OCR
RECOGNISING ACHIEVEMENT

GCE

Computing

Advanced GCE

Unit **F453:** Advanced Computing Theory

Mark Scheme for January 2011

Oxford Cambridge and RSA Examinations

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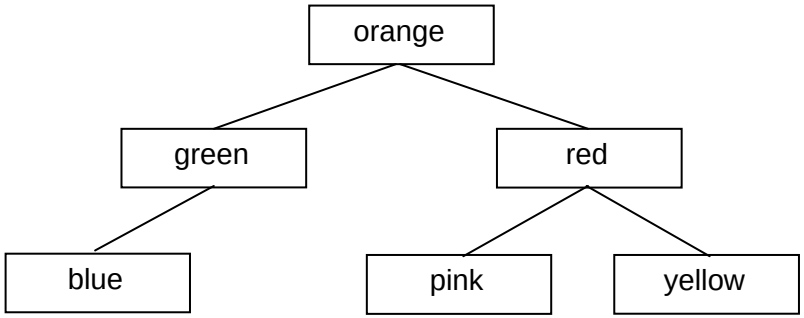
One mark per bullet point unless indicated otherwise

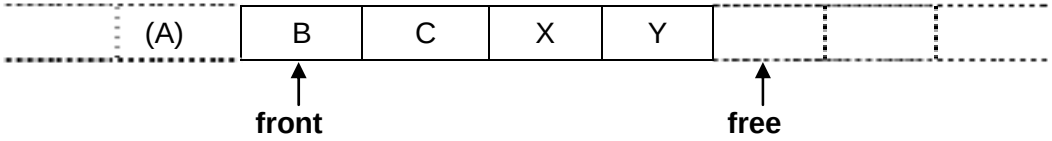
Question	Expected Answer	Mark	Additional Guidance
1 (a)	• output data to disk drive/storage device • for printing at another time • to allow sharing/on a network • job **references** stored in a queue/buffer • avoids delays / avoids speed mismatch • as printers are relatively slow • jobs can be prioritised	**max [4]**	
(b) (i)	• ways of partitioning memory • allow programs to run despite insufficient memory/used for virtual memory • segments and pages are stored on backing store • segments and pages are assigned to memory when needed	**max [2]**	Allow mark for: both use indexes
(ii)	• segments are different sizes but pages are fixed size • segments are complete sections of programs, but pages are made to fit sections of memory • segments are logical divisions, pages are physical divisions	**max [1]**	
(iii)	• disk threshing • more time spent swapping pages than processing • computer may 'hang'	**max [2]**	

Question	Expected Answer	Mark	Additional Guidance
2 (a)	• lexical analysis • code generation	**max [2]**	cao
(b)	• accepts output from lexical analysis • **statements/arithmetic expressions/tokens** are checked... • …against the rules of the language/valid example given eg matching brackets • errors are reported as a list (at the end of compilation) • diagnostics may be given • (if no errors) code is passed to code generation • further detail is added to the symbol table… • …eg data type /scope/address	**max [5]**	
(c)	• simplified code / partly translated code… • …which can be run on any computer/virtual machine/improves portability… • …using an interpreter • sections of program can be written in different languages • runs more slowly than executable code	**max [3]**	Accept: (Syntax) error free

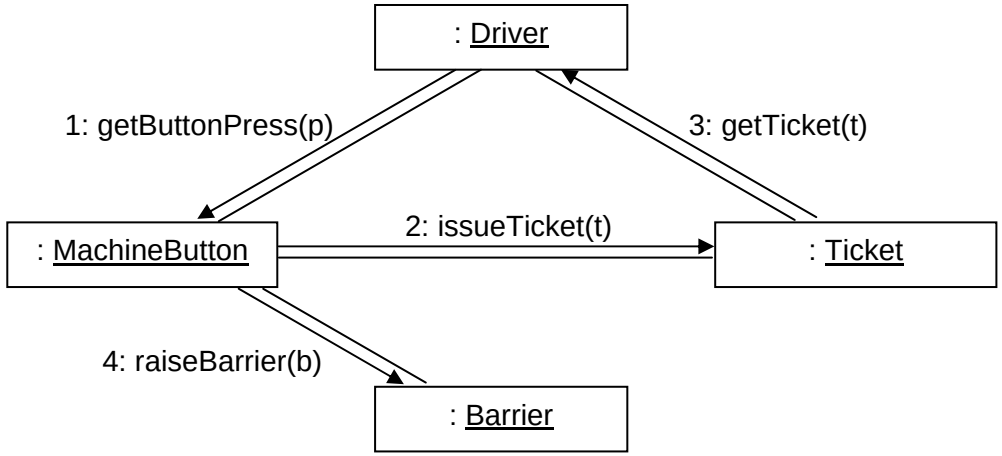
Question	Expected Answer	Mark	Additional Guidance
3 (a) (i)	• a location in the processor • used for a particular purpose • (temporarily) stores data/or control information • explained example of contents held by named register	**max [2]**	
(ii)	• program counter • memory address register • memory data register/memory buffer register • current instruction register • index register • interrupt register • accumulator	**max [2]**	*[Accept status register, although not in the specification]* No abbreviations
(b)	*advantages:* • allows faster processing • more than one instruction (of a program) is processed at the same time • different processors can handle different tasks/parts of same job *disadvantages:* • operating system is more complex... • …to ensure synchronisation • program has to be written in a suitable format • Program is more difficult to test/write/debug	**max [5]**	[max 3 for advantage or disadvantage, total max 5]

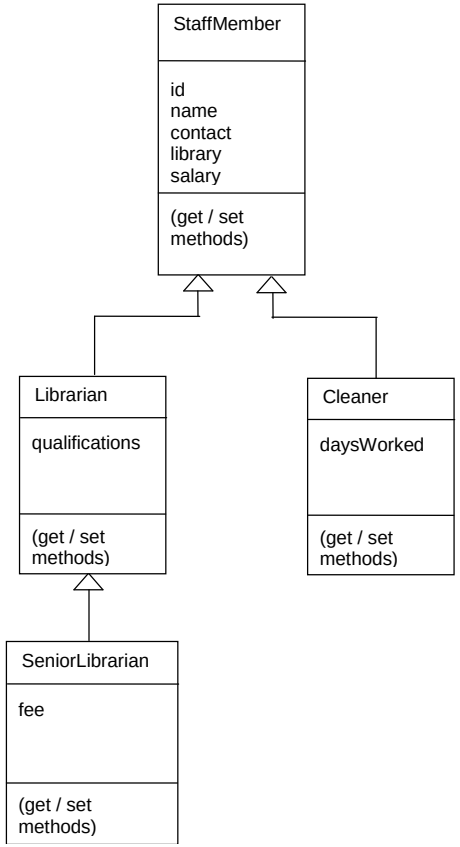
Question	Expected Answer	Mark	Additional Guidance
4 (a)	• P: mantissa 0.010, exponent 010 = 2, P has binary value 1, denary value 1 • Q: mantissa 0.001, exponent 011 = 3, Q has binary value 1, denary value 1 • R: mantissa 0.0001, exponent 100 = -4, R has binary value 0.00000001, denary value 1/256 • R represents a different value *[dependent on P=Q]*	**max [4]**	
(b) (i)	• (exponent is adjusted so that mantissa) starts 01 or 10	**max [1]**	
(ii)	*answer is 01000 001* • (mantissa 00010, move point 2 places) 01000 • (exponent) 001	**max [2]**	
(c)	• maximum (positive) number in this format • as mantissa & exponent each have their largest values	**max [2]**	
(d)	*[answer is 01001 010]* • 2.25 = 010.01 in pure binary • move point 2 places to left… • mantissa is 01001 • exponent is 010	**max [3]**	[*accept any valid method, max 1 if no working shown*, max 3]

Question	Expected Answer	Mark	Additional Guidance
5 (a) (i)	• **size** changes as data is added & removed/**size** is not fixed	**max [1]**	
(ii)	• more complex program to write	**max [1]**	*Accept "more difficult"*
(iii)	• array/fixed length record	**max [1]**	
(b)		**max [3]**	*Accept mirror image* [*award 1 mark each for root, left subtree, right subtree*, max 3]

Question	Expected Answer	Mark	Additional Guidance
(c)	*eg* start at root repeat compare new data with current data if new data < current data, follow left pointer else follow right pointer until pointer is null write new data create (null) pointers for new data *marks for* • start at root • repeat until loop/while loop • comparison of values • follow pointers • condition for end of loop • writing data • creating new pointers • assume new data item is not already in binary tree / is same data type	**max [6]**	Steps should be to a generic binary tree, not a specific example. Allow follow through from (b) if left and right are swapped
(d) (i)	• queue	**max [1]**	
(ii)	 *marks for* • front pointer moved to B • X in cell to right of C **and** Y in cell to right of X • free pointer moved to correct position	**max [3]**	

Question	Expected Answer	Mark	Additional Guidance
6 (a)	• imperative language • uses sequence, selection & iteration • program states what to do… • … & how to do it • program statements are in blocks • each block is a procedure or function • logic of program is given as a series of procedure calls	**max [4]**	
(b) (i)	• getButtonPress( )/processKeyMessage( )/unlock( )	**max [1]**	*Allow answer with no brackets or with (n)*
(ii)	• Driver/Key/Car	**max [1]**	*Allow lower case/preceded by :/underlining*
(iii)	• FlashLights	**max [1]**	*Allow lower case*
(iv)	• object diagram	**max [1]**	
(c) (i)	• communication diagram	**max [1]**	*Accept "collaboration diagram"*

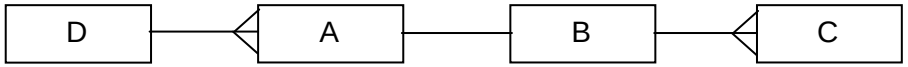
Question	Expected Answer	Mark	Additional Guidance
(ii)	 *marks for* • 2 or more arrows correct • issueTicket( ) label OR getTicket( ) label OR raiseBarrier( ) label • correct number sequence: 2,3,4	**max [3]**	*Give mark for arrows in correct directions even if labels are incorrect* *Give mark for label if brackets are missing*

Question	Expected Answer	Mark	Additional Guidance
(d)	*eg*  *marks for* • superclass StaffMember/Staff/Employee *[accept other relevant name, but not Librarian]* • Librarian as subclass of the named superclass • Cleaner as subclass of the named superclass • SeniorLibrarian as subclass of Librarian • at least 3 of name, contact, library, salary in the superclass only • qualifications in Librarian only • fee in SeniorLibrarian only • daysWorked in Cleaner only • inheritance symbols used correctly throughout • indication of any relevant get or set methods in correct position • all 4 classes included, no extra classes added	**max [8]**	***Must be a class diagram***

Question	Expected Answer	Mark	Additional Guidance
7 (a)	**Mark band 6-8. High level response.** Candidate has explained all 3 of the terms and made some comparisons between them. Candidate has used appropriate technical terminology throughout. There are few, if any, spelling errors or grammatical errors. **Mark band 3-5. Medium level response.** Candidate has explained all 3 of the terms, or explained 2 of the terms and made some comparisons between them. Candidate has used some technical terminology in the response. There may be spelling errors or grammatical errors, but they are not obtrusive. **Mark band 0-2. Low level response.** Candidate has listed some relevant points but failed to explain the terms or make comparisons. 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. *Points may include:* *function:* • block of code… • …which performs a single task/calculation… • returns a single value • uses local variables *procedure:* • block of code… • …which performs a task • …which may or may not produce a single value • uses local variables *stepwise refinement:*		*A distinction must be made between function and procedure to qualify as separate terms*.

Question	Expected Answer	Mark	Additional Guidance
	• breaks a problem into sections… • …which become progressively smaller… • …until each module can be written as a single procedure/function • each module can be tested separately • library routines can be used	**max [8]**	
(b) (i)	• stack	**max [1]**	*cao*
(ii)	• (information about) an item of data… • …supplied to a procedure or function • may be passed by reference or by value • used as a local variable	**max [3]**	

<table>
<tr><th>Question</th><th>Expected Answer</th><th>Mark</th><th>Additional Guidance</th></tr>
<tr><td>8 (a)</td><td>
<table>
<tr><th></th><th>Machine code</th><th>Assembly language</th><th>High level language</th></tr>
<tr><td>Uses mnemonics</td><td></td><td>✓</td><td></td></tr>
<tr><td>Uses only binary (or hexadecimal) code</td><td>✓</td><td></td><td></td></tr>
<tr><td>May use relative addresses</td><td></td><td>✓</td><td></td></tr>
<tr><td>May use local variables</td><td></td><td></td><td>✓</td></tr>
<tr><td>Needs translation before the program can be executed</td><td></td><td>✓</td><td>✓</td></tr>
<tr><td>May be translated into intermediate code</td><td></td><td></td><td>✓</td></tr>
</table>
</td><td>max [6]</td><td>Accept an answer that says that local variables can be used in both assembly and high level languages and that relative addressing is used in machine code.
[1 mark per correct row, max 6]</td></tr>
<tr><td>(b)</td><td>• used in assembly language
• uses data in address field…
• … as a constant
[accept diagram or example showing the above]</td><td>max [2]</td><td></td></tr>
<tr><td>(c)</td><td>• used in indexed addressing
• stores a number used to modify an address…
• … which is given in an instruction
• allows efficient access to a range of memory locations/by incrementing the value in the IR
• eg used to access an array</td><td>max [3]</td><td></td></tr>
</table>

Question	Expected Answer	Mark	Additional Guidance
9 (a)	eg  *marks for:* • A and B linked correctly • B and C linked correctly • A and D linked correctly • no additional entities or relationships and all on one diagram with boxes	**max [4]**	
(b) (i)	• unique identifier (in a table)	**max [1]**	
(ii)	• foreign key links tables (to represent many to one relationship)… • …so that only one record is accessed/to avoid duplicate data • eg primary key from B used as foreign key in C from (a) • primary key is in a table that may contain data not required in another table • eg primary key from C is not used in B and hence cannot be a foreign key	**max [4]**	*[Accept any valid example]*
(c) (i)	• StockNo/Quantity/Price	**max [1]**	*cao*
(ii)	• Stock	**max [1]**	*cao*
(iii)	• lists (values of) attributes StockNo, Quantity & Price in the Stock table • …for all Stock with (quantity) less than 100 remaining… • …in order of Price from highest to lowest/descending order of Price	**max [3]**	
(d) (i)	• CHAR is fixed length • VARCHAR is variable length	**max [2]**	

Question	Expected Answer	Mark	Additional Guidance
(ii)	• line 5 defines DepartmentId as an attribute (of Employee)/DepartmentId is set at 5 characters • line 7 defines DepartmentId as the same attribute in the Department table… • …where it is the primary key • …to link the tables	max [3]	
(e)	• so users can access the data they need • users do not need specialist knowledge • to protect data • to prevent unauthorised access.	max [2]	

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