OCR
Oxford Cambridge and RSA

GCE

Computer Science

Unit **H046/02:** Algorithms and problem solving

Advanced Subsidiary GCE

Mark Scheme for June 2017

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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.

OCR will not enter into any discussion or correspondence in connection with this mark scheme.

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Annotations

Annotation	Meaning
^	Omission mark
BOD	Benefit of the doubt
	Incorrect point
FT	Follow through
NAQ	Not answered question
NBOD	No benefit of doubt given
P	Point being made
REP	Repeat
	Correct point
TV	Too vague
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
CON	Contradiction

Subject-specific Marking Instructions

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper and its rubrics
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

USING THE MARK SCHEME

Please study this Mark Scheme carefully. The Mark Scheme is an integral part of the process that begins with the setting of the question paper and ends with the awarding of grades. Question papers and Mark Schemes are developed in association with each other so that issues of differentiation and positive achievement can be addressed from the very start.

This Mark Scheme is a working document; it is not exhaustive; it does not provide 'correct' answers. The Mark Scheme can only provide 'best guesses' about how the question will work out, and it is subject to revision after we have looked at a wide range of scripts.

The Examiners' Standardisation Meeting will ensure that the Mark Scheme covers the range of candidates' responses to the questions, and that all Examiners understand and apply the Mark Scheme in the same way. The Mark Scheme will be discussed and amended at the meeting, and administrative procedures will be confirmed. Co-ordination scripts will be issued at the meeting to exemplify aspects of candidates' responses and achievements; the co-ordination scripts then become part of this Mark Scheme.

Before the Standardisation Meeting, you should read and mark in pencil a number of scripts, in order to gain an impression of the range of responses and achievement that may be expected.

In your marking, you will encounter valid responses which are not covered by the Mark Scheme: these responses must be credited. You will encounter answers which fall outside the 'target range' of Bands for the paper which you are marking. Please mark these answers according to the marking criteria.

Please read carefully all the scripts in your allocation and make every effort to look positively for achievement throughout the ability range. Always be prepared to use the full range of marks.

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	i	1 mark each • Binary [1] • Linear [1]	2 AO1.1 (2)	

1	a	ii	If the algorithm name does not match the description given then max 4 marks for description.
			
			Binary
			• Works on an ordered set of data [1]
			• Find mid-point [1]
			• If equal to mid-point [1]
			  ○ Report found [1]
			• If less than mid-point[1]
			  ○ Make sub-list from left [1]
			• If greater than mid-point [1]
			  ○ Make sub-list from right [1]
			• Repeat with sub-list until found / sub-list is empty [1]
			
			Linear
			• Can work on both ordered and unordered data sets [1]
			• Get first element [1]
			• If equal [1]
			  ○ Report found [1]
			• If not equal [1]
			  ○ Move to next element [1]
			• Repeat for all elements, until found / end of list reached [1]
					For binary search, allow movement of upper bound and lower bound instead of making sub-lists

1	b		1 mark per bullet
			• Looping through/outputting for each row [1]
			• Calculating/using the middle value [1]
			• Outputting the 6th value from the array correctly [1]
			e.g.
			`for x = 0 to 15`
			`  print(data[x,5])`
			`next x`
				3 AO3.2 (3)	

1	c		1 mark per bullet
			• Looping through each column [1]
			• Looping through each row [1]
			• ...Adding to a total [1]
			• …Calculating average correctly [1]
			• Outputting average [1]
			e.g.
			`for y = 0 to 10`
			`  total = 0`
			`  for x = 0 to 15`
			`  total = total + data[x,y]`
			`  next x`
			`  print(total / 16)`
			`next y`
				5 AO3.2 (5)	Note that the running counter for the sum in each row needs to be reset to get the calculating average correct.
					
					Note average output must appear inside the outer loop

2	a		1 mark per input, 1 for description e.g. • w/up arrow[1] • ...to allow the character to move up • s/down arrow[1] • ...to allow the character to move down • a/left arrow[1] • ...to allow the character to move left • d/right arrow[1] • ...to allow the character to move right	**4 AO2.2 (4)**	Answers must relate specifically to the *character* control, which is via a keyboard.

2	b		1 mark for sub-procedure names (to max 3) 1 for description (to max 3) e.g. • `startGame` [1] • loads the game, displaying the load-up screen[1] • `displayMap` [1] • outputs the map onto the screen[1] • `selectArea` [1] • the user clicks on the area of the map and this is displayed on screen[1] • `loadPuzzle` [1] • loads the puzzle for the chosen area and displays it on screen [1]	**6 AO2.2 (6)**	Allow any reasonable sub-procedure and description for the context Do not award marks for character movement.
2	c	i	1 mark for each parameter – case sensitive • `inputKey` [1] • `characterx` [1] • `charactery` [1]	**3 AO1.2 (3)**	No spaces allowed in parameter names
2	c	ii	1 mark per bullet • Decision is based on the value of `inputKey`… [1] • ... and the values of `characterx` **or** `charactery` are changed [1] • Description of a condition and what it will do e.g. If the input key equals value 37 [1], then the x coordinate is increased [1]	**3 AO1.2 (1) AO2.1 (2)**	
2	c	iii	1 mark per bullet to max 3 • ByRef changes the value in the variable passed (`characterx` and `charactery`) [1]	**3 AO2.1**	

			• ByRef passes the address/location [1] • ByVal only a copy of the data is passed [1] • ByVal the change would be lost when the procedure ended [1]		
2	d		**Mark Band 3 – High level** **(7-9 marks)** The candidate demonstrates thorough knowledge and understanding of the need and purpose of reusable program components. The material is generally accurate and detailed. The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. The candidate provides a thorough discussion which is well-balanced. Evaluate comments are consistently relevant and well-considered. A suitable choice is given with justification. *There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.* **Mark Band 2 – Mid level** **(4-6 marks)** The candidate demonstrates reasonable knowledge and understanding of the need for, or use of reusable program components. The material is generally accurate but at times underdeveloped. The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. 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.	**9** **AO1.1 (2)** **AO1.2 (2)** **AO2.1 (2)** **AO3.3 (3)**	**AO1: Knowledge and Understanding** The following is indicative of possible factors/evidence that the candidates may refer to but is not prescriptive or exhaustive: • Program is split into small components • Can identify components that are needed in more than one place • Write these are independent modules • They can be imported into other areas of the game • They can be imported into future games that are made • They can be edited and tested independently, then the changes auto-update throughout the program(s) **AO2: Application** The selected knowledge/examples should be directly related to the specific question. The following is indicative of possible factors/evidence that candidates may refer to but is not prescriptive or exhaustive: • Sub-procedure character Movement can be used throughout different levels – saves having to rewrite the code for moving the character • Can import sub-procedures e.g. graphics, to save writing these. More likely to be error free as tested **AO3: Evaluation** Candidates will need to consider which methodology will be most appropriate in this scenario and will make evaluative comments about the suitability of each one, justifying their final decision.

			An appropriate methodology is suggested, although the justification may be limited. *There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.* **Mark Band 1 – Low level** **(1-3 marks)** The candidate demonstrates a basic knowledge of reusable program components. The material is basic and contains some inaccuracies. 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. Judgements, if made, are weak and unsubstantiated. A methodology is suggested although it may be lacking any justification, or the choice may be inappropriate. *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.* **0 marks** No attempt to answer the question or response is not worthy of credit.		Any decision is suitable, provided it is justified. • Will save time (not having to rewrite/test code) • Can update one module and it will change all programs that use it – don't have to change every place the code is written, avoids accidentally missing one • Can test independently • Can use code other people have written, to save time writing and testing
2	e		Max 2 for description of abstraction, max 3 for examples. Description, max 2 • Remove unnecessary elements [1] • Reduce computational resources required [1] • Focus on the main purpose of program//does not detract from main purpose of program [1]	**4** **AO1.2** **(4)**	Allow any reasonable example that could be applied to the game

			Examples, max 3, 1 mark per example e.g. • Appearance of characters is replaced by object // a character is a stick man [1] • Places on the board are replaced with shapes and place name//e.g. a square that says 'town' rather than an actual town with buildings[1] • Scenery is removed // e.g. trees, rivers are not included [1]		
3	a		Iteration [1]	**1 AO2.1 (1)**	
3	b		It does not return a value [1]	**1 AO2.1 (1)**	
3	c	i	1 mark per bullet • Tests the expected output… [1] • …based on input [1] • Does not look at the code // looks only at program specification [1]	**3 AO1.2 (3)**	

<table>
<tr><td>3</td><td>c</td><td>ii</td><td>1 mark for two suitable normal data
1 mark for two suitable extreme data
1 mark for two suitable invalid data

Normal: any values between 1 and 100 (inclusive) [1]
Extreme: 1, 100 [1]
Invalid: <1, >100, “x” [1]</td><td>3
AO2.1
(3)</td><td></td></tr>
<tr><td>4</td><td>a</td><td></td><td>1 mark per bullet to max 3
e.g.
A queue is First In First Out (FIFO) [1]
The questions are retrieved in the order they are stored [1]
Questions can be added to the end [1]
Dynamic structure... [1]
...expands to take more questions [1]</td><td>3
AO1.2
(2)
AO2.1
(1)</td><td></td></tr>
<tr><td>4</td><td>b</td><td>i</td><td>"6+1" in the correct box. [1]
Speech marks present [1]<table><tr><td>"2*3"</td><td>"1+4"</td><td>"3-1"</td><td>"10/2"</td><td>"3+6"</td><td>"6+1"</td><td></td><td></td></tr></table></td><td>2
AO2.1
(2)</td><td></td></tr>
<tr><td>4</td><td>b</td><td>ii</td><td>1 mark for head, 1 for tail
<code>head</code> = 0 [1]
<code>tail</code> = 5 [1]</td><td>2
AO2.1
(2)</td><td></td></tr>
</table>

<table>
<tr>
<td>4</td>
<td>c</td>
<td></td>
<td>1 mark for pseudocode/code that meets each bullet
• Checking if queue is empty [1]
• ...outputting message/reporting error [1]
• Outputting element in <code>questions</code> at index <code>head</code> [1]
• Increment <code>head</code> [1]

e.g.
<pre>
procedure remove()
    if head == tail + 1 then
        print("No questions")
    else
        print(questions[head])
        head = head + 1
    endif
endprocedure
</pre></td>
<td>4
AO3.2
(4)</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>d</td>
<td></td>
<td>1 mark for pseudocode/code that meets each bullet
• Input a question [1]
• Check if <code>tail</code> is full and outputs message/reports error [1]
• Increment <code>tail</code> [1]
• Adds question to <code>tail</code> of <code>questions</code> [1]

e.g.
<pre>
procedure add()
    maxElements = 10
    item = input("Enter a question")
    if tail == maxElements - 1 then
        print("Queue is full")
    else
        tail = tail + 1
        questions[tail]=item

    endif
endprocedure
</pre></td>
<td>4
AO3.2
(4)</td>
<td></td>
</tr>
</table>

Assessment Objectives (AO) Grid

Question	Assessment Objectives							Total
	AO1.1	AO1.2	AO2.1	AO2.2	AO3.1	AO3.2	AO3.3	
1ai	2							2
1aii		5						5
1b *m*						3		3
1c *m*						5		5
2a				4				4
2b				6				6
2ci		3						3
2cii		1	2					3
2ciii			3					3
2d*	2	2	2				3	9
2e		4						4
3a			1					1
3b			1					1
3ci		3						3
3cii			3					3
4a		2	1					3
4bi			2					2
4bii			2					2
4c						4		4
4d						4		4
Totals	4	20	17	10	0	16	3	70

*** = extended response**

m = mathematical content

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