Question			Answer/Indicative content	Marks	Guidance
1	a	i	- (Single) Control Unit - (Single) Arithmetic Logic Unit - (Special) registers within CPU - Instructions and Data stored in same area of memory - Instructions and Data stored in same format - A single set of buses / same bus for instructions & data (to connect CPU to Memory and I/O) (1 Mark per -, Max 2)	2 (AO1.1)	Accept acronyms ALU,CU Examiner's Comments The majority of candidates answered this question well although some candidates stated that 'instructions and data are stored in the same memory location' more attention to detail is required at this level of study.
		ii	Two separate areas of memory… …one for instructions & one for data./instructions and data can be accessed concurrently. Different (sets of) buses… … one for instructions & one for data./ instructions and data can be accessed concurrently. Pipelining… …whilst an instruction is being executed the next can be decoded and the subsequent one fetched. Use of Cache… …A small amount of high performance memory is (next to the CPU) / which stores frequently used data/instructions Virtual cores/Hyper-threadingTM … …Treating a physical core as two virtual cores. Multiple Cores… …Each core acts as a separate processing unit. Onboard Graphics… …Built in circuitry for graphics processing. (1 Mark for identifying feature, 1 mark for description)	2 (AO1.2)	Accept any reasonable description. Do not accept "64-bit" e.g. Performance boosting mode… …Clock speed can be temporarily increased for performance boost. Out of Order Execution… …Instructions can be executed before earlier ones if they are ready. Super Scalar… …Multiple instructions can be executed simultaneously. Examiner's Comments A whole range of features were accepted for this question. Most candidates stated an appropriate feature but some then did not go on to describe how the feature improved performance.

<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>i</td><td>
<table>
<tr><td>Input</td><td>Green Light</td><td>Red Light</td></tr>
<tr><td>1</td><td>✓</td><td></td></tr>
<tr><td>2</td><td>✓</td><td></td></tr>
<tr><td>3</td><td>✓</td><td></td></tr>
<tr><td>4</td><td>✓</td><td></td></tr>
<tr><td>5</td><td>✓</td><td></td></tr>
<tr><td>6</td><td></td><td>✓</td></tr>
<tr><td>7</td><td></td><td>✓</td></tr>
<tr><td>8</td><td></td><td>✓</td></tr>
<tr><td>9</td><td></td><td>✓</td></tr>
</table>
Rows 1-4 correct 1 Mark
Rows 5-9 correct 1 Mark
</td><td>2
(AO3.3)</td><td>Accept T for a tick. Penalise if blank table elements have content.

<u>Examiner's Comments</u>

Most candidates achieved the first mark on this question. The second mark was lost by those who ticked 'red light' for an input of 5.</td></tr>
<tr><td></td><td></td><td>ii</td><td>- The value 11 is stored in the MAR.
- 11 is sent down the address bus.
- A read signal is sent down the control bus.
- <u>0</u> is sent (back from memory) down the data bus.
- 0 is stored in the MDR…
- …and then copied to the ACC
(1 Mark per -, max 6)</td><td>6
(AO1.2)</td><td><u>Examiner's Comments</u>

Many candidates gave a comprehensive description of the fetch execute cycle but did not apply their response to the assembly code instruction given in the question therefore losing marks.</td></tr>
<tr><td></td><td></td><td>iii</td><td>- Takes in a value from user.
- If value is 5 or less it shows green
- Otherwise it shows Red

(1 Mark per -, max 3)</td><td>3 (AO 3.2)</td><td>Do not credit structured English
Example

<pre>value = input("Enter a Value")
if value <=5 then
   print("GREEN")
else
   print(“RED”)
endif</pre>
Accept equivalents to <=5 (e.g. < 6) For Green/Red (or 1/0) accept any pseudocode equivalent (GreenLightOn(), Output 1, print(1) Output Green etc.) as long as the logic is correct.

<u>Examiner's Comments</u>

Most candidates gained credit for writing code to read the value from the user with some then losing marks for either specifying the incorrect condition e.g. IF value < 5 and/or not outputting the result.</td></tr>
</table>

Question	Answer/Indicative content	Marks	Guidance
iv	**Mark Band 3-High Level (7-9 marks)1** The candidate demonstrates a thorough knowledge and understanding of assembly code and high level languages. 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 provides a thorough discussion which is well balanced. Evaluative comments are consistently relevant and well-considered. 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 assembly code and high level languages; 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 sound 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 assembly code and high level languages; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided.	9 AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)	**AO1** Assembly code uses mnemonics to represent machine code instructions/opcodes. High level languages use more natural/mathematical notation. Assembly code consists of simple instructions As such many more lines of assembly code are required to perform the same task as a few lines of a high level language. Assembly code is specific to the instruction set of a given processor. High Level languages are not architecture specific. **AO2** Assembly code allows the programmer to choose the exact instructions so they can write code that is highly efficient. It also allows them to have direct control of how memory is used via addressing modes. Direct control of hardware. High level language compilers have optimisers that can also try and do this (and in some cases may outperform a human writing in assembly code). As high level code is more intuitive and easier to read it is easier to follow, debug and build as part of a team. It can also be written in a much shorter time frame. The high level code can be recompiled for different architectures. High level languages come in a variety of paradigms so programmers can choose according to the problem/their preference. **AO3** Assembly language is best suited to situations such as: -compilers or interpreters don't exist for the target CPU i.e. embedded systems -highest possible performance is critical -memory is very limited. For larger projects which don't fall under the constraints above high level languages are likely to be preferable. **Examiner's Comments** Candidates were assessed on the quality

Question			Answer/Indicative content	Marks	Guidance
			The candidate provides a limited discussion which is narrow in focus. Judgments if made are weak and unsubstantiated. The information is basic and communicated 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.		of their extended response in this question. Most candidates could describe the basic differences between assembly code and high level languages, with many giving examples of where each would be best used. Some candidates gave clear and appropriate justification for the coffee machine being programmed in assembly code. In general, most candidates scored reasonably well on this question.
			Total	24	

Question			Answer/Indicative content	Marks	Guidance
2	a	i	- Provide a (user) interface - Manage hardware/peripherals - Manage CPU usage / handles interrupts - Provide security - Provide platform to run other software - Provide utilities for system maintenance (1 Mark per -, Max 3)	3 (AO1.1)	If candidate names utility software, allow BP6 Examiner's Comments This question enabled candidates to demonstrate basic knowledge of the functions of an operating system, many scored well but some candidates responses were too generic for this level of study e.g. 'manage resources'.
		ii	Paging	1 (AO1.1)	Examiner's Comments Most candidates correctly identified paging.
		iii	- Operating system uses area of secondary storage as virtual memory. - Move unused pages/parts (of program A and/or B) into virtual memory - Load program C into (physical) memory. (1 Mark per -, Max 3)	3 (AO2.1)	Examiner's Comments Most candidates clearly described virtual memory but some did not go on to discuss the movement of pages between memory and virtual memory. More so discussing the movement of whole programs in and out of virtual memory.

Question			Answer/Indicative content	Marks	Guidance

	b	i	- Tags to make “Features” a heading (accept h1, h2, h3 etc.)
			- Correct use of ol
			- Correct use of li tags
			- Use of <a tag Around the text “Download the Factsheet”
			- correct use of href=”factsheet.pdf”
			(1 Mark per -, max 5)
				5 (AO3.2)	For making Features a heading only accept `strong/b` if accompanied by code to increase font size.
					
					`<h1>Features</h1>`
					`The new OCR Smart Watch:`
					`<ol>`
					`<li>Uses the CB2 RISC processor for long battery life</li>`
					`<li>Stores up to 20hrs of music</li>`
					`<li>Tracks fitness</li>`
					`</ol>`
					`<a href="factsheet.pdf">Download The Factsheet</a>`
					
					Li close tags are optional
					
					Examiner’s Comments
					
					Surprisingly fewer candidates than anticipated gained full marks on this question. Many candidates gained some marks. Marks were invariably lost on the HTML for the hyperlink.

		ii	- A program called a spider/crawler/bot - Traverses the web / following the links. - It takes each word in the document - …It adds an entry for the page (under the word) in the index… - …alongside the word’s position on the page. (1 Mark per -, Max 3)	3 (AO2.1)	Examiner’s Comments This question was poorly attempted. Many candidates mentioned a crawler/spider program but then failed to clearly describe the process. Some candidates went on to discuss ranking even though the question specifically stated not to.
		iii	- RISC has a smaller instruction set (than CISC) - Requires fewer transistors / less complex circuitry - Means less power is required. (1 Mark per -, Max 3)	3 (AO1.2)	Examiner’s Comments Most candidates achieved two marks on this question with few referring to the fact that RISC requires less complex circuitry.
			Total	**18**	

Question			Answer/Indicative content	Marks	Guidance
3	a		- Gets/selects/outputs the flight numbers from the 'Flight' table - Of flights with the destination JFK - It returns OC0089 and OC7750 (1 Mark per -, Max 2)	2 (AO2.2)	Examiner's Comments Many candidates achieved full marks on this question. Candidates were credited for describing the statement and/or stating the output. Those who did not achieve full marks generally stated that the statement 'outputs the flight numbers of flights with the destination of JFK' omitting to state that the flight numbers will be extracted from the flight table.

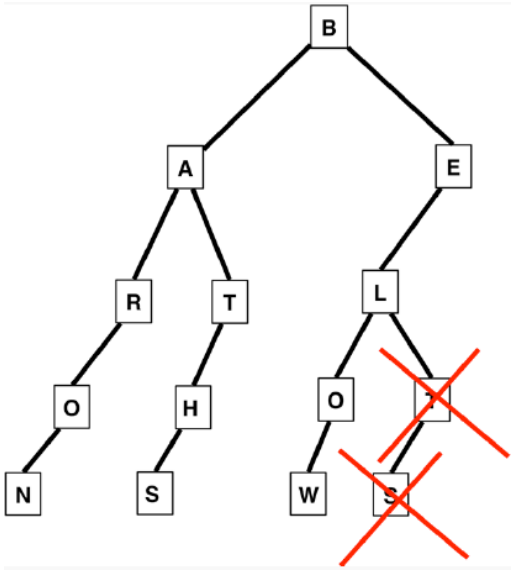
	b		- `SELECT *` changed to `DELETE`
			
			- `Halifax` changed to `Heathrow`
			`DestinationName='Heathrow'/`
			`DestinationCode='LHR'`
			
			- Added `AND`
			`DepartureDate=4/7/18`
			
			(1 Mark per -, Max 3)
				3 (AO3.2)	`DELETE FROM Flight WHERE DestinationName='Heathrow' AND DepartureDate=4/7/18`
					
					Accept quotation marks or #s around the date.
					
					Do not give first mark if asterisk is kept (i.e. DELETE *)
					
					The Departure Date condition could be placed before the Destination Name.
					
					Examiner's Comments
					
					Most candidates did not achieve the first mark for the DELETE statement because they included the wildcard i.e. DELETE *. Many went on to achieve the rest of the marks giving the criteria, using correct SQL statements.

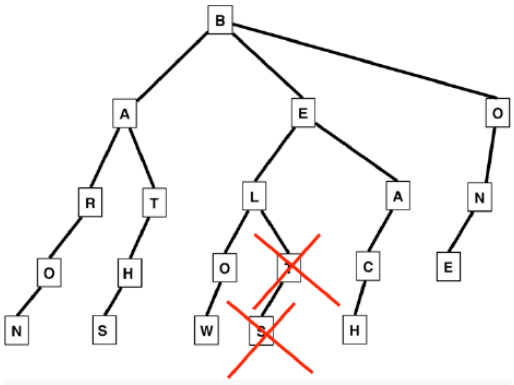
	c	i	It is not unique/ the same value can appear in multiple records	1 (AO2.1)	Examiner's Comments Virtually all candidates correctly identified the lack of uniqueness of DestinationCode as the reason why it should not be the primary key.
		ii	It is likely to be used to search for / index / sorted on	1 (AO2.1)	Examiner's Comments Some candidates clearly did not know what a secondary key is, describing a foreign key instead.

Question			Answer/Indicative content	Marks	Guidance
	d	i	- No Repeating fields/data - Data is atomic - Has a primary Key (1 Mark per -, max 2)	2 (AO2.1)	<u>Examiner's Comments</u> The definition for 1NF was answered well by most candidates.
		ii	- Is in First Normal Form - Every field is dependent on the primary key. (1 Mark per -, max 2)	2 (AO2.1)	<u>Examiner's Comments</u> The definition for 2NF was not as well answered with most candidates omitting to state that the database must first be in 1NF.
		iii	- Has a transitive relationship/ A non-key field depends on another non-key field. - `DestinationName` depends on `DestinationCode` (1 Mark per -, max 2)	2 (AO1.2)	<u>Examiner's Comments</u> Fewer candidates scored well on this part of the normalisation question. Many identified that there was a transitive relationship between DestinationName and DestinationCode but few could describe this with clarity.

Question			Answer/Indicative content	Marks	Guidance
	e		- CSV/Comma Separated Value (file)… - A (text) file/format with values separated by commas (or some other delimiter) - XML/eXstensible Markup Language… - …A markup language that uses tags to denote data. - SQL/Structured Query Language… - ...A language for creating/querying databases Accept any reasonable answer. 1 mark for naming method, 1 mark for valid description.	2 (AO2.1)	Other examples include: - RSS/Really Simple Syndication/Rich Site Summary… - ….A URL is given which points to an XML file which is periodically checked by a browser/program. - API/Application Programming Interface… - …A prewritten set of subroutines/interfaces that provide access to the company's data. - JSON/JavaScript Object Notation… - …text format that can easily be changed to and from JavaScript Objects. Candidates may provide other valid answers (e.g. REST, SOAP etc.). Descriptions may differ from those given. Accept any valid description. Examiner's Comments Many candidates gave vague responses to this question and therefore did not gain credit. Candidates should be encouraged to learn specific formats/methods for exchanging data (specification reference 1.3.2b) some examples could include: CSV; API. A whole range of formats/methods were accepted for this question.
			Total	15	

Question			Answer/Indicative content	Marks	Guidance
4	a		- Wide Area Network - Collection of connected computers/devices over a large geographical area - Often using 3rd party communications channels (1 Mark per -, max 2)	2 (AO1.1)	Examiner's Comments Although most candidates stated that a WAN is a wide area network, many did not go on to state that devices on a WAN are connected over a large geographical area.
	b	i	- Allowing them to communicate - By ensuring all devices follow the same rules/standards - So they interpret data/signals in the same way (1 Mark per -, max 2)	2 (AO1.2)	Examiner's Comments Most candidates explained what a protocol is rather than why they are important on a network. Candidates should be encouraged to apply their knowledge to the question being asked. Some candidates gained credit for correctly explaining that protocols enable devices to interpret data in the same way, allowing them to communicate.
		ii	- Application - Transport - Internet - Network Interface/(Data) Link/Physical (1 Mark per -, max 4)	4 (AO1.1)	Examiner's Comments Most candidates achieved three or four marks on this question, the layers were accepted in any order. Those who did not, invariably scored zero marks.
			Total	8	

Question			Answer/Indicative content	Marks	Guidance
5	a		Foot mouse/pedal… … press key/click button to send signal. Camera/eye tracker… …Move/blink to send signal Microphone… …Make sound to send signal Puff/suck switch… ..blow/suck to send signal. Accept any sensible answer. 1 mark for naming of input device, 1 mark for use.	2 (AO2.1) Identify (1), AO2.2) Describe (1)	First mark must be hardware not software <u>Examiner's Comments</u> Despite the question, specifically outlining the limitations of user mobility some candidates still responded with hardware devices that require use of your hands. Some also gave the technique as opposed to the hardware e.g. speech recognition rather than microphone.
	b	i	- T and S removed /T removed/Link between L and T removed… - …No further nodes removed (1 Mark per -, Max 2)	2 (AO2.1)	

Question			Answer/Indicative content	Marks	Guidance
		ii	- BEACH added - BONE added (1 Mark per -, Max 2)	2 (AO2.1)	 Whether branches point left or right or order of branches is irrelevant. As long as branches form the words without unnecessary repetition of nodes, award the marks. <u>Examiner's Comments</u> Invariably, all candidates fared well on both parts of this question.
	c		- Free of cost - Right to inspect/amend/recompile <u>source code</u> - Can tailor the program to their specific needs - Code open for bugs to be spotted and fixed. (1 Mark per -, Max 2)	2 (AO1.2)	<u>Examiner's Comments</u> Most candidates stated that open source software was free but some went on to explain that users can amend/inspect the code rather than source code. Again, attention to detail is required at this level of study.
			Total	8	

Question	Answer/Indicative content	Marks	Guidance
6	**Mark Band 3-High Level (9-12 marks)** The candidate demonstrates a thorough knowledge and understanding of computing related laws and modern issues that fall under them. 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 assess the extent to which the law is able to keep up with changes in technology. 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 computing related laws and modern issues that fall under them; 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 as to whether the law is able to keep up with changes in technology. 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 computing related laws and modern issues that fall under them; the material is basic and contains some	12 AO1.1 (2) AO1.2 (2) AO2.1 (3) AO3.3 (5)	Points may include but aren't limited to: **AO1 Knowledge and Understanding** Laws that regulate technology include: the Data Protection Act… …which regulates how personal data is stored. The Computer Misuse Act… …which regulates unauthorised access. The Copyright and Patents Act… …regulated intellectual property. Regulation of Investigatory Powers Act… …Regulates how government agencies can use IT for surveillance **AO2 Application** Computer Misuse Act is harder to enforce with the increased use of DDoS attacks (often involving unwitting participants). The Internet of things is likely to make such attacks even more common place. People are connecting to the internet in new ways using mobile networks/public Wi-Fi making attacks potentially difficult to track. Films/Music etc. are being shared in new ways. Streaming is common - often this is legitimate but the global nature of it can bring licensing issues into play. Fast internet speeds, peer to peer and the dark web all contribute to making piracy more prevalent and harder to track. Digital watermarking can be used to track piracy. End to end encryption makes government monitoring of communications trickier. **AO3 Evaluation** May conclude that although technology develops quickly the laws are broad enough to cover all eventualities. Alternatively, may conclude that people are always looking for ways of using technology to access loophole in the law / to avoid detection. Look for a well-reasoned conclusion. Could decide either for or against but should be backed up with examples. Examiner's Comments Candidates were assessed on the quality of their extended response in this

Question			Answer/Indicative content	Marks	Guidance
			inaccuracies. The candidate 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 communicated 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.		question. Many candidates offered a balanced discussion although some were limited in scope i.e. limiting the discussion to one law. Few conclusions were appropriately justified/reasoned leading to many candidates scoring in the mid-level band on this question.
			Total	12	

Question			Answer/Indicative content	Marks	Guidance
7	a		- Needs to be able to respond instantly to changes… - …such as someone stepping in front of car (or other sensible example) - RTOS offers a guaranteed response time. - A non RTOS might be busy dealing with other tasks and not respond until it is too late. (1 Mark per -, Max 3)	3 (AO1.2)	<u>Examiner's Comments</u> There were three marks available for this question. Candidates should be reminded that they need to specify a clear and specific point for each mark awarded. Many candidates did not extend their responses to three points. In addition, there were many definitions of the form 'the car needs to be able to respond in real time' which gained no credit.

	b	i	- Created Obstacle object called bollard
			- Has put the correct arguments in, in the correct order.
			(1 Mark per -, Max 2)
				2 (AO3.2)	Examples
					`bollard=new Obstacle(false, 7.8, 8)`
					`Obstacle bollard = Obstacle(false, 7.8, 8);`
					`bollard=Obstacle(False, 7.8, 8)`
					
					Do not penalise for use of `self` parameter as used by languages such as Python.
					
					<u>Examiner's Comments</u>
					
					In this question, it was evident that more candidates have had practical experience of programming in an Object Oriented Programming languages than previous series but there were still many who clearly have not. Those candidates who are practised in programming using OOP answered well here.

		ii	- The attribute `distance` is private… - -…and therefore updated with the method `update distance`	2 (AO3.2)	<u>Examiner's Comments</u> Many candidates clearly described encapsulation but not in context, as the question asked, therefore not gaining credit.
		iii	- Reduces the chance of errors/inconsistences - Ensures objects can only be changed in the way intended/ Ensuring changes are consistent with how the object should behave - Protecting data/ Can't be changed accidentally (1 Mark per -, Max 2)	2 (AO1.2)	Read 'securing' as 'protecting' <u>Examiner's Comments</u> Most candidates stated an advantage of using encapsulation with many then repeating their first statement. Therefore achieving one mark.

Question			Answer/Indicative content	Marks	Guidance

	c		- First line Clear use of inheritance of Obstacle. E.g.: Person inherits Obstacle / Person extends Obstacle / Person : Obstacle / Person(Obstacle)
			
			In the method
			- Less than 2 metres triggers brake
			- Equal to but not greater than 2 metres triggers brake.
			- Less than or equal to 2 metres triggers horn
			- Less than or equal to 5 metres triggers horn
			(1 Mark per -, Max 5)
				5 (AO3.2)	`class Person inherits Obstacle`
					`public procedure updateDistance(givenDistance)`
					`if givenDistance<=5 then`
					`Controls.beepHorn()`
					`if givenDistance<=2 then`
					`Controls.applyBrakes()`
					`endif`
					`endif`
					`distance = givenDistance`
					`endprocedure`
					`endclass`
					
					NB a number of ways exist of writing the method – be careful of the logic. Two such correct examples are below.NB a number of ways exist of writing the method – be careful of the logic. Two such correct examples are below.
					`if givenDistance<=5 then`
					`Controls.beepHorn()`
					`endif`
					`if givenDistance<=2 then`
					`Controls.applyBrakes()`
					`endif`
					
					`if givenDistance<=2 then`
					`Controls.beepHorn()`
					`Controls.applyBrakes()`
					`elseif givenDistance<=5 then`
					`Controls.beepHorn()`
					`endif`
					
					<u>Examiner's Comments</u>
					
					It was evident in responses to this question that some candidates did not read the question carefully. The methods to be called in their response were given in the question. The variable to be checked was passed as a parameter. Candidates who used this information correctly scored well on this question.

Question			Answer/Indicative content	Marks	Guidance
	d		Advantages of an automated driver are it is potentially: - safer than a human driver (due to quicker reaction speeds etc.). - cheaper as no wage to cover. - less likely to make mistakes with route. Disadvantages of an automated driver are it is potentially: - May not be able to understand natural speech. - May be limited in terms of the roads on which it can operate. - Vulnerable to hacking. - Only as good as the program running it - a bug in the code could cause catastrophic accidents. - May prioritise safety of pedestrians over that of the passenger. (e.g. may take actions that may put the passenger at risk to save the lives of numerous people outside the car.) - No discussion possible with the driver / no "human presence" to reassure nervous customers. Max 1 advantage and max 1 disadvantage	2 (AO2.2)	<u>Examiner's Comments</u> There were a range of acceptable responses to this question. Some candidates did not gain credit because the advantage/disadvantage stated was not specific to the customer as the question asked. Candidates should be reminded to read the question carefully.
			Total	16	

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>8</td><td>a</td><td></td><td>- American Standard Code for Information Interchange
- A character set
- Maps values to characters
- Uses 7-bits/ 8-bits per character
(1 Mark per -, Max 2)</td><td>2
(AO1.1)</td><td></td></tr>
<tr><td></td><td>b</td><td></td><td>Row shift as below (1 Mark)

<table><tr><td>P</td><td>S</td><td>E</td><td>T</td><td>O</td></tr><tr><td>E</td><td>T</td><td>M</td><td>C</td><td>R</td></tr><tr><td>S</td><td>A</td><td>G</td><td>E</td><td>S</td></tr><tr><td>R</td><td>P</td><td>L</td><td>E</td><td>Y</td></tr><tr><td>G</td><td>G</td><td>Q</td><td>U</td><td>O</td></tr></table>
Column Shift as below (1 Mark)

<table><tr><td>G</td><td>G</td><td>Q</td><td>U</td><td>O</td></tr><tr><td>P</td><td>S</td><td>E</td><td>T</td><td>O</td></tr><tr><td>E</td><td>T</td><td>M</td><td>C</td><td>R</td></tr><tr><td>S</td><td>A</td><td>G</td><td>E</td><td>S</td></tr><tr><td>R</td><td>P</td><td>L</td><td>E</td><td>Y</td></tr></table></td><td>2
(AO1.2)</td><td>cao

<u>Examiner's Comments</u>

Most candidates scored well on the first two parts of this question.</td></tr>
<tr><td></td><td>c</td><td></td><td>- Procedure correctly defined with parameters.
- Procedure manipulates the correct row of grid.
- Sensible use of for loop to iterate through the array without generating out of bounds exception.
- Correctly shifts each row.
(1 Mark per -, Max 4)</td><td>4
(AO3.1)</td><td>When checking to see if out of bounds exception keep in mind that in some languages the loop boundaries are exclusive. When unsure give the benefit of the doubt. The final mark is meant to offer stretch and challenge. Be cautious of wrong answers on face value seems to work. For example, the following will <u>not</u> work:

<pre>procedure shiftRow(rowNumber, places)
    for i = 0 to places
       grid[rowNumber,i+1]= grid[rowNumber,i]
    next i
endprocedure</pre>
Possible solutions include…

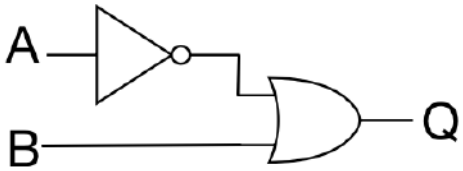
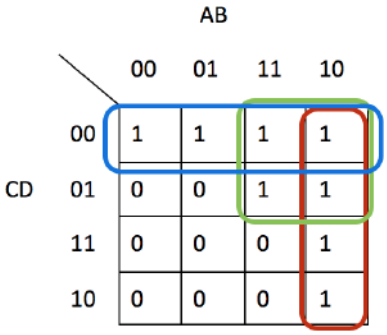
<pre>procedure shiftRow(rowNumber, places)
    array temp[5]
    for i=0 to 4
         temp[i]=grid[rowNumber,i]
    next i
    for i=0 to 4
         newPos=(i+places)MOD 5 //% is the same as MOD</pre></td></tr>
</table>

Question			Answer/Indicative content	Marks	Guidance
					grid[rowNumber,newPos]=temp[i] next i endprocedure **And . .** procedure shiftRow(rowNumber, places) for i=1 to places temp1=grid[rowNumber, 4] temp2=0 for j =0 to 4 temp2=grid[rowNumber,j] grid[rowNumber,j]=temp1 temp1=temp2 next j next i end procedure Note: within solutions, allow for columns to be referenced first eg grid[i,rowNumber] <u>Examiner's Comments</u> Few candidates scored more than two marks on this question. In most cases, this was due to the fact that the code overwrote the original array value when shifting. Only the top scoring candidates appreciated that an intermediate temporary variable/array was required to hold the original value(s).
	d		Mark Band 3-High Level (7-9 marks) The candidate demonstrates a thorough knowledge and understanding of modern encryption and the difference between symmetric and asymmetric encryption. 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 provides a thorough discussion which is well balanced. Evaluative comments are consistently relevant and well-considered. There is a well-developed line of	9 AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)	AO1 Modern encryption is many orders stronger than that used in a pre-computer era. Asymmetric encryption uses different keys for encryption and decryption. Symmetric encryption uses the same key for encryption and decryption. Asymmetric encryption algorithms tend to involve more processing than symmetric algorithms. AO2 Modern encryption can be used without specialist knowledge. Often users may not even be aware their data is being encrypted (e.g. HTTPS, messaging systems) Asymmetric encryption is often used when

Question			Answer/Indicative content	Marks	Guidance
			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 modern encryption and the difference between symmetric and asymmetric encryption; 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 sound 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 modern encryption and the difference between symmetric and asymmetric encryption; the material is basic and contains some inaccuracies. The candidate 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. Judgments if made are weak and unsubstantiated. The information is basic and communicated 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		exchanging data. For example credit card details over the internet. Symmetric encryption is best suited when the same person is encrypting and decrypting. For example when backing up data. AO3 The strength and ease of use of encryption has made it widely used on the Internet. E-Commerce would not be possible without it. Governments are no longer able to easily crack encrypted messages they intercept (as far as we know). This gives individuals unprecedented levels of privacy But also means those communicating for nefarious purposes can do so undetected. <u>Examiner's Comments</u> Candidates were assessed on the quality of their extended response in this question. Many candidates explained the difference between symmetric and asymmetric encryption very well. Some went on to describe the circumstances in which they are used equally well. Few discussed the impact on society. Many candidates scored in the mid band on this question.
			Total	17	

Question			Answer/Indicative content	Marks	Guidance
9	a		10101001 ← Answer, 1 Mark 111111 ← Carry bits, 1 Mark	2 (AO1.2)	Examiner's Comments Most candidates achieved both marks on this question.
	b		1 0~~2~~2 ← Borrowed bits, 1 Mark 1~~100~~1111 00111001 10010110 ← Answer, 1 Mark	2 (AO1.2)	Allow 2 marks for any other valid method with working shown. If converted to denary and calculated, no marks. Examiner's Comments Responses which used binary subtraction or two's compliment were accepted for this question. Most candidates scored two marks.
	c		370F 1 Mark for the first two digits (i.e. 37) 1 Mark for the last two digit (i.e. 0F)	2 (AO1.2)	Examiner's Comments Most candidates achieved both marks on this question.
	d		- Exponent is 2 - Mantissa becomes 010.01 - Value is 2.25 (1 Mark per -, Max 3)	3 (AO1.2)	Examiner's Comments Most candidates achieved full marks on this question. Those who did not, invariably scored zero marks.
	e		01100 0000 1 Mark for mantissa, 1 mark for exponent. 10000 0100 1 Mark for mantissa, 1 mark for exponent.	4 (AO1.2)	Examiner's Comments Surprisingly, this question was poorly attempted. Few candidates gained full marks with many not gaining any credit. Candidates should be reminded that the first two bits of the mantissa must be different in normalised floating point numbers.
	f		10111001	1 (AO1.2)	cao Examiner's Comments Invariably, all candidates achieved the available mark on each of these question parts.

Question			Answer/Indicative content	Marks	Guidance
	g		11111111	1 (AO1.2)	cao Examiner's Comments Invariably, all candidates achieved the available mark on each of these question parts.
			Total	15	

Question			Answer/Indicative content	Marks	Guidance
10	a		 - A going into NOT gate. - B and NOT A going into OR gate (and Q coming out of it) (1 Mark per -, Max 2)	2 (AO1.2)	<u>Examiner's Comments</u> Most candidates achieved both the available marks on this question.
	b		- Groups correctly identified (with no further groups). - Answer includes ¬ C∧¬D - Answer includes ¬ C∧¬D - Answer includes ¬ C∧¬D - All three sections joined with ∧s in any order but with no further sections. E.g. (A∧¬B)∨(A∧¬C)∨(¬ C∧¬D) The brackets aren't necessary (1 Mark per -, Max 5)	5 (AO1.2)	 <u>Examiner's Comments</u> The question required candidates to find the Boolean expression represented in the Karnaugh Map. Most candidates achieved a mark for showing the correct groupings on the map. Many went on to achieve some marks for the resultant expression. Some candidates specified NOT(C AND D) instead of NOT C AND NOT D evidently assuming the expressions are the same.
			Total	**7**	