OCR
Oxford Cambridge and RSA

GCE

Computer Science

Unit **H046/01:** Computing principles

Advanced Subsidiary GCE

Mark Scheme for June 2018

Oxford Cambridge and RSA Examinations

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

Annotations

Annotation	Meaning
⌃	Omission mark
BOD	Benefit of the doubt
C	Subordinate clause / consequential error
✖	Incorrect point
E	Expansion of a point
FT	Follow through
NAQ	Not answered question
NBOD	No benefit of doubt given
P	Point being made
REP	Repeat
/	Slash / half-mark
✔	Correct point
TV	Too vague
0	Zero (big)

Annotation	Meaning
BP	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
L1	Level 1
L2	Level 2
L3	Level 3

LEVELS OF RESPONSE QUESTIONS:

The indicative content indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance.

Using 'best-fit', decide first which set of BAND DESCRIPTORS best describes the overall quality of the answer. Once the band is located, adjust the mark concentrating on features of the answer which make it stronger or weaker following the guidelines for refinement.

- **Highest mark**: If clear evidence of all the qualities in the band descriptors is shown, the HIGHEST Mark should be awarded.
- **Lowest mark**: If the answer shows the candidate to be borderline (i.e. they have achieved all the qualities of the bands below and show limited evidence of meeting the criteria of the band in question) the LOWEST mark should be awarded.
- **Middle mark**: This mark should be used for candidates who are secure in the band. They are not 'borderline' but they have only achieved some of the qualities in the band descriptors.

Be prepared to use the full range of marks. Do not reserve (e.g.) high Band 3 marks 'in case' something turns up of a quality you have not yet seen. If an answer gives clear evidence of the qualities described in the band descriptors, reward appropriately.

	AO1	AO2	AO3
High (thorough)	Precision in the use of question terminology. Knowledge shown is consistent and well-developed. Clear appreciation of the question from a range of different perspectives making extensive use of acquired knowledge and understanding.	Knowledge and understanding shown is consistently applied to context enabling a logical and sustained argument to develop. Examples used enhance rather than detract from response.	Concerted effort is made to consider all aspects of a system/problem or weigh up both sides to an argument before forming an overall conclusion. Judgements made are based on appropriate and concise arguments that have been developed in response resulting in them being both supported and realistic.
Middle (reasonable)	Awareness of the meaning of the terms in the question. Knowledge is sound and effectively demonstrated. Demands of question understood although at times opportunities to make use of acquired knowledge and understanding not always taken.	Knowledge and understanding applied to context. Whilst clear evidence that an argument builds and develops through response there are times when opportunities are missed to use an example or relate an aspect of knowledge or understanding to the context provided.	There is a reasonable attempt to reach a conclusion considering aspects of a system/problem or weighing up both sides of an argument. However the impact of the conclusion is often lessened by a lack of supported judgements which accompany it. This inability to build on and develop lines of argument as developed in the response can detract from the overall quality of the response.

Low (basic)	Confusion and inability to deconstruct terminology as used in the question. Knowledge partial and superficial. Focus on question narrow and often one-dimensional.	Inability to apply knowledge and understanding in any sustained way to context resulting in tenuous and unsupported statements being made. Examples if used are for the most part irrelevant and unsubstantiated.	Little or no attempt to prioritise or weigh up factors during course of answer. Conclusion is often dislocated from response and any judgements lack substance due in part to the basic level of argument that has been demonstrated throughout response.

	Assessment Objective
AO1	Demonstrate knowledge and understanding of the principles and concepts of computer science, including abstraction, logic, algorithms and data representation.
AO1.1	Demonstrate knowledge of the principles and concepts of abstraction, logic, algorithms, data representation or other as appropriate.
AO1.2	Demonstrate understanding of the principles and concepts of abstraction, logic, algorithms, data representation or other as appropriate.
AO2	Apply knowledge and understanding of the principles and concepts of computer science including to analyse problems in computational terms.
AO2.1	Apply knowledge and understanding of the principles and concepts of computer science.
AO2.2	Analyse problems in computational terms.
AO3	Design, program and evaluate computer systems that solve problems, making reasoned judgements about these and presenting conclusions.
AO3.1	Design computer systems that solve problems.
AO3.2	Program computer systems that solve problems.
AO3.3	Evaluate computer systems that solve problems, making reasoned judgements about these and presenting conclusions.

Question			Answer	Marks	Guidance
1	a		<table><tr><td>Operating system</td><td>Tick One</td></tr><tr><td>Distributed</td><td></td></tr><tr><td>Embedded</td><td>✓</td></tr><tr><td>Multi-user</td><td></td></tr></table>	**1** **AO2.1** **(1)**	
	b		- The software will not need updating - Can be loaded quickly when the frame is switched on/will not be lost when the frame is switched off. - Cannot be (accidentally) overwritten/deleted *(1 per -, max 2)*	**2** **AO1.2** **(2)**	
	c		*advantage* - Costs less to design/produce. *because* - Requires less cooling to be built in. - (If battery powered) can run off smaller battery. - Has fewer instructions than other (CISC) processors. - Simpler (circuit/hardware) design/manufacture. - Fewer transistors. *(1 per -, max 2, 1 max from 'because' group)*	**2** **AO2.1** **(2)**	
	d		- Devices on the network have equal status/no (central) server. - Devices on the network share data *(1 per -, max 2)*	**2** **AO1.1** **(2)**	
	e		- Potentially vulnerable to hacking. - Reliant on an internet connection/requires a fast enough internet connection. - Reliant on company servers. *(1 per -, max 1)*	**1** **AO2.1** **(1)**	
	f		- (External) hard (disk) drive/ solid state drive - Flash memory card/stick/drive *(1 per -, max 1)*	**1** **AO1.2** **(1)**	Accept SD Card/Micro SD Card Do not accept just 'USB', must be USB stick/device//pen/drive

Question			Answer	Marks	Guidance
2	a		(Onscreen) keyboard/touchscreen Allowing the user to type in/select reading/numbers on the screen. Camera Takes a photo of the meter/reading and the smartphone/application recognises the numbers. Microphone The user speaks the reading/numbers and the smartphone/application (using speech recognition software) interprets them. *(1 mark per input device, 1 mark per corresponding description of method)*	**2** **AO2.1** **(2)**	Accept keypad

	b		- Returns `false` if reading is not a number.
			- Returns `true` if reading is >=1
			- and <=999999 *(but no other values)*
			- Returns `false` for a number not between these values.
			
			(1 per -, max 4)
				4
				
				AO3.2
				(4)
					Example solution:
					`if(!isNaN(reading) && reading>=1 &&`
					`reading<=999999)`
					`{`
					`        return true;`
					`}`
					`else`
					`{`
					`        return false;`
					`}`
					Do not penalise for lack of ;
					{ } are not needed in this case.
					
					NB: credit should be given for validating length

	c	i	- A program/software - That controls a piece of hardware - Providing an interface/bridge between the device and (operating) system *(1 per -, max 2)*	**2** **AO1.1** **(2)**	

Question			Answer	Marks	Guidance
	c	ii	Protocol(s)	**1** **AO1.1** **(1)**	cao
	c	iii	- Spreadsheet package - DBMS/database (1 per -, max 1)	**1** **AO1.2** **(1)**	Accept any suitable application. No proprietary names
3	a		- The CPUs can work in parallel - … on the same problem - try multiple keys simultaneously… - …to break the code (1 per -, max 2)	**2** **AO3.3** **(2)**	
	b		- The Regulation of Investigatory Powers Act (Accept RIPA) - Legislates as to how organisations can monitor electronic communications - Allows interception of communications - Allows them to get communications information from ISP - Allows them to perform surveillance (e.g. key logging) - Certain actions require government approval - Different organisations have different limits on what they can do (GCHQ is amongst those that have most freedom). (1 per -, max 2)	**2** **AO2.1** **(2)**	
4	a		- The BIOS is loaded/ carries out its checks - the BIOS/bootstrap loads up the OS. (1 per -, max 2)	**2** **AO2.1** **(2)**	
	b		- Disk Defragmenter - Compression Utility - Disk Checker - Virus checker - File manager (1 per -, max 1)	**1** **AO1.2** **(1)**	Accept any sensible utility. No proprietary names

Question			Answer	Marks	Guidance
	c		**Mark Band 3–High Level (7-9 marks)** The candidate demonstrates a thorough knowledge and understanding of how OSs manage resources (for this band these should be reference to CPU time and memory); Strong evaluation of different approaches. The candidate provides a thorough discussion which is well-balanced. Evaluative comments are consistently relevant and well-considered. There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated. Candidate has used appropriate technical terminology throughout. There are few if any spelling errors or errors of grammar. **Mark Band 2 –Mid Level (4-6 marks)** The candidate demonstrates reasonable knowledge and understanding of how OSs manage system resources (for 5+ Marks there should be reference to both CPU time and memory). The candidate provides a reasonable discussion, the majority of which is focused. Evaluative comments are for the most part appropriate, although one or two opportunities for development are missed. There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence. There may be spelling errors or errors of grammar in the response but they are not obtrusive.	9 AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)	**AO1** Memory management divides memory either by paging or segmentation. Virtual memory is where part of secondary storage is treated as extra memory space. It is used when physical memory space is limited. CPU time is allocated to processing using scheduling. Schedulers use different algorithms. When CPU attention is needed interrupts are generated. **AO2** Paging divides memory by fixed size physical divisions. Whilst all pages are the same size, what that size is can vary. Segmentation is dividing memory according to variable size logical divisions. Scheduling algorithms include Round Robin (Each job gets a fixed time slice), First Come First Served (The first job to arrive is processed until completion, then the next…), Shortest Job First (The quickest to complete job is finished first), Shortest Remaining Time (quickest job is completed first but stops and re-evaluates when a new job arrives), Multi-Level Feedback Queue (Jobs are put in different queues depending on their importance). Interrupts are signals sent to the processor asking for attention. **AO3** With segmentation only the exact space needed is used per program, however as programs are loaded and removed from memory there may be wasted space between programs. Programmers often need to specify segments.

Question	Answer	Marks	Guidance
	Mark Band 1-Low Level (1-3 marks) The candidate demonstrates a basic knowledge of how OSs manage system resources The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided The candidate provides a limited discussion which is narrow in focus. Judgments if made are weak and unsubstantiated. The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear. There are likely to be spelling errors and/or errors of grammar, which will disrupt the flow of the response **0 marks** No attempt to answer the question or response is not worthy of credit.		The fixed size of pages make it easier to allocate pages and work out their position. Space inside a page may be 'wasted' as program is unlikely to take up exact number of pages, however all pages can be used with no wasted space between them. Programmer need not worry about the pages. In practice both are used in conjunction (e.g. segmentation on top of paging). Some scheduling algorithms (e.g. SJF, STR) can cause starvation (i.e. certain jobs never get processed). More complicated scheduling algorithms take up lots of processor time for the scheduling itself, taking away processing time from the actual jobs that need processing. Interrupts mean that the processor only has to worry about being needed when told (as opposed to having to constantly check i.e. polling).

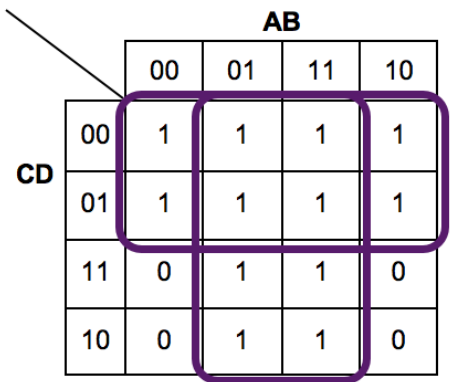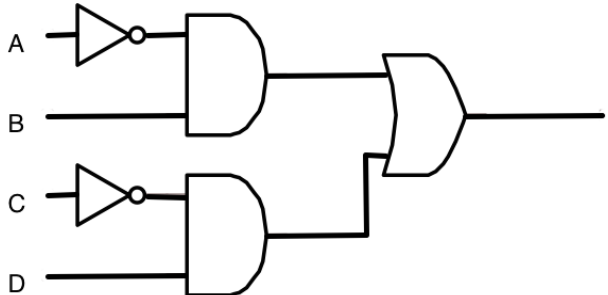| Question			Answer	Marks	Guidance
5	a		01001000	**1** **AO1.2 (1)**	
	b		133	**1** **AO1.2 (1)**	
	c		68	**1** **AO1.2 (1)**	
	d		- Exponent is 4 - Move binary point 4 places to the right - Answer is: 9.25 (1 per -, max 3)	**3** **AO1.2 (3)**	Accept any other method if working is shown
	e		- Computers use a character set/ASCII/ UNICODE - To map binary values to characters - Each character is represented by a unique value (1 per -, max 2)	**2** **AO1.1 (2)**	

Question			Answer	Marks	Guidance
6	a		 Gives: B∨¬C - Correct two groups identified. - B∨ - ¬C (1 per -, max 3)	3 AO2.1 (1, 1st Mark) AO2.2 (2, Last 2 Marks)	Also accept: ¬C ∨ B Accept alternative symbols.
	b		- NOT gates after A and C - AND gates: one taking (NOT) A, B as inputs the other taking (NOT) C, D as inputs. - An OR gate taking in the outputs of both AND gates. - …No further gates or connections (1 per -, max 4)	4 AO2.2 (4)	

Question	Answer	Marks	Guidance

7	- Initialise all 4 totals variables
	- Checks through all items in the array via suitable loop.
	- Add temperatures <=10 to Band A
	- Adds temperatures >=31 to Band D
	- Correctly assigns temperatures between 11 and 20 inclusive to Band B and those between 21-30 inclusive to Band C
	- Uses else if (or equivalent) for efficiency rather than multiple ifs **OR** uses select/case **OR** any other solution that stops trying to categorise a temperature once its band is found.
	- Displays results in similar format to shown in question.
	(1 per -, max 6)
		6
		
		AO3.2
		(6)
			Example:
			`bandA = 0`
			`bandB = 0`
			`bandC = 0`
			`bandD = 0`
			`for i=0 to temperatures[].length - 1`
			`  if temperatures[i]<=10 then`
			`    bandA = bandA + 1`
			`  elseif temperatures[i]<=20 then`
			`    bandB = bandB + 1`
			`  elseif temperatures[i]<=30 then`
			`    bandC = bandC + 1`
			`  else`
			`    bandD = bandD + 1`
			`  endif`
			`next i`
			`print("Band A: " + bandA)`
			`print("Band B: " + bandB)`
			`print("Band C: " + bandC)`
			`print("Band D: " + bandD)`
			
			Some solutions may use Select/Case.
			
			E.g.
			
			`Select Case temperatures[i]`
			`    Case Is<=10`
			`        bandA=bandA+1`
			
			Look out for alternative methods of iteration such as using iterators

Question	Answer	Marks	Guidance
8	**Mark Band 3–High Level (7-9 marks)** The candidate demonstrates a thorough knowledge and understanding of how VMs can be used (for full marks they have identified 2 realistic uses of VMs); Thorough discussion of pros and cons of VMs. The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence/examples will be explicitly relevant to the explanation. The candidate provides a thorough discussion which is well-balanced. Evaluative comments are consistently relevant and well-considered. There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated. Candidate has used appropriate technical terminology throughout. There are few if any spelling errors or errors of grammar. **Mark Band 2 –Mid Level (4-6 marks)** The candidate demonstrates reasonable knowledge and understanding of how a VM could be used and their pros and cons. Evidence/examples are for the most part implicitly relevant to the explanation The candidate provides a reasonable discussion, the majority of which is focused. Evaluative comments are for the most part appropriate, although one or two opportunities for development are missed. There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence. There may be spelling errors or errors of grammar in the response but they are not obtrusive.	**9** **AO1.1 (2)** **AO1.2 (2)** **AO2.1 (2)** **AO3.3 (3)**	*Points May Include:* **AO1** - A virtual machine is a piece of software that behaves in the same way as an actual computer. - In this case the VM on the computer would behave as though it were a games console. - Some VMs are used to interpret intermediate code. **AO2** - VMs of different consoles allow the program to be tested for different machines from the programmer's computer. - Saves space and the time and cost of setting up multiple systems. - Requires a powerful computer (as must run its own OS and the VM). - The VMs need to be accurate representations of the physical machine or the final code will not work on them. - Game could be written in a language that is interpreted to intermediate code and is run off a VM. - This means only one version of the code needs be written and it will run on all systems. - This saves time and maximizes profits. - However the game will run more slowly than if it had been compiled to native code. **AO3** - Using Virtual Machines may be a useful tool during testing, saving time. - Realistically physical machines will have to be used at some point to be 100% sure everything works as it should. - Using a VM to run intermediate code makes it easy to release for a variety of platforms. - But will be at the expense of game performance.

Question			Answer	Marks	Guidance
			Mark Band 1-Low Level (1-3 marks) The candidate demonstrates a basic knowledge of how VMs could be used and an understanding of pros or cons of their use. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided The candidate provides a limited discussion which is narrow in focus. Judgments if made are weak and unsubstantiated. The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear. There are likely to be spelling errors and/or errors of grammar, which will disrupt the flow of the response **0 marks** No attempt to answer the question or response is not worthy of credit.		

Mark Scheme

Question			Answer	Marks	Guidance
9	a		Accumulator	**1** **AO1.2** **(1)**	Accept ACC
	b		<table><tr><td>**Stage**</td><td>**Tick (✓)**</td></tr><tr><td>Fetch</td><td></td></tr><tr><td>Decode</td><td></td></tr><tr><td>Execute</td><td>✓</td></tr></table>	**1** **AO2.1** **(1)**	
| | c | | - Asks for a number.<br>- repeatedly…<br>-  until 3 is entered.<br>(1 per -, max 3) | **3**<br>**AO3.2**<br>**(3)** | ```
loop     INP
         SUB num
         BRZ end
         BRA loop
end      HLT
num      DAT 3
```<br><br>Accept answers that use immediate addressing<br>ie., SUB #3 |

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