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CAMBRIDGE
International Education

Cambridge International AS & A Level

COMPUTER SCIENCE **9618/33**

Paper 3 Advanced Theory **May/June 2026**

MARK SCHEME

Maximum Mark: 75

Published

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

This document consists of **18** printed pages.

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[Turn over

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General marking principles

All examiners must apply these marking principles when marking candidate responses.

1	Examiners must award marks for each response in line with: • the specific **content** defined in the mark scheme • the specific **skills** defined in the mark scheme or in the level descriptions • the **standard of response** required as exemplified by the standardisation scripts.
2	Examiners must award **whole marks** (not half marks, or other fractions).
3	Examiners must award marks **positively**. This means that: • marks are not deducted for errors or omissions • marks are awarded for correct/valid answers as defined in the mark scheme and also for **other valid answers** which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate • the quality of spelling, punctuation and grammar are judged **only** when the mark scheme indicates that these features are **specifically assessed** in the question. However, the meaning of all responses must be unambiguous.
4	Examiners must **consistently** apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.
5	Examiners must use the **full range of marks** defined in the mark scheme, unless limited by the quality of the candidate responses seen.
6	Examiners must award marks according to the mark scheme and **must not** award marks with grade thresholds or grade descriptions in mind.

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Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	Correct
	Incorrect
	To indicate where a key word/phrase/code is missing.
	Not relevant or used to separate parts of an answer.
	Indicates a part of the answer that is incorrect.
Highlighter	To draw attention to a particular aspect or to indicate where parts of an answer have been combined.
	Too vague.
	Repetition
	No examples or not enough.

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Annotation	Meaning
BOD	Benefit of Doubt.
NAQ	Not Answered Question.
SEEN	Indicates that work or a page has been seen including blank answer spaces and blank pages.
FT	Follow through.
I	Ignore

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Question	Answer	Marks	Guidance
1(a)	**One** mark per mark point (**Max 3**) MP1 The programmer may require a data type for their application that doesn't exist within the programming language MP2 … to represent a particular set/group of data / custom data structure MP3 … under a single identifier MP4 They may wish to extend those data types that are already there using composite data types MP5 … to make the code easier to understand / read MP6 To produce a data type that exactly matches a program's requirements.	**3**	
1(b)	**One** mark per mark point (**Max 2**) MP1 `TYPE Fibonacci =` MP2 `(0, 1, 2, 3, 5, 8, 13, 21)` Example answer `TYPE Fibonacci = (0, 1, 2, 3, 5, 8, 13, 21)`	**2**	Do not allow quotation marks around data elements. The order of the elements must be correct.
2	**One** mark for each correct word in the correct place (**Max 4**) protocol layer adjacent Application The implementation of a **protocol** suite can be viewed as a stack. Each **layer** of the stack has its own specific functionality and can only communicate with **adjacent** layers of the stack. User interaction is associated with the highest level of the stack, which is the **Application** layer.	**4**	

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Question	Answer	Marks	Guidance
3(a)	**One** mark for an appropriate use of serial file organisation (**Max 1**) Batch processing tasks Creating a transaction file for a batch Storing bills/payroll Backup Appropriate example where data is added chronologically	**1**	
3(b)	**One** mark per mark point (**Max 2**) MP1 Records are stored in a file one after the other MP2 … in chronological order MP3 New records are appended/added at the end of the file	**2**	
3(c)	**One** mark per mark point (**Max 3**) MP1 Sequential file access is used MP2 Each record in the file is searched / checked, one after the other, MP3 … until the end of the file is reached MP4 … until the record is found.	**3**	

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Question	Answer	Marks	Guidance
4(a)	**One** mark per mark point (**Max 3**) MP1 Massively parallel computers involve the **linking together** of **many processors / computers** MP2 … to form a more powerful 'single machine' MP3 All the processors work simultaneously on the same problem MP4 … with each processor being responsible for its **own part of the problem** MP5 … and communication being via interconnected data pathways/networks // … and communicate via shared pools of memory.	**3**	Accept many/multiple/thousands/extremely large number for 'many' but not some/several.
4(b)	**One** mark for a difference (**Max 1**) MP1 SIMD systems all execute the same instruction and MISD systems perform different instructions MP2 SIMD systems work on many data streams/elements simultaneously MISD systems all work on the same data source/element MP3 MISD systems are more complex than SISD systems // allow the reverse **One** mark for a similarity (**Max 1**) MP4 SIMD and MISD are both parallel systems MP5 SIMD and MISD using multiple processors MP6 SIMD and MISD both may be pipelined MP7 Neither SIMD nor MISD are well suited for sequential applications such as office productivity software or compilers	**2**	Both SIMD and MISD must appear or be clearly inferred in each response for the mark. Simply expanding the acronym is NE.

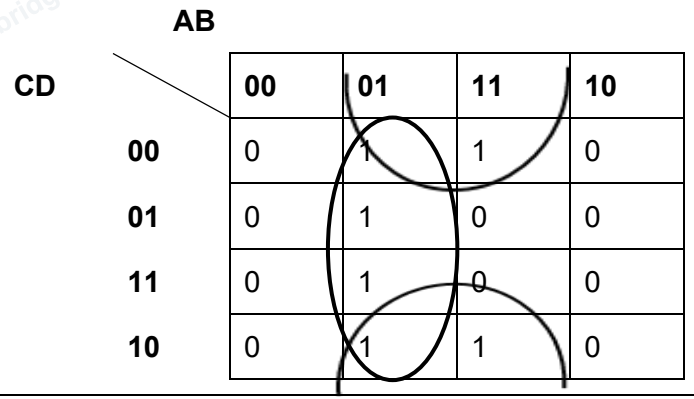
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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>5(a)</td><td>
One mark per mark point for working (Max 2)
• number converted to binary e.g., positive binary version of 18.5625 = 010010.100100
• two’s complement version
bits flipped and 1 added = 101101.011100

One mark per mark point (Max 2)
• correct mantissa
• correct exponent

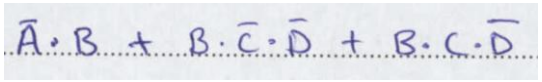
Mantissa
<table>
<tr><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
</table>
Exponent
<table>
<tr><td>0</td><td>1</td><td>0</td><td>1</td></tr>
</table>
</td><td>4</td><td>Allow alternative methods of working.</td></tr>
<tr><td>5(b)</td><td>
One mark per mark point (Max 3)
MP1 If the two numbers were added together, the value would be 214.75
MP2 This value exceeds the highest/largest number that can be stored in this system with an exponent of 7, (which is 127.9375)
MP3 An exponent of 8 would be required to increase the range of possible numbers beyond 128
MP4 Overflow would occur
</td><td>3</td><td></td></tr>
<tr><td>6(a)(i)</td><td>
One mark for each correct loop (Max 2)



</td><td>2</td><td>If incorrect loops seen, max 1.</td></tr>
</table>

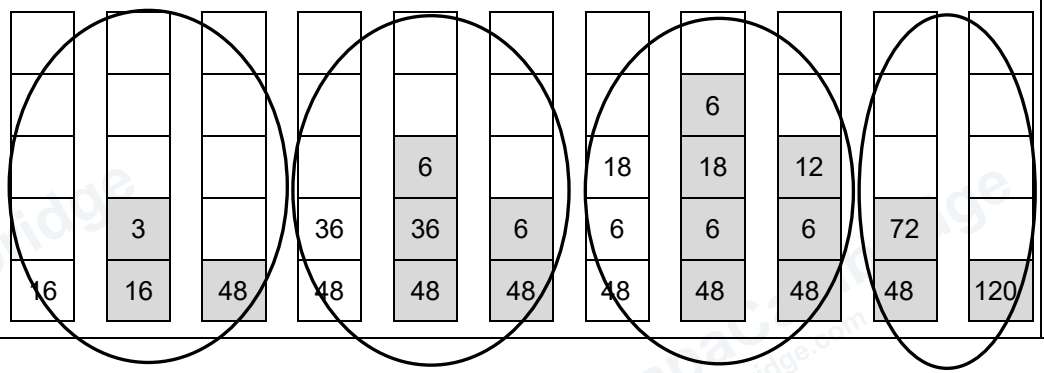
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Question	Answer	Marks	Guidance
6(a)(ii)	**One** mark per mark point (**Max 2**) MP1 One correct Boolean term MP2 Both correct Boolean terms connected by an OR sign and no other terms present $\overline{A}.B + B.\overline{D}$	**2**	Terms can be in either order Accept answers as AND if no dot e.g. A.B = AB 
6(a)(iii)	B.($\underline{A}$ + $\underline{D}$) // B.($\underline{A.D}$)	**1**	Terms can be in any order Allow answers with or without dot e.g. AB for A.B
6(b)	**One** mark for correct answer **(Max 2)** for correct working from points shown **X = ~~A + B + C + B + C~~** **(X =) $\overline{A}.\overline{B}.\overline{C} + \overline{B}.\overline{C}$** **(X =) $\overline{B}.\overline{C}.(\overline{A} + 1)$** Correct answer **(X =) $\overline{B}.\overline{C}$ // $\overline{B + C}$** De Morgan's laws Distributive law Annulment law	**3**	One mark for correct answer and up to two marks to show correct use of different laws in the solution. The top line, shaded grey, is given in the question.

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Question	Answer	Marks	Guidance
7(a)	**One** mark per mark point (**Max 3**) MP1 The RPN expression is read from left to right MP2 If the next element is a number it is pushed onto the stack MP3 If the next element is an operator, the last two elements are popped from the stack MP4 …the operator is applied to them and the result is pushed onto the stack MP5 The process repeats until the whole expression has been evaluated	**3**	
7(b)	**One** mark per mark point (**Max 2**) MP1 `18 15 - 3 +` MP2 `5 * 12 /` Final correct expression `18 15 - 3 + 5 * 12 /`	**2**	
7(c)	**One** mark per ring (**Max 4**)  	**4**	Values in shaded areas are necessary to award the marks in the rings.

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Question	Answer	Marks	Guidance
8(a)	**One** mark per mark point for the purpose (**Max 2**) MP1 To provide a more secure method of cryptography/encryption than current methods // To provide a virtually unbreakable method of encryption // To detect eavesdropping. MP2 … using the laws of quantum physics rather than mathematical formulae to generate keys. MP3 To provide encryption that can be guaranteed for a longer period of time than current methods.	**2**	
8(b)	**One** mark per benefit (**Max 2**) MP1 Better security for internet communication MP2 Can detect eavesdropping, enabling the receiver to request another key MP3 Virtually unhackable due to rapidly changing quantum states MP4 Keys are non-duplicable // No-cloning theorem **One** mark per drawback (**Max 2**) MP5 Currently can only be used over relatively short distances MP6 Very expensive to implement initially due to costs of installation / hardware / implementation // Requires a dedicated line and specialist hardware MP7 The technology to fully implement quantum cryptography is not currently/readily available MP8 Photon polarization might be impacted in the travelling medium // It is possible for the polarisation of the light to be altered while travelling down fibre optic cables MP9 Due to the inherent security system generated by quantum cryptography, terrorists and other criminals can use the technology to hide their activities from government law enforcement	**4**	

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Question	Answer	Marks	Guidance
9(a)	**One** mark per mark point (**Max 3**) MP1 A supervised learning technique of machine learning MP2 It finds a mathematical function // It plots a best-fit line/curve // calculus is used to find the error gradient MP3 … that maps how independent variables/cause influence a dependent variable/effect between the data MP4 It is used for forecasting trends and predicting outcomes MP5 It will be trained to understand the relationship between different causes and effects allow to find relationships between two **sets of data** MP6 The goal is to minimise the difference between the predicted values and the actual values.	**3**	

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>9(b)</td><td>
One mark for each correct calculation as follows (Max 4)
MP1 W to N2 and W to N3 (Lines 3 and 4 in table)
MP2 W ⇨ N2 to N5 (Line 5 in table)
MP3 W ⇨ N2 ⇨ N5 to N4 (Line 6 in table)
MP4 W ⇨ N2 ⇨ N5 to N6 (Line 7 in table)
MP5 W ⇨ N2 ⇨ N5 to E (Line 8 in table)
MP6 W ⇨ N2 ⇨ N5 ⇨ N6 to E (Line 9 in table)
One mark for correct path (Max 1)
MP7 W ⇨ N2 ⇨ N5 ⇨ N6 ⇨ E

<table>
<tr><th></th><th>Current path</th><th>Destination node</th><th>Cost of current path (g)</th><th>Heuristic (h)</th><th>Total (f = g + h)</th></tr>
<tr><td>1</td><td>W</td><td>W</td><td>0</td><td>18</td><td>18</td></tr>
<tr><td>2</td><td>W</td><td>N1</td><td>6</td><td>15</td><td>21</td></tr>
<tr><td>3</td><td>W</td><td>N2</td><td>4</td><td>14</td><td>18</td></tr>
<tr><td>4</td><td>W</td><td>N3</td><td>7</td><td>13</td><td>20</td></tr>
<tr><td>5</td><td>W⇨N2</td><td>N5</td><td>4+7=11</td><td>7</td><td>18</td></tr>
<tr><td>6</td><td>W⇨N2⇨N5</td><td>N4</td><td>4+7+2=13</td><td>9</td><td>22</td></tr>
<tr><td>7</td><td>W⇨N2⇨N5</td><td>N6</td><td>4+7+4=15</td><td>3</td><td>18</td></tr>
<tr><td>8</td><td>W⇨N2⇨N5</td><td>E</td><td>4+7+11=22</td><td>0</td><td>22</td></tr>
<tr><td>9</td><td>W⇨N2⇨N5⇨N6</td><td>E</td><td>4+7+4+3=18</td><td>0</td><td>18</td></tr>
</table>

<table>
<tr><td>Final path</td><td>W⇨N2⇨N5⇨N6⇨E</td></tr>
</table>
</td><td>5</td><td>Lines 3 and 4 can be in either order.

Lines 6, 7 and 8 can be in any order.

Everything else must be in the table order.

Shaded parts given in question.</td></tr>
</table>

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>10(a)(i)</td><td>One mark for every two correct rows (Max 2)

<table>
<tr><th>Identifier</th><th>Data type</th><th>Description</th></tr>
<tr><td>Left</td><td>INTEGER</td><td>Lowest index in the search area</td></tr>
<tr><td>Right</td><td>INTEGER</td><td>Highest index in the search area</td></tr>
<tr><td>Mid</td><td>INTEGER</td><td>Centre/middle index in the search area</td></tr>
<tr><td>Target</td><td>STRING</td><td>The item to be found</td></tr>
</table>
</td><td>2</td><td>Don’t accept mid as description for the centre index, but middle is OK</td></tr>
</table>

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Question	Answer	Marks	Guidance

10(a)(ii)	**One** mark per mark point (**Max 5**)
	MP1 Function header correctly completed
	MP2 Left and right indexes correctly initialised
	MP3 Appropriate loop **and** escape condition.
	MP4 Setting of the search index (Mid)
	MP5 Conditional statement to find item
	MP6 Conditional statement **and** changing of left and right indexes if item not found
	MP7 Return of location if item/target found **and** -1 if not
	
	Example completed algorithm
	
	`FUNCTION PartSearch(Target : STRING) RETURNS INTEGER`
	`  Left ← 1`
	`  Right ← 1000000`
	`  WHILE Left <= Right`
	`  Mid ← (Left + Right) DIV 2)` **OR**
	`  Mid ← DIV(Left + Right, 2)`
	`  IF PartName[Mid] = Target THEN`
	`  RETURN Mid`
	`  ELSE`
	`  IF PartName[Mid] < Target THEN`
	`  Left ← Mid + 1`
	`  ELSE`
	`  Right ← Mid – 1`
	`  ENDIF`
	`  ENDIF`
	`  ENDWHILE`
	`  RETURN -1`
	`ENDFUNCTION`
		5	All required identifiers (variables. Indexes and array) are given in the question, so must be used.
			
			Grey shaded areas given in question.
			
			Watch out for incorrect `RETURN` / `RETURNS` in candidate responses.
			
			Accept == for =

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Question	Answer	Marks	Guidance
10(b)	**One** mark per mark point (**Max 2**) MP1 The time it takes to execute a binary search increases logarithmically as the number of search items increases // The time increases linearly as the number of search items increases exponentially MP2 Binary search worst case Big O is O(log n)/ O($\log_2$ n)	**2**	The Big O notation must be completely correct (including brackets).

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>11(a)</td><td>
One mark per mark point (Max 5)
MP1 <code>LDM #325</code> and <code>STO A</code>
MP2 <code>LDD 232</code> and <code>STO B</code>
MP3 <code>SUB #50</code> and <code>STO 875</code> (ignore <code>LDD B</code>)
MP4 <code>LDD A</code> and <code>ADD 580</code> // <code>LDD 580</code> and <code>ADD A</code>
MP5 <code>SUB 875</code>
MP6 <code>STO Final</code>

<table>
<tr><th>Opcode</th><th>Operand</th></tr>
<tr><td>LDM</td><td>#325</td></tr>
<tr><td>STO</td><td>A</td></tr>
<tr><td>LDD</td><td>232</td></tr>
<tr><td>STO</td><td>B</td></tr>
<tr><td>SUB</td><td>#50</td></tr>
<tr><td>STO</td><td>875</td></tr>
<tr><td>LDD</td><td>A</td></tr>
<tr><td>ADD</td><td>580</td></tr>
<tr><td>SUB</td><td>875</td></tr>
<tr><td>STO</td><td>Final</td></tr>
</table>
</td><td>5</td><td></td></tr>
</table>

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<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>11(b)</td><td>one mark for each correct contents value (Max 3)

<table><tr><th>Label</th><th>Contents</th></tr><tr><td>A:</td><td>325</td></tr><tr><td>B:</td><td>120</td></tr><tr><td>Final:</td><td>281</td></tr></table></td><td>3</td><td>Accept denary values with leading #

Shaded parts given in question.</td></tr>
</table>

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