| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 1 | a | i | To render models of proposed buildings. (1)<br>Run CAD software. (1)<br>Run modelling calculations. (1)<br>Any example sensible to scenario. (1)<br><br>(Max 1) | 1<br><br>(AO2.1) | **Examiner's Comments**<br>Some candidates did not apply the use of GPU to the scenario. Those who did, generally gained full marks for this question. |
| | | ii | Random Access Memory (1)<br>A form of primary memory (1)<br>Used to hold data and / or programs <u>in use</u> (1)<br>Volatile / Loses its contents when power is lost. (1)<br><br>(Max 2) | 2<br><br>(AO1.1) | |
| | | iii | Multiple Cores (1)<br>High / Fast Clock Speed (1)<br>Ability to use pipelining (1)<br>Large Cache (1)<br><br>(Max 1) | 1<br><br>(AO1.1) | Accept concurrency / parallel processing for pipelining |
| | b | i | Paging…(1)<br>…Memory is divided into fixed / physical units (1)<br>Segmentation… (1)<br>…Memory is divided logically / variable size according to its contents. (1) | 4<br><br>(AO1.1) | Accept same size units for MP1<br><br>**Examiner's Comments**<br>Candidates who correctly cited paging and segmentation as the methods of dividing memory, invariably went on to achieve full marks. |
| | | ii | Multitasking allows the user to run more than one program <u>at the same time.</u> (1)<br>E.g. running CAD software whilst checking emails. (1) | 2<br><br>(AO1.1 – 1 mark<br><br>AO1.2 – 1 mark ) | Accept any reasonable work related answer<br><br>**Examiner's Comments**<br>Most candidates achieved both marks on this question. Those who did not, either explained multi-tasking **or** gave appropriate examples. The question asked for both. |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | c | i | Advantage:<br>– Centrally administered in one location. (1)<br>– One location to back up. (1)<br>Disadvantage:<br>– Central point of failure. (1)<br>– Can be expensive to maintain / set up (e.g. cabling costs, specialist staff.) (1)<br>(Max 1 Advantage, 1 Disadvantage) | 2<br>(AO1.2) | Accept for MP1 better security<br>Do not credit quick access as an advantage<br>**Examiner's Comments**<br>Many candidates offered advantages and disadvantages of networks in general as opposed to those of a client-server over a peer to peer setup. |
| | | ii | A hardware device / piece of software that monitors (and filters / blocks) traffic / packets going to and from a network. (1)<br>(Max 1) | 1<br>(AO1.1) | Accept 'content' for 'traffic / packages'<br>**Examiner's Comments**<br>To achieve this mark, candidates were required to show an understanding that firewalls monitor traffic going to and from a network, many only discussed one-way traffic. |
| | | iii | Prevent unauthorised access to a network. (1)<br>To restrict applications that are used internally that have internet access. (1)<br>To restrict websites that can be accessed from within the company. (1)<br>To protect the company's data / intellectual property. (1)<br>(Max 1) | 1<br>(AO 1.2) | Accept for MP1 malicious attacks / traffic<br>**Examiner's Comments**<br>Most candidates gave 'to stop malicious attacks' which was awarded as an interpretation of 'to protect company data'. |
| | | | **Total** | **14** | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 2 | a | i | A dynamic / data structure (1)<br>Each node / item consists of data and pointer (1)<br>Pointer gives location of next node. (1) | 3<br><br>(AO1.2) | Accept 'element' instead of 'node / item'<br><br>**Examiner's Comments**<br>Surprisingly few candidates achieved full marks on this question. Many received some marks but in general responses lacked detail. Centres should advise candidates that the number of marks awarded for questions gives an indication of the number of different points required in the response. |
| | | ii | Description can be written:<br>– Oxford pointer changed to bypass Birmingham and point to Manchester. (1)<br>– A node is created holding the data York / York is placed is next free space / node / item (1)<br>– Manchester remains in original position and pointer changed to point to the York node. (1)<br>– The York node points to null (or terminator). (1)<br>OR via diagram eg.:<br>  <br> | 4<br><br>(AO2.1) | On diagram don't penalise if the pointer from Birmingham is left intact. It should be clear in both diagram and text that Oxford no longer points to Birmingham.<br><br>In diagram solution, London, Oxford and Manchester must remain in the same positions.<br><br>**Examiner's Comments**<br>Those candidates who scored well in 2ai) went on to achieve at least some of the marks here. Many candidates found it challenging to clearly explain how the linked list was manipulated. If the question states that 'you may use the diagram to illustrate your answer', centres should encourage candidates to do so. |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | b | | A linked list requires every node to be checked (until the desired record is found). (1)<br>A linked list will take longer to search (as more nodes are added). (1)<br>A hash table enables direct access to the location of the record. (1)<br>A hash table will take the same time to search (as more nodes are added)/It takes no longer as more records are added. (1) | 4<br><br>(AO1.2 – 2 marks<br><br>AO2.2 –<br><br>2 marks) | Some candidates may talk about time complexity: linked lists being linear / O(n) and hash table being constant / O(1) Accept these as points 1& 2 and 3 & 4 conjoined i.e. full marks.<br><br>**Examiner's Comments**<br>Most candidates gained some credit on this question by explaining why hash tables are better suited than linked lists for searching. Those who did not gain credit described in some detail how hash tables were structured, but did not apply their response to the scenario. |
| | | | Total | 11 | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 3 | a | i | Downloads quicker. (1)<br>Saves user money by using less bandwidth / on data usage. (1)<br><br>(Max 1) | 1<br><br>(AO1.2) | Do not accept 'saves the user space on their device'.<br><br>Examiner's Comments<br>This question was well received by most candidates, invariably scoring most marks. |
| | | ii | Lossy takes away some of the information from the original. (1)<br>Lossless preserves all the information from the original. (1)<br>With text the loss of small amounts of information will make it unreadable. (1) | 3 (AO1.1 – 2 marks AO2.1 – 1mark) | |

| Question | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|
| b | **Mark Band 3–High Level (9–12 marks)**<br><br>The candidate demonstrates a thorough knowledge and understanding of dictionary and run length encoding for compression. The material is generally accurate and detailed.<br><br>The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence / examples will be explicitly relevant to the explanation.<br><br>The candidate is able to weigh up both forms of compression and justify dictionary encoding being the better choice.<br><br>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.<br><br>**Mark Band 2-Mid Level (5–8 marks)**<br>The candidate demonstrates reasonable knowledge and understanding of dictionary and run length encoding for compression; the material is generally accurate but at times underdeveloped.<br><br>The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence / examples are for the most part implicitly relevant to the explanation.<br><br>The candidate makes a reasonable attempt to come to a conclusion as to which form of compression is better suited.<br><br>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.<br><br>**Mark Band 1-Low Level (1–4 marks)**<br><br>The candidate demonstrates a basic knowledge of dictionary and run length encoding for compression; the material is | AO1.1<br><br>(2)<br><br>AO1.2<br><br>(2)<br><br>AO2.1<br><br>(3)<br><br>AO3.3<br><br>(5)<br><br>12 | Points may include but aren't limited to:<br><br>**AO1 Knowledge and Understanding**<br><br>Run length encoding relies on consecutive pieces of data / characters being the same.<br><br>Each set of consecutive symbols can be represented by the symbol and its number of occurrences<br>e.g. AAAABBBBBCCC could be represented as 4A5B3C (or A4B5C3 or any sensible RLE encoding)<br><br>In dictionary encoding frequently occurring pieces of data / groups of characters are replaced by symbols / tokens / smaller groups of characters / indexes.<br><br>A dictionary is then used to say which symbols / tokens / characters / indexes match which groups of characters.<br>When decompressed the dictionary is used to replace the tokens with the original text.<br><br>**AO2.1 Application**<br>Run Length Encoding is very unsuitable for the example text. There are very few consecutive repeating symbols in the text. only instances being ll and ee<br>these still require 2 characters to represent them 2l and 2e<br><br>Dictionary encoding is well suited.<br>There are lots of repeating groups of characters<br>For example 'call' 'name' '[SPACE]we' 'Romeo'<br>We could for example have:<br>What's in53? that which2 15 rose<br><br>By5ny other3 would smell5s sweet;<br><br>So4would,2re he not41'd<br><br>1:call<br><br>2:[space]we<br><br>3:[space]name<br><br>4:[space]Romeo[space] |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | | | basic and contains some inaccuracies.<br>The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided.<br><br>The candidate provides nothing more than an unsupported assertion.<br><br>0 marks<br><br>No attempt to answer the question or response is not worthy of credit. | | 5:[space]a<br><br>(NB candidates are unlikely to show full compression, just a demonstration of the principle is sufficient. The best candidates are likely to show an awareness that space is a character that can be used in compression and that upper and lowercase letters are different. Demonstrating this is indicative of but not a requisite of the band.)<br><br>AO3.3: Evaluation<br><br>Run length encoding is not suited to natural language (more likely to be used in simple images).<br><br>Applying it to the example the resulting text would be the same size as the original / worse than the original (if we use 1s to represent every individual instance of a character).<br><br>Dictionary encoding works well. We can already see benefit on small piece of text. Would fare substantially better on full works.<br><br>Dictionary encoding is the best compression method for this scenario.<br><br>Examiner's Comments<br>Candidates were assessed on the quality of their extended response in this question. Most candidates could describe each of the given types of compression appropriately, with many applying them to the scenario. Many candidates correctly concluded that dictionary encoding was the most appropriate in this case, but few then went on to give clear and appropriate justification for their assertion. In general, most candidates scored well on this question. |
| | | | Total | 16 | |

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>4</td><td>a</td><td></td><td>Q = (A∧B) ∨ (C∧D)<br><br>1 mark for (A∧B)<br><br>1 mark for (C∧D)<br><br>1 mark for the ∨ joining the two parts.</td><td>3<br><br>(AO1.2)</td><td>Accept (C∧D) ∨ (A∧B)<br><br>Accept (B∧A) instead of (A∧B)<br><br>Accept (D∧C) instead of (C∧D)<br><br>Accept alternative notations (e.g. +/. OR / AND)<br><br>Accept AB as (A.B) and CD as (C.D)<br><br>Accept answers without brackets<br><br>Examiner's Comments<br>In general, most candidates achieved all of the available marks in these questions.</td></tr>
<tr><td></td><td>b</td><td>i</td><td><table><tr><th>E</th><th>F</th><th>G</th><th>(E∧F)</th><th>(E∧G)</th><th>(E∧F)V (E∧G)</th></tr><tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr><tr><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td></tr><tr><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td></tr><tr><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr><tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr></table><br>1 mark for each of the pairs of rows.</td><td>4<br><br>(AO1.2)</td><td></td></tr>
<tr><td></td><td></td><td>ii</td><td>(F∨G) ∧ E<br><br>One mark for the (F∨G)<br><br>One mark for the ∧ E</td><td>2<br><br>(AO2.2)</td><td>Accept:<br><br>(G∨F) ∧ E<br><br>E ∧ (F∨G)<br><br>E ∧ (G∨F)<br><br>Examiner's Comments<br>In general, most candidates achieved all of the available marks in these questions.</td></tr>
</table>

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | c | | Encrypt the film (1)<br><br>Send the key / password out on the release date (1) | 2<br><br>(AO2.2) | Accept<br><br>Use Digital Rights Management / DRM…<br><br>..To keep content encrypted until given date.<br><br>Examiner's Comments<br>Some candidates lost credit on this question by failing to mention encryption. |
| | | | Total | 11 | |

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>5</td><td>a</td><td>i</td><td>– Stores the value 10 (1)<br><br>– In a memory location (1)<br><br>– Given the label / symbolic address ten (1)</td><td>3<br><br>(AO1.2)</td><td>MP3 Accept identifier<br><br>Examiner’s Comments<br>Surprisingly few candidates gained full marks on this question. Many responses did not use appropriate assembly language terminology e.g. label, memory location.</td></tr>
<tr><td></td><td></td><td>ii</td><td><table><tr><th>Starting value in Accumulator</th><th>Pass or Fail</th></tr><tr><td>29</td><td>Fail</td></tr><tr><td>30</td><td>Pass</td></tr><tr><td>31</td><td>Fail</td></tr></table>1 Mark per row</td><td>3<br><br>(AO2.1)</td><td>Examiner’s Comments<br>Very few candidates did not gain full marks on this question.</td></tr>
<tr><td></td><td>b</td><td>i</td><td>LDA (1)<br>SUB (1)<br>ADD (1)<br>INP (1)<br>(Max 1)</td><td>1<br><br>(AO1.2)</td><td>Examiner’s Comments<br>Most candidates identified correctly, an instruction which changed the value in the Accumulator but fewer correctly identified an instruction which changed the value in the Program Counter.</td></tr>
<tr><td></td><td></td><td>ii</td><td>BRA (1)<br>BRP (1)<br>BRZ (1)<br><br>(Max 1)</td><td>1<br><br>(AO1.2)</td><td>Examiner’s Comments<br>Most candidates identified correctly, an instruction which changed the value in the Accumulator but fewer correctly identified an instruction which changed the value in the Program Counter.</td></tr>
</table>

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | | iii | 20 | 1<br><br>(AO2.1) | **Examiner's Comments**<br>Candidates invariably gave both correct output values. |
| | | iv | 40 | 1<br><br>(AO2.1) | **Examiner's Comments**<br>Candidates invariably gave both correct output values. |
| | | v | Rounds up (the number input)… (1)<br><br>…To the nearest multiple of ten (and outputs it) (1) | 2<br><br>(AO2.2) | Rounds to multiple of ten gets one mark. |
| | | | **Total** | **12** | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 6 | a | i | 10111100 | 1<br><br>(AO1.2) | Examiner's Comments<br>Again, these questions were very well received by candidates with most scoring full marks. |
| | | ii | BC | 1<br><br>(AO1.2) | |
| | b | i | 10101100 | 1<br><br>(AO1.2) | Examiner's Comments<br>Again, these questions were very well received by candidates with most scoring full marks. |
| | | ii | 11010100 | 1<br><br>(AO1.2) | |
| | c | | Shift Right (1)<br>Two Places (1) | 2<br><br>(AO1.2) | Allow one mark for correct number of places but wrong direction.<br><br>Examiner's Comments<br>Generally most candidates stated that two bit shifts were required but some went on to state the incorrect direction i.e. left. |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | d | | Binary point: shifted four places gives: 01001.0 (1)<br>Binary point shifted two places gives: 010.010 (1)<br><br>Subtraction carried out …<br>`01001.000 –`<br>`010.010`<br>(1)<br><br>…'Borrowing' shown… (1)<br>…Answer: 0110.110 (1)<br>Normalised to: 011011 (1)<br>Mantissa<br>Exponent 0011 (1) | 6<br><br>(AO1.2) | Correct answer with clear binary subtraction/2's complement addition calculation gives full marks.<br><br>**Examiner's Comments**<br>Candidates whose solution was presented in a logical manner tended to score at least 4 marks on this question. Candidates used different methods to find the solution, all of which were accepted (provided the logic of the calculation could be followed). Centres should advise candidates to present the layout of their responses to this type of question in a logical manner. |
| | | | **Total** | **12** | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 7 | a | | A field which has a unique value for every record / A unique identifier. (1)<br><br>E.g. userID (1) | 2<br><br>(AO1.1 – 1, AO2.1 -1) | **Examiner's Comments**<br>Well received and answered by most candidates. |
| | b | i | A result generated by applying an algorithm / numeric process to a value. (1) | 1<br><br>(AO1.1) | |
| | | ii | Hash functions are one way / can't be reverse (1)<br><br>If someone gains access to the database they cannot access user's password. (1) | 2<br><br>(AO1.2 1 mark,<br><br>AO2.1<br><br>1 mark) | **Examiner's Comments**<br>Many candidates achieved the mark in part i) few achieved both marks in part ii) mostly stating as opposed to describing the advantage e.g. 'those who gain unauthorised access cannot access passwords' without going on to say 'hash functions are one way'. |
| | c | | `SELECT passwordHash, locked` (1)<br>`FROM Users` (1)<br>`WHERE username='Apollo'` (1) | 3<br><br>(AO 3.2) | Do not award first mark for SELECT *<br><br>**Examiner's Comments**<br>In most cases, candidates who achieved marks in c) went on to achieve marks in d) with few candidates achieving all marks in either. Many candidates did not use correct SQL statement structure or syntax e.g. confusing attribute names with string literals. |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | d | | `UPDATE Users` (1)<br>`SET locked=1` (1)<br><br>`WHERE username='Hades'` (1) | 3<br><br>(AO 3.2) | Allow other updating method<br>e.g. a DELETE statement followed by an INSERT statement, for full marks e.g.<br>`DELETE FROM Users`<br>`WHERE username = 'Hades'` (1 mark)<br>`INSERT INTO Users` (1 mark)<br>`VALUES (<userID value>,'Hades',<passwordHash value>,1)` (1 mark)<br><br>**Examiner's Comments**<br>In most cases, candidates who achieved marks in c) went on to achieve marks in d) with few candidates achieving all marks in either. Many candidates did not use correct SQL statement structure or syntax e.g. confusing attribute names with string literals. |
| | e | | Takes a hash of `givenPassword` (NB this may be done inline e.g. `if hash (givenPassword)==passwordHash and locked==0 then` (1)<br><br>Returns true if password is correct and account is unlocked. (1)<br><br>Returns false if account is locked (1)<br><br>Returns false if password is incorrect (1) | 4<br><br>(AO 3.2) | Example code:<br>`temp = hash(givenPassword)`<br>`if temp==passwordHash and locked==0 then`<br>`  return true`<br>`else`<br>`  return false`<br>`endif`<br><br>Candidates may have taken a different approach - any solution that fulfils the criteria on the left should get them marks.<br><br>**Examiner's Comments**<br>Candidates were asked to complete a function in this question. Although many students demonstrated reasonable logic in solving this problem, some used output statements rather than returned values from the function, therefore, not gaining full marks. |
| | | | **Total** | **15** | |

| Question | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|
| 8 | **Mark Band 3–High Level (7–9 marks)**<br>The candidate demonstrates a thorough knowledge and understanding issues around computers and the workforce and Artificial Intelligence. The material is generally accurate and detailed.<br><br>The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence / examples will be explicitly relevant to the explanation.<br><br>The candidate provides a thorough discussion which is well balanced. Evaluative comments are consistently relevant and well-considered.<br><br>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.<br><br>**Mark Band 2-Mid Level (4–6 marks)**<br>The candidate demonstrates reasonable knowledge and understanding issues around computers and the workforce and Artificial Intelligence; the material is generally accurate but at times underdeveloped.<br><br>The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence / examples are for the most part implicitly relevant to the explanation.<br><br>The candidate provides a sound discussion, the majority of which is focused. Evaluative comments are for the most part appropriate, although one or two opportunities for development are missed. | AO1.1<br>(2)<br>AO1.2<br>(2)<br>AO2.1<br>(2)<br>AO3.3<br>(3)<br>9 | Points may include but aren't limited to:<br><br>**AO1 Knowledge and Understanding**<br><br>Artificial Intelligence (AI) is the study of computers displaying intelligent behaviour (usually characterised by decision making).<br><br>AI techniques include neural networks, evolutionary computation, Bayesian networks etc.<br><br>Computers are well suited to certain jobs and as AI techniques improve the range of jobs they can do is likely to increase.<br><br>**AO2.1 Application**<br><br>**For the argument:**<br><br>Many jobs have already been taken over by computers.<br><br>Manual job such as work in the automotive industry has been replaced by robots.<br><br>Computer based systems are attractive to employers, they don't require paying, don't get sick and can work 24/7 without making mistakes.<br><br>Computer systems can be used for work that is considered dangerous for humans<br><br>And for repetitive and menial tasks.<br><br>Future developments may make computers better at highly skilled tasks making computers preferable<br><br>And in the case of certain tasks (e.g. surgery) would make the use of human workers unethical.<br><br>May cite recent developments in AI (e.g. beating world Go Champion)<br><br>**Against the argument:**<br><br>As technology develops people will be required to design these new systems. |

| Question | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|
| | There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.<br><br>Mark Band 1-Low Level (1–3 marks)<br>The candidate demonstrates a basic knowledge around computers and the workforce and Artificial Intelligence.; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided.<br><br>The candidate provides a limited discussion which is narrow in focus. Judgments if made are weak and unsubstantiated. The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.<br>0 marks<br>No attempt to answer the question or response is not worthy of credit. | | It is likely to assist but not take over all roles<br><br>Producing a more skilled workforce<br><br>Developments in AI have been forecast for many decades but never materialised.<br><br>Forecasts as to the development of AI have always been wildly optimistic<br><br>There is debate as to whether AI will ever be able to show human levels of intelligence.<br><br>Tasks that humans find inherently 'easy' are still beyond the reach of computers.<br><br>Crucially for many areas of work computers will have to pass the Turing Test – i.e. converse to such a level that will enable them to pass as human…<br><br>…Most believe this is still well beyond our current understanding. Laws would need changing as currently people have the right to have automated decisions checked over by humans (DPA)<br><br>AO3.3 Evaluation<br><br>Candidate should have come to a well reasoned conclusion for or against the argument. They could come down on either side, the important thing is they have considered both points of view and based their conclusion on the evidence they have discussed.<br><br>Examiner's Comments<br>Candidates were assessed on the quality of their extended response in this question. Many candidates offered a balanced discussion although some of the examples used did not demonstrate that the candidate understood the difference between AI and robotic automation. Conclusions were often not fully justified / reasoned. Many candidates scored in the mid-level band on this question. |
| | Total | 9 | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 9 | a | | Only one element can have a given id / id is unique. (1)<br><br>Class can be used assigned to multiple elements / used multiple times. (1) | 2<br><br>(AO1.1) | **Examiner's Comments**<br>Those candidates who achieved credit on this question, generally achieved both marks. |
| | b | | `h1{` (1 mark for open and close)<br>`font-family:Arial(;)` (1 mark)<br>`}`<br>`.customerQuote{` (1 mark)<br>`background-color: #E8C3E1(;)` (1 mark)<br>`}`<br>`#intro{` (1 mark)<br>`(font-)color: darkRed(;)` (1 mark)<br>`}` | 6<br>(AO3.1) | `.customerQuote` must have . and opening and closing { } for 3rd mark.<br><br>`#intro` must have # and opening and closing { } for 4th mark<br><br>Must match case sensitivity, except for '`Arial`' and '`darkRed`' and colour code<br>Allow quotes around `Arial` and `darkRed`<br><br>**Examiner's Comments**<br>Few candidates scored more than two marks on this question. There was a general lack of attention to detail resulting in fundamental mistakes e.g. missing close bracket }; equals (=) instead of colon (:) when setting attributes. |
| | c | i | JavaScript | 1<br><br>(AO1.1) | **Cao** do not accept Java<br><br>**Examiner's Comments**<br>Well attempted by most candidates with many scoring two out of a possible three marks. Some candidates did not gain credit in iii) because they cited '*...time taken to process*' as a disadvantage. |
| | | ii | Change line `if(hour>9 && hour<17)` …<br>… To<br>`if(hour>8 && hour<17)` (1 Mark)<br>or<br>… `if(hour>=9 && hour<17)` (1 Mark) | 1<br><br>(AO3.3) | Accept Change 'greater than' to 'great than or equal to' or similar |

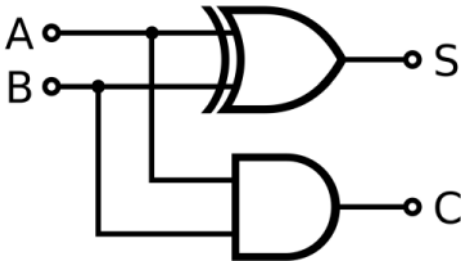
| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | | iii | – Won't work if JavaScript is disabled. (1)<br><br>– Shows incorrect message if user's computer's clock is wrong / in different time zone. (1)<br><br>– (Source) code is visible allowing it to be copied / modified. (1)<br><br>(Max 1) | 1<br><br>(AO2.2) | |
| | | | Total | 11 | |

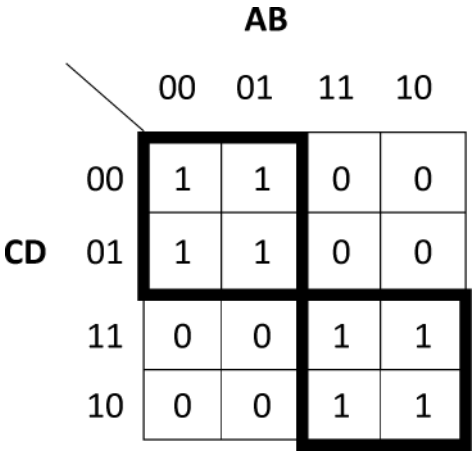
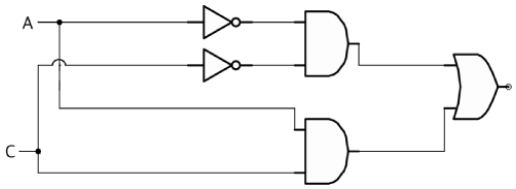
| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 10 | a | | – Prototype is created (1)<br><br>– (Evaluated and) feedback used to inform next iteration (1)<br><br>– Any changes are made (1)<br><br>– Process repeated until…(1)<br><br>…prototype becomes final product. (1)<br><br>(Max 4) | 4<br><br>(AO1.1) | **Examiner's Comments**<br>Most candidates gained some marks on this question but few achieved full marks. In general responses lacked attention to detail and clarity of expression. Centres should advise candidates that the number of marks awarded for questions gives an indication of the number of points required in the response. |
| | b | | – Function traverses every letter of answer (1)<br><br>– Function traverses every randomLetters (1)<br><br>– Correctly checks each letter of answer against each of randomLetters (1)<br><br>– Returns 0 if answer contains a letter that doesn't occur in randomLetters (1)<br><br>– Returns 0 if letter occurs more times in answer than randomLetters (1)<br><br>– Returns answer length for a valid word.(1) | 6<br><br>(AO3.2) | `i=0`<br>`while i<answer.length`<br>`  j=0`<br>`  letter=answer.substring(i,1)`<br>`  while j<10 and randomLetters[j]!=letter`<br>`  j=j+1`<br>`  endwhile`<br>`  if j<10 then`<br>`  randomLetters[j]="!"`<br>`  else`<br>`  return 0`<br>`  endif`<br>`  i=i+1`<br>`endwhile`<br>`return answer.length`<br><br>**Examiner's Comments**<br>Many candidates achieved some of the available marks on this question for attempting to traverse each letter in the word and each letter in the random word - a loop with a nested loop. Some achieved more marks for comparing the current letters and outputting the length of the valid word. Fewer candidates achieved the final marks for checking if the letter was in the word or duplicated. |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | c | | BS Tree can be searched quicker than an array. | 1<br><br>(AO1.2) | Accept O(log n) search time rather than O(n)<br><br>**Examiner's Comments**<br>Very few candidates did not achieve this mark, most correctly stating the advantage '*faster to search*'. |
| | d | i | Saves time / money as prewritten (1)<br><br>Draws on expertise of other programmers (1)<br><br>Pre-tested (so likely to work) (1)<br><br>Can have been written in a different language (1)<br><br>(Max 2) | 2<br><br>(AO1.2) | **Examiner's Comments**<br>Those candidates who cited generic advantages of using subroutines as opposed to library routines did not gain credit. The question asked for advantages to the team of using a library. |
| | | ii | **Mark Band 3–High Level (7–9 marks)**<br>The candidate demonstrates a thorough knowledge and understanding of how source code is compiled and library code incorporated. The material is generally accurate and detailed.<br><br>The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence / examples will be explicitly relevant to the explanation.<br><br>The candidate provides a thorough discussion which is well balanced. Evaluative comments are consistently relevant and well-considered.<br><br>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated. | AO1.1<br><br>(2)<br><br>AO1.2<br><br>(2)<br><br>AO2.1<br><br>(2)<br><br>AO3.3<br><br>(3)<br><br>9 | Points may include but are not limited to:<br><br>**AO1 Knowledge and Understanding**<br><br>The compiler is effectively a group of programs.<br><br>The stages of compilation are: lexical analysis, syntax analysis, code generation and optimisation.<br><br>A linker is then used to combine the object code with the library code to make the final executable.<br><br>**AO2.1 Application**<br><br>Source code is input into a compiler program.<br><br>The first stage is lexical analysis in which..<br><br>Comments and whitespace are removed<br><br>Variables, and subroutines stored in symbol table |

| Question | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|
| | | | Which also holds data such as scope and data type<br><br>Code is converted to a series of tokens |
| | **Mark Band 2–Mid Level (4–6 marks)**<br>The candidate demonstrates reasonable knowledge and understanding of how source code is compiled and library code incorporated; the material is generally accurate but at times underdeveloped.<br><br>The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence / examples are for the most part implicitly relevant to the explanation.<br><br>The candidate provides a sound discussion, the majority of which is focused. Evaluative comments are for the most part appropriate, although one or two opportunities for development are missed.<br><br>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.<br><br>**Mark Band 1–Low Level (1–3 marks)**<br>The candidate demonstrates a basic knowledge of how source code is compiled and / or library code incorporated; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided.<br><br>The candidate provides a limited discussion which is narrow in focus. Judgments if made are weak and unsubstantiated. The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear. | | The series of tokens and symbol table is passed onto the next stage, syntax analysis:<br>Here the code is checked to ensure it follows the rules of the language.<br><br>This is often accomplished by placing the tokens into a (abstract syntax) tree.<br><br>Where it breaks the rules of the language errors are generated.<br><br>If no rules are broken then it's passed on to the next stage…<br><br>..Which is code generation.<br><br>Here the object code (accept machine code) is created.<br><br>(i.e. the binary that is executed by the processor)<br><br>This code may be inefficient..<br><br>.. it may contain unnecessary instructions or groups of instructions that can be replaced by simpler ones.<br><br>Code from the library is likely already compiled.<br><br>And may well have been written in a different language to the main program.<br><br>The main program source code will have contained lines importing the library code.<br><br>A program called a linker can incorporate the code from the library with the main program…<br>…into a single executable file.<br>An alternative approach is for the main executable to link to the compiled library code (i.e. dynamic linking).<br><br>AO3.3 Evaluation |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | | | 0 marks<br>No attempt to answer the question or response is not worthy of credit. | | Lexical analysis is necessary to put the code into a format which can be read and processed (i.e. parsed) by the syntax analyser.<br><br>Syntax Analysis is necessary to ensure the code is valid in as much as it meets all the structural rules of the language. This guarantees it will run (though it might not do as expected and may still have occurrences of runtime errors).<br><br>Code generation is necessary to turn the code into a format that the processor can understand (i.e. binary machine code).<br><br>The code optimisation whilst not necessary, does ensure the code runs quicker or using less memory.<br><br>Linking is necessary to ensure the library code is incorporated into the final program.<br><br>Examiner's Comments<br>Candidates were assessed on the quality of their extended response in this question. Many candidates explained the stages of compilation very well. Some went on to describe how code from the library becomes part of the finished program equally well. Few justified why each stage was necessary. Many candidates scored well on this question. |
| | | | Total | 22 | |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| 11 | a | |  <br>XOR Gate (1)<br><br>AND Gate (1)<br><br>Correct connections and no additional gates (1) | 3<br><br>(AO1,1) | **Examiner's Comments**<br>Most candidates scored well on these questions demonstrating their understanding of logic gate circuits. Some candidates simplified the circuit in part b) which achieved full marks provided the resultant circuit gave the same output. |

| Question | | | Answer/Indicative content | Marks | Guidance |
|---|---|---|---|---|---|
| | b | | – Correctly identified groups on Karnaugh map / Correct boolean statement.(1)<br><br>– NOT A AND NOT C Gates (1)<br><br>– A AND C gates (1)<br><br>– Both sets of gates joined by OR gate (with no other gates used). (1) | 4<br><br>(AO2.2) |  <br>(¬A ∧ ¬C) ∨ (A∧C)<br><br>Or equivalent.<br>  <br><br>Or equivalent.<br><br>**Examiner's Comments**<br>Most candidates scored well on these questions demonstrating their understanding of logic gate circuits. Some candidates simplified the circuit in part b) which achieved full marks provided the resultant circuit gave the same output. |
| | | | Total | 7 | |