

GCE

Computing

Unit **F453**: Advanced Computing Theory

Advanced GCE

Mark Scheme for June 2014

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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.

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1. These are the annotations, (including abbreviations), including those used in scoris, which are used when marking

Annotation	Meaning of annotation
	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.

2. **Subject-specific marking instructions**

Award **one** mark per valid statement to maximum for the section unless stated otherwise.

question			Answer	Mark	Guidance
1	a	i	Once a job starts it prevents other jobs from being processed A job using a slow resource (eg printer) wastes processor time	2	
		ii	Round robin Time slice to each user in turn <i>Or</i> Length of job Shortest job first	2	One method only – marks in pairs Accept other examples, including Priorities Highest priority first
		iii	Process as many jobs as possible... ...in least possible time/quicker Ensure all jobs are processed (fairly) Maximise number of interactive users... ...with fast response times/real time Efficient use of resources/processor time	4	
	b		Organise the use of (main) memory... ...by converting logical addresses to physical addresses Allows programs to share memory/allocate memory... ...& protect programs/data from each other Allows programs larger than main memory to run	3	
	c		Partitioning memory Pages are fixed size Pages are physical divisions Used for virtual memory	3	cao

question		Answer	Mark	Guidance
2	a	<p>Mark band 6-8. High level response.</p> <p>Candidate has explained both terms in detail. Candidate has used appropriate technical terminology throughout. There are few, if any, spelling errors or grammatical errors.</p> <p>Mark band 3-5. Medium level response.</p> <p>Candidate has explained 1 of the terms in detail or explained both terms superficially. Candidate has used some technical terminology in the response. There may be spelling errors or grammatical errors, but they are not obtrusive.</p> <p>Mark band 0-2. Low level response.</p> <p>Candidate has listed some relevant points but failed to explain the terms in any detail. There is a lack of cohesion in the response. Candidate has failed to use correct technical terms in the response. Spelling and grammatical errors affect the readability of the response.</p> <p><i>Points may include:</i> <i>Intermediate code:</i> Is simplified code that... ...is between high level & machine code ...is produced by compiler ...runs on any computer ...allows portability between machines Allows sections of code to be written in different languages...</p>	8	For descriptions “in detail”, 3 or more relevant points are expected.

question			Answer	Mark	Guidance																				
			...by different programmers ...suitable for specific tasks Error free <i>Virtual machine:</i> A theoretical computer which provides... ...an environment in which a translator is available Uses an interpreter to run the intermediate code <i>Points in the context of</i> A translator is used to convert code from one language to another... ...from source code to object code Mention of types of translator: compilers, interpreters, assemblers																						
	b		Relatively error free /has already been tested Ready to use/saves time/already been written Used multiple times/common tasks/reduces repeated code Programmer expertise Different source languages	3																					
3	a	i	Von Neumann	1	cao																				
		ii	<table border="1"> <thead> <tr> <th></th> <th>CIR</th> <th>MDR</th> <th>PC</th> </tr> </thead> <tbody> <tr> <td>Holds a binary value</td> <td>✓</td> <td>✓</td> <td>✓</td> </tr> <tr> <td>Always holds only an address</td> <td></td> <td></td> <td>✓</td> </tr> <tr> <td>May change more than once during a single cycle</td> <td></td> <td>✓</td> <td>✓</td> </tr> <tr> <td>May pass a value to the MAR</td> <td>✓</td> <td></td> <td>✓</td> </tr> </tbody> </table>		CIR	MDR	PC	Holds a binary value	✓	✓	✓	Always holds only an address			✓	May change more than once during a single cycle		✓	✓	May pass a value to the MAR	✓		✓	4	One mark per correct row
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question			Answer	Mark	Guidance
3	b	i	<p><i>CISC:</i> Each instruction may take multiple cycles Single register set Instructions have variable format Many instructions are available Many addressing modes are available Complicated processor design Integrated circuit is expensive</p> <p><i>RISC:</i> An instruction performs a simple task Limited number of instructions available Complex tasks can only be performed by combining multiple instructions Simple processor design</p>	4	Max 3 marks for either CISC or RISC, total max 4
		ii	<p>Programs run faster... ...due to simpler instructions</p>	2	
	c	i	<p>Calculations are done by the maths co-processor... ...so processing is faster ...when using floating point arithmetic</p>	2	
		ii	<p>No increase in speed... ...as co-processor not suitable for task/as there are no calculations</p>	2	
4	a	i	<p>Exponent 0110 = 6 Mantissa 0.101, move point 6 places right becomes 0101000. Denary value is 40</p>	3	Accept alternative methods
		ii	<p>Exponent 1110 = -2 Mantissa 0.100, move point 2 places left becomes 0.001 Denary value is $1/8 = 0.125$</p>	3	Accept alternative methods Accept either fraction or decimal value

question			Answer	Mark	Guidance
4	b	i	P normalised... ... as mantissa starts 10	2	
		ii	Mantissa 0001101 move point 2 places right & fill with 0s on right Decrease exponent by 2 0110100 00011	3	Correct mantissa & exponent with no explanation max 2 cao
5	a	i	Size is fixed when structure created/size cannot change during processing	1	
		ii	array	1	
		iii	Size can change during processing	1	
		iv	Storage required is unknown initially/more difficult to program	1	
	b	i	Compare 607 with 500 Compare 607 with 750 Compare 607 with 625+/-1 <i>or</i> go to middle value <u>500 / 502</u> compare value with <u>607</u> discard first half / repeat in second half of set	3	Must use values given
		ii	Compare 607 with 2 Compare 607 with 4 Compare 607 with 6 <i>or</i> Start at <u>2</u> Compare with <u>607</u> Go to 4 (& repeat comparison... etc)	3	Must use values given
		iii	Binary search discards half data at each step Serial search discards one data item at each step/each item in turn	2	
		iv	<i>Advantage:</i> Generally faster (in large set of data) <i>Disadvantage:</i> Values must have been sorted/values must be in order	2	

question			Answer	Mark	Guidance
6	a	i	Class diagram	1	cao
		ii	Method / operation	1	
		iii	Shows inheritance Eg Nurse is a subclass of Staff/Staff is a superclass of Nurse	2	Accept any relevant example from this diagram
		iv	Jones is the value of an attribute/not defined as an object in Staff	1	
		v	Staff includes setSalary() Nurse is a subclass of Staff SeniorNurse is a subclass of Nurse SeniorNurse inherits setSalary() from Staff via Nurse *	3	*Final statement listed is equivalent of the 2 previous statements
	b	i	actor	1	
		ii	Association line	1	
		iii	Use case	1	
7	a	i	High-level language/3GL/imperative language Gives a series of instructions in a (logical) order/line by line/what to do and how to do it	2	
		ii	Declare (result) as a local variable in each procedure Accessible within one procedure (at a time)/the scope of the variable is for one procedure at a time/only exists as long as the procedure is running	2	
		iii	Parameters passed by value or by reference By value, local copy of data is used then discarded... ...so value of (original) data is unchanged By reference, location of data is used... ...so changes may be made to value of data	5	

question			Answer	Mark	Guidance																													
7	b	i	<p>Answer pq-r/ Marks for pq- pq-r/ Alternative answer rpq-/ Marks for rpq rpq-/ </p>	2																														
		ii	<p>Answer s+t*u Marks for t*u s+t*u</p>	2	<p>Either t*u or u*t acceptable Also allow brackets s+(t*u) but NOT (s+t)*u</p>																													
8	a		<p>Reflects design of processor Direct access to memory locations Limited memory in processor Direct coding of operations</p>	3																														
	b		<table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="4">Addressing mode</th> </tr> <tr> <th>Immediate</th> <th>Direct</th> <th>Relative</th> <th>None of these</th> </tr> </thead> <tbody> <tr> <td>123 is the address of the data to use</td> <td></td> <td>✓</td> <td></td> <td></td> </tr> <tr> <td>ADD is an operand</td> <td></td> <td></td> <td></td> <td>✓</td> </tr> <tr> <td>The data to use in a calculation is 123</td> <td>✓</td> <td></td> <td></td> <td></td> </tr> <tr> <td>The address 123 holds a value which is the address of the data to use</td> <td></td> <td></td> <td></td> <td>✓</td> </tr> </tbody> </table>		Addressing mode				Immediate	Direct	Relative	None of these	123 is the address of the data to use		✓			ADD is an operand				✓	The data to use in a calculation is 123	✓				The address 123 holds a value which is the address of the data to use				✓	4	One mark per correct row in table
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question		Answer	Mark	Guidance
	c	<p>Relative addressing... ...uses offset 3 to calculate real address from base address 11</p> <p>Indexed addressing... ...modifies address 3 by adding number 11 from index register</p>	4	
9	a	<p>Mark band 6-8. High level response.</p> <p>Candidate has discussed both storage methods in detail & related them to the applications. Candidate has used appropriate technical terminology throughout. There are few, if any, spelling errors or grammatical errors.</p> <p>Mark band 3-5. Medium level response.</p> <p>Candidate has discussed both storage methods. Some attempt has been made to relate the methods to the applications. Candidate has used some technical terminology in the response. There may be spelling errors or grammatical errors, but they are not obtrusive.</p> <p>Mark band 0-2. Low level response.</p> <p>Candidate has listed some relevant points but failed to discuss the storage methods in any detail or relate them to the applications.. There is a lack of cohesion in the response. Candidate has failed to use correct technical terms in the response. Spelling and grammatical errors affect the readability of the response.</p>	8	

question			Answer	Mark	Guidance
			<p><i>Points may include:</i></p> <p><i>Flat files</i></p> <p>Limited amount of data</p> <p>Limited technical expertise available in family</p> <p>Data format difficult to change</p> <p>Security not a major issue for family compared with company</p> <p><i>Relational database</i></p> <p>Software may be available as part of computer package</p> <p>Technical help readily available on-line</p> <p>Easy to add data</p> <p>Easy to link to other applications / e.g. address labels</p> <p>Large volume of data for company</p> <p>Saves space / reduces data duplication / redundant data</p> <p>Improves data consistency / integrity</p> <p>Easy to change data format</p> <p>Improves security / easy to control access to data</p>		
	b	i	Unique identifier	1	
		ii	<p>Primary key in one table...</p> <p>...used as an attribute/foreign key in another</p> <p>Provides a link between tables</p> <p>Represents many-one relationship</p>	3	
10	a		declarative	1	Throughout question, accept any appropriate example using the statements given in question
	b		e.g. studies_science (A,B) if student (A) and science (B)	1	
	c		<p>A problem that needs to be solved</p> <p>e.g. student (X) ?</p>	2	Accept e.g. "searching for a list of students" with either of answers here
	d		<p>Setting an initial value to replace a variable</p> <p>e.g. find X=ben, set X=ben to test science(Y)</p>	2	
	e		<p>After finding a solution/failing to find a solution...</p> <p>...go back to an earlier step to test an alternative</p>	2	Accept example that demonstrates this

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