



**DUNMAN HIGH SCHOOL**  
**General Certificate of Education Advanced Level**  
**Higher 2**  
**JC2 Preliminary Examination**

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**COMPUTING**

**9754/01**

**Paper 1**

**14 Sep 2009**

**Mon 0830 – 1130**

**3 hours**

Additional Materials: Writing Paper

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**READ THESE INSTRUCTIONS FIRST**

Write your centre number, index number and name on all the work you hand in.  
Write in dark blue or black pen on both sides of the paper.  
You may use a soft pencil for any diagrams, graphs, tables or rough working.  
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions. Total Marks is 120.

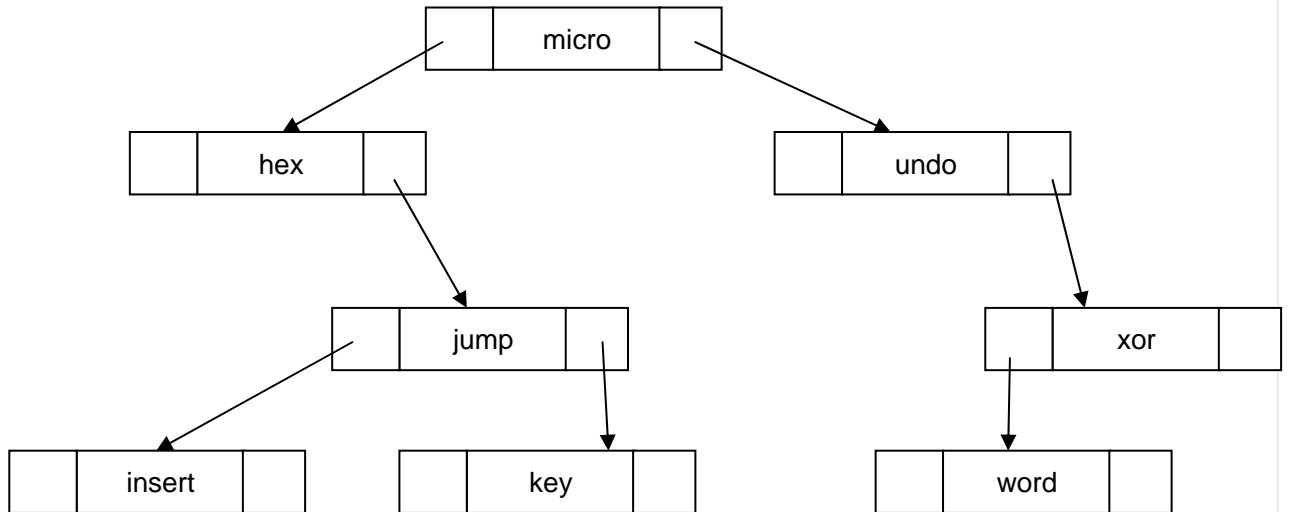
At the end of the examination, fasten all your work securely together.  
The number of marks is given in brackets [ ] at the end of each question or part question.

Answer **all** questions.

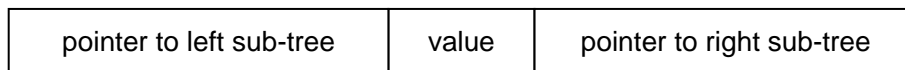
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|---|--|
| 1 | The Central Processing Unit (CPU) consists of the Control Unit (CU), the Arithmetic Unit (ALU) and some registers.   |
|   | <p>(a) List 5 registers in the CPU and their functions. [10]</p> <p>(b) What is meant by the fetch-execute cycle? [5]</p>  |
| 2 | A team of programmers is developing a real-time program for a new aircraft prototype capable of cutting down significantly the travelling time between destinations.   |
|   | <p>(a) Explain the significance of real time programs and prototype in this context. [3]</p> <p>(b) Software could contain various types of errors. Explain each of the following, giving an example in each case:</p> <p>(i) Syntax error; [2]</p> <p>(ii) Logical error; [2]</p> <p>(iii) Runtime error. [2]</p> <p>(c) Why is the documentation of version control vital when developing computer programs in teams? [1]</p> <p>(d) One approach to ensure the high quality of the real-time program for the aircraft is to make extensive use of standard modules. Explain how using standard modules helps to achieve this goal and describe other measures that can be taken. [5]</p>  |
| 3 | Explain the following terms illustrating your answer using appropriate examples from the banking industry:   |
|   | <p>(a) Backup; [2]</p> <p>(b) Archive; [2]</p> <p>(c) Transaction log. [2]</p>   |
| 4 | <p>The recursive procedure <code>SHRINK(aString)</code> makes use of the function <code>BUTLAST(aString)</code>. <code>BUTLAST(aString)</code> returns a string which is the same as the input except that the last character is missing. Thus, if <code>aString</code> is "abcde", <code>BUTLAST(aString)</code> returns "abcd".</p> <p>The recursive procedure <code>SHRINK(aString)</code> also makes use of the function <code>PRINT(identifier)</code> which prints the value of <code>identifier</code> as a string, left justified, on a new line. The procedure <code>SHRINK(aString)</code> is defined as follows.</p> <pre> SHRINK(aString)   PRINT(aString)   IF length of aString = 1 endproc   SHRINK(BUTLAST(aString))   PRINT(aString) endproc </pre> |

|   |  |
|---|--|
|   | <p>(a) Trace the output produced by the call <code>SHRINK("byte")</code>. [3]</p> <p>(b) The procedure <code>BUTFIRST(aString)</code> returns a string which is the same string but with the first character missing; that is <code>BUTFIRST("abcde")</code> returns "bcde". Write a recursive procedure <code>SHRINK2(aString, integer)</code> such that <code>SHRINK2("byte", 0)</code> produces</p> <pre> byte yte te e te yte byte </pre> <p>[5]</p>   |
| 5 | <p>(a) Explain why Reverse Polish Form (postfix notation) might be used in preference to algebraic form (infix notation) for the representation of an algebraic expression to be processed in a computer. [2]</p> <p>(b) Convert the following algebraic expression into Reverse Polish Form.</p> $3 * (a+b) - c*d$ <p>[3]</p> <p>(c) Using the Reverse Polish expression</p> $s\ 2\ t\ +\ -\ u\ /$ <p>(i) with the aid of diagrams, show how the computer uses a stack to calculate the result; [2]</p> <p>(ii) write the expression in algebraic form. [2]</p>   |
| 6 | <p>(a) The following list of 21 integers is stored in ascending order in an array:</p> <p>8,12,17,18,24,27,28,35,38,39,49,63,64,68,70,71,77,84,88,89,91</p> <p>If the list is searched by means of a <i>binary search</i>, state which elements would be accessed, and in what order,</p> <p>(i) when searching for the number 88 (which <i>is</i> present), and [1]</p> <p>(ii) when searching for the number 65 (which is <i>not</i> present)? [1]</p> <p>(b) If the list contained 8000 integers instead of 21, what is the greatest number of integers which would need to be accessed using a binary search? [1]</p> <p>(c) Write an algorithm which performs a binary search on an array containing a set of integers arranged in ascending order. [8]</p> |
|   |  |

7 The diagram shows a binary tree.



The tree is constructed as a set of nodes with the format



- (a) Describe a data structure which could be used to store the nodes. [3]
- (b) Describe an algorithm which will add a value to the tree (which may be empty) in such a way that if the new value is before the value at the current node, add the new value to the left sub-tree, else add it to the right sub-tree. [8]
- (c) Describe an algorithm which will print the values in descending order. [3]

8 A country club issues membership cards to its members. Each card has a unique 7-digit number. Access to the club facilities is authorized by entering this card number into a computer system to verify against a membership list. The card number is validated using a check digit which is the seventh digit of the card number.

- (a) Explain what validation is. [1]
- (b) Using modulus-11, explain how the check digit can be used to validate the card number. [3]
- (c) What types of errors are reduced by the use of check digit? Give examples to illustrate your answer. [4]
- (d) Suggest and justify an alternative solution which not only excludes human errors but is also a faster process when entering the card number. [2]

9 (a) Testing is an important aspect of software development. Using appropriate examples, explain 4 types of testing performed by software developers. [8]

- (b) Describe 3 common debugging facilities found in modern software development tools. [6]

| 10           | Syntax diagrams and Backus-Naur Form (BNF) are methods of defining syntax. Assume that the symbols <letter> and <digit> are already defined for parts (a) and part (b) below. |  |         |                  |              |              |       |         |            |      |             |   |     |                  |      |           |   |     |                  |      |         |   |     |             |      |          |   |     |             |      |         |   |     |         |      |                 |   |     |         |     |
|--------------|---|--|---------|------------------|--------------|--------------|-------|---------|------------|------|-------------|---|-----|------------------|------|-----------|---|-----|------------------|------|---------|---|-----|-------------|------|----------|---|-----|-------------|------|---------|---|-----|---------|------|-----------------|---|-----|---------|-----|
|              | (a)   | An identifier must start with a letter or an underscore which may be followed by letters, digits and underscores. A single letter is a valid identifier. Examples of valid identifiers are<br><br>L<br>MIKE3<br>X2Y3<br>_x1y1_<br>x_value<br><br>Draw a syntax diagram to define an identifier.  |         |                  | [3]          |              |       |         |            |      |             |   |     |                  |      |           |   |     |                  |      |         |   |     |             |      |          |   |     |             |      |         |   |     |         |      |                 |   |     |         |     |
|              | (b)   | A stock file contains thousands of records. Each record has fields for item code, description and quantity in stock.<br><br>(i) The item code is always two uppercase letters followed by two digits. The description can consist of uppercase and lower case letters and spaces. The quantity in stock consists of up to three digits. Write down the definition for this record in Backus-Naur form. [3]<br><br>(ii) It is decided to include the cost into the stock record. The cost will consist of one or more digits, followed by a decimal point, followed by two digits. Examples are 0.27, 23.40 and 150.00. Write down the definition for cost in Backus-Naur form. [3]   |         |                  |              |              |       |         |            |      |             |   |     |                  |      |           |   |     |                  |      |         |   |     |             |      |          |   |     |             |      |         |   |     |         |      |                 |   |     |         |     |
| 11           | (a)   | Give 3 advantages of reducing a database design to third normal form.  |         |                  | [3]          |              |       |         |            |      |             |   |     |                  |      |           |   |     |                  |      |         |   |     |             |      |          |   |     |             |      |         |   |     |         |      |                 |   |     |         |     |
|              | (b)   | Consider the following data which shows a single student record.<br><br><b>ABC Institute of Technology</b><br><b>Student name</b> Peter Hood <b>Student ID</b> 12345<br><b>Address</b> 123 Sesame Road, Singapore 987654<br><b>Telephone</b> 87654321<br><table><tr><th>Subject Code</th><th>Subject name</th><th>Grade</th><th>Teacher</th><th>Department</th></tr><tr><td>CS01</td><td>Programming</td><td>A</td><td>ABC</td><td>Computer Science</td></tr><tr><td>CS02</td><td>Databases</td><td>B</td><td>DEF</td><td>Computer Science</td></tr><tr><td>MA01</td><td>Algebra</td><td>A</td><td>JKL</td><td>Mathematics</td></tr><tr><td>MA02</td><td>Calculus</td><td>B</td><td>MNO</td><td>Mathematics</td></tr><tr><td>PH01</td><td>Physics</td><td>C</td><td>GHI</td><td>Physics</td></tr><tr><td>EL01</td><td>General Studies</td><td>E</td><td>STU</td><td>English</td></tr></table><br>Derive a set of tables to show the above data in first, second and third normal form. |         |                  | Subject Code | Subject name | Grade | Teacher | Department | CS01 | Programming | A | ABC | Computer Science | CS02 | Databases | B | DEF | Computer Science | MA01 | Algebra | A | JKL | Mathematics | MA02 | Calculus | B | MNO | Mathematics | PH01 | Physics | C | GHI | Physics | EL01 | General Studies | E | STU | English | [6] |
| Subject Code | Subject name  | Grade  | Teacher | Department       |              |              |       |         |            |      |             |   |     |                  |      |           |   |     |                  |      |         |   |     |             |      |          |   |     |             |      |         |   |     |         |      |                 |   |     |         |     |
| CS01         | Programming   | A  | ABC     | Computer Science |              |              |       |         |            |      |             |   |     |                  |      |           |   |     |                  |      |         |   |     |             |      |          |   |     |             |      |         |   |     |         |      |                 |   |     |         |     |
| CS02         | Databases   | B  | DEF     | Computer Science |              |              |       |         |            |      |             |   |     |                  |      |           |   |     |                  |      |         |   |     |             |      |          |   |     |             |      |         |   |     |         |      |                 |   |     |         |     |
| MA01         | Algebra   | A  | JKL     | Mathematics      |              |              |       |         |            |      |             |   |     |                  |      |           |   |     |                  |      |         |   |     |             |      |          |   |     |             |      |         |   |     |         |      |                 |   |     |         |     |
| MA02         | Calculus  | B  | MNO     | Mathematics      |              |              |       |         |            |      |             |   |     |                  |      |           |   |     |                  |      |         |   |     |             |      |          |   |     |             |      |         |   |     |         |      |                 |   |     |         |     |
| PH01         | Physics   | C  | GHI     | Physics          |              |              |       |         |            |      |             |   |     |                  |      |           |   |     |                  |      |         |   |     |             |      |          |   |     |             |      |         |   |     |         |      |                 |   |     |         |     |
| EL01         | General Studies   | E  | STU     | English          |              |              |       |         |            |      |             |   |     |                  |      |           |   |     |                  |      |         |   |     |             |      |          |   |     |             |      |         |   |     |         |      |                 |   |     |         |     |