Question			Answer/Indicative content	Marks	Guidance
1	a		1 mark per bullet to max 3. e.g. • Remove unnecessary details // remove character features that are not needed • e.g. remove the outside world • e.g. Remove complexity from the realistic entities // Simply real-life objects • e.g. simplify characters/animals/tents • e.g. by representing them with specific objects/shapes	3 AO2.1 (2) AO2.2 (1)	
	b	i	1 mark per bullet to max 2 e.g. • Multiple processes being executed at the same time // appearing to happen simultaneously • Giving processes a slice of the processor time • Having multiple processors each carrying out a different process	2 AO1.1 (2)	
		ii	1 mark per bullet to max 3 e.g: • Game could have large number of requests to the server at a time • … server needs to respond in reasonable time • … having multiple processors handling the different requests would increase response time • Users could override each other's changes • … e.g. needs to handle if someone updates their circus while someone else is visiting • …use record locking to stop edits if someone else has access to data • Different users will have different response times • …therefore the processor can still handle other requests • …so that the performance for other users is not affected	3 AO2.1 (2) AO2.2 (1)	

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

• A rule of thumb / estimate / guess
• That estimates the distance / cost from each node to the destination node
• To speed up the process of finding a solution
• …by identify which paths to follow first</td><td>2 AO1.1 (1)
AO1.2 (1)</td><td></td></tr>
<tr><td></td><td></td><td>ii</td><td>
<table>
<tr><th>Node</th><th>Distance travelled</th><th>Heuristic</th><th>Distance travelled + Heuristic</th><th>Previous node</th><th>MARKING GUIDANCE</th></tr>
<tr><td>A (✓)</td><td>0</td><td>90</td><td>90</td><td></td><td>1 MARK</td></tr>
<tr><td>B (✓)</td><td>$\underline{\infty}$ 21</td><td>80</td><td>101</td><td>A</td><td>1 MARK</td></tr>
<tr><td>C (✓)</td><td>$\underline{\infty}$ 42</td><td>65</td><td>107</td><td>A</td><td>1 MARK</td></tr>
<tr><td>D (✓)</td><td>$\underline{\infty}$ 42+12=54</td><td>50</td><td>104</td><td>C</td><td>1 MARK</td></tr>
<tr><td>E</td><td>$\underline{\infty}$ 21+40=61</td><td>50</td><td>111</td><td>B</td><td>1 MARK</td></tr>
<tr><td>F (✓)</td><td>$\underline{\infty}$ 42+12+23=77</td><td>30</td><td>107</td><td>D</td><td>1 MARK</td></tr>
<tr><td>G</td><td>$\underline{\infty}$ 42+12+23+33=110</td><td>0</td><td>110</td><td>F</td><td>1 MARK</td></tr>
</table>

Final path = A,C,D,F,G and Distance = 110 (1 Mark)</td><td>8 AO1.2 (3)
AO2.1 (3)
AO2.2 (2)</td><td></td></tr>
<tr><td></td><td>d</td><td></td><td>1 mark per bullet to max 6

• Visit root node M
• Visit E and S
• Visit C and J (from E)
• …then P and V (from S)
• Visit G and K (from J)
• Visit L (from K)</td><td>6 AO1.2 (1)
AO2.1 (3)
AO2.2 (2)</td><td></td></tr>
</table>

Question	Answer/Indicative content	Marks	Guidance
e	**Mark Band 3 – High level (7-9 marks)** The candidate demonstrates a thorough knowledge and understanding of data mining; 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. The candidate is able to weigh up the use of data mining which results in a supported and realistic judgment as to whether it is possible to use them in this context. *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 data mining; 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 makes a reasonable attempt to come to a conclusion showing some recognition of influencing factors that would determine whether it is possible to use data mining in this context. *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 data mining 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 nothing more than an unsupported assertion. *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*.	9 AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)	**AO1: Knowledge and Understanding** **Indicative content** • Data mining searches large amounts of data • Searches for relationships between facts/components/events that may not be obvious • May include pattern matching algorithms • May involve anomaly detection algorithms • Used for business modelling • Used to plan for future eventualities **AO2: Application** • Can look for how people use the website e.g. visiting times, what they click on, how long they spend on certain features, what they do first, which elements are used least • Give recommendations for future changes to the game e.g. features to add, or remove **AO3: Evaluation** Candidates will need to evaluate the benefits and drawbacks of using data mining. e.g. • Can use to introduce new features • Increase use from users • Increase revenue by selling features used more often • Make the game more appealing • Remove features people don't use • Use to target advertising • Privacy concerns from users • Misuse of information

Question			Answer/Indicative content	Marks	Guidance
			0 marks No attempt to answer the question or response is not worthy of credit.		
			Total	33	

Question			Answer/Indicative content	Marks	Guidance

2	a	i	1 mark for each number/statement up to a maximum of 6 marks:
			
			`function binarySearch(dataArray:byref, upperbound, lowerbound, ***searchValue***)`
			`  while true`
			`  middle = lowerbound +)`
			`  ((upperbound – lowerbound))`
			`  ***DIV 2***)`
			`  if upperbound < lowerbound`
			`  then`
			`  return **-1**`
			`  else`
			`  if dataArray[middle] <`
			`  searchValue then`
			`  lowerbound = ***middle + 1***`
			`  elseif dataArray[middle] >`
			`  searchValue then`
			`  upperbound = ***middle - 1***`
			`  else`
			`  return ***middle***`
			`  endif`
			`  endif`
			`  endwhile`
			`endfunction`
				6 AO1.2 (2)
				AO3.3 (4)	

		ii	Do…until // repeat…until // post condition	1 AO1.2 (1)	

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td>b</td><td></td><td>1 mark for each tick up to a maximum of 6 marks
Worst-case space complexity:

<table><tr><th></th><th>Binary search</th><th>Linear search</th></tr><tr><td>O(log(n))</td><td></td><td></td></tr><tr><td>O(1)</td><td>✓</td><td>✓</td></tr><tr><td>O(n)</td><td></td><td></td></tr></table>Best-case space complexity:

<table><tr><th></th><th>Binary search</th><th>Linear search</th></tr><tr><td>O(log(n))</td><td></td><td></td></tr><tr><td>O(1)</td><td>✓</td><td>✓</td></tr><tr><td>O(n)</td><td></td><td></td></tr></table>Average time complexity:

<table><tr><th></th><th>Binary search</th><th>Linear search</th></tr><tr><td>O(log(n))</td><td>✓</td><td></td></tr><tr><td>O(1)</td><td></td><td></td></tr><tr><td>O(n)</td><td></td><td>✓</td></tr></table></td><td>6 AO1.1
(6)</td><td></td></tr>
<tr><td></td><td>c</td><td></td><td>1 mark for any example
e.g.

• Data is not sorted
• Item you are looking for is the first item in the list
• Small number of items</td><td>1 AO1.2
(1)</td><td></td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>14</td><td></td></tr>
</table>

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
3	a		1 mark per bullet, each must be applied correctly to data • Choose a pivot // identify start and end pointers • Compare each element to the pivot… // compare start and end pointers • Put items < pivot in the left sublist • Put items > pivot in the right sublist • Choose a pivot in each sublist • If start pointer is larger than end pointer… • …then swap data items around • And repeat the process until each item becomes a pivot	5 AO1.2 (2) AO2.2 (3)	
	b		1 mark per bullet to max 2 • decomposing data sets into smaller subsets • and then sorting each split subset • until each subset is sorted • and then combining the subsets to provide a solution	2 AO1.1 (1) AO2.1 (1)	
			Total	7	

Question			Answer/Indicative content	Marks	Guidance
4			**Mark Band 3 – High level (7-9 marks)** The candidate demonstrates a thorough knowledge and understanding of IDEs; 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. The candidate is able to weigh up the use of IDEs which results in a supported and realistic judgment as to whether it is possible to use them in this context. *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 IDEs; 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 makes a reasonable attempt to come to a conclusion showing some recognition of influencing factors that would determine whether it is possible to use IDEs in this context. *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 IDEs 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 nothing more than an unsupported assertion. *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*.	9 AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)	**AO1: Knowledge and Understanding** **Indicative content** e.g. • IDE is software that includes an editor, compiler, run-time environment Creating • Autocorrect • Autocomplete • Pretty printing Testing • Breakpoints • Stepping • Variable watch window **AO2: Application** e.g. • Tell you when you make a syntax error • Allows you to write and run the code in one piece of software • Suggests code so you don't have to remember code, or autocorrect spelling mistakes • Helps you trace the program so you can see what happens when values change without having to manually insert print statements etc. • Autogenerate boilerplate code. **AO3: Evaluation** Candidates will need to evaluate the benefits and drawbacks of using IDEs. e.g. • Reduce errors through autocorrect and suggestions • Reduce time to write the program because features help you spot errors before running the code, some errors will be corrected so you don't have to • Write and test in one environment so you don't have to close and run elsewhere, then re-open etc.

Question			Answer/Indicative content	Marks	Guidance
			0 marks No attempt to answer the question or response is not worthy of credit.		
			Total	9	

Question			Answer/Indicative content	Marks	Guidance
5	a		To create an instance of an object from a class	1 AO2.1 (1)	
	b		1 mark per bullet up to a maximum of 2 marks, e.g: • When the child/derived/subclass class office/house takes on attributes/methods… • … from building / parent/base/superclass/ class	9 AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)	

	c		1 mark for each completed statement up to a maximum of 5 marks:
			`private numberFloors`
			`private width`
			`private` **`height`**
			`public procedure new(pFloors, pWidth, pHeight)`
			`numberFloors =` **`pFloors`**
			`width = pWidth`
			`height = pHeight`
			`endprocedure`
			`public function getNumberFloors()`
			`return` **`numberFloors`**
			`endfunction`
			`public function setNumberFloors(pFloors)`
			`if pFloors >= 1 then`
			`numberFloors =` **`pFloors`**
			`return true`
			`else`
			`return` **`false`**
			`endif`
			`endfunction`
			`endclass`
				5 AO2.2 (3) AO3.2 (2)	Accept other specific language conventions that would correctly achieve the same outcomes.

Question			Answer/Indicative content	Marks	Guidance

	d		1 mark per bullet up to a maximum of 6 marks:
			
			• Class declaration for house with inherits building
			• Declaring bedrooms and bathrooms as private
			• New declaration …
			• … with all **five** parameters
			• Calling super constructor // equivalent with floors, width and height set
			• Setting bedrooms and bathrooms
			
			e.g.
			`class house inherits building`
			`  private bedrooms, bathrooms`
			`  public procedure new(pFloors, pWidth, pHeight, pBedrooms, pBathrooms)`
			`  super.new(pFloors, pWidth, pHeight)`
			`  bedrooms = pBedrooms`
			`  bathrooms = pBathrooms`
			`  endprocedure`
			`endclass`
				6 AO2.1 (1)
				AO2.2 (2)
				AO3.2 (3)	

	e		1 mark per bullet up to a maximum of 4 marks:
			
			• Procedure header taking parameter
			• Adding parameter to array
			• …at position `numberBuildings`
			• Incrementing `numberBuilding`
			
			e.g.
			`procedure newbuilding(pBuilding)`
			`  buildings[numberBuildings] = pBuilding`
			`  numberBuildings = numberBuildings + 1`
			`endprocedure`
				4 AO2.1 (1)
				AO3.2 (3)	

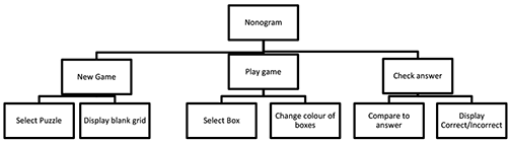
Question			Answer/Indicative content	Marks	Guidance

	f		1 mark per bullet up to a maximum of 4 marks:
			
			• Creating a new instance of house with identifier `houseOne`
			• …with the correct parameters
			• Creating a new instance of houseRoad named `limeAvenue`
			• …sending `houseOne` as parameter to the constructor
			
			e.g.
			`houseOne = new house(2, 8, 10, 3, 2)`
			`limeAvenue = new houseRoad(houseOne)`
				4 AO2.1 (1) AO3.2 (3)	

			Total	**22**	

Question			Answer/Indicative content	Marks	Guidance
6	a		1 mark for each interval Interval 1 • A is fetched Interval 2 • A is decoded • B is fetched Interval 3 • A is executed • B is decoded • C is fetched Interval 4 • B is executed • C is decoded • D is fetched	4 AO1.2 (4)	
	b		1 mark per bullet up to a maximum of 2 marks: • Reduces/removes latency • … CPU is not idle while waiting for next instruction • Next instruction is fetched while current one is decoded/executed • All parts of the processor can be used at any instance in time.	2 AO1.2 (2)	
			Total	6	

Question			Answer/Indicative content	Marks	Guidance
7	a		1 mark for the purpose and 1 mark for matching appropriate name (4 marks total), e.g: • Pointer to the first element in the queue • firstElement // any other meaningful name • Pointer to the last element in the queue // Pointer to the first free element in the queue • lastElement / any other meaningful name	4 AO1.2 (4)	Must cover purpose and name for 2 marks for each pointer.
	b		1 mark per bullet up to a maximum of 5 marks, e.g: • Check if the queue is full • … if the firstElement pointer (+1) = lastElement // length variable == queue's capacity • … if it is return False • Adds element at lastElement (+1) position // Adds element at startposition+length • … increments lastElement pointer • If lastElement is greater than last Index // pointer becomes pointer MOD array.size • …reset to 0	5 AO1.2 (5)	Look out for variations in representing the queue
			Total	9	

Question			Answer/Indicative content	Marks	Guidance
8	a	i	1 mark per box up to a maximum of 3 marks. • **Select puzzle** and **display blank grid** (below new game) • **Select box** and **change colour of boxes** (below play game) • **Compare to answer** and **display correct/incorrect** (below check answer) e.g.  	12 AO1.1 (2) AO1.2 (2) AO2.1 (23 AO3.3 (5)	
		ii	1 mark per bullet up to a maximum of 2 marks, e.g: e.g. • Splits the problem into smaller chunks • Smaller problems are more manageable • Smaller problems are easier to solve • To see where code can be reused in the solution • To split tasks between different programmers	2 AO1.1 (1) AO1.2 (1)	
		iii	1 mark for input, 1 for process 1 for output e.g. Input: • Clicking a box Process: • Generating new puzzle • Checking if block is black • Changing block to white Output: • Grid with coloured squares	3 AO2.2 (3)	

Question			Answer/Indicative content	Marks	Guidance
	b	i	1 mark for each correctly completed statement up to a maximum of 5 marks: 01 function countRow(puzzle:byref, rowNum:byval) 02 count = 0 03 output = " " 04 for i = 0 To **4** 05 if puzzle[rowNum, i] == **1** then 06 count = count + 1 07 elseif count >= 1 then 08 output = output + str(**count**) + " " 09 count = 0 10 endif 11 next i 12 if count>= 1 then 13 output=ouput+str(count) 14 elseif output == "" then 15 output = **"0"** 16 endif 17 return **output** 18 endfunction	5 AO2.2 (2) AO3.2 (3)	Accept for i = 0 to **row.length-1** for i = 0 to **row.length** for i=0 to 5
		ii	1 mark per bullet up to a maximum of 2 marks, e.g: • Initialise the variable output… • …with a space • …for use later on in the code… • …So it can be used for concatenation later in the code … • …to avoid an error being generated	2 AO1.2 (1) AO2.2 (1)	
		iii	1 mark per bullet up to a maximum of 3 marks, e.g: • check the value stored in each index • check whether it is at the end of a row • check whether each row has been given an output or not	3 AO2.2 (3)	

Question			Answer/Indicative content	Marks	Guidance

		iv	1 mark per bullet up to a maximum of 6 marks:
			
			• Procedure heading for displayRowAnswer
			• …taking puzzle as parameters
			• Nested loops through all array elements
			• …outputting all rows
			• … at the end of each row calling countRow ….
			• …..with parameters puzzle and the current loop counter
			
			e.g.
			`procedure displayRowAnswer(puzzle)`
			`  for i = 0 To 4`
			`  for j = 0 To 4`
			`  print(puzzle[i, j] + " ")`
			`  next j`
			`  print (" " + countRow (puzzle, i))`
			`  next i`
			`endprocedure`
				6 AO2.2 (3)
				AO3.2 (3)
					Accept
					
					for i = 0 to **row.length-1**
					
					for i = 0 to **row.length**
					
					for i=0 to **5**

		v	1 mark for clearly identifying each error and giving the correction. • Line 01 needs `answerGrid` as parameter • Line 04 == should be != • Line 08 should be `next row`	3 AO2.1 (3)	Do not award marks for line numbers alone without stating the error. Consider 1 mark for not changing line 04 but changing 05 to true and 09 to False

Question			Answer/Indicative content	Marks	Guidance
	c		**Mark Band 3 – High level (7-9 marks)** The candidate demonstrates a thorough knowledge and understanding of local and global variables; 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. The candidate is able to weigh up the use of both local and global variables which results in a supported and realistic judgment as to whether it is possible to use them in this context. *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 knoledge and understanding of local and global variables; 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 makes a reasonable attempt to come to a conclusion showing some recognition of influencing factors that would determine whether it is possible to use local and global variables in this context. *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 local and global variables 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 nothing more than an unsupported assertion. *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** Local variables: • Scope within the module defined within • Cannot access externally unless passed as parameter, or returned from function • When module is exited, memory of variable is freed Global variables: • Scope within the entire program • Can access from anywhere • Retained in memory permanently ByRef Points to location of variable ByVal Sends the value **AO2: Application** • If global the arrays can be accessed from all modules by direct reference • If local to the main, the arrays will need to be passed as parameters byreference • Can send ByVal – but not always possible with arrays in some languages • Modules are self contained and then can be reused in other programs he wants to create without needing to take the global variables with them **AO3: Evaluation** e.g. • +ve Local = memory efficient • +ve Global = easier programming, simpler to follow, easier to debug • -ve Global = memory inefficient, not good programming technique • -ve Local = more difficult to trace/debug/follow where the values are passed • Relatively small program – don't know about overall plan for it, it might not be memory intensive, unlikely anyone else is going to access/amend e.g. use as a library – therefore global would not waste significant resources

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.		
	d		1 mark per bullet to max 4 e.g. • Make use of random numbers • Generate an x/horizontal size for the grid • Generate a y/vertical size for the grid • Loop through each row/column • …generate a number between 0 and the number of rows/columns (depending on MP4 answer) • Loop through each box • …generate a 1 or 0 to store in it	4 AO2.1 (2) AO2.2 (2)	
			Total	40	