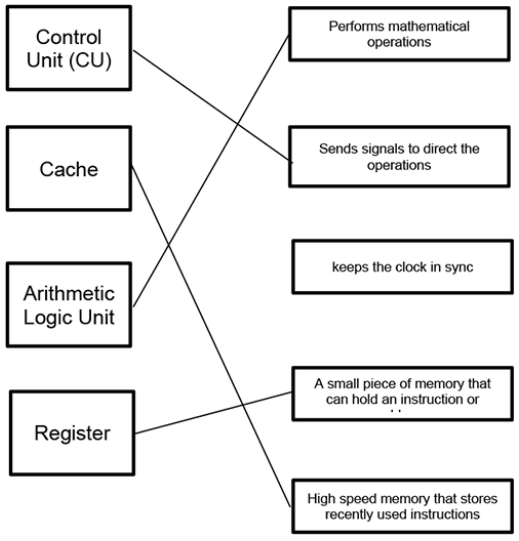
Purpose _____

[2]

END OF QUESTION PAPER

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td></td><td></td><td>• An instruction is fetched from memory
• The instruction is then decoded
• The decoded instruction is then executed so that the CPU performs continuously
• The process is repeated
• The program counter is incremented
• The instruction is transferred to the MDR
• The address of the instruction to be fetched is placed in the MAR</td><td>4</td><td>1 mark is to be awarded for each correct answer to a maximum of 4 marks.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>4</td><td></td></tr>
<tr><td>2</td><td></td><td></td><td>• An instruction is fetched from memory
• The instruction is then decoded
• The decoded instruction is then executed so that the CPU performs continuously
• The process is repeated
• The program counter is incremented
• The instruction is transferred to the MDR
• The address of the instruction to be fetched is placed in the MAR</td><td>2
(AO1 1a)</td><td>1 mark to be awarded for each correct answer to a maximum of 2 marks.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>2</td><td></td></tr>
<tr><td>3</td><td></td><td></td><td><table><tr><th>Statement</th><th>True</th><th>False</th></tr><tr><td>CPU stands for Central Processing Unit</td><td>?</td><td></td></tr><tr><td>The CPU fetches and decodes instructions</td><td>?</td><td></td></tr><tr><td>The speed of a CPU is usually measured in GigaHertz (GHz)</td><td>?</td><td></td></tr><tr><td>If a CPU has many cores, this slows down the computer</td><td></td><td>?</td></tr><tr><td>The hard disk drive is part of the CPU</td><td></td><td>?</td></tr></table>One mark per row</td><td>5</td><td>?Examiner's Comments??

This question was generally well answered.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>5</td><td></td></tr>
</table>

Question			Answer/Indicative content	Marks	Guidance
4			1 mark per bullet to max 2 • The number of FDE cycles run per given time/second // the frequency that the clock 'ticks' • 3.8 billion cycles/instructions … • …per second	2 AO1 1b (1) AO2 1a (1)	Do not award: how fast the computer is // speed of CPU 3.8 = 3,800,000,000 <u>Examiner's Comments</u> This question was answered well with many candidates able to demonstrate an understanding of the clock speed of a computer. Fewer candidates correctly translated the 3.8 GHz into the correct number of instructions/FDE cycles performed. Less able candidates did not identify an appropriate time frame, for example 'the number of instructions it can process' has a different meaning to 'the number of instructions it can process per second'. Another common misconception was it is the number of instructions it can perform at a time, a processor can only perform one instruction at a time.
			Total	**2**	
5			1 mark per correct line from component to definition  	4	Any 2 lines from 1 component = 0 mark
			Total	**4**	

Question			Answer/Indicative content	Marks	Guidance
6			2 from • Tasks can split between the processors… • …tasks / processes / software / can be processed faster • …more processes completed per second • Allows multitasking // Run more than one process / task / instruction / data at a time / per clock cycle… • … tasks / processes / software / can be processed faster • …more processes completed per second	2	MUST have given splitting tasks, or multi-tasking to allow speed Faster can only be given a mark if the first bullet(s) have been given. Examiner's Comments This question was answered fairly well, candidates were able to express that two processes could be carried out at once, and they then often got a second mark for identifying that this made it faster. Some candidates could not clearly express what was being processed, or simply stated that it was faster which was insufficient as the actual processes are not carried out faster, it is faster because it is completing two processes at the same time.
			Total	2	

Question			Answer/Indicative content	Marks	Guidance
7	a		1 mark per bullet to max 2 per register • MAR // memory address register • Stores the address/location where data will be **read/written/accessed/fetched** // address/location of data/instruction being **processed** // address/location of data/instruction next to be **processed** • MDR // memory data register • Stores the data/instruction that is **fetched/read** from memory // stores the data that is to be written to memory // stores the data/instruction from the address in the MAR // data/instruction next to be **processed** • Program counter • Stores the address/location of the next instruction to be run // stores the address/location of the current instruction being run • Accumulator • Stores the result of manipulation/process/calculation	4 AO1 1a (2) AO1 1b (2)	MAR stores address is not enough for description MDR stores the data is not enough for description Allow: • Current instruction register // IR • Stores the instruction currently being processed Accept MBR // Memory buffer register for MDR <u>Examiner's Comments</u> Many candidates were able to accurately name two registers. The more able were able to accurately describe the purpose of these registers. Some candidates were not specific enough in their responses to gain the descriptive marks, or repeated the name of a register without the purpose, e.g. 'The memory address register stores the address of the data'.

Question			Answer/Indicative content	Marks	Guidance

	b		1 mark per bullet to max 3
			e.g.
			
			• Software may be designed to run on 1 core and not multiple cores
			// depends on the task(s)
			• …some tasks cannot be split across cores
			• Clock speed also affects speed
			// dual core may have a faster clock speed
			// quad-core may have slower clock speed
			• …so one task may be run faster/slower
			• RAM size also affects speed
			// Quad-core may have less RAM
			// amount of VM being used
			• Cache size also affects speed
			// Quad-core may have less cache
				3
				AO1 1b (1)
				AO2 2b (2)
					Allow marks for other components that could affect the speed e.g. secondary storage access speed, onboard GPU.
					Award description of concurrent processing.
					
					<u>Examiner's Comments</u>
					
					Most candidates were able to identify other features that could also have an impact on the speed of the computer such as the processor speed, amount of RAM etc. The more able candidates were also able to identify that the tasks being performed will also impact on the speed, for example how software may not be optimised for quad-core, or that a process may have to wait for a different process to finish execution before it can be processed.

			Total	**7**	
8			It has more cores.	1	Although Computer 1 has a lower clock speed than the CPU in Computer 2 it has more cores, which means that it can be faster than Computer 2. Any answer relating to splitting a program into processes that be carried out consecutively will be accepted.
			Total	**1**	

Question			Answer/Indicative content	Marks	Guidance
9			1 mark for each completed term Embedded systems have limited **functions.** They are often built into a **larger** machine. Two examples of embedded systems are a **washing machine** and automated **lights** in a car.	4	
			Total	**4**	
10		i	Smart watch	1 AO2 1a (1)	CAO <u>Examiner's Comments</u> This question was answered correctly by the majority of candidates who were able to identify that a smart watch is an example of an embedded system.
		ii	1 mark per bullet for justification to max 2 • A smart watch is not a <u>general-purpose computer</u> • … which means the smart watch has one/limited/specific/dedicated function(s) • Smart watch has a microprocessor • … on a single circuit board • It is a computer system that is built within the watch • Runs firmware • Smart watch has built-in OS // difficult to change/manipulate the OS/function • Smart watch has few components all essential to its purpose • Smart watch has specific hardware required to function i.e. speaker/headphones	2 AO2 1b (2)	• Answers must be applied to scenario. Do not award generic definitions. • Allow opposite reasons for why a laptop is not an embedded system but do not allow repeated points. <u>Examiner's Comments</u> Candidates were able to gain marks for explaining why a smart watch is an embedded system or why a laptop is not or a combination of the two. The most common answers referred to the limited features of a smart watch, while a laptop is a general-purpose computer that can perform any number of tasks. Some candidates gave a generic definition of an embedded system which was insufficient because the question required candidates to apply their knowledge to the scenario.
			Total	**3**	

Question			Answer/Indicative content	Marks	Guidance
11	a		• Instructions / programs(currently running) / data are stored in the RAM… • these are fetched from the RAM by the CPU / Processor • … where the instructions are executed / instructions are processed / data is processed	3	If the candidate has described the functions of RAM and the CPU separately, only award the 2nd bullet if it is clearly stated that instructions are fetched from RAM. Mention of the fetch – execute cycle in the CPU is enough to award bullet 3.
	b		• To store instructions / data that is frequently used / previously used / next to be used • Data does not need to be fetched from RAM • Speeds up access	2	
			Total	5	

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>12</td><td></td><td>i</td><td>1 mark for correct ticks and gaps on each row

<table><tr><th>Statement</th><th>MAR</th><th>MDR</th><th>Cache</th><th>Program Counter</th><th>RAM</th></tr><tr><td>It stores a single address</td><td>✓</td><td></td><td></td><td>✓</td><td></td></tr><tr><td>It stores frequently used instructions</td><td></td><td></td><td>✓</td><td></td><td></td></tr><tr><td>It is a register</td><td>✓</td><td>✓</td><td></td><td>✓</td><td></td></tr><tr><td>It stores all currently running data and instructions</td><td></td><td></td><td></td><td></td><td>✓</td></tr></table></td><td>4</td><td>If extra ticks on each row, 0 marks for that row</td></tr>
<tr><td></td><td></td><td>ii</td><td>1 mark for register e.g. accumulator
1 mark for description e.g. stores the result of arithmetic operations</td><td>2</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>6</td><td></td></tr>
</table>