Question			Answer/Indicative content	Marks	Guidance
1	a	i	• <u>Both data and instructions</u> share the same memory • <u>Instructions and Data</u> stored in same format • A single set of buses / same <u>bus for instructions & data</u> (to connect CPU to Memory and I/O) • Has a (single) control unit • Has an ALU. • Has ways to input and output. • Has access to storage, • Works sequentially through instructions // follows Fetch-execute cycle • (Special) registers within CPU • Based on stored program concept	2	**Examiner's Comments** Many candidates were able to access full marks on this question. This question has been asked in previous papers and candidates should be encouraged to use these to make sure they are clear in their responses. There were many possible responses in the mark scheme to help candidates to gain full marks. Most candidates gained at least 1 mark.
		ii	• Separate <u>memory for data and instructions</u> / Multiple memory units • Different (sets of) buses one for <u>instructions</u> & one for <u>data</u>/ <u>instructions and data</u> can be accessed concurrently.	1	**Examiner's Comments** This question was generally answered well by candidates and the majority gave separate areas of memory for data and instructions. Where candidates were not given marks, it was generally because their answer was unclear, e.g. just saying 'separate memory'.
	b		• **Higher/faster** clock speed • **More** cores//dual/quad/etc core • **More** cache memory.	2	Answers must refer to an improvement (more/higher/faster) not just "change the clock speed" Allow discussions of level 1/level 2 cache sizes for one mark. Accept valid features of CPUs that would improve performance e.g. Use of: Pipelining Simultaneous Multithreading Do not accept RISC/CISC. **Examiner's Comments** Most candidates were able to gain full marks on this question. Less successful responses often mentioned clock speed, cache or cores without referring to an improvement, e.g. higher or faster.
	c	i	• 10 • 60 • 200	3	1 mark per number **Examiner's Comments** This was generally well answered by candidates who had a good understanding of LMC. Candidates should be encouraged to trace through LMC programs with different values as well as writing them.

Question			Answer/Indicative content	Marks	Guidance

		ii	• Loads a value into the accumulator
			• Establishes a zero value (by use of DAT / SUB)
			• Stores a <u>zero value</u> into total
			• Program stops
				4	Example 1
					```\nLDA zero\nSTA total\nHLT\nzero DAT 0\n```
					
					Example 2
					```\nLDA total\nSUB total\nSTA total\nHLT\n```
					
					BP1 can be given for any value being loaded into the accumulator e.g. INP
					
					If candidate writes LDA donation/total (case sensitive) they can get BP2 as they've used the labels from the question
					
					BP3 - total is case sensitive as given in the question
					
					BP4 - must not be given if the zero value will be attempted to be fetched e.g. HLT is placed after DAT
					
					<u>Examiner's Comments</u>
					This was generally answered well, and the majority of students were able to gain marks with most gaining 3 or 4 marks. Less successful responses over complicated the program leading to them making mistakes. A small number of candidates attempted to answer in pseudocode rather than LMC. Candidates should be encouraged to use the commands in Appendix 5d of the specification.

Question			Answer/Indicative content	Marks	Guidance
		iii	• One **instruction** can be fetched while another is being decoded… • …and another is executed • The output of one <u>process/instruction</u> is the input of the next. • Concurrent processing of multiple instructions // completing multiple FDE cycles at once	3	For BP1, allow any 2 of the 3 parts of the FDE cycle For BP2, must give the other part of the FDE cycle not given in BP1 Do not award if explaining multiple cores working on different parts of FDE cycle <u>**Examiner's Comments**</u> Many candidates were able to gain at least 2 marks on this question. Some candidates were not awarded marks as they wrote about multiple cores or programs being fetched instead, of instructions. **Exemplar 1** *Pipelining is when a computer can fetch the next instruction whilst the previous is being decoded and the one before that is being executed. There is two types of pipelining: arithmetic and instruction. Pipelining allows multiple instructions to be processed at the same time.* [3] The candidate has clearly described pipelining with correct terminology. They gained full marks for the description of one <u>instruction</u> being decoded while another is fetched and another is executed, as well as describing that it allows <u>multiple instructions</u> to be processed <u>at the same time</u>.
		iv	• More <u>instructions</u> can be carried out in a **set amount of time** // **less time** to execute the same number of <u>instructions</u> • Increasing the speed/performance/efficiency of the computer/program // quicker for the program to complete	2	Do not allow "each instruction is quicker to execute". BP2 has to be specific to the charity e.g. processing more donations <u>**Examiner's Comments**</u> Many candidates gained 1 mark for giving a benefit to the charity, but they did not go on to say why pipelining enabled that. Some candidates did not apply their answer to the charity, so were not awarded the mark for the benefit.
	d	i	• Holds all input/output • Holds **results** of calculations (from the ALU) • Checked for conditional branching (e.g. BRZ) • Stores data which has come from the MDR/RAM	2	<u>**Examiner's Comments**</u> Most candidates were able to access 1 mark for the result of ALU calculations, but few were able to give two uses. Some confused the accumulator with the program counter and the ALU.

Question			Answer/Indicative content	Marks	Guidance
		ii	• Holds the <u>address/location</u> of the <u>next</u> instruction (to be executed/fetched) • Contents copied to the MAR at start of FDE • Incremented (by one) on every cycle • Can be changed by branch/jump instructions	2	<u>Examiner's Comments</u> This question was generally well answered by candidates who gave clear responses. **Misconception** (?) Some candidates thought that the program counter kept track of a count of the number of instructions that had been fetched.
		iii	• Memory Address Register // MAR • Memory Data Register // MDR • Current Instruction Register // CIR • Index Register // IR	3	Allow Memory Buffer Register for MDR <u>Examiner's Comments</u> Most candidates gained full marks on this question and were able to correctly identify three other registers. Some lost marks for saying the ALU or control unit were registers.
	e		**Mark Band 3–High Level (9-12 marks)** The candidate demonstrates a thorough knowledge and understanding of both CISC and RISC. 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 (5-8 marks)** The candidate demonstrates reasonable knowledge and understanding of CISC and/or RISC; 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.	12 (AO1.1) (2), (AO1.2) (2), (AO2.1) (3), (AO3.3). (5)	AO1 CISC is a complex instruction set. The traditional approach to processor design. Lots of instructions available although some instructions in CISC will rarely get used. RISC is a reduced instruction set. A smaller number of instructions available, several instructions can be combined to perform the same tasks as CISC processors. RISC instructions are used regularly. RISC has fewer transistors/less complex circuitry whereas CISC integrated circuits are more expensive/complicated. RISC instructions take one cycle whereas CISC may take several. RISC can only do complex things by combining multiple instructions whereas CISC is done in one line. Compilers for RISC need to be more complex than compilers for CISC AO2 CISC processors would run the same software as the desktop machines. Would be less power efficient and require larger battery and cooling mechanisms. More expensive to purchase. RISC processor requires software to be written specifically for it (cannot use CISC instructions). More power efficient and so requires less/no cooling and smaller battery/longer battery life. RISC devices may require greater RAM as programs tend to be larger than their CISC

Question			Answer/Indicative content	Marks	Guidance
			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 (1-4 marks)** The candidate demonstrates a basic knowledge of CISC or RISC; 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.		equivalents. AO3 Mobile use of CISC would save money on software and increase compatibility but cost more to purchase and be physically larger (heat sink/larger battery) and/or have a shorter battery life. RISC would require investment in software but be cheaper to purchase and give a better performance out of the office (lighter/longer battery life). Some compatibility issues may be reduced with emulators and translators. Examiner's Comments Many candidates were able to discuss the difference in reduced or complex instruction sets and gave some discussion of the increase in hardware requirements for CISC. Few talked about the software differences, and some assumed the charity would need to be programming the devices which was not relevant to the question.
			Total	36	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
2	a	i	• Field that is unique/does not repeat	1	
		ii	• **Foreign Key:** PackageType • **Table Name:** Membership	2	Must be spelled correctly **Examiner's Comments** Many candidates gained 1 mark for the foreign key and most gained both marks, although some candidates gave 'package' as the table where it is a primary key rather than the membership table where it is the foreign key.
		iii	• Float / Floating Point / Real	1	Allow currency/double/single/decimal
		iv	• Adverts	1	CAO
2	a	i	• Field that is unique/does not repeat		

Question			Answer/Indicative content	Marks	Guidance

	b		• Username and FirstName fields (and no others) selected correctly using `SELECT` keyword
			• `Membership` / both tables correctly selected using `FROM` keyword
			• Tables joined using correct `JOIN` / `INNER JOIN` keywords // Tables joined using correct `WHERE` clause
			• Fields use table identifiers before them
			• `WHERE` clause used to correctly show only records where `Adverts = true`
				5	For full marks, a fully correct working answer must be provided. Candidates can join tables in either of two valid ways (using `JOIN` or `WHERE`). Note that `JOIN` is given in the specification but `INNER JOIN` is also equally acceptable.
					
					BP1 is the same for either method
					For BP2, candidates can either choose just the Membership table **or** <u>both</u> the Membership and Packagetable
					BP3 credited for correct JOIN / INNER JOIN or correct use of WHERE clause to join tables. <u>Do not credit if FROM clause incorrect for this method</u>
					BP4 credited if candidates have used table identifiers before the field name (i.e they have used `Membership.PackageType` and not just `PackageType`)
					BP5 will require use of `AND` if `WHERE` is used to join tables.
					
					Spellings of all field names, table names and keywords must be accurate but only penalise once.
					
					<u>Example one using JOIN keyword</u>
					`SELECT Username, Firstname`
					`FROM Membership`
					`JOIN Package on`
					`Membership.PackageType=Package.`
					`PackageType`
					`WHERE Adverts = true`
					
					<u>Example two using WHERE clause</u>
					`SELECT Username, Firstname`
					`FROM Membership, Package`
					`WHERE Membership.PackageType =`
					`Package.PackageType`
					`AND Adverts = true`
					
					<u>Examiner's Comments</u>
					Many candidates were able to gain some marks. The question refers to the Adverts field which is in the package table and states that the data shown in the tables is only an extract from the tables. For full marks on this question, candidates were expected to attempt to join the two tables to access the Username and Firstname from the membership table, and the Adverts from the package table.

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
	c	i	• Form / web form • Can use validation to check for common errors… • Can check for duplicate values • Data can be entered direct into the database / limited manual processing • Can be done from remote locations	3	One mark maximum for identification of method Two marks for discussion of suitability Accept other valid methods of capturing data. Do NOT accept OCR/OMR/barcodes/QR codes If the method is incorrect, don't read on **Examiner's Comments** Few candidates were able to gain full marks on this question as many overcomplicated it or could not give a relevant data capture method. When they did give form as a relevant answer, they often had unclear suitability. **Exemplar 2** Method ...... E lectronic form filled out by customer. Suitability ...... An electronic form can be processed automatically and details new customer details automatically added it to the database. An electronic form is also suitable for the customer as it can be filled in at home. [3] The candidate has given a valid method and has given clear and correct suitability by describing that the details could be automatically added to the database and can be filled in from home, which would be a remote location. The candidate gained the full 3 marks.
		ii	e.g. • CSV • JSON • XML • SQL • APIs • EDI • RSS • SOAP	2	**Examiner's Comments** Few candidates gained full marks on this question although there were a range of relevant responses they could have given.
	d	i	• (Committed) data/transaction is not lost… • …in case of power / system failure	2	
		ii	• Completed transactions stored in secondary storage // data not stored long-term in RAM/cache	1	

Question			Answer/Indicative content	Marks	Guidance
		iii	• The outcome of concurrent transactions is the same as if transactions were completed sequentially. • Record locking allows one user/process to access/modify record level data at any one time • So data that is being used elsewhere cannot be modified // data that is being modified elsewhere cannot be used	3	Allow reference to lost updates/dirty reads/phantom reads for BP3. Examiner's Comments For candidates with a good understanding of ACID, these questions were well answered. Unfortunately, some had only a vague knowledge or confused it with referential integrity. Some answers were unclear. Some candidates talked about locking the entire database when record locking rather than just the relevant records.
		iv	• Can cause delays (as users wait for access) • Can cause deadlock	1	Examiner's Comments Many candidates were given a mark for deadlock or longer wait times. Those candidates given a mark in Question 2 (d) (iv) tended to be those who has gained marks in Question 2 (d) (iii).
	e		• Copyright assigned to owner of video automatically on creation • Makes it illegal to copy/distribute videos **as your own/without permission** • Copyright holder can ask for their work to be removed from the streaming platform • Membership/licence gives subscribers the agreement to view videos • Which may restrict their use (e.g. to whom it is shown or geographical location from which it is accessed).	2	Examiner's Comments Most candidates were able to gain 1 mark for this question, but few went on to gain a second mark.
	f		• Lossy **permanently** removes data • Lossless rewrites original data in more efficient format • Lossless is able to recreate the original file // Lossy is not able to recreate the original file • Lossy reduces quality of videos // Lossless keeps original quality • Lossy file size is smaller than if lossless were used • Lossy: compression ratio may be adjusted depending on bandwidth • Resulting in a noticeable decrease in quality on slower connections. • Lossy: the video will buffer less / quicker to start watching the video // Lossless: the video will buffer more / slower to start watching the video	5	Do not allow answers relating to speed of download unless this clearly refers to the video starting or reduction in buffering – scenario is video being streamed, not downloaded. Examiner's Comments Candidates tended to write at length for this question, but often made the same point twice. Many missed marks for not making the comparison between lossy and lossless and only gave one side. Some candidates discussed the videos being downloaded rather than streamed.
	g	i	• Class definition with identifier <u>video</u> • name, number of views and star rating	7	Accept implementations in high-level languages (e.g. __ for private, class name

Question			Answer/Indicative content	Marks	Guidance
			attributes defined… • …As private • Constructor method definition <u>inside class definition</u>… • …that accepts only one parameter • …Name attribute set to parameter passed in • Views set to 0 and rating set to 3 **either** when initialised or in constructor.		used for constructor, no need for end of class definition in Python) BP1 - allow empty brackets. Do not allow anything in the brackets BP5 - ignore self if included as parameter

Guidance continued:

```
class video

    private name

    private views

    private starrating


    public procedure new(newname)

        name = NewName

        views = 0

        starrating = 3

    end procedure

end class
```

<u>Examiner's Comments</u>
This question was well answered by some candidates. The question asks for pseudocode or program code and candidates should be encouraged to do one or the other if given a choice, rather than a combination of the two. Many candidates did not use the information in the question stem to help them structure their answer and gave more than one parameter in the constructor.

Exemplar 3

```
Class Video
    private name
    private number of views
    private star rating

    public procedure new (aName)
        name = aName
        number of views = 0
        star rating = 3
    end procedure
end class
```

This was a good clear example of an answer given in pseudocode. The candidate has declared the 3 given attributes as private, shown a constructor with one parameter and set name to the parameter and views and rating to 0 and 3. The candidate gained 7 marks.

Question			Answer/Indicative content	Marks	Guidance
		ii	• Method definition <u>that is public</u> • View attribute incremented by one	2	``` public procedure updateviews() views = views + 1 end procedure ``` View attribute must have the same name as part i <u>Examiner's Comments</u> Most candidates were able to gain at least 1 mark for this question. Those who were not given marks used pseudocode but did not state that the procedure was public, or they did not use the same attribute they had declared in Question 2 (g) (i).
			Total	38	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
3	a	i	• 1011 0111 1110	1	CAO
		ii	• -149	1	CAO
		iii	0011 1001 • One mark for correct left hand nibble (CAO) • One mark for correct right hand nibble (CAO) • One mark for working clearly shown	3	Working could include showing "borrowing" values from other columns or making the second number negative and adding. Answer must be 8 bits to achieve full marks (stated in question). No marks if only working is denary Examiner's Comments Most candidates were able to gain some marks, with many gaining full marks. A popular method was to do two's complement addition. Candidates should be encouraged to show their working in binary and not do the subtraction in denary and then just give the answer in binary. The question asks them to complete a binary subtraction.
	b		• Exponent is -2 • Move decimal place 2 places <u>left</u> • Fill with 1s giving 1.1101 • Denary answer is -0.1875 // $\frac{-3}{16}$	4	Accept alternative method of -0.75 x 2^{-2} for BP2 and BP3. BP2 credited for -0.75, BP3 credited for multiplying by 2^{-2} Correct answer with valid working gets full marks Examiner's Comments Most candidates correctly identified the exponent and that the point needed to be moved to the left. Any valid method of working was given marks here, where candidates got the correct answer.
	c		See table below	4	One mark per row. No mark if both/neither box is ticked. Accept other marks that clearly indicate choice (e.g. X) Examiner's Comments This question was mostly well answered. However, some candidates were able to identify 01 as being normalised but not 10 being normalised.
			Total	13	

Table for question 3c:

Binary number	Normalised	Not normalised
010101 100	x	
110101 111		x
011010 010	x	
101010 110	x	

Question			Answer/Indicative content	Marks	Guidance
4			**Mark Band 3–High Level (7-9 marks)** The candidate demonstrates a thorough knowledge and understanding of artificial intelligence, machine learning and how biases can be inherited. 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 of artificial intelligence, machine learning and/or how biases can be inherited; 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 of some aspects of artificial intelligence or machine learning; the material is basic and contains some inaccuracies. The candidate makes a	9 (AO1.1) (2), (AO1.2) (2), (AO2.1) (2), (AO3.3). (3)	AO1 Artificial intelligence is used for computer systems that are required to perform tasks that normally require human intelligence. AI is generally programmed. Machine learning is where a machine improves its performance/output through experience/access to data. Machine learning is a subset of AI. AO2 AI follows programming so if a program contains biases then so will the AI outcomes. Programmers must be aware of this and tackle it during design/implementation/testing. Machine learning bias depends on data given. Larger data sets are generally more inclusive/less biased but must be aware of data that is itself biased. Candidates may give examples that meet this. AO3 Thorough testing, multiple programmers and scrutiny of data sets are essential to ensure that unconscious biases are not inherited. If not thoroughly considered then biases will certainly be inherited. Datasets for machine learning need to be large enough to be representative but not so large that data is not able to be checked. <u>Examiner's Comments</u> There were a wide range of responses to this question and a wide range of marks given. The most successful responses were able to address all parts of the question and could give the meaning of AI as well as some relevant examples of AI bias. They were also able to give at least one measure that could be taken. Many candidates used self-driving cars as their only example and should be encouraged to explore the use of AI in different fields. Some confused the AI being biased with people being biased against AI. Many candidates were unable to give relevant measures for preventing bias. Candidates should be encouraged to make sure they include all points the question asked for, in their answer.

Question			Answer/Indicative content	Marks	Guidance
			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.		
			Total	9	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
5	a	i	• 40	1	CAO
		ii	• 70	1	CAO
		iii	• 300	1	CAO
	b	i	• To convert (high-level or assembly) code to <u>low level/machine code</u>	1	Do not allow answers referring to making the program executable, given in question. <u>Examiner's Comments</u> This question was generally well answered, though some candidates thought that a translator translated machine code into source code or that it translated code into something the computer could understand, without specifying what that was.
		ii	• Compiler translates code all at once/before it's executed • Interpreter translates code line by line / during runtime • Compiler produces executable file for reuse // Doesn't need to be translated everytime it is run • Interpreter needs to re-translate next time program is run • Compiler lists all errors//Compiled code doesn't run if there are any errors • Interpreter stops at the first error • Compiled programs have the source code hidden • Interpreted programs have the source code visible	4	Mark answers in pairs Max 2 marks per answer space <u>Examiner's Comments</u> This question was well answered by many candidates who showed two distinct differences.

Question			Answer/Indicative content	Marks	Guidance
	c		<table><tr><td></td><td>Lexical analysis</td><td>Syntax analysis</td><td>Code generation</td></tr><tr><td>Comments and white-space are removed</td><td>x</td><td></td><td></td></tr><tr><td>Keywords are replaced with tokens</td><td>x</td><td></td><td></td></tr><tr><td>Object code is created</td><td></td><td></td><td>x</td></tr><tr><td>Symbol table created for variables</td><td>x</td><td></td><td></td></tr><tr><td>Builds an abstract syntax tree</td><td></td><td>x</td><td></td></tr></table>	5	One mark per row. No mark if more than one/no box is ticked. Accept other marks that clearly indicate choice (e.g. X)
	d		- To make the program run faster// code is more efficient - To make the program use fewer resources/less memory	2	<u>Examiner's Comments</u> Many candidates gave good descriptions of how code is optimised, but they did not answer the question which asked what the purpose of optimisation is.

	e	i	<pre>function countCapitals(text)
			    // initialise counter to 0
			    capCount = 0
			    // loop through each character in
			the string passed in
			    for x = 0 to text.length-1
			        c = text.subString(x, 1)
			        // check if character is a capital
			        if asc(c) >= 65 and asc(c) <= 90
			// if so, increment counter
			            capCount = capCount + 1
			        endif
			    next x
			    return capCount
			endfunction</pre>
				3	Accept alternative answers in high-level languages (e.g. `capCount ++` or `capCount +=1 / &&` for and for BP1)
					
					Accept `countCapitals = capCount` for BP3 (Returning via assigning to function identifier is used in VB / Pascal)
					
					Accept **and asc(c) < 91** instead of **<=90**
					
					Allow FT for returning the value they increment as a counter if it isn't capCount

Question			Answer/Indicative content	Marks	Guidance
		ii	• Both (use binary) to represent characters // are character sets • The first 7/8 bits of Unicode is the same as ASCII (overlaps)	1	
		iii	• ASCII has fewer characters (128/256) // Unicode has more characters • ASCII is 7/8 bits whereas Unicode can be larger 16/32 / can have variable sized characters • ASCII limited to Latin / English / European characters whereas Unicode can represent other symbols (e.g. Chinese/Cyrillic/Emojis)	2	Only mark the 1st answer for each difference For BP2&3, must have both sides to get the mark <u>Examiner's Comments</u> Candidates should be encouraged to give a complete answer. Just saying 'Unicode uses more bits than ASCII' is not enough to be given a mark at this level.

Question			Answer/Indicative content	Marks	Guidance
	f		**Mark Band 3–High Level (7-9 marks)** The candidate demonstrates a thorough knowledge and understanding of both waterfall and the spiral model. The material is generally accurate and detailed.	9 (AO1.1), (2) (AO1.2), (2), (AO2.1) (2), (AO3.3). (3)	**AO1** The spiral model has four quadrants (determine objectives, identify and manage risk, develop and test, plan next iteration). Client feedback then informs future development and prototypes which feedback into future revisions. Waterfall has a structured analysis/design/development/test flow. Progress to the next step is not made until the previous step is completed.
			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.		**AO2** The spiral model relies on frequent client feedback. Spiral produces functional prototypes where features are added incrementally. Spiral model has more focus on risk; projects may be modified or even dropped if risk is too great. Waterfall is much more structured and very reliant on getting the definition of requirements correct at the start; changes are harder to add in at a later stage. However, this forces the definition to be well understood.
			Mark Band 2-Mid Level (4-6 marks) The candidate demonstrates reasonable knowledge and understanding of waterfall and/or the spiral model; 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.		**AO3** Spiral involves client feedback, prototypes and evolving projects. Better option where requirements may change. Waterfall is better where requirements are very clear to begin with and outcomes known. Spiral is better for risk management. If the programmer has a large team then waterfall may be more appropriate due to the clearly defined responsibilities at each stage. **Examiner's Comments** Most candidates gained some marks on this question. Most could explain that spiral was iterative and waterfall was done in linear stages, but many did not expand on this. Few candidates linked their answer to the complex computer program mentioned in the question. Some candidates also described waterfall as iterative.
			Mark Band 1-Low Level (1-3 marks) The candidate demonstrates a basic knowledge of some aspects of either waterfall or the spiral model; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and		

Question			Answer/Indicative content	Marks	Guidance
			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.		
			Total	30	

Mark Scheme

Question			Answer/Indicative content	Marks	Guidance
6	a	i	• For printer queue • All documents/users have equal priority • Whichever document is received first is printed first • First in First Out / Last in Last Out	2	**Examiner's Comments** This question was generally well answered with many candidates gaining at least 1 mark. The question asked why the OS used 'first come first served' and many candidates were not given marks for stating why the user would want the OS to use it. Some candidates talked about other scheduling algorithms even though this was not relevant to the question.
		ii	• To enable <u>multitasking</u> to take place • To switch between active processes and those running in the background • To limit each process to a certain amount of time//allow processes an equal share of processor time…. • …to ensure the OS cycles through all processes // the process then goes to the back of the end of the queue • …so that users can receive an immediate response • …to handle an interrupt immediately	3	BP4, 5 & 6 are dependent on BP3 only
		iii	• Shortest job first / shortest remaining time • Process which has the shortest <u>time</u> (remaining) is completed first • Multilevel feedback queues • Uses <u>queues</u> with different priorities • Jobs can be moved between <u>queues</u>	2	One mark for name, one mark for description.
	b	i	• Protocol to be used is decided based on the application • E.g. HTTPS **for browser based service** // SMTP/IMAP **for messaging service** • Adds encryption • Passes on <u>to</u> transport layer to **send** • Gets data <u>from</u> transport layer **when receiving** • Unpacks message ready for display // removes headers or other non-viewable data • Decrypts message	5	For BP2, don't allow HTTP (question mentions encryption). Don't allow a list of protocols which aren't relevant to the question. Don't allow a protocol without its use **Examiner's Comments** Very few students could explain what happens at the application layer and answers tended to be about splitting data into packets. Some candidates did mention that encryption would take place but didn't go on to mention decryption when receiving data. Those candidates that identified that protocols are applied here were unable to give a specific example and simply listed protocols they knew, but without context.

Question			Answer/Indicative content	Marks	Guidance
		ii	• Receives (layered) data <u>from</u> internet layer **to send** • MAC addresses are added to the packet • Passes and receives data across wireless network (to WAN / other machine) • Passes (layered) data back up <u>to</u> internet layer **when receiving**	2	Wireless access given in question stem <u>**Examiner's Comments**</u> Very few candidates were able to gain 2 marks on this question. Some candidates talked about transmitting data via cables, despite wireless being mentioned in the question.
			Total	14	