



# Cambridge International AS & A Level

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## COMPUTER SCIENCE

9618/22

Paper 2 Fundamental Problem-solving and Programming Skills

May/June 2026

MARK SCHEME

Maximum Mark: 75

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Published

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

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This document consists of **21** printed pages.

**General marking principles**

All examiners must apply these marking principles when marking candidate responses.

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Examiners must award marks for each response in line with: <ul style="list-style-type: none"> <li>the specific <b>content</b> defined in the mark scheme</li> <li>the specific <b>skills</b> defined in the mark scheme or in the level descriptions</li> <li>the <b>standard of response</b> required as exemplified by the standardisation scripts.</li> </ul>                                                                                                                                                                                                                                                                                    |
| 2 | Examiners must award <b>whole marks</b> (not half marks, or other fractions).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 3 | Examiners must award marks <b>positively</b> . This means that: <ul style="list-style-type: none"> <li>marks are not deducted for errors or omissions</li> <li>marks are awarded for correct/valid answers as defined in the mark scheme and also for <b>other valid answers</b> which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate</li> <li>the quality of spelling, punctuation and grammar are judged <b>only</b> when the mark scheme indicates that these features are <b>specifically assessed</b> in the question. However, the meaning of all responses must be unambiguous.</li> </ul> |
| 4 | Examiners must <b>consistently</b> apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 5 | Examiners must use the <b>full range of marks</b> defined in the mark scheme, unless limited by the quality of the candidate responses seen.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 6 | Examiners must award marks according to the mark scheme and <b>must not</b> award marks with grade thresholds or grade descriptions in mind.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

**Annotations guidance for centres**

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

**Annotations**

| Annotation                                                                          | Meaning                                                                                                                                    |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
|    | Benefit of the doubt                                                                                                                       |
|    | To indicate where a key word/phrase/code is missing                                                                                        |
|  | Incorrect                                                                                                                                  |
|  | Follow through                                                                                                                             |
|  | Indicate a point in an answer                                                                                                              |
| Highlighted text                                                                    | To draw attention to a particular aspect or to indicate where parts of an answer have been combined                                        |
|  | Ignore                                                                                                                                     |
|  | Not answered question                                                                                                                      |
|  | No examples or not enough                                                                                                                  |
|  | Not relevant or used to separate parts of an answer                                                                                        |
| Off-page comment                                                                    | Allows comments to be entered at the bottom of the RM marking window and then displayed when the associated question item is navigated to. |
|  | Repetition                                                                                                                                 |
|  | Indicates that work on a page has been seen including blank answer spaces and blank pages.                                                 |
|  | Correct                                                                                                                                    |

| Annotation | Meaning   |
|------------|-----------|
| <b>TV</b>  | Too vague |

**Mark scheme abbreviations**

|                  |                                                                             |
|------------------|-----------------------------------------------------------------------------|
| /                | separates alternative words / phrases within a marking point                |
| //               | separates alternative answers within a marking point                        |
| <u>underline</u> | actual word given must be used by candidate (grammatical variants accepted) |
| <b>max</b>       | indicates the maximum number of marks that can be awarded                   |
| ( )              | the word / phrase in brackets is not required, but sets the context         |
| <b>bold</b>      | similar word(s) to the one(s) emboldened must be used by candidate          |

**Note:** No marks are awarded for using brand names of software packages or hardware.

| Question  | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Marks | Guidance |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------|
| 1(a)(i)   | STRING                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1     |          |
| 1(a)(ii)  | <p>IF <b>LENGTH</b> (Pass) &lt; 6 OR <b>LENGTH</b> (Pass) &gt; 8 / &gt;= 9<br/>THEN</p> <p>Mark as follows:<br/>1 Mark: Use of <b>LENGTH</b> function twice<br/>1 Mark: Number <b>8</b> used in second condition</p>                                                                                                                                                                                                                                                                                                                                                                                                                                               | 2     |          |
| 1(a)(iii) | <p>Mark as follows:</p> <p>1 DECLARE LetterFlag, DigitFlag: <u>BOOLEAN</u><br/>1 mark for <u>BOOLEAN</u></p> <p>2 LetterFlag ← <u>FALSE</u><br/>1 mark for <u>FALSE</u></p> <p>3 FOR Index ← 1 TO <u>LENGTH</u> (Pass)<br/>1 mark for <u>LENGTH</u></p> <p>4 Character ← <u>MID</u> (Pass, <u>Index</u>, <u>1</u>)<br/>1 mark for <u>MID</u>, <u>Index</u> and 1</p> <p>5 IF <u>IS_NUM</u> (Character) = TRUE THEN<br/>1 mark for <u>IS_NUM</u></p> <p>6 DigitFlag ← <u>TRUE</u><br/>ELSE<br/>LetterFlag ← <u>TRUE</u><br/>1 mark for <b>both</b> variables being set to TRUE</p> <p>7 IF <u>NOT</u> (LetterFlag AND DigitFlag) THEN<br/>1 mark for <u>NOT</u></p> | 7     |          |
| 1(b)(i)   | <p>One mark per state</p> <p>Example answers:</p> <p>1 Sensor activated (mode) // Intruder/movement detected (mode) // Alert Mode</p> <p>2 Alarm sounding // Light flashing (mode) // Alarm activated</p> <p>3 Error mode // Power loss detected (mode) // Battery too low mode</p> <p>4 Tamper detected (mode) // Lockdown (mode)</p> <p>5 Disarm Mode // Maintenance Mode // Password <u>Change</u> Mode // Service Mode</p> <p>Max 2</p>                                                                                                                                                                                                                        | 2     |          |

| Question | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Marks    | Guidance                                                                                                          |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------------------------------------------------------------------------------------------------------------|
| 1(b)(ii) | <p>One mark per event</p> <p>Example answers:</p> <ol style="list-style-type: none"> <li>1 Movement / pressure (detected)</li> <li>2 Window opened / broken (detected)</li> <li>3 Door open (detected)</li> <li>4 Entering <b>wrong</b> password (repeatedly)</li> <li>5 Entering password to enter / exit maintenance mode / silence alarm</li> <li>6 Tampering / damaging alarm (system)</li> <li>7 Time delay // Time passed after alarm triggered / before alarm activated</li> <li>8 Battery charge too low</li> <li>9 Pressing panic button</li> </ol> | <b>3</b> | <p>Do not accept repeating examples in stem. Reject Turning system on. Reject reference to creating password.</p> |

| Question          | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Marks                                                                  | Guidance             |                              |        |    |                       |        |                     |                          |        |               |                                 |        |                |                                  |        |          |                      |        |          |                               |        |        |                                                                        |           |                                                                                                                                                        |        |                             |   |                                                                                                                                                           |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|----------------------|------------------------------|--------|----|-----------------------|--------|---------------------|--------------------------|--------|---------------|---------------------------------|--------|----------------|----------------------------------|--------|----------|----------------------|--------|----------|-------------------------------|--------|--------|------------------------------------------------------------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------------------------|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1(c)              | <p>Example Solution</p> <table><tr><th>rule being tested</th><th>example of test data</th><th>reason for invalid test data</th></tr><tr><td>rule 1</td><td>1A</td><td>password is too short</td></tr><tr><td>rule 1</td><td><b>PHRASE345678</b></td><td><b>Password too long</b></td></tr><tr><td>rule 2</td><td><b>ABCDEF</b></td><td><b>Does not contain a digit</b></td></tr><tr><td>rule 2</td><td><b>1234567</b></td><td><b>Does not contain a letter</b></td></tr><tr><td>rule 3</td><td>PASSWRD2</td><td>letters are repeated</td></tr><tr><td>rule 3</td><td>ABCDEF11</td><td>Digits / Numbers are repeated</td></tr><tr><td>rule 3</td><td>AAA111</td><td>Both digits and letters are repeated<br/><br/>Accept Characters repeated</td></tr></table> <p>Mark as follows:</p> <p>Rule 1 test:<br/>1 mark for <b>one</b> example of test data for rule 1 <b>and</b> appropriate reason</p> <table><tr><td>Test data</td><td>A string of more than 8 characters that contains both letters and digits.<br/><br/>The letters must be upper case<br/><br/>Each character only occurs once</td></tr><tr><td>Reason</td><td><b>Password is too long</b></td></tr></table> | rule being tested                                                      | example of test data | reason for invalid test data | rule 1 | 1A | password is too short | rule 1 | <b>PHRASE345678</b> | <b>Password too long</b> | rule 2 | <b>ABCDEF</b> | <b>Does not contain a digit</b> | rule 2 | <b>1234567</b> | <b>Does not contain a letter</b> | rule 3 | PASSWRD2 | letters are repeated | rule 3 | ABCDEF11 | Digits / Numbers are repeated | rule 3 | AAA111 | Both digits and letters are repeated<br><br>Accept Characters repeated | Test data | A string of more than 8 characters that contains both letters and digits.<br><br>The letters must be upper case<br><br>Each character only occurs once | Reason | <b>Password is too long</b> | 3 | <p>Do not accept once if lower-case letters or characters that are not letters or digits used.</p> <p>Reject if test data breaks Rule 2 or/and Rule 3</p> |
| rule being tested | example of test data                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | reason for invalid test data                                           |                      |                              |        |    |                       |        |                     |                          |        |               |                                 |        |                |                                  |        |          |                      |        |          |                               |        |        |                                                                        |           |                                                                                                                                                        |        |                             |   |                                                                                                                                                           |
| rule 1            | 1A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | password is too short                                                  |                      |                              |        |    |                       |        |                     |                          |        |               |                                 |        |                |                                  |        |          |                      |        |          |                               |        |        |                                                                        |           |                                                                                                                                                        |        |                             |   |                                                                                                                                                           |
| rule 1            | <b>PHRASE345678</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Password too long</b>                                               |                      |                              |        |    |                       |        |                     |                          |        |               |                                 |        |                |                                  |        |          |                      |        |          |                               |        |        |                                                                        |           |                                                                                                                                                        |        |                             |   |                                                                                                                                                           |
| rule 2            | <b>ABCDEF</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Does not contain a digit</b>                                        |                      |                              |        |    |                       |        |                     |                          |        |               |                                 |        |                |                                  |        |          |                      |        |          |                               |        |        |                                                                        |           |                                                                                                                                                        |        |                             |   |                                                                                                                                                           |
| rule 2            | <b>1234567</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Does not contain a letter</b>                                       |                      |                              |        |    |                       |        |                     |                          |        |               |                                 |        |                |                                  |        |          |                      |        |          |                               |        |        |                                                                        |           |                                                                                                                                                        |        |                             |   |                                                                                                                                                           |
| rule 3            | PASSWRD2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | letters are repeated                                                   |                      |                              |        |    |                       |        |                     |                          |        |               |                                 |        |                |                                  |        |          |                      |        |          |                               |        |        |                                                                        |           |                                                                                                                                                        |        |                             |   |                                                                                                                                                           |
| rule 3            | ABCDEF11                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Digits / Numbers are repeated                                          |                      |                              |        |    |                       |        |                     |                          |        |               |                                 |        |                |                                  |        |          |                      |        |          |                               |        |        |                                                                        |           |                                                                                                                                                        |        |                             |   |                                                                                                                                                           |
| rule 3            | AAA111                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Both digits and letters are repeated<br><br>Accept Characters repeated |                      |                              |        |    |                       |        |                     |                          |        |               |                                 |        |                |                                  |        |          |                      |        |          |                               |        |        |                                                                        |           |                                                                                                                                                        |        |                             |   |                                                                                                                                                           |
| Test data         | A string of more than 8 characters that contains both letters and digits.<br><br>The letters must be upper case<br><br>Each character only occurs once                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                        |                      |                              |        |    |                       |        |                     |                          |        |               |                                 |        |                |                                  |        |          |                      |        |          |                               |        |        |                                                                        |           |                                                                                                                                                        |        |                             |   |                                                                                                                                                           |
| Reason            | <b>Password is too long</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                        |                      |                              |        |    |                       |        |                     |                          |        |               |                                 |        |                |                                  |        |          |                      |        |          |                               |        |        |                                                                        |           |                                                                                                                                                        |        |                             |   |                                                                                                                                                           |



| Question  | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Marks     | Guidance                                                                         |        |                          |           |                                                                          |        |                           |           |                                                                         |        |                     |           |                                                                                                      |        |                                      |  |                                                                                                                                                                 |
|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|----------------------------------------------------------------------------------|--------|--------------------------|-----------|--------------------------------------------------------------------------|--------|---------------------------|-----------|-------------------------------------------------------------------------|--------|---------------------|-----------|------------------------------------------------------------------------------------------------------|--------|--------------------------------------|--|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1(c)      | <p>Rule 2 test (1 mark):<br/>1 mark for <b>two</b> examples of test data that only breaks rule 2 <b>and</b> appropriate reasons.</p> <table><tr><td>Test data</td><td>A string between 6 and 8 characters long that contains <b>no</b> digits</td></tr><tr><td>Reason</td><td>Does not contain a digit</td></tr><tr><td>Test data</td><td>A string between 6 and 8 characters long that contains <b>no</b> letters</td></tr><tr><td>Reason</td><td>Does not contain a letter</td></tr></table> <p>Rule 3:<br/>1 mark for two examples of test data for rule 3 <b>and</b> appropriate reasons</p> <table><tr><td>Test data</td><td>A string between 6 and 8 characters long where only digits are repeated</td></tr><tr><td>Reason</td><td>Digits are repeated</td></tr><tr><td>Test data</td><td>A string between 6 and 8 characters long where <b>both</b> characters <b>and</b> digits are repeated</td></tr><tr><td>Reason</td><td>Both digits and letters are repeated</td></tr></table> | Test data | A string between 6 and 8 characters long that contains <b>no</b> digits          | Reason | Does not contain a digit | Test data | A string between 6 and 8 characters long that contains <b>no</b> letters | Reason | Does not contain a letter | Test data | A string between 6 and 8 characters long where only digits are repeated | Reason | Digits are repeated | Test data | A string between 6 and 8 characters long where <b>both</b> characters <b>and</b> digits are repeated | Reason | Both digits and letters are repeated |  | <p>Reject if letters repeated</p> <p>Reject if digits repeated</p> <p>Reject characters repeated</p> <p>Reject if letters repeated<br/>Reject if no letters</p> |
| Test data | A string between 6 and 8 characters long that contains <b>no</b> digits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |           |                                                                                  |        |                          |           |                                                                          |        |                           |           |                                                                         |        |                     |           |                                                                                                      |        |                                      |  |                                                                                                                                                                 |
| Reason    | Does not contain a digit                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |                                                                                  |        |                          |           |                                                                          |        |                           |           |                                                                         |        |                     |           |                                                                                                      |        |                                      |  |                                                                                                                                                                 |
| Test data | A string between 6 and 8 characters long that contains <b>no</b> letters                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |           |                                                                                  |        |                          |           |                                                                          |        |                           |           |                                                                         |        |                     |           |                                                                                                      |        |                                      |  |                                                                                                                                                                 |
| Reason    | Does not contain a letter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |                                                                                  |        |                          |           |                                                                          |        |                           |           |                                                                         |        |                     |           |                                                                                                      |        |                                      |  |                                                                                                                                                                 |
| Test data | A string between 6 and 8 characters long where only digits are repeated                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |           |                                                                                  |        |                          |           |                                                                          |        |                           |           |                                                                         |        |                     |           |                                                                                                      |        |                                      |  |                                                                                                                                                                 |
| Reason    | Digits are repeated                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |           |                                                                                  |        |                          |           |                                                                          |        |                           |           |                                                                         |        |                     |           |                                                                                                      |        |                                      |  |                                                                                                                                                                 |
| Test data | A string between 6 and 8 characters long where <b>both</b> characters <b>and</b> digits are repeated                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |                                                                                  |        |                          |           |                                                                          |        |                           |           |                                                                         |        |                     |           |                                                                                                      |        |                                      |  |                                                                                                                                                                 |
| Reason    | Both digits and letters are repeated                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |           |                                                                                  |        |                          |           |                                                                          |        |                           |           |                                                                         |        |                     |           |                                                                                                      |        |                                      |  |                                                                                                                                                                 |
| 1(d)      | <p>One mark per example</p> <p>Example answers:</p> <p>1 Structure chart // Problem / Program broken into modules // Modular Diagram</p> <p>2 Flowchart</p> <p>3 Data Flow Diagram</p> <p>4 Identifier / Variable table // Data structure / Record structure (designs)</p> <p>5 File structure // Database Design</p> <p>6 E-R Diagram</p> <p>7 HCI Design // Report Design</p> <p>8 Class Diagram // UML Diagram</p> <p>9 Programming language to use</p> <p>Max 3</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 3         | <p>Reject<br/>'Decomposition' by itself<br/>Reject Module Overview by itself</p> |        |                          |           |                                                                          |        |                           |           |                                                                         |        |                     |           |                                                                                                      |        |                                      |  |                                                                                                                                                                 |

| Question | Answer                                                                                                                                                                                                                                                                                                                   | Marks    | Guidance                                    |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---------------------------------------------|
| 1(e)     | One mark per stage<br><br>1 Analysis<br>2 Coding // Implementation<br>3 Maintenance<br><br><b>Max 2 marks</b>                                                                                                                                                                                                            | <b>2</b> | NE Development / Programming                |
| 1(f)(i)  | Integration                                                                                                                                                                                                                                                                                                              | <b>1</b> |                                             |
| 1(f)(ii) | One mark for the name, one for the description<br><br>Method:<br>Stub (testing)<br><br>Description:<br>1 A simple / dummy module is written to <b>replace</b> the module (that is not working)<br>2 The simple / dummy module will return an expected value / will output a message (to show the module has been called) | <b>3</b> | Do not mark description if method incorrect |

| Question | Answer                                                                                                                                                                                                                                                                                                                                                   | Marks    | Guidance                                                                                        |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-------------------------------------------------------------------------------------------------|
| 2(a)     | One mark for either explanation:<br><br>• To filter out <u>information / data</u> that is <b>not</b> necessary for the task<br><br>• To keep only <u>information / data</u> that <b>is</b> necessary for the task<br><br><b>Max 1 mark</b>                                                                                                               | <b>1</b> |                                                                                                 |
| 2(b)     | One mark for each <b>TWO</b> data items<br><br>Example answers<br>1 Tool ID // Tool name // Type of tool<br>2 Customer ID // Customer name // Customer address // Account reference<br><br>3 Hire ID<br>4 (Hire) Date<br>5 Hire time<br>6 Length of hire: Full or Half day<br>7 Cost of hire<br>8 Payment details<br>9 Tool status<br><b>Max 2 marks</b> | <b>2</b> | Reject Quantity<br>Reject Return date if Hire date already given<br>MP 2 Reject just 'Customer' |

| Question | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Marks    | Guidance |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----------|
| 2(c)     | <p>One mark for each process.</p> <p>Examples include:</p> <ol style="list-style-type: none"> <li>1 Input customer details / customer ID / payment details / Tool ID</li> <li>2 Search for required tool // Checking if tool returned // Checking if tool available // Searching for dates when tool is available</li> <li>3 Record tool booking // Amend Tool booking // Create tool booking // Record when tool returned // Confirm booking</li> <li>4 Calculating <b>time</b> when tool has to be returned</li> <li>5 Change / check tool <b>status</b> e.g. hired / available / damaged // Prevent same tool being hired twice</li> <li>6 Process payment / calculate hire cost</li> </ol> <p><b>Max 2 marks</b></p> | <b>2</b> |          |

| Question | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Marks    | Guidance                                                                                                                                                                                                                                                                                                                                 |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3        | <p>Example solution</p> <p>Mark points:</p> <p>MP 1 (Step 4) Open <u>WordList.txt</u> / File in <b>read</b> mode (and subsequently close)</p> <p>MP 2 (Step 5) <b>Read</b> the next <b>line</b> from the <b>file</b> in a loop</p> <p>MP 3 (Step 6) Increment line counter in a loop</p> <p>MP 4 (Step 7) Check if the line read equals the word (input) in a loop</p> <p>MP 5 (Step 8) ...If it does output line counter</p> <p>MP 6 (Step 9) If word not found in file then output "Not Found" after all iterations</p> <p>MP 7 (Step 10) Otherwise repeat from step 5</p> <p><b>Max 6 marks from 7 possible marks</b></p> | <b>6</b> | <p>MP 1 cannot be in a loop structure</p> <p>Do not accept once if MP 2, 3, 4 is <b>clearly</b> not in a loop</p> <p>Award only one mark for MP 5 and MP 6 if <b>both</b> outputs are possible</p> <p>MP 7 Can be any loop but it <b>must be clear</b> where it starts and ends and must include at least one of the end conditions.</p> |

| Question     | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Marks | Guidance |  |  |              |            |  |              |              |              |              |            |  |  |  |              |              |            |  |  |              |              |              |            |              |              |              |              |              |            |  |  |  |  |  |            |   |  |
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| 4(a)         | <div>After group 1</div> <div><div><div>back stack</div><table><tr><td></td></tr><tr><td></td></tr><tr><td></td></tr><tr><td></td></tr><tr><td>www.aaa.home</td></tr><tr><td>www.ccc.my</td></tr></table><div>← TOS</div></div><div><div>forward stack</div><table><tr><td></td></tr><tr><td>www.bbb.home</td></tr><tr><td>www.333.corp</td></tr><tr><td>www.111.home</td></tr><tr><td>www.999.corp</td></tr><tr><td>www.222.me</td></tr></table><div>← TOS</div></div></div> <div>Web address currently displayed in the browser: www.zzz.corp</div> <div>After group 2</div> <div><div><div>back stack</div><table><tr><td></td></tr><tr><td></td></tr><tr><td></td></tr><tr><td>www.zzz.corp</td></tr><tr><td>www.aaa.home</td></tr><tr><td>www.ccc.my</td></tr></table><div>← TOS</div></div><div><div>forward stack</div><table><tr><td></td></tr><tr><td></td></tr><tr><td>www.333.corp</td></tr><tr><td>www.111.home</td></tr><tr><td>www.999.corp</td></tr><tr><td>www.222.me</td></tr></table><div>← TOS</div></div></div> <div>Website displayed in the browser: www.bbb.home</div> <div>After group 3</div> <div><div><div>back stack</div><table><tr><td>www.111.home</td></tr><tr><td>www.333.corp</td></tr><tr><td>www.bbb.home</td></tr><tr><td>www.zzz.corp</td></tr><tr><td>www.aaa.home</td></tr><tr><td>www.ccc.my</td></tr></table><div>← TOS</div></div><div><div>forward stack</div><table><tr><td></td></tr><tr><td></td></tr><tr><td></td></tr><tr><td></td></tr><tr><td></td></tr><tr><td>www.222.me</td></tr></table><div>← TOS</div></div></div> |       |          |  |  | www.aaa.home | www.ccc.my |  | www.bbb.home | www.333.corp | www.111.home | www.999.corp | www.222.me |  |  |  | www.zzz.corp | www.aaa.home | www.ccc.my |  |  | www.333.corp | www.111.home | www.999.corp | www.222.me | www.111.home | www.333.corp | www.bbb.home | www.zzz.corp | www.aaa.home | www.ccc.my |  |  |  |  |  | www.222.me | 6 |  |
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| Question | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Marks    | Guidance                                       |
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| 4(a)     | <p>Website displayed in the browser: www.999.corp</p> <p>Mark as follows:</p> <p>Group 1</p> <ol style="list-style-type: none"> <li>1 mark for back stack as shown <b>and</b> TOS position as shown on both stacks</li> <li>1 mark for forward stack as shown <b>and</b> current web address</li> </ol> <p>Group 2</p> <ol style="list-style-type: none"> <li>1 mark for stacks <b>and</b> correct TOS pointers as shown <b>and</b> current web address</li> </ol> <p>Group 3</p> <ol style="list-style-type: none"> <li>1 mark for back stack as shown <b>and</b> TOS as shown</li> <li>1 mark for forward stack as shown <b>and</b> TOS as shown</li> <li>1 mark current web address</li> </ol>                                                                                                                                                                                                                                                                                                                                                                     |          |                                                |
| 4(b)     | <p>One mark for identifying an ADT.</p> <p>Queue / Linked List</p> <p>One mark per feature</p> <p>Features of a Queue:</p> <ol style="list-style-type: none"> <li>1 Each queue element contains one data item</li> <li>A front/start pointer <b>and</b> a rear/end pointer</li> <li>Data is added at back / end <b>and</b> removed from front / start // works on a FIFO basis</li> <li>Can be <b>circular or linear</b></li> </ol> <p><b>MAX 2 marks for features</b></p> <p>Features of a Linked List:</p> <ol style="list-style-type: none"> <li>1 Each node / item contains data and a pointer (to the next node/item)</li> <li>A pointer to the start of the list</li> <li>Last node in the list has a null pointer</li> <li>Data may be added / removed by manipulating <u>pointers</u></li> <li>Pointers are followed to move through nodes in the list (in a given sequence)</li> <li>Unused nodes are stored on a free list // a free-list pointer to the Free List</li> <li>Is a dynamic (data structure)</li> </ol> <p><b>MAX 2 marks for features</b></p> | <b>3</b> | <p>Need both</p> <p>Reject use of 2 arrays</p> |

| Question | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Marks | Guidance                                                                                                                      |
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| 5(a)     | <p>The greater than logic operator / &gt; in the selection statement would need to be changed to a less than operator / &lt;</p> <p>Or by example</p> <pre>IF Numbers[Index] &gt; Numbers[Index + 1] THEN</pre> <p>would be changed to</p> <pre>IF Numbers[Index] &lt; Numbers[Index + 1] THEN OR IF Numbers[Index] &lt;= Numbers[Index + 1] THEN OR IF Numbers[Index + 1] &gt; Numbers[Index] THEN OR IF Numbers[Index + 1] &gt;= Numbers[Index] THEN</pre>                                                                                                                                                                                                                     | 1     |                                                                                                                               |
| 5(b)(i)  | <p>2 marks for inner loop</p> <p><b>MP 1:</b> The inner loop <b>iterates</b> one less time (in algorithm B) each time the outer / repeat loop iterates.</p> <p><b>MP 2:</b> this is because for each <b>iteration</b> of the outer / repeat loop (in algorithm B) the last / one more element in the <code>Numbers</code> array will be in the correct place.</p> <p>2 marks for outer loop</p> <p><b>MP 3:</b> The outer / repeat loop (in algorithm B) would stop <b>iterating</b> if no swaps are made / all numbers in array are sorted</p> <p><b>MP 4:</b> so not as many <b>iterations</b> would be needed (if the <code>Numbers</code> array is not initially sorted)</p> | 4     | <p>Reject answers that just repeat the algorithm</p> <p>Reject program stops rather than iteration ends or algorithm ends</p> |
| 5(b)(ii) | <b>1 mark:</b> When <code>Numbers</code> (array) / array is already in (ascending) order / sorted                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1     |                                                                                                                               |
| 5(c)(i)  | <p><b>1 mark:</b> The parameters / <code>Num1</code> and <code>Num2</code> are passed by value / BYVAL</p> <p>// The parameters / <code>Num1</code> and <code>Num2</code> are <b>not</b> passed / should be passed by reference / BYREF</p> <p><b>1 mark:</b> (The swap made inside) the procedure does <b>not</b> change the arguments used / parameters (passed) / the values stored in the <code>Numbers</code> elements passed</p> <p>// The procedure does <b>not</b> swap / change the values stored in the array</p>                                                                                                                                                      | 2     |                                                                                                                               |

| Question | Answer                                                                                                                                                                                                                                        | Marks    | Guidance                                                                                                      |
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| 5(c)(ii) | <p><b>Solution</b></p> <pre>PROCEDURE Swap (BYREF Num1, Num2 : INTEGER)   DECLARE Temp : INTEGER   Temp ← Num1   Num1 ← Num2   Num2 ← Temp ENDPROCEDURE</pre> <p>2 marks: code as above</p> <p>1 mark: just the procedure header as above</p> | <b>2</b> | NE for header mark If ByRef is mentioned in the header but syntax is not correct but allow FT for second mark |

| Question | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Marks | Guidance                                                                                          |
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| 6(a)     | <p><b>Mark Scheme One – loop used to form return string<br/>(See MS Two for solutions using LEFT () /MID () to form return string)</b></p> <p>Example solution</p> <pre> FUNCTION AddPadding() RETURNS STRING   CONSTANT Space = ' '    DECLARE Plaintext : STRING   DECLARE LenOfPlaintext : INTEGER   DECLARE Index : INTEGER    REPEAT     OUTPUT "Enter plaintext"     INPUT Plaintext     LenOfPlaintext ← LENGTH(Plaintext)   UNTIL LenOfPlaintext &gt;= 1 AND LenOfPlaintext   &lt;= 25    FOR Index ← LenOfPlaintext + 1 TO 25     Plaintext ← Plaintext &amp; Space   NEXT Index    // Alternative way to append spaces using   while loop   WHILE LENGTH(Plaintext) &lt;&gt; 25     Plaintext ← Plaintext &amp; Space   ENDWHILE    //Alternative way to append spaces   DECLARE SpaceString : STRING   SpaceString ← ""   FOR Index ← LenOfPlaintext + 1 TO 25     SpaceString ← SpaceString &amp; Space   NEXT Index   Plaintext ← Plaintext &amp; SpaceString    RETURN Plaintext  ENDFUNCTION </pre> <p>Mark points</p> <ol style="list-style-type: none"> <li>Function heading, return type and ending</li> <li>Prompt for <b>and</b> input of plaintext</li> <li>Conditional loop that checks one of the boundary values</li> <li>Conditional loop that correctly checks both boundaries of plaintext</li> <li>...Re-input of plaintext in a loop</li> <li>Loop that iterates for number of spaces to add to end of plaintext</li> <li>...Spaces appended to plaintext // Spaces appended to an empty string</li> <li>Correctly padded plaintext returned following a reasonable attempt at MP7</li> </ol> | 8     | <p>MP 4 Must be a conditional loop<br/>If no loop used then MP3, MP4 and MP5 can not be given</p> |



| Question | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Marks | Guidance                                                                                                                                |
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| 6(a)     | <p><b>Mark Scheme Two - No Loop used to form return string – use of LEFT () /MID () Function</b></p> <p>Example Solution:</p> <pre> FUNCTION AddPadding() RETURNS STRING   CONSTANT Fill = "                " //24   Spaces    DECLARE Plaintext : STRING   DECLARE LenOfPlaintext : INTEGER   DECLARE Index : INTEGER    REPEAT     OUTPUT "Enter plaintext"     INPUT Plaintext     LenOfPlaintext ← LENGTH(Plaintext)   UNTIL LenOfPlaintext &gt;= 1 AND LenOfPlaintext   &lt;= 25    Plaintext ← LEFT(Plaintext &amp; Fill, 25)    RETURN Plaintext ENDFUNCTION </pre> <p><b>Mark points</b></p> <ol style="list-style-type: none"> <li>Function heading, return type and ending</li> <li>Prompt for and input of plaintext</li> <li>Conditional loop that checks one of the boundary values<br/>Conditional loop that correctly checks for length of plaintext</li> <li>...Re-input of plaintext <b>in a loop</b></li> <li>Use of string of at least 24 spaces<br/>Correct use of LEFT () / MID () function and &amp; to append padding characters</li> <li>Correctly padded plaintext returned following a reasonable attempt at<br/>MP 6 and MP 7</li> </ol> |       | <p>Do not accept use of language specific string manipulation which is not the compatible with the pseudocode used for the syllabus</p> |

| Question | Answer                                                                                                                                                                                                                                                                                                                                                            | Marks    | Guidance                                                                                                                                                                                   |
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| 6(b)(i)  | <p>Solutions:</p> <ul style="list-style-type: none"> <li>Grid : ARRAY[1 : 5, 1 : 5] OF <u>CHAR</u></li> <li>Grid : ARRAY[0 : 4, 0 : 4] OF <u>CHAR</u></li> </ul> <p>1 mark for boundaries of both array dimensions:</p> <ul style="list-style-type: none"> <li>[1 : 5, 1 : 5]</li> <li>[0 : 4, 0 : 4]</li> </ul> <p>1 mark for all other parts of declaration</p> | <b>2</b> | <p>Reject use of different brackets eg ( )</p> <p>Reject CHARACTER instead of CHAR</p> <p>Reject STRING instead of CHAR</p> <p>Must be as exactly as above but accept use of lowercase</p> |

| Question | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Marks | Guidance                                                                                                                                                                                                                                                                       |
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| 6(b)(ii) | <p><b>Solution One</b> : Using nested loop and output of each row in a loop following nested loop</p> <p>Example Solution</p> <pre> PROCEDURE PopulateGrid(Plaintext : STRING)   DECLARE Row, Column, Index : INTEGER   Index ← 1   FOR Row ← 1 TO 5     FOR Column ← 1 TO 5       Grid[Row, Column] ← MID(Plaintext, Index, 1)       Index ← Index + 1     NEXT Column   Next Row    FOR Row ← 1 TO 5     OUTPUT Grid[Row, 1], Grid[Row, 2], Grid[Row, 3],_ Grid[Row, 5]     NEXT Row  ENDPROCEDURE </pre> <p>Mark Points</p> <ol style="list-style-type: none"> <li>1 <b>Generate</b> Index, 1 to 25, used to extract all characters from Plaintext</li> <li>2 <b>Generate both</b> Row and Col <b>in a loop</b></li> <li>3 Extract an individual character from Plaintext <b>in a loop</b></li> <li>4 Attempt to assign the extracted character to Grid <b>in a loop</b></li> <li>5 Extraction <b>and</b> assignment of <b>all</b> 25 characters in Plaintext to Grid <b>in a loop</b></li> <li>6 Attempt to identify / isolate 5 characters comprising at least <b>one</b> row</li> <li>7 Identify / isolate all 5 characters for all 5 rows</li> <li>8 Output all five rows of GRID, each on a separate line</li> </ol> | 8     | <p>Syntax for MID()<br/>function must use parameters of correct type – allow other string handling function combinations if they work.</p> <p>Max 7 if Procedure heading/parameter type incorrect<br/>Penalise incorrect syntax for indexes i.e. [Row] [Col] instead once.</p> |

| Question | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Marks | Guidance |
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| 6(b)(ii) | <p><b>Solution Two:</b> Using nested loop and output of each string in a loop following nested loop -</p> <p><b>Example Solution</b></p> <pre> PROCEDURE PopulateGrid(Plaintext : STRING)      DECLARE Row, Column, Index : INTEGER     DECLARE RowString : STRING      FOR Row ← 1 TO 5         FOR Column ← 1 TO 5             Index ← (Row - 1) * 5 + Column             Grid[Row, Column] ← MID(Plaintext, Index, 1)         NEXT Column     NEXT Row      FOR Row ← 1 TO 5         RowString ← ""         For Col ← 1 TO 5             RowString ← RowString &amp; Grid[Row, Column]         Next Col         OUTPUT RowString     NEXT Row  ENDPROCEDURE </pre> <p><b>Solution Three:</b> Using nested loop where output string is formed in the inner loop and output in string in the outer loop – complex use of Index. No additional loop after nested loop</p> <p><b>Example Solution</b></p> <pre> PROCEDURE PopulateGrid(Plaintext : STRING)      DECLARE Row, Column, Index : INTEGER     DECLARE RowString : STRING      FOR Row ← 1 TO 5         RowString ← ""         FOR Column ← 1 TO 5             Index ← (Row - 1) * 5 + Column             Grid[Row, Column] ← MID(Plaintext, Index, 1)             RowString ← RowString &amp; MID(Plaintext, Index, 1)         NEXT Column         OUTPUT RowString     NEXT Row  ENDPROCEDURE </pre> |       |          |

| Question | Answer                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Marks | Guidance |
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| 6(b)(ii) | <p><b>Solution Four: No nested loop</b></p> <p>Example Soution</p> <pre> PROCEDURE PopulateGrid(Plaintext : STRING)      DECLARE Row, Column, Index : INTEGER      Row ← 1     Col ← 0     FOR Index ← 1 TO 25         IF Index MOD 5 = 0 THEN             Row ← Row + 1             Col ← 0         ENDIF         Col ← Col + 1         Grid[Row, Column] ← MID(Plaintext, Index, 1)     NEXT Index      FOR Row ← 1 TO 5         OUTPUT Grid[Row, 1], Grid[Row, 2], _             Grid[Row, 3], Grid[Row, 4], _ Grid[Row, 5]     NEXT Row  ENDPROCEDURE </pre> |       |          |