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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | |  |  | | --- | --- | | **Computer Science (9-1)**  Binary Addition and Shifts |  | | Please note that you may see slight differences between this paper and the original.  Candidates answer on the Question paper.  **OCR supplied materials:** Additional resources may be supplied with this paper.  **Other materials required:** •   Pencil •   Ruler (cm/mm) | **Duration:** Not set | |  | | |  |

## INSTRUCTIONS TO CANDIDATES

•   Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.  
•   Use black ink. HB pencil may be used for graphs and diagrams only.  
•   Answer **all** the questions, unless your teacher tells you otherwise.  
•   Read each question carefully. Make sure you know what you have to do before starting your answer.  
•   Where space is provided below the question, please write your answer there.  
•   You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number  
    and question number(s).

## INFORMATION FOR CANDIDATES

•   The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography   
    a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and  
    grammar and the use of specialist terminology* is assessed.  
•   The number of marks is given in brackets **[ ]** at the end of each question or part question.  
•   The total number of marks for this paper is **22**.  
•   The total number of marks may take into account some 'either/or' question choices.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | |  |  | | --- | --- | |  |  | | **1(a).** | Add the following bytes.    **[2]** | |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | |  |  | | --- | --- | |  |  | | **(b).** | State the problem that will occur if a computer is to store the result as a byte.    **[1]** | | |
| |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | |  | |  |  | | --- | --- | |  |  | | **2.** | 1. Add together the following two 8 bit binary numbers. Express your response in an 8 bit binary form.   01101010  10010110           |  | | --- | | **[2]** |  1. Identify the problem this addition has created.        |  | | --- | | **[1]** | | | |
| |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | |  | |  |  | | --- | --- | |  |  | | **3(a).** | Complete a 2 place right shift on the binary number 11001011.       |  | | --- | | **[1]** | | |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | |  | |  |  | | --- | --- | |  |  | | **(b).** | Explain the effect of performing a 2 place right shift on the binary number 11001011.       |  | | --- | | **[2]** | | | |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | |  |  | | --- | --- | |  |  | | **4(a).** | Add the following two 8-bit binary numbers.    **[2]** | |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | |  |  | | --- | --- | |  |  | | **(b).** | An overflow error can occur when adding two 8-bit binary numbers.  Describe what is meant by an overflow error.        **[2]** | | |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | |  |  | | --- | --- | |  |  | | **5.** | Perform the following binary addition    **[2]** | | |
| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | |  | |  |  | | --- | --- | |  |  | | **6.** | 1. Convert the denary number **132** into an 8 bit binary number.         **[2]**   1. Convert the binary number **10110101** to its hexadecimal equivalent.         **[2]**   1. Show the effect of a binary shift right of two places on the binary number **00110100.**         **[1]**   1. Describe a shift that can be used to double the value of the binary number **00100100.**         **[2]** | | |

**END OF QUESTION paper**

# Mark scheme

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Question** | | | **Answer/Indicative content** | **Marks** | **Guidance** |
| 1 | a |  | *Correct answer:*    *Award marks for:*   * 1 1 1 0 0 0 for bits 5 to 0 * 0 0 for bits 7 and 6. | 2 | **Examiner's Comments**  Most candidates had no difficulty with the portion of the binary addition where there was no carry, but weaker candidates were less sure about what to do about the carry with some even using the digit 2. |
|  | b |  | * there is an overflow / a carry left over after the addition / does not fit into one byte. | 1 | **Examiner's Comments** It was unfortunate that a good number of candidates did not simply use the technical term (“overflow”) – however, those who did not use this term were still able to get the mark by giving an accurate description of an overflow error. |
|  |  |  | **Total** | **3** |  |
| 2 |  | i | 0000 0000 | 2 | Correct Answer Only 1 mark per nibble |
|  |  | ii | overflow | 1 | Correct Answer Only |
|  |  |  | **Total** | **3** |  |
| 3 | a |  | 00110010 | 1 | Correct Answer Only |
|  | b |  | * The number is divided by 4 * Loss of accuracy … * … the bits on the right are removed * … the bits on the right are removed | 2 | 1 mark per bullet to a maximum of 2. |
|  |  |  | **Total** | **3** |  |
| 4 | a |  | Answer: 1 1 1 0 1 1 1 1 One mark per nibble | 2 | **Examiner's Comments** This part posed no difficulty for most candidates. |
|  | b |  | * There is an extra carry / bit * As number cannot fit into 8 bits * Result is greater than 255 / 11111111 | 2 | **Examiner's Comments**  In this part, while most candidates showed some understanding of what an overflow error is, fewer were able to give a detailed description for full marks. Using the context provided by the question (that we were dealing specifically with the addition of 2 8-bit numbers) might have helped some of these candidates to achieve the second mark. Candidates continue to confuse the terms “number” and “digit”. In most cases, this did not affect the candidates’ mark as their meaning was clear in the context of their answer, but in some cases it can be so ambiguous that the examiner is unable to determine the candidate’s level of understanding. |
|  |  |  | **Total** | **4** |  |
| 5 |  |  | 1 mark per nibble 1100 0110 | 2 | **Examiner's Comments**  Many candidates were able to answer this correctly. |
|  |  |  | **Total** | **2** |  |
| 6 |  | i | * 1000 0100 | **2** | 1 mark per nibble. Mark right to left.  **Examiner’s Comments**  This question was answered correctly by the vast majority of candidates. Pleasingly, conversion of numbers to and from binary is now obviously a comfortable skill for candidates of all levels. |
|  |  | ii | * B 5 | **2** | 1 mark per hex digit  **Examiner’s Comments**  Slightly fewer candidates were able to answer this question successfully compared to 5(a)(i). Most were able to split the binary number up into two nibbles, but then the conversion to binary for each nibble sometimes was incorrectly completed. Common wrong answers included 11 5 (which achieved 1 mark for 5 but did not recognise that 11 in denary equates to B in hexadecimal) or C5, where a mistake was made once the hexadecimal value went over 9. Very few answers showed a complete lack of understanding, but where this was seen, candidates tended to simply convert the binary to denary and ignore the requirement to use hexadecimal. This achieved no marks. |
|  |  | iii | 1 mark per bullet, max 1.   * 00001101 * Divides by 4 | **1** | Accept 001101 / 1101. Allow any number of leading zeros. |
|  |  | iv | 1 mark per bullet, max 2.   * Left shift * one place | **2** | Do not accept answers that simply show the number shifted.  **Examiner’s Comments**  Candidates showed a good understanding of binary shifts, which is especially pleasing as this is a new point that was not covered in the old GCSE Computing specification. The majority of candidates were able to both carry out a shift and describe a shift that matched a give outcome. One common mistake was for candidates to describe the direction of a shift but not say how many places to shift (e.g. ‘shift left’ but missing ‘by one place’). |
|  |  |  | **Total** | **7** |  |