<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>1</td><td>a</td><td>i</td><td>1 mark for each correct item in bold

<pre>procedure sortit(dataArray, lastIndex)
   for x = 1 to lastIndex
      currentData = dataArray[x]
      position = x
      while (position > 0 AND dataArray[x - 1] > currentData)
         dataArray[position] = dataArray[position-1]
         position = position - 1
      endwhile
      dataArray[position] = currentData

   next x
endprocedure</pre></td><td>3
AO1.1
(3)</td><td>answers must be in the correct case as given
e.g. currentData

Examiner’s Comment:
Many candidates found it difficult to apply the logic required to calculate the correct solution. Stronger candidates could do so even if they did not know the algorithm for insertion sort.</td></tr>
<tr><td></td><td></td><td>ii</td><td>1 mark for contents of each row in table

<table>
<tr><td>6</td><td>1</td><td>15</td><td>12</td><td>5</td><td>6</td><td>9</td><td></td><td></td></tr>
<tr><td>1</td><td>6</td><td>15</td><td>12</td><td>5</td><td>6</td><td>9</td><td>6 is the sorted list
1 is the compared to sorted list
1 is put in place in sorted list</td><td>1</td></tr>
<tr><td>1</td><td>6</td><td>15</td><td>12</td><td>5</td><td>6</td><td>9</td><td>15 is compared
15 is in place in sorted list</td><td>1</td></tr>
<tr><td>1</td><td>6</td><td>12</td><td>15</td><td>5</td><td>6</td><td>9</td><td>12 is compared
12 is in place in sorted list</td><td>1</td></tr>
<tr><td>1</td><td>5</td><td>6</td><td>12</td><td>15</td><td>6</td><td>9</td><td>5 is compared
5 is in place in sorted list</td><td>1</td></tr>
<tr><td>1</td><td>5</td><td>6</td><td>6</td><td>12</td><td>15</td><td>9</td><td>6 is compared
6 is in place in sorted list</td><td>1</td></tr>
<tr><td>1</td><td>5</td><td>6</td><td>6</td><td>9</td><td>12</td><td>15</td><td>9 is compared and put in place</td><td>1</td></tr>
</table></td><td>6
AO2.1
(6)</td><td>… each row is dependent upon the preceding row being correct

Examiner’s Comment:
Some candidates confused insertion sort with other sorting algorithms, but many candidates gave good answers in diagrammatic form. Answers in diagrammatic form after each pass of the loop were often far clearer than prose descriptions. This form of answer should be encouraged.</td></tr>
<tr><td></td><td>b</td><td>i</td><td>O(n)</td><td>1
AO1.1
(1)</td><td></td></tr>
<tr><td></td><td></td><td>ii</td><td>1 mark per bullet to max 3

• The best case is for a sorted list (O(n))
• As the number of elements increases
• … the number of steps increases in a linear fashion</td><td>3
AO1.2
(3)</td><td>B(ii) dependent upon b(i) being correct
i.e. answers for O(n) only

Accept appropriate graph for bullet points 2 and 3

Examiner’s Comment:
Whilst many candidates had some knowledge of 'Big O' notation fewer could apply it correctly within the context given.</td></tr>
</table>

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Question	Answer/Indicative content	Marks	Guidance
c	**Mark Band 3 - High level** **(7–9 marks)** The candidate demonstrates a **thorough** knowledge and understanding of how bubble sort works and Big O complexity; the material is generally accurate and detailed. 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. *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 of how bubble sort works and Big O complexity; 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. *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 of how bubble sort works and Big O complexity with limited understanding shown; the material is basic and contains some inaccuracies. The candidates make a limited attempt to apply acquired knowledge and understanding to the context provided. The candidate provides a limited	9 AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)	**AO1: Knowledge and Understanding** **Indicative content** • Description of bubble sort: ◊Starting at the beginning of the list Items are swapped with their neighbour if they are out of order. ◊Each pair of neighbours is checked in order. ◊When a swap is made a flag is set. ◊If at the end of the list the flag has been set the flag is unset and the algorithm starts from the beginning of the list again. ◊When the algorithm gets to the end of the list and the flag is unset the list is sorted and the algorithm finishes. • $O(n^2)$ denotes as the data size increases the time the list takes to sort increases in a quadratic manner. • O(1) denotes the space used is constant **AO2: Application** • As data set gets bigger, bubble sort's time gets larger at an increasing rate.. • Complexity doesn't denote the actual time but the order with which the time / space grows. • O(1) space complexity means no matter how big the data set becomes the amount of space (extra to the data itself) remains the same. • $O(n^2)$ time complexity means as n increases time increases by n^2 / if n doubles the time taken is squared. • Bubble sort can be tweaked with improvements (e.g. checking one less item per iteration and alternating sorting directions). • These optimisations don't change the complexity. IT will run a little quicker on smaller sets but time taken increases rapidly with data size. • When choosing an algorithm we may also want to take into account the average and best case scenarios. (in this case they are also the same for both algorithms.)

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Question			Answer/Indicative content	Marks	Guidance
			discussion which is narrow in focus. Judgements if made are weak and unsubstantiated. *The information is basic and comunicated 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.		AO3: Evaluation • The algorithms may have the same time complexity but this does not mean they take the same time to execute on the same data set. • Insertion sort generally performs quicker than bubble sort and is therefore preferable. (Neither scale well however.) • Both algorithms have a space complexity of O(1). This is because both algorithms are inplace (i.e. all sorting takes place within the actual data). • Both have a time complexity of $O(n^2)$ as a consequence of their nested loops. (NB last two points are only likely to appear in the very highest mark answers.) Examiner's Comment: Most candidates achieved some credit, especially for a description of the bubble sort. Fewer candidates could compare the relative merits of both bubble and insertion sort in terms of the best / average / worse case.
			Total	22	

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<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>2</td><td>a</td><td></td><td>1 mark per bullet, to max 2, e.g.

• Orders can be processed in the order they are in the queue

• Orders can be inserted at any place in the list e.g. high priority item inserted earlier in the list

• Orders can be deleted from any position in the list once they are complete

• List is dynamic…

• … to allow orders to be added / deleted</td><td>2
AO1.2
(1)
AO2.1
(1)</td><td>Examiner's Comment:
Many candidates struggled to apply the context given to computer science concepts and hence answer with the relevant properties of a linked list that would be relevant in context.</td></tr>
<tr><td></td><td>b</td><td>i</td><td>1 mark per bullet

• <code>nodeNo</code> and <code>next</code> columns are both correct

• <code>orderNo</code> column is correct

<table><tr><th><code>nodeNo</code></th><th><code>orderNo</code></th><th><code>next</code></th></tr><tr><td>Ø</td><td>154</td><td>1</td></tr><tr><td>1</td><td>157</td><td>2</td></tr><tr><td>2</td><td>155</td><td>3</td></tr><tr><td>3</td><td>156</td><td>4</td></tr><tr><td>4</td><td>158</td><td>Ø</td></tr></table></td><td>2
AO1.2
(2)</td><td></td></tr>
</table>

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<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td></td><td>ii</td><td>1 mark per correct column

<table>
<tr><th>nodeNo</th><th>orderNo</th><th>next</th></tr>
<tr><td>Ø</td><td>154</td><td>4</td></tr>
<tr><td>1</td><td>157</td><td>2</td></tr>
<tr><td>2</td><td>155</td><td>3</td></tr>
<tr><td>3</td><td>156</td><td>Ø</td></tr>
<tr><td>4</td><td>159</td><td>1</td></tr>
</table></td><td>3
AO1.2
(3)</td><td>Examiner's Comment:
Most candidates scored well in part (i), but fewer understood how the pointers in a linked list could be updated in part (ii) to allow the insertion of the new item in the next free space.</td></tr>
<tr><td></td><td>c</td><td>i</td><td>• The index / subscript of the array acts as the nodeNo</td><td>1
AO1.2
(1)</td><td></td></tr>
<tr><td></td><td></td><td>ii</td><td>1 mark for each correctly completed column

<table>
<tr><th>Finished</th><th>Count</th><th>output</th></tr>
<tr><td>False</td><td>0</td><td>184</td></tr>
<tr><td>(False)</td><td>1</td><td>186</td></tr>
<tr><td>(False)</td><td>2</td><td>185</td></tr>
<tr><td>True</td><td>3</td><td>187</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
</table></td><td>3
AO1.2
(1)
AO2.2
(2)</td><td></td></tr>
<tr><td></td><td></td><td>iii</td><td>1 mark per bullet to max 2

• Output the order numbers …

• … in the order they are in the linked list</td><td>2
AO2.2
(2)</td><td></td></tr>
</table>

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<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td></td><td>iv</td><td>1 mark per bullet to max

• Order 190 is added to the end

• Pointers are updated

• 186 will point to 4

• 190 will point to 2

OR
<table><tr><td>Index</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>Data</td><td>184</td><td>186</td><td>185</td><td>187</td><td>190</td></tr><tr><td>Pointer</td><td>1</td><td>4</td><td>3</td><td></td><td>2</td></tr></table></td><td>4
AO1.2
(2)
AO2.1
(2)</td><td>If a diagram is given then the mark for updating the pointers is implicit

Examiner’s Comment:
Few candidates could give a clear answer in part (i) using the correct technical vocabulary that the array index / subscript could be used as the node number. Many candidates could work through the logic required in the trace table in part (ii), but fewer could actually explain what it was doing in (iii) within the context of the scenario. Part (iv) was often best answered by those candidates who used the diagram to give the solution. Candidates should be encouraged to use diagrams where they can be used to good effect rather than lengthy or vague prose descriptions.</td></tr>
<tr><td></td><td>d</td><td></td><td>Algorithm, max 1

• linear

Justification, 1 mark per bullet to max 2

• Items do not have to be in a specific order

• Binary needs items in order</td><td>3
AO1.1
(1)
AO2.1
(2)</td><td>No marks for justification if <u>linear</u> has not been identified

Examiner’s Comment:
Many candidates correctly identified a linear search and could justify the need for it. However, a lot of candidates did answer binary search without appreciating that the data set needed to be in order first.</td></tr>
</table>

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Question			Answer/Indicative content	Marks	Guidance
	e		1 mark for feature, 1 for benefit. Max 2 per feature. e.g. • Auto-complete • Can view identifiers / avoid spelling mistakes • Colour coding text / syntax highlighting • Can identify features quickly / use to check code is correct • Stepping • Run one line at a time and check result • Breakpoints • Stop the code at a set point to check value of variable(s) • Variable watch / watch window • Check values of variables and how they change during the execution • Error diagnostics • Locate and report errors / give detail on errors	6 AO1.1 (3) AO1.2 (3)	Question states when writing the code, therefore use of compiler / producing .exe etc. are not awarded marks Accept any suitable features e.g. traces, crash dump, stack contents, cross-references, line numbers, auto-indent Examiner's Comment: Most candidates achieved some credit for factual recall. However, weaker candidates often answered debugger rather than explaining the specific features of the debugger which would have been creditworthy.

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Question	Answer/Indicative content	Marks	Guidance
f	Mark Band 3 – High level (7-9 marks) The candidate demonstrates a **thorough** knowledge and understanding of concurrent programming; the material is generally accurate and detailed. 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. *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 concurrent programming; 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. *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 concurrent programming with limited understanding shown; the material is basic and contains some inaccuracies. The candidates 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	9 AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)	AO1: Knowledge and Understanding Indicative content • Processes are happening at the same time / at overlapping times • Only 1 process can actually happen at a time on a single core processor, concurrent tries to simulate multiple processes • One process may need to start before a second has finished • Individual processes are threads, each thread has a life line AO2: Application • Multiple orders can be made and added to the list at the same time • Programming will need to allow multiple threads to manipulate a single list • Will allow those reading and writing to manipulate at the same time • Locking will need implementing – more complex programming AO3: Evaluation • Will allow for multiple orders at the same time – as it would happen in real life • Access to the linked list will need to be limited so it cannot be accessed / overwritten by two threads trying to do different operations • Not all of the process will be paralleliseable. X processors does not mean it will run in 1/xth of the time of one processor.

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Question			Answer/Indicative content	Marks	Guidance
			unsubstantiated. *The information is basic and comunicated 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.		Examiner's Comment: It was clear that many candidates had not covered the concept of concurrency and how it allows different processes to occur at the same time. Strong candidates appreciated that this could be simulated on a single core with time slicing or implemented within a parallel architecture. Many candidates lost sight of the fact that answers needed to be related to computer science rather than a restaurant chain and could not explain the underlying computer science that would allow a solution to be delivered.
			Total	35	

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Question			Answer/Indicative content	Marks	Guidance
3	a	i	Save string in file	1 AO2.2 (1)	
		ii	1 mark per bullet, max 2 per advantage to max 4 e.g. • Procedures can be re-used • No need to reprogram / saves time • Program can be split between programmers • Can specialise in their area • Speed up completion time • As multiple procedures worked on concurrently • Easy to test / debug • As each module can be tested on its own then combined.	4 AO1.2 (4)	Allow any appropriate advantages **Examiner's Comment:** Part (i) was well answered where candidates had read the question stem and thought logically about the steps involved. Many candidates gained some credit in part (ii), but fewer could expand on the points they made to gain full credit.

	b		1 mark each
			
			`function readMessage(fileName)`
			`  messageFile = openRead(fileName)`
			`  message = messageFile.readLine()`
			`  messageFile.close()`
			`  return message`
			`endfunction`
				4
				AO2.1
				(4)
					We are not testing pseudocode knowledge – answers that work but do not match the pseudo code given should still be credited full marks.
					
					readMessage and **fileName** and **message** are case sensitive
					
					Examiner's Comment:
					Many candidates struggled to produce good answers which could have been calculated and did not require factual recall.

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Question			Answer/Indicative content	Marks	Guidance

	c		1 mark per bullet to max 5
			
			• Use of appropriate loop
			• Correct end condition (length of `message`)
			• Correct use of `.push` with `messageStack`
			• Accessing `substring` (or equivalent) correctly
			• Appropriate comment(s)
			
			`procedure pushToStack(message)`
			`  for x = 0 to message.length() //loop through each //letter`
			`  messageStack.push(message.substring(x,1)) //take //each character and push onto stack`
			`  next x  //move to next letter`
			`endprocedure`
				5
				AO2.1
				(2)
				AO3.2
				(3)
					Examiner's Comment:
					Many candidates scored well, but fewer scored full marks. The use of pseudocode rather than Python like syntax would have prevented errors with loop lengths.

	d		1 mark per bullet to max 5 • Pop element from stack • Convert to ASCII value • Subtract 10 from ASCII value • Convert back to character • Append / concatenate with variable	5 AO1.2 (2) AO2.2 (3)	Accept pseudocode equivalent. **Examiner's Comment:** Most candidates scored some of the marks, but fewer appreciated that the characters needed to be popped from the stack initially, and that the converted characters would have to be concatenated into a string at the end of the process.
			Total	19	

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Question			Answer/Indicative content	Marks	Guidance
4	a		Tree // Graph (undirected)	1 AO1.2 (1)	Do not accept binary tree
	b	i	1 mark per bullet to max 4 • Depth-first goes to left child node when it can… • If there is no left child it goes to the right child • when there are no child nodes the algorithm 'visits' it' and backtracks to the parent node. • Breadth-first visits all nodes connected directly to start node… • Then visits all nodes directly connected to each of those nodes (and then all nodes directly connected to those nodes and so on…) • Depth-first uses a stack • Breadth-first uses a queue	4 AO1.2 (4)	
		ii	1 mark per node in correct order D→K→L→H→B→G (X)	6 AO2.1 (6)	

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Question			Answer/Indicative content	Marks	Guidance
		iii	Max 3 e.g. • When a node does not have any node to visit e.g. D • The algorithm goes back to the previous visited node e.g. B • To check for further nodes to visit e.g. H • This repeats until a new node can be visited, or all nodes have been visited	3 AO1.2 (2) AO2.1 (1)	Examiner's Comment: A number of candidates incorrectly identified the data structure as a binary tree which indicated that this was the only type of tree that they were familiar with. Descriptions of depth and breadth first traversals were often very vague, and precision in terms of the algorithmic steps involved would have produced stronger answers. A pleasing number of candidates produced the correct traversal of the tree, but of those, a number did not appreciate that the node was only output when it was popped from the stack, and hence missed location G before X was actually output.
			Total	14	

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Question			Answer/Indicative content	Marks	Guidance
5	a		05 and 07	1 AO2.1 (1)	
	b		1 mark for each highlighted element • calculate(4,10) if 4 == 10 FALSE elseif 4 < 10 TRUE return calculate(4, (10-4)) return calculate(4, 6) • if 4 == 6 FALSE elseif 4 < 6 TRUE return calculate(4, 6-4) return calculate(4, 2) • if 4 == 2 FALSE elseif 4 < 2 FALSE else return calculate(2, 4-2) return calculate(2,2) • if 2 == 2 TRUE return 2 return 2 return 2 return 2 • output(2)	5 AO2.1 (5)	Allow trace table or any sensible equivalent. **Examiner's Comment:** Many candidates scored well in parts (a) and (b) and it was pleasing to see that recursion could both be identified and traced. Few candidates achieved full marks in part (b) because they did not appreciate that the function was inside a print statement so a final output of 2 would be produced after the value 2 was returned.

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Question			Answer/Indicative content	Marks	Guidance

	c		1 mark per bullet to max 4
			
			• Suitable loop with correct condition
			
			• In IF: Overwriting num2 with num2 – num1
			
			• In ELSE: Overwriting num1 with num2…
			
			• … Overwriting num2 with num1–num2 correctly (using a temp variable)
			
			e.g.
			`while num1 != num2`
			`  if num1 < num2 then`
			`  num2 = num2 - num1`
			`  else`
			`  temp = num1 - num2`
			`  num1 = num2`
			`  num2 = temp`
			`  endif`
			`endwhile`
				4
				AO2.1 (1)
				AO2.2 (1)
				AO3.2 (2)
					Alternatively swapping values by
					`temp = num1`
					`num1 = num2`
					`num2 = temp - num2`
					
					Examiner's Comment:
					Most candidates produced recognisable pseudocode. Weaker candidates produced logically incorrect solutions or did not understand the difference between an iterative and a recursive solution – reformulating another recursive solution. Where strong candidates produced good solutions they sometimes forget the necessity to have a temporary swap variable when swapping the values in two different variables over.

			Total	**10**	

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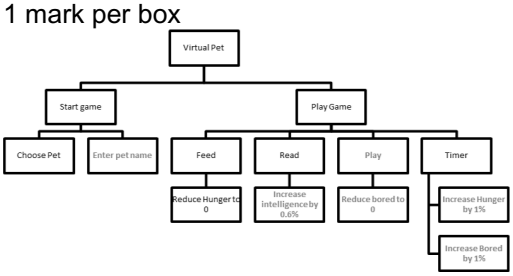
Question			Answer/Indicative content	Marks	Guidance
6	a		1 mark per input to max 3 • Choice of pet • Pet name • Feed • Play • Read	3 AO2.1 (3)	Allow any reasonable input to this system **Examiner's Comment:** Nearly all candidates achieved full marks after analysing the requirements in the stem of the question.
	b	i	1 mark per bullet to max 2 - Splitting a problem down - Into its component parts/sub-procedures/modules	2 AO1.1 (2)	**Examiner's Comment:** Nearly all candidates scored full marks for factual recall of the required definition.
		ii	1 mark per box  	6 AO2.2 (6)	Calculations must be correct **Examiner's Comment:** Nearly all candidates achieved three or more marks after analysing the requirements in the stem of the question. A number gave incorrect multiplying factors for some of the required elements and thus lost marks where mathematical accuracy was required.

Question			Answer/Indicative content	Marks	Guidance

	c	i	1 mark per bullet to max 3
			
			• Defining procedure play
			◦ Resetting bored to 0
			◦ Outputting result
			
			e.g.
			`procedure play()`
			`  bored = 0`
			`  print("bored: " + bored + "%")`
			`endprocedure`
				3
				AO3.2
				(3)	

		ii	1 mark per bullet to max 3
			
			• Defining procedure read
			◦ Correct calculation
			◦ Outputting result
			
			e.g.
			`procedure read()`
			`  intelligence = intelligence * 1.006`
			`  print("intelligence: " + intelligence)`
			`endprocedure`
				3
				AO2.2
				(1)
				AO3.2
				(2)
					Examiner's Comment:
					Most candidates scored some credit, but a disappointing number did not give a correct procedural declaration. The correct mathematical expression to increase the *intelligence* by 0.6% in (ii) was often incorrectly given.

	d	i	1 mark per bullet to max 4
			
			• Correct declaration, appropriate name (e.g. `new`)
			• Taking `name` and `theType` as a parameter
			• Setting `petName` to parameter
			• Setting `bored, hunger` and `intelligence` to 0
			
			e.g.
			`public procedure new(name, theType)`
			`  petName = name`
			`  bored = 0`
			`  hunger = 0`
			`  intelligence = 0`
			`  type = theType`
			`endprocedure`
				4
				AO2.2
				(1)
				AO3.2
				(3)	

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Question			Answer/Indicative content	Marks	Guidance
		ii	1 mark per bullet to max 2 • `myPet`/appropriate = `new pet` • `Springy` and `Tiger`, in `" "`, in same order as constructor declaration e.g. `myPet = new pet("Springy", "Tiger")`	2 AO2.1 (2)	

		iii	1 mark per bullet to max
			
			• Class declaration including inherit (or equivalent e.g. Tiger extends Pet, Tiger::Pet, Tiger(Pet))
			
			• Constructor procedure (new) with all attributes present
			
			  • bored = 10, hunger = 50, intelligence = 10, type = "Tiger"
			
			• outputGreeting procedure
			
			  • Outputting original and new messages correctly
			
			e.g.
			`class Tiger inherits Pet`
			`public procedure new(name)`
			`petName = name`
			`bored = 10`
			`hunger = 50`
			`intelligence = 10`
			`type = "Tiger"`
			`endprocedure`
			
			`public procedure outputGreeting()`
			`print("Hello, I'm " + petName + ", I'm a " + type)`
			`print("I like to eat meat and roar")`
			`endprocedure`
			`endclass`
				5
				AO2.2
				(2)
				AO3.2
				(3)
					Accept
					super.outputGreeting()
					In place of first print statement
					
					Examiner's Comment:
					Many candidates struggled with the application of object oriented techniques and concepts and it was clear that many of these candidates had not had practical experience of object oriented programming. Stronger candidates did perform well and understood how to create instances from classes and how to use inheritance.

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Question	Answer/Indicative content	Marks	Guidance
e	Mark Band 3 – High level (7–9 marks) The candidate demonstrates a **thorough** knowledge and understanding of abstraction; the material is generally accurate and detailed. 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. *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 abstraction; 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. *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 abstraction with limited understanding shown; the material is basic and contains some inaccuracies. The candidates 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. *The information is basic and comunicated in an unstructured way. The information is*	9 AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)	AO1: Knowledge and Understanding Indicative content • Removal of unnecessary elements • Uses symbols to represent elements of the problem • Increase chance of creating the program successfully • Reduces programming time and factors that can detract from the program AO2: Application • Examples of use in this system e.g. ◦ Environment is not shown ◦ Movements reduced / removed ◦ Other factors that can be done / affect the 'pet' are removed ◦ Time may not be represented as minutes, seconds AO3: Evaluation • Reduces complexity of programming • Requires less computational power, so the game can be played on lower spec devices e.g. phones • Focus is on the core aspects of the program rather than the extras • Too much abstraction can detract from the appeal of the game, may be too simplistic / not realistic enough, may not have enough scope to engage users

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Question			Answer/Indicative content	Marks	Guidance
			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.		**Examiner's Comment:** Abstraction was well understood by the majority of candidates. Candidates needed to be able to give relevant examples in context and to be able to evaluate the advantages that abstraction gave to achieve marks in the top band. The level of clarity and analysis required for the top band was only seen in the strongest candidates' responses.
	f	i	O(n)	1 AO1.1 (1)	Examiner's Comment: Most candidates scored well for this section.
		ii	1 mark per bullet to max 2 • 20(ms) • … showing working	2 AO1.2 (1) AO2.1 (1)	**Examiner's Comment:** Most candidates scored well for this section.
			Total	**40**	

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