



**GCE**

**Computer Science**

**H446/01: Computer systems**

A Level

**Mark Scheme for June 2022**

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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## MARKING INSTRUCTIONS

### PREPARATION FOR MARKING SCORIS

1. Make sure that you have accessed and completed the relevant training packages for on-screen marking: *RM assessor Online Training*; *OCR Essential Guide to Marking*.
2. Make sure that you have read and understood the mark scheme and the question paper for this unit. These are posted on the RM Cambridge Assessment Support Portal <http://www.rm.com/support/ca>
3. Log-in to RM Assessor and mark the **required number** of practice responses (“scripts”) and the **number of required** standardisation responses.

YOU MUST MARK 5 PRACTICE AND 10 STANDARDISATION RESPONSES BEFORE YOU CAN BE APPROVED TO MARK LIVE SCRIPTS.

### MARKING

1. Mark strictly to the mark scheme.
2. Marks awarded must relate directly to the marking criteria.
3. The schedule of dates is very important. It is essential that you meet the 50% and 100% deadlines. If you experience problems, you must contact your Team Leader (Supervisor) without delay.

1. If you are in any doubt about applying the mark scheme, consult your Team Leader by telephone or the RM messaging system, or by email.

#### 2. Crossed Out Responses

Where a candidate has crossed out a response and provided a clear alternative then the crossed out response is not marked. Where no alternative response has been provided, examiners may give candidates the benefit of the doubt and mark the crossed out response where legible.

#### Rubric Error Responses – Optional Questions

Where candidates have a choice of question across a whole paper or a whole section and have provided more answers than required, then all responses are marked and the highest mark allowable within the rubric is given. Enter a mark for each question answered into RM assessor, which will select the highest mark from those awarded. *(The underlying assumption is that the candidate has penalised themselves by attempting more questions than necessary in the time allowed.)*

#### Contradictory Responses

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When a candidate provides contradictory responses, then no mark should be awarded, even if one of the answers is correct.

**Short Answer Questions** (requiring only a list by way of a response, usually worth only **one mark per response**)

Where candidates are required to provide a set number of short answer responses then only the set number of responses should be marked. The response space should be marked from left to right on each line and then line by line until the required number of responses have been considered. The remaining responses should not then be marked. Examiners will have to apply judgement as to whether a 'second response' on a line is a development of the 'first response', rather than a separate, discrete response. *(The underlying assumption is that the candidate is attempting to hedge their bets and therefore getting undue benefit rather than engaging with the question and giving the most relevant/correct responses.)*

**Short Answer Questions** (requiring a more developed response, worth **two or more marks**)

If the candidates are required to provide a description of, say, three items or factors and four items or factors are provided, then mark on a similar basis – that is downwards (as it is unlikely in this situation that a candidate will provide more than one response in each section of the response space.)

**Longer Answer Questions** (requiring a developed response)

Where candidates have provided two (or more) responses to a medium or high tariff question which only required a single (developed) response and not crossed out the first response, then only the first response should be marked. Examiners will need to apply professional judgement as to whether the second (or a subsequent) response is a 'new start' or simply a poorly expressed continuation of the first response.

3. Always check the pages (and additional objects if present) at the end of the response in case any answers have been continued there. If the candidate has continued an answer there then add a tick to confirm that the work has been seen.

7. Award No Response (NR) if:
  - there is nothing written in the answer space

Award Zero '0' if:

- anything is written in the answer space and is not worthy of credit (this includes text and symbols).

Team Leaders must confirm the correct use of the NR button with their markers before live marking commences and should check this when reviewing scripts.

8. The RM **comments box** is used by your team leader to explain the marking of the practice responses. Please refer to these comments when checking your practice responses. **Do not use the comments box for any other reason.**  
If you have any questions or comments for your team leader, use the phone, the RM messaging system, or e-mail.
9. Assistant Examiners will send a brief report on the performance of candidates to their Team Leader (Supervisor) via email by the end of the marking period. The report should contain notes on particular strengths displayed as well as common errors or weaknesses. Constructive criticism of the question paper/mark scheme is also appreciated.

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10. For answers marked by levels of response:
- To determine the level** – start at the highest level and work down until you reach the level that matches the answer
  - To determine the mark within the level**, consider the following:

Descriptor	Award mark
On the borderline of this level and the one below	At bottom of level
Just enough achievement on balance for this level	Above bottom and either below middle or at middle of level (depending on number of marks available)
Meets the criteria but with some slight inconsistency	Above middle and either below top of level or at middle of level (depending on number of marks available)
Consistently meets the criteria for this level	At top of level

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<b>Annotation</b>	<b>Meaning</b>
	<b>Omission mark</b>
	<b>Benefit of the doubt</b>
	<b>Subordinate clause / consequential error</b>
	<b>Incorrect point</b>
	<b>Expansion of a point</b>
	<b>Follow through</b>
	<b>Not answered question</b>
	<b>No benefit of doubt given</b>
	<b>Point being made</b>
	<b>Repeat</b>
	<b>Correct point</b>
	<b>Too vague</b>

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<b>0</b>	<b>Zero (big)</b>
<b>BP</b>	<b>Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.</b>
<b>L1</b>	<b>Level 1</b>
<b>L2</b>	<b>Level 2</b>
<b>L3</b>	<b>Level 3</b>

11.

## 12. Subject Specific Marking Instructions

Question			Answer	Mark	Guidance
1	(a)	(i)	<ul style="list-style-type: none"> <li>Both <u>data and instructions</u> share the same memory</li> <li><u>Instructions and Data</u> stored in same format</li> <li>A single set of buses / same <u>bus for instructions &amp; data</u> (to connect CPU to Memory and I/O)</li> <li>Has a (single) control unit</li> <li>Has an ALU.</li> <li>Has ways to input and output.</li> <li>Has access to storage,</li> <li>Works sequentially through instructions // follows Fetch-execute cycle</li> <li>(Special) registers within CPU</li> <li>Based on stored program concept</li> </ul>	2	
		(ii)	<ul style="list-style-type: none"> <li>Separate <u>memory for data and instructions</u> / Multiple memory units</li> <li>Different (sets of) buses one for <u>instructions</u> &amp; one for <u>data/ instructions and data</u> can be accessed concurrently.</li> </ul>	1	
	(b)		<ul style="list-style-type: none"> <li><b>Higher/faster</b> clock speed</li> <li><b>More</b> cores//dual/quad/etc core</li> <li><b>More</b> cache memory.</li> </ul>	2	<p>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.</p> <p>Accept valid features of CPUs that would improve performance e.g. Use of: Pipelining Simultaneous Multithreading</p> <p>Do not accept RISC/CISC.</p>
	(c)	(i)	<ul style="list-style-type: none"> <li>10</li> <li>60</li> <li>200</li> </ul>	3	1 mark per number



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		<p><b>(ii)</b></p> <ul style="list-style-type: none"> <li>• Loads a value into the accumulator</li> <li>• Establishes a zero value (by use of DAT / SUB)</li> <li>• Stores a <u>zero value</u> into total</li> <li>• Program stops</li> </ul>	4	<p>Example 1</p> <pre>LDA zero STA total HLT zero DAT 0</pre> <p>Example 2</p> <pre>LDA total SUB total STA total HLT</pre> <p>BP1 can be given for any value being loaded into the accumulator e.g. INP</p> <p>If candidate writes LDA donation/total (case sensitive) they can get BP2 as they've used the labels from the question</p> <p>BP3 - total is case sensitive as given in the question</p> <p>BP4 - must not be given if the zero value will be attempted to be fetched e.g. HLT is placed after DAT</p>
		<p><b>(iii)</b></p> <ul style="list-style-type: none"> <li>• One <b>instruction</b> can be fetched while another is being decoded...</li> <li>• ...and another is executed</li> <li>• The output of one <u>process/instruction</u> is the input of the next.</li> <li>• Concurrent processing of multiple instructions // completing multiple FDE cycles at once</li> </ul>	3	<p>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</p> <p>Do not award if explaining multiple cores working on different parts of FDE cycle</p>

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		<b>(iv)</b>	<ul style="list-style-type: none"> <li>• More <u>instructions</u> can be carried out in a <b>set amount of time // less time</b> to execute the same number of <u>instructions</u></li> <li>• Increasing the speed/performance/efficiency of the computer/program // quicker for the program to complete</li> </ul>	2	<p>Do not allow “each instruction is quicker to execute”.</p> <p>BP2 has to be specific to the charity e.g. processing more donations</p>
	<b>(d)</b>	<b>(i)</b>	<ul style="list-style-type: none"> <li>• Holds all input/output</li> <li>• Holds <b>results</b> of calculations (from the ALU)</li> <li>• Checked for conditional branching (e.g. BRZ)</li> <li>• Stores data which has come from the MDR/RAM</li> </ul>	2	
		<b>(ii)</b>	<ul style="list-style-type: none"> <li>• Holds the <u>address/location</u> of the <u>next</u> instruction (to be executed/fetched)</li> <li>• Contents copied to the MAR at start of FDE</li> <li>• Incremented (by one) on every cycle</li> <li>• Can be changed by branch/jump instructions</li> </ul>	2	
		<b>(iii)</b>	<ul style="list-style-type: none"> <li>• Memory Address Register // MAR</li> <li>• Memory Data Register // MDR</li> <li>• Current Instruction Register // CIR</li> <li>• Index Register // IR</li> </ul>	3	Allow Memory Buffer Register for MDR

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(e)	<p><b>Mark Band 3–High Level (9-12 marks)</b> The candidate demonstrates a thorough knowledge and understanding of both CISC and RISC. The material is generally accurate and detailed.</p> <p>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.</p> <p>The candidate provides a thorough discussion which is well balanced. Evaluative comments are consistently relevant and well-considered.</p> <p>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</p> <p><b>Mark Band 2-Mid Level (5-8 marks)</b> The candidate demonstrates reasonable knowledge and understanding of CISC and/or RISC; the material is generally accurate but at times underdeveloped.</p> <p>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.</p> <p>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.</p> <p>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.</p>	<p>12</p> <p>AO1.1 (2), AO1.2 (2), AO2.1 (3), AO3.3 (5)</p>	<p><b>AO1</b> 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</p> <p><b>AO2</b> 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 equivalents.</p> <p><b>AO3</b> 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</p>
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		<p><b>Mark Band 1-Low Level (1-4 marks)</b> 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.</p> <p>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.</p> <p><b>0 marks</b> No attempt to answer the question or response is not worthy of credit.</p>		<p>of the office (lighter/longer battery life). Some compatibility issues may be reduced with emulators and translators.</p>
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Question			Answer	Mark	Guidance
2	(a)	(i)	<ul style="list-style-type: none"> <li>Field that is unique/does not repeat</li> </ul>	1	
		(ii)	<ul style="list-style-type: none"> <li><b>Foreign Key:</b> PackageType</li> <li><b>Table Name:</b> Membership</li> </ul>	2	Must be spelled correctly
		(iii)	<ul style="list-style-type: none"> <li>Float / Floating Point / Real</li> </ul>	1	Allow currency/double/single/decimal
		(iv)	<ul style="list-style-type: none"> <li>Adverts</li> </ul>	1	CAO

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	<b>(b)</b>	<ul style="list-style-type: none"> <li>• Username and FirstName fields (and no others) selected correctly using <code>SELECT</code> keyword</li> <li>• Membership / both tables correctly selected using <code>FROM</code> keyword</li> <li>• Tables joined using correct <code>JOIN / INNER JOIN</code> keywords // Tables joined using correct <code>WHERE</code> clause</li> <li>• Fields use table identifiers before them</li> <li>• <code>WHERE</code> clause used to correctly show only records where <code>Adverts = true</code></li> </ul>	5	<p>For full marks, a fully correct working answer must be provided. Candidates can join tables in either of two valid ways (using <code>JOIN</code> or <code>WHERE</code>). Note that <code>JOIN</code> is given in the specification but <code>INNER JOIN</code> is also equally acceptable.</p> <p>BP1 is the same for either method  For BP2, candidates can either choose just the Membership table <b>or both</b> the Membership and Packagetable  BP3 credited for correct <code>JOIN / INNER JOIN</code> or correct use of <code>WHERE</code> clause to join tables. <u>Do not credit if <code>FROM</code> clause incorrect for this method</u>  BP4 credited if candidates have used table identifiers before the field name (i.e they have used <code>Membership.PackageType</code> and not just <code>PackageType</code>)  BP5 will require use of <code>AND</code> if <code>WHERE</code> is used to join tables.</p> <p>Spellings of all field names, table names and keywords must be accurate but only penalise once.</p> <p><u>Example one using <code>JOIN</code> keyword</u>  <code>SELECT Username, Firstname</code>  <code>FROM Membership</code>  <code>JOIN Package on</code>  <code>Membership.PackageType=Package.PackageType</code>  <code>WHERE Adverts = true</code></p> <p><u>Example two using <code>WHERE</code> clause</u>  <code>SELECT Username, Firstname</code>  <code>FROM Membership, Package</code>  <code>WHERE Membership.PackageType =</code>  <code>Package.PackageType</code>  <code>AND Adverts = true</code></p>
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	<b>(c)</b>	<b>(i)</b>	<ul style="list-style-type: none"> <li>Form / web form</li> <li>Can use validation to check for common errors...</li> <li>Can check for duplicate values</li> <li>Data can be entered direct into the database / limited manual processing</li> <li>Can be done from remote locations</li> </ul>	3	<p>One mark maximum for identification of method Two marks for discussion of suitability</p> <p>Accept other valid methods of capturing data. Do NOT accept OCR/OMR/barcodes/QR codes</p> <p>If the method is incorrect, don't read on</p>
		<b>(ii)</b>	<p>e.g.</p> <ul style="list-style-type: none"> <li>CSV</li> <li>JSON</li> <li>XML</li> <li>SQL</li> <li>APIs</li> <li>EDI</li> <li>RSS</li> <li>SOAP</li> </ul>	2	
	<b>(d)</b>	<b>(i)</b>	<ul style="list-style-type: none"> <li>(Committed) <b>data/transaction</b> is not lost...</li> <li>...in case of power / system failure</li> </ul>	2	
		<b>(ii)</b>	<ul style="list-style-type: none"> <li>Completed transactions stored in secondary storage // data not stored long-term in RAM/cache</li> </ul>	1	
		<b>(iii)</b>	<ul style="list-style-type: none"> <li>The outcome of concurrent transactions is the same as if transactions were completed sequentially.</li> <li>Record locking allows one user/process to access/modify record level data at any one time</li> <li>So data that is being used elsewhere cannot be modified // data that is being modified elsewhere cannot be used</li> </ul>	3	Allow reference to lost updates/dirty reads/phantom reads for BP3.
		<b>(iv)</b>	<ul style="list-style-type: none"> <li>Can cause delays (as users wait for access)</li> <li>Can cause deadlock</li> </ul>	1	

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	<b>(e)</b>	<ul style="list-style-type: none"> <li>● Copyright assigned to owner of video automatically on creation</li> <li>● Makes it illegal to copy/distribute videos <b>as your own/without permission</b></li> <li>● Copyright holder can ask for their work to be removed from the streaming platform</li> <li>● Membership/licence gives subscribers the agreement to view videos</li> <li>● Which may restrict their use (e.g. to whom it is shown or geographical location from which it is accessed).</li> </ul>	2	
	<b>(f)</b>	<ul style="list-style-type: none"> <li>● Lossy <b>permanently</b> removes data</li> <li>● Lossless rewrites original data in more efficient format</li> <li>● Lossless is able to recreate the original file // Lossy is not able to recreate the original file</li> <li>● Lossy reduces quality of videos // Lossless keeps original quality</li> <li>● Lossy file size is smaller than if lossless were used</li> <li>● Lossy: compression ratio may be adjusted depending on bandwidth</li> <li>● Resulting in a noticeable decrease in quality on slower connections.</li> <li>● Lossy: the video will buffer less / quicker to start watching the video // Lossless: the video will buffer more / slower to start watching the video</li> </ul>	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.



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	<b>(g)</b>	<b>(i)</b>	<ul style="list-style-type: none"> <li>• Class definition with identifier <u>video</u></li> <li>• name, number of views and star rating attributes defined...</li> <li>• ...As private</li> <li>• Constructor method definition <u>inside class definition</u>...</li> <li>• ...that accepts only one parameter</li> <li>• ...Name attribute set to parameter passed in</li> <li>• Views set to 0 and rating set to 3 <b>either</b> when initialised <b>or</b> in constructor.</li> </ul>	7	<p>Accept implementations in high-level languages (e.g. __ for private, class name used for constructor, no need for end of class definition in Python)</p> <p>BP1 - allow empty brackets. Do not allow anything in the brackets BP5 - ignore self if included as parameter</p> <pre>class video   private name   private views   private starrating    public procedure new(newname)     name = NewName     views = 0     starrating = 3   end procedure end class</pre>
		<b>(ii)</b>	<ul style="list-style-type: none"> <li>• Method definition <u>that is public</u></li> <li>• View attribute incremented by one</li> </ul>	2	<pre>public procedure updateviews()   views = views + 1 end procedure</pre> <p>View attribute must have the same name as part i</p>

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Question			Answer	Mark	Guidance															
3	(a)	(i)	<ul style="list-style-type: none"> <li>1011 0111 1110</li> </ul>	1	CAO															
		(ii)	<ul style="list-style-type: none"> <li>-149</li> </ul>	1	CAO															
		(iii)	0011 1001 <ul style="list-style-type: none"> <li>One mark for correct left hand nibble (CAO)</li> <li>One mark for correct right hand nibble (CAO)</li> <li>One mark for working clearly shown</li> </ul>	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															
	(b)		<ul style="list-style-type: none"> <li>Exponent is -2</li> <li>Move decimal place 2 places <u>left</u></li> <li>Fill with 1s giving 1.1101</li> <li>Denary answer is <math>-0.1875 // \frac{-3}{16}</math></li> </ul>	4	Accept alternative method of $-0.75 \times 2^{-2}$ for BP2 and BP3. BP2 credited for -0.75, BP3 credited for multiplying by $2^{-2}$  Correct answer with valid working gets full marks															
	(c)		<table border="1"> <thead> <tr> <th>Binary number</th> <th>Normalised</th> <th>Not normalised</th> </tr> </thead> <tbody> <tr> <td>010101 100</td> <td>x</td> <td></td> </tr> <tr> <td>110101 111</td> <td></td> <td>x</td> </tr> <tr> <td>011010 010</td> <td>x</td> <td></td> </tr> <tr> <td>101010 110</td> <td>x</td> <td></td> </tr> </tbody> </table>	Binary number	Normalised	Not normalised	010101 100	x		110101 111		x	011010 010	x		101010 110	x		4	One mark per row. No mark if both/neither box is ticked.  Accept other marks that clearly indicate choice (e.g. X)
Binary number	Normalised	Not normalised																		
010101 100	x																			
110101 111		x																		
011010 010	x																			
101010 110	x																			

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<b>Question</b>	<b>Answer</b>	<b>Mark</b>	<b>Guidance</b>
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4		<p><b>Mark Band 3–High Level (7-9 marks)</b>  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.</p> <p>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.</p> <p>The candidate provides a thorough discussion which is well balanced. Evaluative comments are consistently relevant and well-considered.</p> <p>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</p> <p><b>Mark Band 2-Mid Level (4-6 marks)</b>  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.</p> <p>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.</p> <p>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.</p>	<p>9</p> <p>AO1.1 (2),  AO1.2 (2),  AO2.1 (2),  AO3.3. (3)</p>	<p>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.</p> <p>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.</p> <p>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.</p>
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		<p>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.</p> <p><b>Mark Band 1-Low Level (1-3 marks)</b> 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 limited attempt to apply acquired knowledge and understanding to the context provided.</p> <p>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.</p> <p><b>0 marks</b> No attempt to answer the question or response is not worthy of credit.</p>		
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Question			Answer	Mark	Guidance
5	(a)	(i)	<ul style="list-style-type: none"> <li>• 40</li> </ul>	1	CAO
		(ii)	<ul style="list-style-type: none"> <li>• 70</li> </ul>	1	CAO
		(iii)	<ul style="list-style-type: none"> <li>• 300</li> </ul>	1	CAO
	(b)	(i)	<ul style="list-style-type: none"> <li>• To convert (high-level or assembly) code to <u>low level/machine code</u></li> </ul>	1	Do not allow answers referring to making the program executable, given in question.
		(ii)	<ul style="list-style-type: none"> <li>• Compiler translates code all at once/before it's executed</li> <li>• Interpreter translates code line by line / during runtime</li> <li>• Compiler produces executable file for reuse // Doesn't need to be translated everytime it is run</li> <li>• Interpreter needs to re-translate next time program is run</li> <li>• Compiler lists all errors//Compiled code doesn't run if there are any errors</li> <li>• Interpreter stops at the first error</li> <li>• Compiled programs have the source code hidden</li> <li>• Interpreted programs have the source code visible</li> </ul>	4	Mark answers in pairs  Max 2 marks per answer space

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	<b>(c)</b>	<table border="1"> <thead> <tr> <th data-bbox="409 180 645 284"></th> <th data-bbox="645 180 880 284">Lexical analysis</th> <th data-bbox="880 180 1115 284">Syntax analysis</th> <th data-bbox="1115 180 1350 284">Code generation</th> </tr> </thead> <tbody> <tr> <td data-bbox="409 284 645 464">Comments and whitespace are removed</td> <td data-bbox="645 284 880 464">x</td> <td data-bbox="880 284 1115 464"></td> <td data-bbox="1115 284 1350 464"></td> </tr> <tr> <td data-bbox="409 464 645 603">Keywords are replaced with tokens</td> <td data-bbox="645 464 880 603">x</td> <td data-bbox="880 464 1115 603"></td> <td data-bbox="1115 464 1350 603"></td> </tr> <tr> <td data-bbox="409 603 645 707">Object code is created</td> <td data-bbox="645 603 880 707"></td> <td data-bbox="880 603 1115 707"></td> <td data-bbox="1115 603 1350 707">x</td> </tr> <tr> <td data-bbox="409 707 645 845">Symbol table created for variables</td> <td data-bbox="645 707 880 845">x</td> <td data-bbox="880 707 1115 845"></td> <td data-bbox="1115 707 1350 845"></td> </tr> <tr> <td data-bbox="409 845 645 999">Builds an abstract syntax tree</td> <td data-bbox="645 845 880 999"></td> <td data-bbox="880 845 1115 999">x</td> <td data-bbox="1115 845 1350 999"></td> </tr> </tbody> </table>		Lexical analysis	Syntax analysis	Code generation	Comments and whitespace are removed	x			Keywords are replaced with tokens	x			Object code is created			x	Symbol table created for variables	x			Builds an abstract syntax tree		x		5	<p>One mark per row. No mark if more than one/no box is ticked.</p> <p>Accept other marks that clearly indicate choice (e.g. X)</p>
	Lexical analysis	Syntax analysis	Code generation																									
Comments and whitespace are removed	x																											
Keywords are replaced with tokens	x																											
Object code is created			x																									
Symbol table created for variables	x																											
Builds an abstract syntax tree		x																										
	<b>(d)</b>	<ul style="list-style-type: none"> <li>• To make the program run faster// code is more efficient</li> <li>• To make the program use fewer resources/less memory</li> </ul>	2																									
	<b>(e)</b>	<p><b>(i)</b></p> <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</pre>	3	<p>Accept alternative answers in high-level languages (e.g. capCount ++ or capCount +=1 / &amp;&amp; for and for BP1)</p> <p>Accept countCapitals = capCount for BP3 (Returning via assigning to function identifier is used in VB / Pascal)</p>																								

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			<pre>         if asc(c) &gt;= 65 and asc(c) &lt;= 90         // if so, increment counter             capCount = capCount + 1         endif     next x     return capCount endfunction </pre>		<p>Accept <b>and asc(c) &lt; 91</b> instead of <b>&lt;=90</b></p> <p>Allow FT for returning the value they increment as a counter if it isn't capCount</p>
		<b>(ii)</b>	<ul style="list-style-type: none"> <li>Both (use binary) to represent characters // are character sets</li> <li>The first 7/8 bits of Unicode is the same as ASCII (overlaps)</li> </ul>	1	
		<b>(iii)</b>	<ul style="list-style-type: none"> <li>ASCII has fewer characters (128/256) // Unicode has more characters</li> <li>ASCII is 7/8 bits whereas Unicode can be larger 16/32 / can have variable sized characters</li> <li>ASCII limited to Latin / English / European characters whereas Unicode can represent other symbols (e.g. Chinese/Cyrillic/Emojis)</li> </ul>	2	<p>Only mark the 1st answer for each difference</p> <p>For BP2&amp;3, must have both sides to get the mark</p>



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	(f)	<p><b>Mark Band 3–High Level (7-9 marks)</b> The candidate demonstrates a thorough knowledge and understanding of both waterfall and the spiral model. The material is generally accurate and detailed.</p> <p>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.</p> <p>The candidate provides a thorough discussion which is well balanced. Evaluative comments are consistently relevant and well-considered.</p> <p>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</p> <p><b>Mark Band 2-Mid Level (4-6 marks)</b> The candidate demonstrates reasonable knowledge and understanding of waterfall and/or the spiral model; the material is generally accurate but at times underdeveloped.</p> <p>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.</p> <p>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.</p> <p>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.</p> <p><b>Mark Band 1-Low Level (1-3 marks)</b> 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 understanding to the context provided.</p>	<p>9</p> <p>AO1.1 (2), AO1.2 (2), AO2.1 (2), AO3.3 (3)</p>	<p>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.</p> <p>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.</p> <p>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.</p>
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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.

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Question			Answer	Mark	Guidance
6	(a)	(i)	<ul style="list-style-type: none"> <li>For printer queue</li> <li>All documents/users have equal priority</li> <li>Whichever document is received first is printed first</li> <li>First in First Out / Last in Last Out</li> </ul>	2	
		(ii)	<ul style="list-style-type: none"> <li>To enable <u>multitasking</u> to take place</li> <li>To switch between active processes and those running in the background</li> <li>To limit each process to a certain amount of time//allow processes an equal share of processor time....</li> <li>...to ensure the OS cycles through all processes // the process then goes to the back of the end of the queue</li> <li>...so that users can receive an immediate response</li> <li>...to handle an interrupt immediately</li> </ul>	3	BP4, 5 & 6 are dependent on BP3 only
		(iii)	<ul style="list-style-type: none"> <li>Shortest job first / shortest remaining time</li> <li>Process which has the shortest <u>time</u> (remaining) is completed first</li> <li>Multilevel feedback queues</li> <li>Uses <u>queues</u> with different priorities</li> <li>Jobs can be moved between <u>queues</u></li> </ul>	2	One mark for name, one mark for description.
	(b)	(i)	<ul style="list-style-type: none"> <li>Protocol to be used is decided based on the application</li> <li>E.g. <b>HTTPS for browser based service // SMTP/IMAP for messaging service</b></li> <li>Adds encryption</li> <li>Passes on <u>to</u> transport layer to <b>send</b></li> <li>Gets data <u>from</u> transport layer <b>when receiving</b></li> <li>Unpacks message ready for display // removes headers or other non-viewable data</li> <li>Decrypts message</li> </ul>	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

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		<b>(ii)</b>	<ul style="list-style-type: none"><li>• Receives (layered) data <u>from</u> internet layer <b>to send</b></li><li>• MAC addresses are added to the packet</li><li>• Passes and receives data across wireless network (to WAN / other machine)</li><li>• Passes (layered) data back up <u>to</u> internet layer <b>when receiving</b></li></ul>	2	Wireless access given in question stem
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