Mark scheme

Question			Answer/Indicative content	Marks	Guidance
1	a	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'.
	b	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.	2	Allow for other valid benefits of using decomposition.

			• 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		**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	**9**	
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.	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.

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.

0 mark

No attempt to answer the question or response is not worthy of credit.

- 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

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**	
3			**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. 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	9	**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 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

			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.		• 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 **Examiner's Comments** 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	**9**	
4			**Mark Band 3 – High level (7–9 marks)** The candidate demonstrates a thorough knowledge and understanding of both computational thinking methods; 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)**	9	**AO1: Knowledge and Understanding** **Indicative content** • Problem recognition is identifying that there is a problem to be solved, to determine exactly what the problem is from a description/scenario and to determine if the problem can be solved with computational methods • Decomposition is splitting the problem down into subproblems that can be solved independently **AO2: Application**

The candidate demonstrates reasonable knowledge and understanding of both computational thinking methods; 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 both computational thinking methods 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.

- Problem recognition: identifying the need for the scheduling system, what it will take as its inputs, what will need to be output etc.
- Decomposition: subproblems could include:
  - inputting the requirements
  - generating possible routes
  - evaluating the routes
  - outputting the schedule

AO3: Evaluation
Computational methods allow the e.g.:

- programmer to determine what the problem, what the challenges may be and what additional information is required before starting to code the solution
- identification of the key features for programmers to focus on
- splitting of the task into smaller, more manageable/solvable problems which allows for a solution to be developed quicker
- design of an effective/efficient solution that makes best use of a processor
- splitting of a task to allow programmers to focus on areas they specialise in.

Examiner's Comments

Many Level 1 responses gave simplistic definitions of problem recognition and/or decomposition, often with more successful descriptions for decomposition. Relatively few candidates could clearly state that problem recognition starts with identifying inputs and outputs. Some degree of application to the question scenario context was required for Level 2. Most candidates' marks clustered around Level 2 with 4

			or 5 marks. Many generic answers focused on problem recognition and/or decomposition as learnt terms, with associated benefits given, but little more than that, which limited marks to Level 2. For Level 3 an evaluation of ideas relevant to the context of the scenario given was expected. Some good responses indicated recognition of a pathfinding type problem with a need for shortest path/A* algorithm, approximation to travelling salesman type solutions or the need to employ heuristics. Candidates giving this level of insight often accessed Level 3.		
		Total	**9**	
5	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. 	12AO1.1 (2)AO1.2 (2)AO2.1 (23AO3.3 (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	2AO1.1 (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	3AO2.2 (3)	

b	i		1 mark for each correctly completed statement up to a maximum of 5 marks:
			
			``
			   function
			01 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
			``
				5AO2.2
				(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	2AO1.2 (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	3AO2.2 (3)	

		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`
				6AO2.2 (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.	3AO2.1 (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
	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*	9AO1.1 (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

Above the mark band row (first row cell):

- Line 01 needs `answerGrid` as parameter
- Line 04 == should be !=
- Line 08 should be `next row`

			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 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.		• +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
	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	4AO2.1 (2)AO2.2 (2)	
		Total		**40**	
6	a		1 mark for each interval Interval 1 • A is fetched Interval 2 • A is decoded • B is fetched Interval 3	4AO1.2 (4)	

			- A is executed - B is decoded - C is fetched Interval 4 - B is executed - C is decoded - D is fetched		
	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.	2AO1.2 (2)	
			Total	**6**	
7			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	4AO1.2 (4)	Must cover purpose and name for 2 marks for each pointer.
			Total	**4**	
8			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	2AO1.1 (1)AO2.1 (1)	

			Total	2	
9	a		**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	9AO1.1 (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

			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.* **0 marks** No attempt to answer the question or response is not worthy of credit.		
•	b		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	3AO2.1 (2)AO2.2 (1)	
			Total	**12**	
10			1 mark per bullet to max 4 e.g. • Decomposition splits the problem into smaller sub problems • Repeated decomposition gives solvable parts • The division can lead to the development of subroutines/modules • The division can lead to a logical division between programmers/teams • ...e.g. one team works on one section and another concurrently on another	4 AO1.1 (2) AO1.2 (2)	
			Total	**4**	

11	i	1 mark per bullet up to a maximum of 3 marks, e.g: • Classroom displays have been removed • People have been removed / simplified with symbols • Wall/carpet colours/details have been removed • Diagram is not to scale.	3 A02.1 (3)	Allow other suitable responses that are applied to the scenario in the question.
	ii	1 mark per bullet up to a maximum of 2 marks for each benefit (4 marks maximum in total), e.g: • Reduced development time (1) as factors that can detract from the program can be ignored (1) • Program more likely to solve the problem (1) as unnecessary aspects will not detract from the main purpose of the program (1) • Reduces complexity of programming code (1) therefore can run on lower spec computers(1)	4 A01.2 (2) A02.1 (2)	
		Total	**7**	