Question			Answer/Indicative content	Marks	Guidance
1	a	i	1 mark each • A memory location // named storage location • Stores/holds data / a value • That can be changed	2	Element/identifier on its own is not enough for BP1 Examiner's Comments Most candidates gained some credit for identifying that a variable holds a value, and this was the most popular response. Element/identifier on its own was insufficient for the first mark point as there had to be a clear indication that the identifier referred to a memory/storage location.
		ii	1 mark for all variables: a b c	1	Must have all three for the mark to be awarded. Examiner's Comments The majority of candidates had little difficulty correctly identifying the variables given in the code.
	b		1 mark for do loop and 1 mark for while loop up to a maximum of 2 marks. • While loop will check the condition at the **start** of the loop // pre-condition loop • Do loop will check the condition at the **end** of the loop // post-condition • The code in a while loop may never run (if the condition is already met) • The code in a do loop will always run at least one.	2	Answer must cover both do loop and while loop for 2 marks to be awarded BP1 and BP2 must be specific as to the location that the condition is placed Examiner's Comments Many responses were vague and did not accurately identify or distinguish that a while loop is a pre-condition loop while a do loop is a post-condition loop. Responses had to be clear as to the relative position of the condition in the loop. Accepted responses included a while loop is a pre-condition loop while a do loop is a post-condition loop. Fewer candidates identified that the body of a while loop may not be executed while the body of a do loop will always be executed at least once.

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Question			Answer/Indicative content	Marks	Guidance

	c		1 mark each
			
			• Initialisation of counter variable before loop
			• Condition (e.g. while c <= a)
			• c incremented in loop
			• Completed loop will produce correct results 12, 24 … 144
			
			e.g.
			
			`c = 1`
			`while c <= a`
			`  print(c * a)`
			`  c = c + 1`
			`endwhile`
			
			`c = 0`
			`while c < a`
			`  c = c + 1`
			`  print(c * a)`
			`endwhile`
			
			`c = 0`
			`while c <> a`
			`  c = c + 1`
			`  print(c * a)`
			`endwhile`
				4	BP2 – Allow any suitable logic for the while loop condition that iterates between 1 and a.
					
					Allow != for <>
					Allow += or equivalent for c = c + 1
					
					Allow hard coded values for upper bound such as a = 12 or a = 13 depending on the relational operator used.
					
					No marks awarded if a conditional loop has not been used.
					
					Max 3 if solution does not completely work.
					
					<u>Examiner's Comments</u>
					
					This question was generally well attempted with marks relatively evenly distributed throughout the range of marks available. There were some off-by-one errors, with the loop counter or the position of the output line being incorrectly positioned before/after the counter increment. Incorrect loops such as count-controlled for loops were rejected. If responses did not produce a fully correct output, marks given were limited to 3 marks.
					
					Exemplar 1
					
					 
					`c = 1`
					`while c < a:`
					`  print(c*a)`
					`  c = c+1`
					
					This response showed a typical off-by-one error where the candidate had not thought through the logic of the entire response. The condition operator should have been <= rather than < to iterate through all values of c from 1 to 12.

			Total	9	

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Question	Answer/Indicative content	Marks	Guidance
2	**Mark Band 3 - High level (9-12 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. *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 (5-8 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 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 (1-4 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 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 supported by limited evidence and the relationship to the evidence may not be clear.*	12	**AO1: Knowledge and Understanding** **Indicative content** • Analysis of patterns and anomalies in large data sets • Turns large quantities of data into useful information. These may not be immediately obvious to a casual reader. • Resulting information is used to make predictions, to increase revenue, to target advertising and improve services. **AO2: Application** • Identify the amount of time students spend on the system • Identify the days / times when is it used most? Least? • Identify the features/tools students use most and least • Identify which questions find the most difficult. • Identify the time / day of the week when students learn the most • Identify which schools are performing better or which areas of the country are performing better. • Identify which courses students are enjoying more **AO3: Evaluation** • Data mining can spot patterns/trends, however it cannot explain them. Company may still need to do extra research. • Students may have privacy concerns about their activities being logged. • Requires powerful computers with a lot of processing power to process huge amounts of data. • Need to make sure data collection is legal and in terms and conditions • Analysis can be costly e.g. may need an external company • Security - data being collected requires protection • Include more features students use so they will use it more, and gain more revenue • Identifying features not used means resources and development can be moved from these onto other areas

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Question			Answer/Indicative content	Marks	Guidance
			0 mark No attempt to answer the question or response is not worthy of credit.		Examiner's Comments Many Level 2 responses demonstrated an ability to define data mining and give relevant examples of its use. Few candidates were able to give an evaluative critique as to the effectiveness of data mining for this scenario. Many candidates struggled to structure their responses. Where candidates did produce a clear structure, they often used paragraphs effectively, starting with a definition, considering benefits and drawbacks, then going on to evaluate within the parameters of the scenario.
			Total	12	

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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>3</td><td>a</td><td></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>N/A</td><td>1 Mark</td></tr>
<tr><td>B</td><td>20</td><td>80</td><td>100</td><td>A</td><td rowspan="2">1 Mark</td></tr>
<tr><td>C</td><td>44</td><td>43</td><td>87</td><td>A</td></tr>
<tr><td>D</td><td>128</td><td>70</td><td>198</td><td>E</td><td>1 Mark</td></tr>
<tr><td>E</td><td>66</td><td>20</td><td>86</td><td>C</td><td>1 Mark</td></tr>
<tr><td>F</td><td>81</td><td>8</td><td>89</td><td>E</td><td>1 Mark</td></tr>
<tr><td>G</td><td>90</td><td>0</td><td>90</td><td>F</td><td>1 Mark</td></tr>
</table>

Path: A→ C →E → F → G Distance: 90 (1 Mark)</td><td>7</td><td>For Row A allow N/A, None, Null, - or a blank cell / equivalent.

<u>Examiner's Comments</u>

Many candidates demonstrated a good understanding of the A* algorithm and most candidates achieved at least some of the marks available, with the most commonly given being the final path (often through inspection) and the first row of the table.

A few candidates treated the algorithm as if it were Dijkstra's and explored all possible paths/routes rather than stopping as soon as the goal node was located.</td></tr>
<tr><td></td><td>b</td><td></td><td>1 mark for each difference up to a maximum of 4 marks:
e.g.

• Trees have one root node // graphs do not have a root node (1)
• Trees do not allow cycles/loops // graphs do allow cycles / loops (1)
• Trees store hierarchy // graphs have no hierarchy (1)
• Trees are always undirected // graphs can be directed (1)
• Trees are always connected // graphs can be connected or disconnected (1)</td><td>4</td><td>Do not allow responses related to weighted / unweighted.

<u>Examiner's Comments</u>

Most candidates struggled to score more than one or two marks for this question. Responses had to be clearly mappable to technical terms, but there was evidence of vague language in many cases. Candidates were expected to be able to talk about root nodes, cycles, hierarchy, directed/undirected edges and connected/disconnected nodes. Clear use of technical terms is expected at this level. A common incorrect response was weighted/unweighted. A minimum spanning tree is a subset of a graph that can have weighted edges.</td></tr>
<tr><td></td><td>c</td><td></td><td>Mark Band 3 – High level (7-9 marks)

The candidate demonstrates a thorough knowledge and understanding of heuristics; 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.</td><td>9</td><td>AO1: Knowledge and Understanding
Indicative content

• Heuristics are used to reduce time taken to solve a problem
• It is a general 'rule of thumb' or an educated guess.
• It finds a solution which is 'good enough' / close to the best solution
• Heuristic is a weight added to a</td></tr>
</table>

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Question	Answer/Indicative content	Marks	Guidance
	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 heuristics; 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 heuristics 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 supported by limited evidence and the relationship to the evidence may not be clear. 0 mark No attempt to answer the question or response is not worthy of credit.		node/decision • E.g. Description of use such as in A* algorithm as estimate of distance to destination AO2: Application • Heuristics reduce the time complexity as every possibilities within the game does not need to be examined. • Heuristics require skill to implement effectively • Used in AI when the exact steps cannot be pre-programmed and decisions need making • Due to time-saving, they are not always accurate, the solution e.g. shortest path might not be the most efficient. AO3: Evaluation • Heuristics are more appropriate with complex time-critical tasks - some aspects of game may require faster searching/decisions - current graph is not complex or time-critical so not required • Heuristics are more appropriate with large-scale tasks - game could be large scale and AI algorithms may need to be shortened • Games are not life-critical, so a good answer is likely enough, a perfect answer is not necessarily required. • Avoid programs running indefinitely - in a computer game there could be too many possibilities so will terminate with a solution faster <u>Examiner's Comments</u> Candidates demonstrated reasonable knowledge of heuristics in terms of definition and application to the game. Many candidates identified some benefits and drawbacks and the need to have an accurate heuristic value. Few candidates were able to give a detailed evaluation, or expand to scalability for example, to achieve a Level 3 response.
	Total	20	

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Question			Answer/Indicative content	Marks	Guidance
4	a		1 mark each • `headPointer` to identify the **first item/element** in the queue // identify which item to dequeue/remove next • `tailpointer` to identify the **next free** space in the queue // identify where the next item/element will be enqueued/added	2	<u>Examiner's Comments</u> This question was generally well answered by many candidates. There were some vague responses such as 'start of queue', which was not precise enough to indicate the first item, or the index of the first item, as distinct to the indexes of the actual data structure itself.
	b		1 mark for queue elements 1 mark for both pointers  	2	Allow 20 and 15 in place but crossed out OR allow 20 and 15 in place only if `headPointer` and `tailPointer` are correct <u>Examiner's Comments</u> Most candidates either tended to score full marks or no marks. Many candidates missed labelling the pointers in their diagrams and just gave updated queue values. Some candidates kept the values 20 and 15 on the diagram and correctly moved the `headPointer` to point to index 3 and the `tailPointer` to the next free space available. A considerable number of candidates erroneously shifted all items forward, showing a lack of understanding as to how a queue is efficiently implemented.
	c		1 mark each to max 2 e.g. • A queue is a FIFO structure // elements processed in the order entered • A queue will not allow new data inserted at the front // only allows new data to be enqueued at the rear • The queue contents cannot be resequenced/sorted without rewriting	2	<u>Examiner's Comments</u> The first part of many responses was well attempted, with most candidates identifying the First In First Out (FIFO) property of a queue. Far fewer candidates were able to successfully expand on this for the second mark. A linked explanation was required such as a higher priority item cannot be inserted at the front/in the middle of the queue because only the first element can be accessed/dequeued. Some candidates just reiterated what FIFO meant instead of giving the linked explanation to a priority queue which was insufficient to gain the second mark.
			Total	6	

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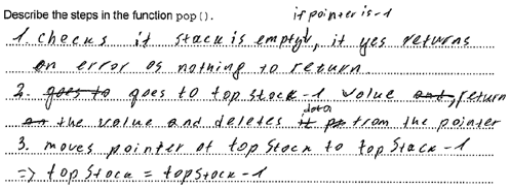
Question			Answer/Indicative content	Marks	Guidance
5	a		1 mark each • Check if the stack is empty // check `topStack` is equal to 0 • …and if so return a suitable value (e.g. -1/ null) // do nothing //give warning • (If not empty) decrement `topStack` • Return the value in element `topStack` from the array numbers	4	Do not award BP3 if a value has been returned from the function for BP4 first. <u>Examiner's Comments</u> There were many weak responses that did not outline the discrete steps required in the `pop()` function and there was often no reference to the `topStack` pointer. A number of candidates confused a stack with a queue and talked about head/rear pointers. Some candidates confused 'space for 100 elements' in the question with the top of the stack and then erroneously talked about removing item 100. Some candidates erroneously stated that the value at `topStack - 1` would be returned before saying that `topStack` would be decremented. The order of the steps was important for the function to operate correctly, and many candidates lost a mark due to this. Exemplar 2  Describe the steps in the function pop(). 1. checks if stack is empty, if yes returns an error as nothing to return 2. ~~goes to~~ goes to topStack - 1 value ~~and~~ return the value and deletes it from the pointer 3. moves pointer of topStack to topStack - 1 => topStack = topStack - 1 This response shows the candidate returning the value from `topStack - 1` in step 2. As soon as the function returns a value no further actions are performed within the function, so decrementing `topStack` in point 3 was not given.

	b		1 mark for each completed statement
			
			`function push (dataValue)`
			`  if topStack != 100 then`
			`  numbers[topStack] = dataValue`
			`  topStack = topStack + 1`
			`  return true`
			`  else`
			`  return false`
			`  endif`
			`end function`
				4	<u>Examiner's Comments</u>
					
					The majority of candidates scored three or more marks. Some candidates erroneously used `numbers.length` or `len(numbers)` in the second space instead of `topStack`.

Question			Answer/Indicative content	Marks	Guidance

	c		1 mark each
			
			• Calling push() with parameter 15
			• …storing/using return value in selection …
			• …comparing true/false (may be implicit e.g. `if push(15) then`) …
			• …outputting a suitable message if false and if true
			
			e.g.
			
			`added = push(15)`
			`if added = false then`
			`  print("Not added")`
			`else`
			`  print("Added")`
			`endif`
			
			`if push(15) then`
			`  print("Added")`
			`else`
			`  print("Not Added")`
			`endif`
				4	True/False comparisons must be Boolean values and not strings, but allow FT after that.
					
					If `push()` is called twice BP4 cannot be awarded.
					
					Examiner's Comments
					
					Some candidates erroneously tried to make a call such as `Function Push(15)` instead of calling and using/storing the result of `Push(15)`. A number of responses incorrectly used string values "`True`" / "`False`" instead of Boolean `True / False`. Many candidates tried to directly access and use the `topStack` pointer instead of using the function return value as required in the question.

			Total	12	

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Question			Answer/Indicative content	Marks	Guidance
6	a		1 mark each • Compare the first element (rainbow) to search item / clouds • If it is equal to the search item return index / found • If it is not equal move to the next element • Repeat until either search item / clouds is equal // or the end of the list has been reached	3	Allow answers by example from the given dataset Examiner's Comments Most candidates scored the majority of the marks available and demonstrated a clear understanding of a linear search. Many candidates answered by example with values from the given list.
	b		1 mark for: the data is not in order/sorted	1	Examiner's Comments Most candidates correctly identified the requirement for data to be sorted/ordered for a binary search to work. 'Organised' was too vague and was not accepted.

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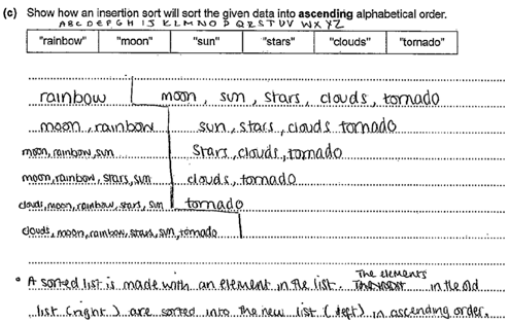
Question			Answer/Indicative content	Marks	Guidance
	c			5	If candidate has given descending order, max 4. MP1, MP3 and MP4 are lines that show a change of values during a pass. MP2 and MP5 do not have to be explicitly given in full if there is a comment to identify no change occur during the pass. Award no marks if not an insertion sort. Examiner's Comments Nearly half the candidates achieved full marks and clearly demonstrated the steps involved in an insertion sort for the given data. Some candidates confused insertion sort with either bubble, merge or selection sort, and so scored no marks for not answering the question. Exemplar 3  (c) Show how an insertion sort will sort the given data into **ascending** alphabetical order. "rainbow" "moon" "sun" "stars" "clouds" "tornado" rainbow | moon , sun , stars , clouds , tornado moon , rainbow | sun , stars , clouds , tornado moon , rainbow , sun | stars , clouds , tornado moon , rainbow , stars , sun | clouds , tornado clouds , moon , rainbow , stars , sun | tornado clouds , moon , rainbow , stars , sun , tornado * A sorted list is made with an element in the list. The elements in the old list (right) are sorted into the new list (left) in ascending order. This exemplar demonstrated the state of the dataset after each pass of the insertion sort. The candidate has separated the sorted and unsorted parts of the list to make the response much clearer.

rainbow	moon	sun	stars	clouds	tornado	Marking Guidance	Marking Guidance
rainbow	moon	sun	stars	clouds	tornado		
moon	rainbow	sun	stars	clouds	tornado	Values change	1 Mark
moon	rainbow	sun	stars	clouds	tornado		1 Mark
moon	rainbow	stars	sun	clouds	tornado	Values change	1 Mark
clouds	moon	rainbow	stars	sun	tornado	Values change	1 Mark
clouds	moon	rainbow	stars	sun	tornado		1 Mark

Question			Answer/Indicative content	Marks	Guidance
	d	i	1 mark each • Linear • The time will (increase) in **direct proportion** to the number of items	2	Examiner's Comments Many candidates did not identify linear but gave a description for 'directly proportional' or vice-versa, so only gained one mark. Candidates needed to specify that the time required increased in direct proportion to the number of items. Proportion on its own was too vague and could have meant inverse proportion for example. Incorrect responses included 'quickest time to find / least operations' defining best case rather than answering the question regarding O(n).
		ii	1 mark each • Logarithmic • The additional memory space required grows at a decreasing rate as the number of items increases	2	Examiner's Comments Many candidates did not identify logarithmic but tried to give a description or vice-versa. Many candidates just said the memory space increased in proportion to the log of n without explaining what this meant. For the second mark candidates had to explain that as the number of items n increased the amount of additional memory required became progressively smaller.
		iii	Constant // O(1)	1	Examiner's Comments The vast majority of candidates gave the correct response of constant or O(1).

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Question			Answer/Indicative content	Marks	Guidance
		iv	Exponential // O(2^n) // O(K^n)	1	<u>Examiner's Comments</u> Half the candidates correctly identified exponential complexity, but common erroneous responses included O(n^2) or O(2n) instead of O(2^n). **Misconception** A number of candidates erroneously thought that n^2 or 2^n demonstrated exponential growth instead of 2^n. Candidates need to have the mathematical grounding to understand the difference between different Big O growth factors.
			Total	15	

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Question			Answer/Indicative content	Marks	Guidance
7	a		1 mark each to max 2 for justification e.g. • Can store multiple items of data under **one identifier** // so all the data about a task can be accessed using the same identifier • Can store data of **different data types** and this task has string, real and integers	2	Examiner's Comments Record structures were poorly understood, and it was clear that many candidates had very limited experience of using records / structures within a programming language. Many candidates gave responses related to database records rather than record data structures.
	b	i	1 mark each e.g. • Each node can have 0, 1 or 2 child nodes // a maximum of 2 child nodes • Nodes are ordered (with left nodes less than the parent and right nodes greater) • The location to which a node is added depends on its order.	2	Examiner's Comments Some candidates gave generic properties of trees such as 'root' instead of specific characteristics of a binary search tree as required by the question. There was then some lack of precision when describing the number of child nodes each parent node could have (maximum two, not always two), or lack of clarity in defining 'ordered' without qualifying what this meant.
		ii	1 mark for advantage e.g. • Searching is faster (O(log n)) • Inserting new tasks is faster • Do not need to sort the structure (each time a new task is inserted)	1	Examiner's Comments A number of candidates erroneously talked about binary tree traversal to traverse a 1D list. However, there were many clear and correct responses. Some unqualified 'easier' / 'quicker' type responses gained no credit. Candidates had to identify that it was quicker to search/insert into the tree.

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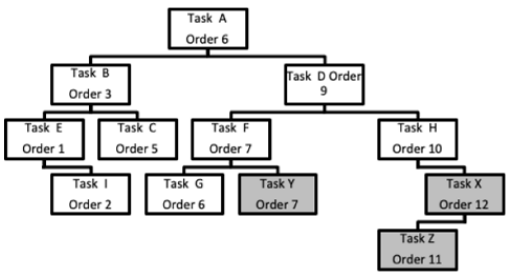
<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td></td><td></td><td>iii</td><td>1 mark for each row

<table>
<tr><th>Statement</th><th>Depth-first (post-order)</th><th>Breadth-first</th><th>Neither of these two traversals</th></tr>
<tr><td>All nodes at the current depth are visited before moving to the next depth</td><td></td><td>✓</td><td></td></tr>
<tr><td>The algorithm traverses to the end of one branch before moving to another branch</td><td>✓</td><td></td><td></td></tr>
<tr><td>The algorithm will make use of backtracking</td><td>✓</td><td></td><td></td></tr>
<tr><td>The traversal can be used to output the contents of the tree in ascending order</td><td></td><td></td><td>✓</td></tr>
<tr><td>The algorithm will output the root node last</td><td>✓</td><td></td><td></td></tr>
</table></td><td>5</td><td><u>Examiner's Comments</u>

Many candidates achieved at least partial credit if not full credit.</td></tr>
<tr><td></td><td></td><td>iv</td><td>1 mark for Task Y to right of Task F
1 mark for Task X to right of Task H …
… 1 mark for Task Z to left of Task X

 
</td><td>3</td><td>The direction of left/right child nodes must be clear and cannot just be a downward vertical line.

<u>Examiner's Comments</u>

The binary search tree diagram generally was answered well with the majority of candidates gaining full marks.</td></tr>
<tr><td></td><td></td><td></td><td>Total</td><td>13</td><td></td></tr>
</table>

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Question			Answer/Indicative content	Marks	Guidance
8	a		1 mark for each input to max 2 e.g. • Entering a name • Selecting a vehicle • Pressing arrow key to move forward • Pressing arrow key to move backward • Pressing arrow key to move left • Pressing arrow key to move right 1 mark for each output to max 2 e.g. • Images of vehicles to choose from • Background of area • Image of other vehicles • Image of controls and description of what they do	4	Allow any feasible input/output for scenario Examiner's Comments While many candidates scored full marks for this question for identifying suitable inputs and outputs within the context of the problem a number of candidates scored no marks for erroneously giving input or output devices. Sometimes responses were unqualified such as 'left arrow key' rather than 'left arrow to turn left' where candidates did not identify an input within the context of the scenario as an input to the game.
	b	i	1 mark for definition, 1 mark each for each example of use to max 2 (3 overall) **Definition:** • Removal of unnecessary detail **Example use:** • E.g. simplifying scenery • E.g. removing internal features of a vehicle that are not needed • E.g. simplify physics for vehicle movement • E.g. The vehicles may not be drawn to scale	3	Allow any reasonable examples for this scenario For the example use, allow 2 marks for stating a valid example of abstraction with an expansion. For example,"simplify track (1) by taking out the bumps in the road (1)" would be given two marks. Examiner's Comments Many candidates scored two marks for defining abstraction and giving one example of its application to the game, but fewer managed to identify a second example for full marks.
		ii	1 mark each to max 2 • Simplifies the problem / algorithm / programming code • Faster to create the program code • Final program uses less memory/processor time • Programmer can focus on core aspects of the game • Completed game will be simpler for end users to understand / play	3	Do not accept a reiteration of a definition of abstraction. Examiner's Comments Some candidates reiterated a definition of abstraction and did not focus on the benefits of abstraction as the question required. Most candidates struggled to give more than one or two benefits. There were also a number of unqualified responses such as 'saves time' that did not specify 'saving coding development time'.

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Question			Answer/Indicative content	Marks	Guidance
	c	i	Splitting the problem down into smaller (sub) problems	1	Examiner's Comments Most candidates correctly defined decomposition, but some candidates lost marks for lack of clarity for not specifying that a problem is broken down into sub problems.
		ii	1 mark each to max 2 e.g. • To break the problem down into individual components • …to see which components can be tackled concurrently • Identify any resusable program elements … • …to avoid creating the same algorithm twice • Split the program between individuals • … so they can focus on individual elements // to focus on their speciality • Identify the subroutines and how they will interract • …so everyone knows the requirements for their part of the problem • Easier to tackle/focus on one smaller problem at a time… • … so this simplifies writing/testing code	2	Allow for other valid benefits of using decomposition. Examiner's Comments Many candidates identified that decomposition would make it simpler to code individual subproblems but then lacked a clear related expansion. The most popular response was that this allowed workload to be shared between different members of a team to reduce overall development time or to play to team member expertise.
			Total	13	

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Question			Answer/Indicative content	Marks	Guidance
9	a		1 mark each to max 3. Max 2 for generic answers with no relation to scenario. e.g. • Has a set/fixed number of values • …and the number of spaces in the road will not change • Stores data of one type • … as the array is only made up of prize objects • Stores data linearly • … match the linear nature of the road • Array contents are mutable • … so prizes can be added/removed from the road • A single indentifier is used to directly index • … any position in the road • Can be iterated by index • … to perform an operation on all road positions	3	<u>Examiner's Comments</u> Many responses were too vague, showing little knowledge of the properties of arrays. Relatively few candidates appeared to be able to make explicit links to the scenario to achieve full marks.

	b	i	1 mark each
			
			• Function/subroutine with identifier `getName` taking **no** parameters
			• Returning `name`
			
			e.g.
			
			`public function getName() { return name } endfunction`
			`public getName(){ return name }`
			`def getName(self): return self.__name`
			`function getName() { return this.name }`
				2	BP1 Do not award procedure or method
					
					BP1 Allow self as an additional parameter if Python is used.
					
					BP1 If an access modifier is given for the method, it must be public and not private.
					
					BP2 Do not allow any modified name attribute to be returned.
					
					<u>Examiner's Comments</u>
					
					While many candidates had little difficulty giving code for a `getter()` there were a number of common errors. Some candidates used a private access modifier when a `getter()` needs to be public. There was often erroneous use of 'procedure' whereas a `getter()` is a function that must return a value.
					Some candidates tried to set values within the `getter()` function when it should only have returned the class attribute value.

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Question			Answer/Indicative content	Marks	Guidance

		ii	1 mark each
			
			• New instance of `prize` …
			• … with “Box”, “money” and 25 as parameters
			• Assigned to `allPrizes` index 3
			
			e.g.
			`allPrizes[3] = new prize("Box", "money", 25)`
			`allPrizes[3] = prize.new("Box", "money", 25)`
			`allPrizes[3] = prize("Box", "money", 25)`
				3	MP2 allow any order of parameters
					
					"`Box`" and "`Money`" must be strings and `25` must be an integer
					
					Allow `prize.new()` as new is given as the constructor method in the class diagram
					
					Examiner’s Comments
					
					Many candidates struggled with the instantiation of an object. Where candidates made an attempt to instantiate some did not use a string for “box” and “money” or did not give 25 as an integer but instead gave the string “25”.

		iii	1 mark for each bullet to maximum 3 e.g. • **Decision** - check whether the space already has a prize allocated … • **Action if true** - another space/number will need to be generated • **Action if false** - the prize will be stored here • **Decision** - check if all 10 prizes have been allocated … • **Action if true** - the algorithm needs to stop generating numbers • **Action if false** - a new number/space needs to be generated and checked	3	Give: • 1 mark for stating a decision • 1 mark for the action required if true • 1 mark for the action required if false Examiner’s Comments There were only two reasonable decisions that could be given from the scenario details. Candidates needed to make it clear that a decision with a Boolean output was present that would dictate two potential outcomes. Some candidates quoted actions such as ‘randomly assign space for prize’ which did not represent a decision. Many responses described the mechanics of setting up the game and the random spaces but did not highlight the program conditions/decisions as required.

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Question			Answer/Indicative content	Marks	Guidance

	c	i	1 mark each
			
			• Constructor header (any suitable name e.g. new, constructor, create, init)
			• …taking **one** parameter only
			• Initialising name to the parameter
			• Initialising money to 5
			• Initialising experience to 0 and roadPosition to 0
			
			e.g.
			
			Pseudocode example:
			`public procedure new(pName)`
			`    name = pName`
			`    experience = 0`
			`    roadPosition = 0`
			`    money = 5`
			`endprocedure`
			Python Example:
			`def __init__(self, pName):`
			`    self.__name = pName`
			`    self.__experience = 0`
			`    self.__roadPosition = 0`
			`    self.__money = 5`
			C# Example:
			`public Character(string pName) {`
			`    string name = pName;`
			`    int experience = 0;`
			`    int roadPosition = 0;`
			`    int money = 5;`
			`}`
				5	Allow minor changes to identifiers as long as purpose is clear.
					
					Allow
					`procedure new(pName)`
					`    this.name = pName`
					…
					(or similar e.g. self.name)
					
					Allow two parameters if one is *self* and the response is clearly in Python.
					
					The parameter name should be different to the attribute name.
					
					Examiner's Comments
					
					It was clear that those candidates with limited OOP programming knowledge found the writing of a relatively simple constructor method difficult. Those with relevant programming experience often found this to be a very straightforward question. Common errors included passing additional values to set the `experience, roadPosition` and `money` attributes rather than setting them to the constant values indicated in the question.

Question			Answer/Indicative content	Marks	Guidance

		ii	1 mark each
			
			• Procedure/method header …
			• … taking **two** parameters, type (or similar) followed by value (or similar) …
			• … compare type parameter with "`money`"
			• … compare type parameter with "`experience`"
			• … both attributes updated correctly and nothing else modified
			
			e.g.
			`public procedure updateValues(pType, pValue)`
			`  if pType == "money" then`
			`  money = money + pValue`
			`  elseif pType == "experience"`
			`  experience = experience + pValue`
			`  endif`
			`endprocedure`
			
			`def updateValues(self, pType, pValue):`
			`  if pType == "money":`
			`  money += pValue`
			`  elif pType == "experience":`
			`  experience += pValue`
				5	Do not allow Function for BP1
					
					BP2 parameters must be given in the correct order to match the calls to `updateValues()` in the question.
					
					"`money`" and "`experience`" must be string values
					
					<u>Examiner's Comments</u>
					
					The `updateValues` procedure again proved problematic for candidates with limited OOP experience. No marks were given for the first mark point if a function was declared as there was no return value. Parameter names needed to be fit for purpose, understandable, and had to match the order given in the question scenario to work for the given example calls.

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Question			Answer/Indicative content	Marks	Guidance

	d		1 mark for each completed space
			
			`character1 = new Character("Jamal")`
			`newPosition = 0`
			`while newPosition < 50`
			`  move = random(1, 4)`
			`  character1.changePosition(move)`
			`  newPosition = character1.getRoadPosition()`
			`  if newPosition < 50 and road[newPosition] != null then`
			`  prizeType = road[newPosition].getType()`
			`  valueAmount = road[newPosition].getValue()`
			
			`  character1.updateValues(prizeType, valueAmount)`
			`  print("Congratulations you are in position", newPosition, "and found", road[newPosition].getName())`
			`  print("Money", character1.getMoney(), "and experience", character1.getExperience())`
			`  endif`
			`endwhile`
			`print("You reached the end of the road")`
				6	Allow `road.length // len(road)` instead of `50`
					
					Allow `<=49` instead of `< 50`
					
					Examiner's Comments
					
					Nearly all candidates achieved some marks, and a majority scored five or six marks.

	e		1 mark each • (Line 02) `for x = 0 to 49` • (Line 03) `print("Space", x)` • (Line 06) `else // elseif road[x] <> null` • (Line 07) `print(road[x].getName())`	4	Line `07` allow `print(road[x].name)` Examiner's Comments Many candidates scored three or four marks but in general candidates found it harder to identify errors in the code than to complete code in the previous question. Some candidates didn't give the line number but rewrote the incorrect line before giving the corrected line, which was acceptable, although not ideal given the scaffolding.

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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 global variables and the alternatives; 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 global variables and the alternatives; 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 global variables and the alternatives 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 supported by limited evidence and the relationship to the evidence may not be*	9	AO1: Knowledge and Understanding Indicative content • Global variables are created when the program starts, all subroutines can access/update the contents • Local variables are created in the subroutine they are created in, they are not accessible directly from any other subroutine • Local variables are removed from memory when the subroutine ends. • Local variables can be passed as parameters to a function to be updated, and then returned to override the original local variable • Local variables can be passed by reference to a subroutine to allow the content of the variable to be updated AO2: Application • The variables will be stored in memory throughout the whole code execution. However, the amount of data they are storing is relatively low so would not use a lot of memory. • When the game is expanded, the amount of data may increase so it could be memory intensive, especially if graphics are used in the game. • Both arrays are needed throughout the whole game so keeping them as global will make writing the code easier as the programmer will not need to keep passing them as parameters and setting return values. • Only one part of the game is being created initially and therefore the use of global variables would not affect the efficiency greatly. However, when the program expands, it could cause accuracy / testing / debugging and maintenance problems. AO3: Evaluation • As this is only a prototype, the use of global variables would be beneficial. • However, when the game expands, the use of global variables could create issues such as running out of memory, coupling, testing & debugging problems and maintenance problems.

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Question			Answer/Indicative content	Marks	Guidance
			clear. 0 mark No attempt to answer the question or response is not worthy of credit.		• The programmer may be best to keep the variables as local and then pass them between the different subroutines as parameters byVal and byRef. <u>Examiner's Comments</u> Most responses were Level 2 for definitions and some expansion to passing parameters. Very few candidates were able to go into depth about alternatives to global variables such as passing by value and passing by reference in detail or extending to issues such as scalability within a larger more extended game. Few candidates picked up on the fact that this was a more limited prototype that was likely to be expanded on which would require more consideration to be given to variable scope.
			Total	40	

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