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EDEXCEL INTERNATIONAL GCSE COMPUTER SCIENCE: QUESTIONS BY TOPIC

Computers (Topic 4)

International GCSE Computer Science Topic 4

9 questions · 117 marks · Mark schemes included

Pearson Edexcel International GCSE (9–1) Computer Science 4CP0, Papers 1 & 2, June 2019 - June 2022

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HOW TO USE THIS BOOKLET

Grouped by sub-topic, lowest mark tariff first. Paper 2 answers use the Python mark scheme (2A).

Click any heading or question row below to jump straight to it.

On every question page, click ANSWER in the top-right corner to jump to its mark scheme.

Diagrams, graphs, tables and data are printed exactly as they appeared in the original papers.

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QUESTIONS

9 questions · 117 marks · grouped by sub-topic



SUB-TOPIC 4(a)

4(a) MACHINES AND COMPUTATIONAL MODELS (THE CPU)

4 questions in this booklet



1 Computers are made up of both hardware and software components.

(a) Computers use a three-step computational model.

Complete the diagram with the names of the **three** steps.

(3)



(b) Identify the hardware component responsible for controlling the fetch-decode-execute cycle.

(1)

- ☐ A Cache
- ☐ B Central processing unit
- ☐ C ROM
- ☐ D Address bus

(c) Von Neumann developed the stored program concept that permits two different types of item to reside in memory.

Name these **two** types.

(2)

- 1
- 2

(d) Some computers use virtual memory.

Explain how virtual memory works.

(2)

(e) An optical storage device writes data onto a CD or DVD.

Describe how data is stored physically on optical media.

(2)

(f) A disc-formatting program is an example of a type of software.

Identify the type.

(1)

- ☐ **A** Security software
- ☐ **B** Application software
- ☐ **C** Translation software
- ☐ **D** System software

(Total for Question 1 = 11 marks)



1 Computer systems have both hardware and software components.

(a) The central processing unit (CPU) uses the fetch-decode-execute cycle.

(i) State what is meant by the term **program instruction**.

(1)

(ii) State what is meant by the term **memory address**.

(1)

(b) Identify the component of the CPU that provides temporary data storage.

(1)

- ☐ A Address bus
- ☐ B Data bus
- ☐ C Control unit
- ☐ D Register

(c) The performance of the CPU is affected by the clock speed.

(i) Give **one** benefit of having a higher clock speed.

(1)

(ii) Give **one** drawback of having a higher clock speed.

(1)



(d) Identify which **one** of these describes a sequential computational model.

(1)

- ☐ **A** Program instructions are read one after another from external storage
- ☐ **B** Program instructions are executed by multiple agents working together
- ☐ **C** Program instructions are executed in parallel by different cores
- ☐ **D** Program instructions are executed one after another

(e) A program can be written in a high-level or a low-level language.

(i) Give **one** reason for writing a program in a low-level language.

(1)

(ii) State the purpose of an assembler.

(1)

(iii) Complete the table by adding **one** tick (✓) in **each** row to match the description.

(3)

Description	Compiler	Interpreter
Translates the program each time it is executed		
Produces permanent object code		
Translates line by line		
Translates the whole program before it is run		
Generates a list of errors once the complete program has been translated		

(Total for Question 1 = 11 marks)



- 5 Computers can be general-purpose or specific-purpose machines.
- (a) The central processing unit (CPU) is responsible for executing a program.

Figure 4 shows some of the hardware components of a computer system.

Complete the table by matching the component to the letters shown in **Figure 4**. (5)

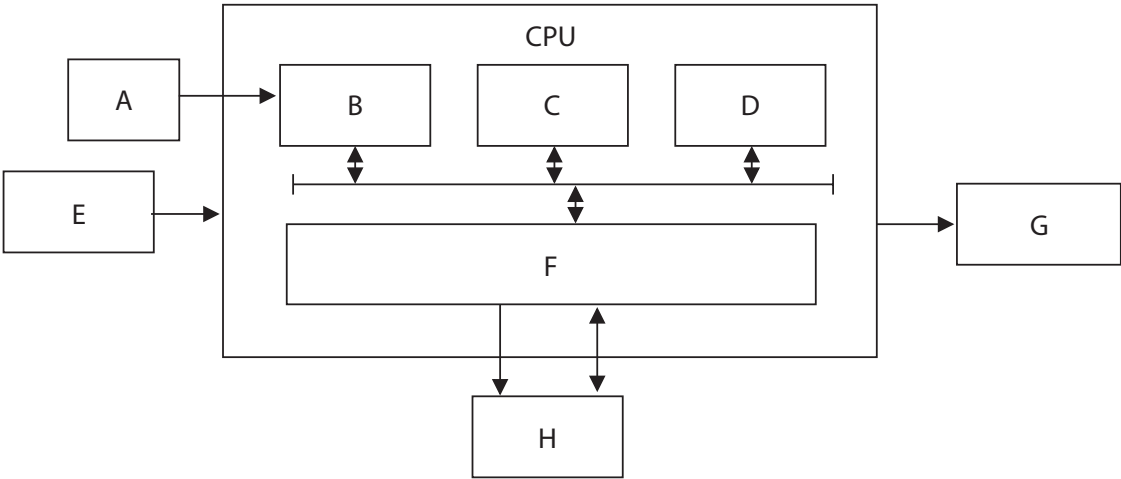


Figure 4

Component	Letter
Control unit	
Output device	
Registers	C
Main memory	
Cache	F
Input device	
Arithmetic/logic unit (ALU)	
Clock	A

(b) The CPU runs a fetch-decode-execute cycle.

- (i) Some registers within the CPU are general-purpose whilst others perform a specific function.

One register is the program counter. Its function is to keep track of the next instruction to be fetched.

Describe how it does this.

(2)

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.....

.....

- (ii) The control bus carries signals from the processor to other components.

Identify the signal that would be used during the **fetch** stage of the cycle.

(1)

- ☐ **A** Memory delete signal
- ☐ **B** Memory read signal
- ☐ **C** Memory store signal
- ☐ **D** Memory write signal

- (iii) Clock speed is the number of pulses the CPU's clock generates per second.

State how increasing the speed of the clock impacts on the fetch-decode-execute cycle.

(1)

.....

.....

(c) An embedded system forms part of a larger system, device or machine.

- (i) Give **two** features of an embedded system.

(2)

1

.....

2

.....



- (ii) There are many factors to consider when choosing a CPU for an embedded system.

For example, the clock speed of the CPU in a TV remote control can be low because it only has to be fast enough to create a low frequency output signal for the TV.

Explain **one other** factor that should be considered when choosing a CPU for an embedded system within a TV remote control.

(2)

(Total for Question 5 = 13 marks)



3 The central processing unit (CPU) and other hardware components work together with the operating system to run programs and store data.

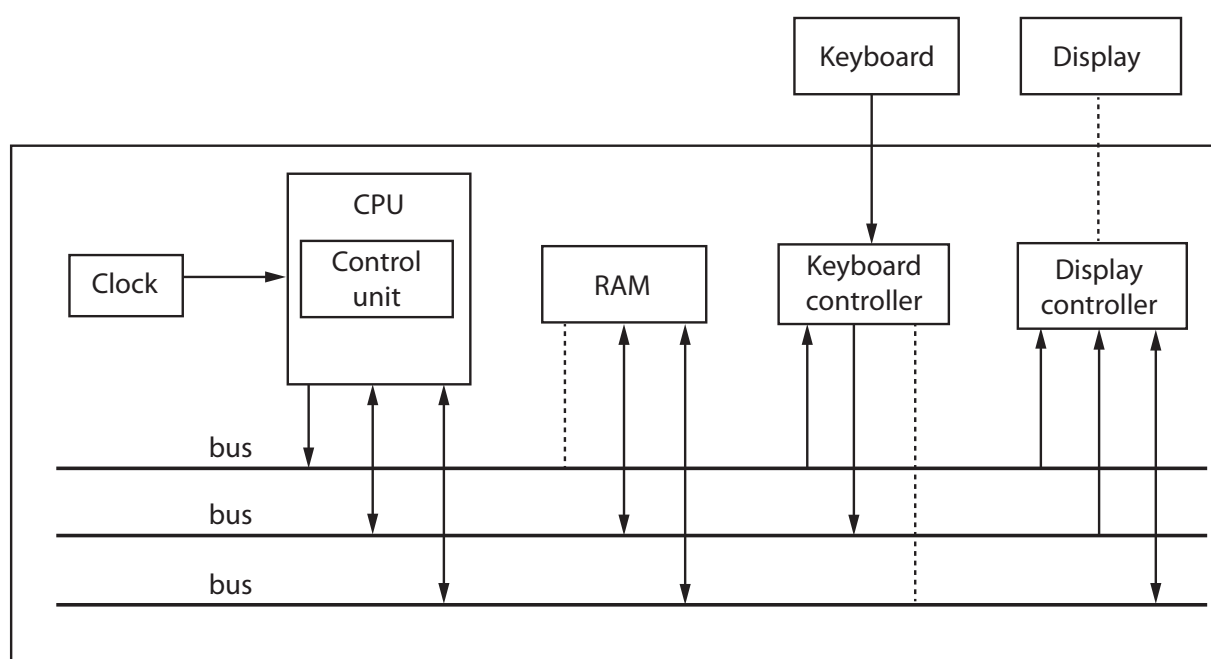
(a) Here is a partially completed diagram showing the hardware components used in the fetch-decode-execute cycle.

The function of the I/O controller is to manage communication between the CPU and input/output devices.

Complete the diagram by:

- labelling the buses
- adding directional arrows to the dotted lines to show the flow of communication.

(6)



(b) The CPU includes an area of cache memory.

Increasing the size of the cache will improve the performance of the CPU.

Explain how increasing the size of the cache improves the performance.

(2)

.....

.....

.....

.....

(c) Some computers have more than one CPU. The CPUs work in parallel to execute instructions.

Complete the table to show how two CPUs working in parallel could execute the expression:

$(5 * 2) + (4 * 3) - (24 / 4)$

(4)

CPU 1	CPU 2
$5 * 2 = 10$	

(d) One function of an operating system is to manage files on secondary storage.

Describe how an operating system manages the storage of a file on random access secondary storage.

(4)

SUB-TOPIC 4(b)

4(b) HARDWARE: MEMORY AND STORAGE

2 questions in this booklet



3 Zakir wants to buy a new laptop.

(a) He knows that a laptop has both hardware and software.

Explain why the laptop needs both hardware and software.

(2)

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.....

(b) Zakir needs to choose between a solid state drive and a hard disc drive.

(i) Give **two** reasons, other than cost and capacity, why Zakir may choose a solid state drive rather than a hard disc drive.

(2)

1

.....

2

.....

(ii) Solid state drives store data on flash memory, which is similar to RAM.

Explain **one** difference between flash memory and RAM.

(2)

.....

.....

.....

.....

(c) One of the laptops has 4 megabytes (MB) of cache memory.

Explain the purpose of cache memory.

(2)

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(d) Zakir uses many devices.

Complete the table by adding **one** tick (✓) in each row to show whether the device is an input device, an output device or both.

(2)

Device	Input	Output	Both
Headset			
Mouse			
Printer			
Touch screen			

(e) Zakir needs to protect his laptop against malware.

Give **two** types of anti-malware software he could install.

(2)

1

2

(Total for Question 3 = 12 marks)



6 A train company uses ticket vending machines at each station.

(a) The machines use embedded systems.

(i) Explain **one** benefit of using an embedded system in these machines.

(2)

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(ii) Customers use a touch screen to select their destination. They can pay by cash or bank card. Their tickets and a receipt are printed.

The touch screen is controlled by an embedded system.

Give **two** other hardware components in the ticket machine that are controlled by embedded systems.

(2)

1

.....

2

.....

(iii) The ticket machine uses data encryption when a customer pays using a bank card.

State why data encryption is used in this case.

(1)

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.....

(b) Compare **four** features of high-level and low-level programming languages.

(4)

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(c) Artificial intelligence (AI), in many forms, has an increasing impact on our lives.

Discuss this statement considering characteristics, uses and ethical issues.

(6)



SUB-TOPIC 4(c)

4(c) LOGIC

2 questions in this booklet



5 Programmers work as part of a team to develop software.

(a) They use truth tables to determine if an expression evaluates to true or false.

Complete this truth table for the Boolean expression

P AND (Q OR R)

You may not need to use all rows.

(3)

P	Q	R	Q OR R	P AND (Q OR R)

(b) The team is working on software for a ride-on lawn mower.

The lawn mower must not start unless it is safe for the driver.

- The brake (B) must be engaged.
- The driver's seat sensor (S) must be engaged.
- The blade safety lock (L) must be removed.

Construct a Boolean expression, using AND, OR, and NOT with the letters B, S and L to show the safe starting condition.

(2)

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(c) The team uses code reviews as part of the software development process.

State **two** ways in which code reviews can help protect software systems from cyber attacks.

(2)

1

.....

2

.....

(d) The team needs to protect its intellectual property rights over the systems that it develops.

Give **three** types of legal protection the team could use.

(3)

1

.....

2

.....

3



4 Scientists often use models and simulations.

(a) Give **one** reason, other than cost, why scientists use simulations.

(1)

.....

.....

(b) Explain **one** reason why a simulation may require a powerful processor.

(2)

.....

.....

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.....

(c) A scientist uses Boolean logic in programs.

Complete the table to show the results of each operation.

(3)

R	S	W	NOT S	R AND W	(NOT S) OR (R AND W)
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			



(d) Von Neumann developed the stored program concept.

(i) Describe the **stored program concept**.

(2)

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(ii) The fetch-decode-execute cycle is the cycle the central processing unit (CPU) follows in order to process instructions.

Name **two** registers used in the cycle.

(2)

1

2

(iii) Describe the role of the address bus and the data bus during the **fetch** part of the cycle.

(2)

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.....

(iv) Complete the table to show the effect on a computer system of increasing the width of a bus.

(2)

Change made	Effect
Increasing the width of the data bus	
Increasing the width of the address bus	

(Total for Question 4 = 14 marks)



SUB-TOPIC 4(d)

4(d) SOFTWARE AND PROGRAMMING LANGUAGES

1 question in this booklet



6 Akiko develops software programs.

(a) Akiko can use a low-level or a high-level programming language to write code.

(i) Give **one** benefit of using a low-level programming language to develop a program.

(1)

.....

.....

(ii) Give **one** drawback of using a low-level programming language to develop a program.

(1)

.....

.....

(b) Akiko is writing an anti-virus program.

(i) The program will include a virus removal function.

Give **two other** functions that should be included.

(2)

1

.....

2

.....

(ii) An anti-virus program is one type of anti-malware.

Give **one other** type of anti-malware.

(1)

.....



(c) Akiko is also working on a burglar alarm system.

The alarm must only be triggered if:

- the alarm (A) is set
- it is dark outside (O)
- a window (W) or a door (D) has been opened.

Construct a Boolean expression, using AND, OR and NOT with the letters A, O, W, and D to show the conditions that will trigger the alarm.

(4)

(d) Akiko wants to know how the software she writes can be protected.

Discuss how the software can be protected from illegal copying and/or illegal distribution.

You should consider:

- intellectual property
- licensing.

(6)

MARK SCHEMES

official Pearson Edexcel mark schemes



Question Number	Answer	Additional Guidance	Mark
1(a)	Award one from: Input, process, output in this order – 3 marks Input, process, output in any order – 2 marks At least one of input, process, output – 1 mark		3

Question Number	Answer	Additional Guidance	Mark
1(b)	B: Central processing unit The only correct answer is B A is not correct as this is memory only C is not correct as this is memory only D is not correct as this is used only for transporting memory addresses		1

Question Number	Answer	Additional Guidance	Mark
1(c)	• Data (1) • Instructions (1)		2

Question Number	Answer	Additional Guidance	Mark
1(d)	Any two from: 1. Virtual memory (VM) is used when RAM becomes full (1) (to hold all programs and data). 2. Virtual memory is used as (an extension to) main memory/RAM / works like RAM. (1) 3. Virtual memory is stored/created on (internal) secondary storage/HDD/SSD. (1) 4. Virtual memory is used as temporary storage. (1) 5. Instructions and data not currently being used are transferred from RAM to VM/HDD. (1) 6. When needed again, instructions and data are transferred back to RAM. (1)		2

Question Number	Answer	Additional Guidance	Mark
1(e)	Any two from: 1. The disc surface is made out of polycarbonate. (1) 2. A laser (beam) is used. (1) 3. Data is stored as a series of tiny grooves arranged in tracks on the surface of the disc. (1) 4. Bumps/lands/flats/troughs/pits/dips imprinted/burnt on the disc. (1) 5. Bumps and flats (etc.) represent 1 and 0 (bits) / the reflection (of the laser) represents 1 and 0 (bits). (1)		2

Question Number	Answer	Additional Guidance	Mark
1(f)	D: System software The only correct answer is D A is not correct because this category is purely for software that is used for security purposes B is not correct because this category is designed for end user tasks rather than for managing the computer itself C is not correct because this software is used to translate a high level program into machine code		1

Question Number	Answer	Additional Guidance	Mark
1(a)(i)	Award one mark from: • An action/task that is carried out (by the CPU) (1) • An operation/code that is/will be executed (by the CPU) (1) • Something that tells the CPU/processor/device what to do (1)	Allow examples	1
1 (a)(ii)	Award one mark from: • A pointer/reference to/identification of a location in memory (1) • A pointer/reference to/location where data will be accessed from/stored (to)(1)		1

Question Number	Answer	Additional Guidance	Mark
1(b)	The only correct answer is D <i>A is not correct because the address bus carries the address of the memory location</i> <i>B is not correct because the data bus carries but does not store data</i> <i>C is not correct because the control unit sends signals but does not handle the data</i>		1

Question Number	Answer	Additional Guidance	Mark
1(c)(i)	Award one mark from: • More instructions can be carried out per second (1) • Processes run faster (1) • Programs executed faster (1) • Can run more complex programs (1)		1
1(c)(ii)	Award one mark from: • The CPU/computer could overheat (1) • More cooling required (1) • Needs more power (1) • CPU could become unstable/crash / its lifespan could be shortened (1)		1

Question Number	Answer	Additional Guidance	Mark
1(d)	The only correct answer is D <i>A is not correct because it describes a method of accessing data from a secondary storage device</i> <i>B is not correct because it describes the multi-agent computational model</i> <i>C is not correct because it describes the parallel computational model</i>		1



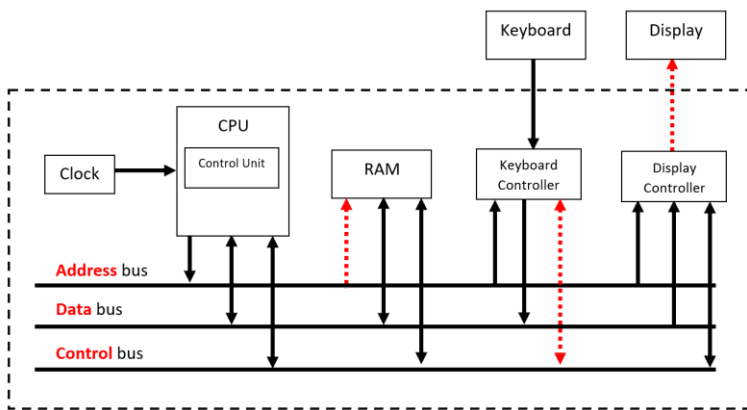
Question Number	Answer	Additional Guidance	Mark																		
1(e)(i)	Award one mark from: • When fast execution of the program is essential/gives faster execution (1) • When writing code to control a device / directly access the hardware (1) • To make efficient use of a device's limited storage/memory/power (1) • When writing code for a particular architecture/hardware/embedded system (1)		1																		
1(e)(ii)	Award one mark for: • To translate/convert assembly language into machine/object code (1)		1																		
1(e)(iii)	Award one mark for any two correct rows (1) Award two marks for any four correct rows (2) Award three marks for all five correct rows (3) <table border="1"><thead><tr><th>Description</th><th>Compiler</th><th>Interpreter</th></tr></thead><tbody><tr><td>Translates the program each time it is executed</td><td></td><td>☐</td></tr><tr><td>Produces permanent object code</td><td>☐</td><td></td></tr><tr><td>Translates line by line</td><td></td><td>☐</td></tr><tr><td>Translates the whole program before it is run</td><td>☐</td><td></td></tr><tr><td>Generates a list of errors once the complete program has been translated</td><td>☐</td><td></td></tr></tbody></table>	Description	Compiler	Interpreter	Translates the program each time it is executed		☐	Produces permanent object code	☐		Translates line by line		☐	Translates the whole program before it is run	☐		Generates a list of errors once the complete program has been translated	☐		Row can only be correct if there is only one tick.	3
Description	Compiler	Interpreter																			
Translates the program each time it is executed		☐																			
Produces permanent object code	☐																				
Translates line by line		☐																			
Translates the whole program before it is run	☐																				
Generates a list of errors once the complete program has been translated	☐																				
Total for question 1			11																		



Question Number	Answer	Additional Guidance	Mark																		
5(a)	Award one mark for each correct component: <table><tr><th>Component</th><th>Letter</th></tr><tr><td>Control unit</td><td>B</td></tr><tr><td>Output device</td><td>G</td></tr><tr><td>Registers</td><td>C</td></tr><tr><td>Main memory</td><td>H</td></tr><tr><td>Cache</td><td>F</td></tr><tr><td>Input device</td><td>E</td></tr><tr><td>Arithmetic/logic unit (ALU)</td><td>D</td></tr><tr><td>Clock</td><td>A</td></tr></table>	Component	Letter	Control unit	B	Output device	G	Registers	C	Main memory	H	Cache	F	Input device	E	Arithmetic/logic unit (ALU)	D	Clock	A		
Component	Letter																				
Control unit	B																				
Output device	G																				
Registers	C																				
Main memory	H																				
Cache	F																				
Input device	E																				
Arithmetic/logic unit (ALU)	D																				
Clock	A																				

Question Number	Answer	Additional Guidance	Mark
5(b)(i)	Award one mark each to a maximum of two marks for: - stores a memory address (for the next instruction) (1) - memory address incremented/changed during the fetch process (1)		2
5(b)(ii)	The only correct answer is B <i>A is not correct because</i> there is no such signal <i>C is not correct because</i> as there is no such signal <i>D is not correct because</i> as that does not take place during the fetch stage		1
5(b)(iii)	Award one mark from: - processes more instructions in the same amount of time (1) - more cycles can be performed in the same amount of time (1) - fetch-execute-decode cycle runs faster (1)		1

Question Number	Answer	Additional Guidance	Mark
5(c)(i)	Award one mark from: - a system designed for one/a few specific functions/task(s) (1) - has both hardware and software (1) - has integrated memory (1) - has no or minimal user interface (1) - is power efficient/low power consumption (1) - its functionality cannot be changed/upgraded by users (1) - often use sensors and actuators to interact with the external environment (1) - functions in real time (1)		2
5(c)(ii)	Award up to two marks for a linked explanation such as: - Performance / number of cores / power consumption needs to be adequate for the task (1) because any more would waste money / power (1) - Size of cache can be small or non-existent (1) because there is no need to store frequently used instructions (1) - The RAM can be limited/very small (1) because it is only holding a limited number of instructions (1) - Only needs a small bus width (1) because the output signals are serial binary (1)		2
Total			13

Question Number	Answer	Additional Guidance	Mark
3(a)	 • Address bus labelled correctly (1) • Data bus labelled correctly (1) • Control bus labelled correctly (1) • Arrow from address bus to RAM (1) • Bi-Directional arrows from control bus to keyboard controller (1) • Arrow points from display controller to display (1)		6

Question Number	Answer	Additional Guidance	Mark
3(b)	Award two marks for a linked explanation such as: The cache stores frequently used data/instructions (1) so the processor does not have to wait because cache is checked before main memory / because RAM is further away from the processor (1). It speeds up processing (1) because cache is a faster type of memory (1).		2

Question Number	Answer	Additional Guidance	Mark								
3(c)	<table><tr><th>CPU1</th><th>CPU2</th></tr><tr><td>$5 * 2 = 10$</td><td>$4 * 3 = 12$ (1)</td></tr><tr><td>$10 + 12 = 22$ (1)</td><td>$24 / 4 = 6$ (1)</td></tr><tr><td>$22 - 6 = 16$ (1)</td><td></td></tr></table>	CPU1	CPU2	$5 * 2 = 10$	$4 * 3 = 12$ (1)	$10 + 12 = 22$ (1)	$24 / 4 = 6$ (1)	$22 - 6 = 16$ (1)		The second row expressions can be in either column $22 - 6 = 16$ May appear in either CPU in the final row	4
CPU1	CPU2										
$5 * 2 = 10$	$4 * 3 = 12$ (1)										
$10 + 12 = 22$ (1)	$24 / 4 = 6$ (1)										
$22 - 6 = 16$ (1)											

Question Number	Answer	Additional Guidance	Mark
3(d)	Any four from: - The OS checks whether sufficient space is available on the storage (media) for the file (1). - The file is broken into blocks (1) - The blocks are stored in spaces that are large enough (1) - OS looks for (fat/ntfs)/ reserves (linux) (groups of) contiguous blocks (1) - Blocks can reside anywhere on the storage (1). - The OS updates the file allocation table (with the start location and sequence number of each block) (1) - OS sets hard links to files (1) ntfs - OS updates journal/MFT (1) ntfs/linux - Metadata about the file such as read/write permissions, date created and last accessed is separately stored (1)		4

Question Number	Answer	Additional Guidance	Mark
3(a)	Award two marks for an explanation that includes hardware and software. • The laptop is/contains the hardware (1) and the software allows the user to interact with it (1) • Hardware gives input and output devices (1) /memory, storage, cpu, processing ability • Software allows instructions to be passed to the hardware (1) so that it can carry out tasks (1) • Software is the set of instructions (1) that controls the hardware (1)		2

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	Award two marks from: • Lighter/thinner (1) • Less heat generated (1) • Faster access speed / faster booting of operating system / faster data transfer/read/write speeds (1) • Silent operation (1) • Less power required / longer battery life (1) • More robust (due to no moving parts) (1)		2
3(b)(ii)	Award two marks for a linked explanation such as: • Flash memory is non-volatile (1) whereas RAM is volatile (1) • Flash memory persists even when power is lost (1) whereas RAM clears its data whenever power is lost (1) • Flash memory is used for storage (1) whereas RAM is used in performing operations on data taken from storage (1)		2

Question Number	Answer	Additional Guidance	Mark
3(c)	Award two marks for a linked explanation such as: Cache memory stores active/commonly used instructions / cache is a temporary storage (1) and is used to speed up processing. (1) stop data transfer bottlenecks between RAM and CPU (1)		2

Question Number	Answer	Additional Guidance	Mark																				
3(d)	Award one mark for two correct rows. Award two marks for four correct rows. <table border="1"> <thead> <tr> <th>Device</th><th>Input</th><th>Output</th><th>Both</th></tr> </thead> <tbody> <tr> <td>Headset</td><td></td><td></td><td>✓</td></tr> <tr> <td>Mouse</td><td>✓</td><td></td><td></td></tr> <tr> <td>Printer</td><td></td><td>✓</td><td></td></tr> <tr> <td>Touch screen</td><td></td><td></td><td>✓</td></tr> </tbody> </table>	Device	Input	Output	Both	Headset			✓	Mouse	✓			Printer		✓		Touch screen			✓		2
Device	Input	Output	Both																				
Headset			✓																				
Mouse	✓																						
Printer		✓																					
Touch screen			✓																				

Question Number	Answer	Additional Guidance	Mark
3(e)	Award two marks from: - Antivirus (1) - Anti-spyware (1) (Software) firewall (1)	Do not award tradenames	2

Question Number	Answer	Additional Guidance	Mark
6(a)(i)	Features such as power consumption / processor / memory / number and type of components / physical size (1) can be optimised / chosen to fit just one specific task. (1)		2

Question Number	Answer	Additional Guidance	Mark
6(a)(ii)	Any two from: • Printer (1) • Bank card (magnetic strip) reader/scanner (1) • Bank card contactless/NFC reader/scanner (1) • Cash input and giving change device (1)	Allow any hardware that relates to paying by cash for MP4	2

Question Number	Answer	Additional Guidance	Mark
6(a)(iii)	To prevent unauthorised people from reading / understanding the bank card information (1)	Do not award 'to keep it from being hacked / accessed'.	1

Question Number	Answer	Additional Guidance	Mark
6(b)	Award one mark for each of (maximum of 4): 1. Readability: high-level language is easily readable by a human because it is designed to look like English whereas a low-level language is binary patterns / mnemonics / abbreviations. (1) 2. Portability: code written in a high-level language is easily transportable across machines whereas a low-level language is designed for a specific microprocessor / piece of hardware. (1) 3. Uses: low-level languages are commonly used to write programs for hardware or devices, like printers, whereas high-level languages are commonly used for to write higher-level applications, such as word processors. (1) 4. Optimisation: low-level languages are used to improve performance, especially of hardware, whereas high-level languages have to go through multiple layers of software to get to the hardware, e.g. the need for HLL to be compiled/interpreted makes programmes run slower than LLL, HLL has a higher level of abstraction removing unnecessary detail (one to many), LLL keeps more of a detail (one to one) (1) 5. Ease of use: high-level languages usually have tools, functions, libraries and development environments which are accessible, even by those with little knowledge, whereas, low-level languages are often challenging to work with and require expertise and depth of knowledge. (1)	For each mark point: • the general feature is followed by exemplification • needs to be a comparison, which may be implicit	4

Question Number	Answer	Mark
6(c)	Indicative content: Characteristics – Any of the following: • Implemented in software. • Could involve the use of neural networks / clustering / modelling • Algorithms are trained by exposure to data that has been validated / checked • Algorithms learn by identifying commonalities between the validated / checked data • Algorithms make predictions for new data based on prior learning • Algorithms may incorporate recursive self-improvement Uses – Any of the following: • Game playing (opponents) • Analytics (analyse buying patterns, predicting behaviours, predictive text, targeted advertising, personalised news feeds, friend suggestions) • Image / Audio processing (recognising objects/patterns, face recognition) • Logistics (scheduling, order fulfilment) • Control systems (cars, manufacturing, weapons, navigation) • Diagnostic systems (medical, mechanical, electrical) • Natural languages processing (chatbots, chatbots, speech recognition, personal assistants) • Robotics (dangerous situations, help aged or disabled) Ethical issues – Any of the following: • Training sets could include data that should not be used to make decisions (race, religion, gender, etc.) that could cause biased outcomes • Is a computer to be trusted to make decisions (life-death)? • If a computer discovers something that humans can't prove, should it be accepted as truth? • How do we know that the answer produced is correct? • Will people be comfortable interacting with machines that are considered intelligent? • Some jobs may be at risk, especially those requiring human skills such as empathy or creativity.	6



Level	Mark	Descriptor
	0	No rewardable content.
Level 1	1-2	Basic, independent points are made showing elements of knowledge and understanding of key concepts/principles of computer science. The discussion will contain basic information with little linkage between points made.
Level 2	3-4	Demonstrates adequate knowledge and understanding of key concepts/principles of computer science. The discussion shows some linkages and lines of reasoning with some structure.
Level 3	5-6	Demonstrates comprehensive knowledge and understanding by selecting relevant knowledge and understanding of key concepts/principles of computer science to support the discussion being presented. The discussion shows a well-developed, sustained line of reasoning which is clear, coherent and logically structured.

5(a)

P	Q	R	Q OR R	P AND (Q OR R)
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	1	0
1	0	0	0	0
1	0	1	1	1
1	1	0	1	1
1	1	1	1	1

Award **one** mark for each of:

- All possible combinations in columns P, Q and R (1)
- Correct values in Q or R (1)
- Correct values in final column (1)

Allow follow through for incorrect mark point 2.

3

Question Number	Answer	Additional Guidance	Mark
5(b)	B AND S AND NOT L Award one mark for each of: NOT L or B AND S (1) Fully correct (1)	Any order and ignore brackets	2

Question Number	Answer	Additional Guidance	Mark
5(c)	Any two of: - Remove code vulnerabilities in programming languages (1). - Eliminate bad programming practices (1).		2

Question Number	Answer	Additional Guidance	Mark
5(d)	Award one mark each for any of: - Copyright (1) - Patent (1) - Licensing (1) - Trademark (1)		3

Question Number	Answer	Additional Guidance	Mark
4(a)	Award one mark from: - Predict/model outcomes (1) - Investigate hypotheses (1) - Run experiments that cannot be run / are dangerous in real life (1) - Simulations can be speeded up/slowed down (1)		1

4(b)	Award two marks from: - Simulations (may) use/collect large amounts of data (1) - Simulations (may) involve a large number of calculations (1) - Simulations may need more CPU cycles as the amount of data grows (1) - To be of value, the results must be calculated as quickly as possible (1) - Calculations may grow exponentially / become more complex as the simulation runs/is modified (1) - Simulation may output complex graphics (e.g. virtual world) (1)		2
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Question Number	Answer	Additional Guidance	Mark																											
4(c)	<table><tr><th>NOT S</th><th>R AND W</th><th>(NOT S) OR (R AND W)</th></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>1</td><td>1</td></tr><tr><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td></tr></table> Award one mark for each of: • Correct values in NOT S column (1) • Correct values in R AND W column (1) • Correct values in final column (1)	NOT S	R AND W	(NOT S) OR (R AND W)	1	0	1	1	0	1	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	1	1	Allow follow through for incorrect mark point 1 and/or mark point 2	3
NOT S	R AND W	(NOT S) OR (R AND W)																												
1	0	1																												
1	0	1																												
0	0	0																												
0	0	0																												
1	0	1																												
1	1	1																												
0	0	0																												
0	1	1																												

Question Number	Answer	Additional Guidance	Mark						
4(d)(i)	Award two marks for a linked description such as: • Instructions (and data) are stored in (main) memory (1) • Instructions (and data) are fetched, decoded, and executed (in a sequence by the CPU) (1)	Must include storage and execution for 2 marks	2						
4(d)(ii)	Award two marks from: • Program counter / PC (1) • Current instruction (register) / CIR (1) • Memory address (register) / MAR (1) • Memory buffer/data (register) / MBR/MDR (1) • Accumulator/ACC (1)		2						
4(d)(iii)	Award two marks for a linked description such as: Address of instruction carried on address bus (to main memory) (1) contents at that address carried back (to the CPU) on the data bus (1)		2						
4(d)(iv)	Award two marks from: <table border="1"><thead><tr><th>Change made</th><th>Effect</th></tr></thead><tbody><tr><td>Increasing the width of the data bus</td><td>Increases the number of bits/data/ size of word that can be transferred at one time / increases rate of data transfer (1)</td></tr><tr><td>Increasing the width of the address bus</td><td>Increases the number of memory addresses / increases the maximum amount of memory that can be addressed (1)</td></tr></tbody></table>	Change made	Effect	Increasing the width of the data bus	Increases the number of bits/data/ size of word that can be transferred at one time / increases rate of data transfer (1)	Increasing the width of the address bus	Increases the number of memory addresses / increases the maximum amount of memory that can be addressed (1)	Do not accept increases bandwidth without further explanation	2
Change made	Effect								
Increasing the width of the data bus	Increases the number of bits/data/ size of word that can be transferred at one time / increases rate of data transfer (1)								
Increasing the width of the address bus	Increases the number of memory addresses / increases the maximum amount of memory that can be addressed (1)								

Question Number	Answer	Additional Guidance	Mark
6(a)(i)	Award one mark from: • faster translation/execution (1) • allows her to directly address components / make efficient use of available memory space (1) • can dispense with the need for an OS to make the code run faster/free up memory space (1)		1
6(a)(ii)	Award one mark from: • difficult to read/understand (1) • easy to make mistakes (1) • can be hard to find errors in the code (1) • time consuming (to write) (1) • not very portable / processor-specific (1) • lack of built-in functions/procedures (1) • few development/editorial tools available (1)		1

Question Number	Answer	Additional Guidance	Mark
6(b)(i)	Award one mark from: • virus detection/scanner (1) • threat identification (1) • real-time scanning (1) • scan scheduling (1) • quarantine files (1) • carry out automatic updates (1) • on-demand file scanning (1) • kill switch (1)		2
6(b)(ii)	Award one mark from: • anti-spyware (1) • anti-adware (1)		1
6(c)	A AND O AND (W OR D) Award one mark each to a maximum of four marks for: • A AND O (1) • W OR D (1) • Brackets around W OR D (1) • AND between A AND O (W OR D) (1)		4

6(d)	Intellectual property • Intellectual property is any work that is distinct, owned, and protected by patent or copyright laws • Akiko's software programs fall into this category • She will be able to protect her intellectual property • Her software is protected by copyright without her having to apply for it Licensing • Purchasing software does not mean you own it • Could add a licence key to the software. • Could require compulsory registration using the internet • Could allow proprietary licences, which do not allow code modification or code reuse. • Could allow Free and open-source software (FOSS), which would allow the user to modify and reuse the code. • Creative Commons (CC) ◦ Could use creative commons (CC) licences that would allow the free distribution of copyrighted work ◦ Would use if Akiko wanted to allow people to share, use and build on the programs. ◦ May mention some of the CC licences and conditions		6
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Level	Mark	Descriptor
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Total		15

