



22117011



**COMPUTER SCIENCE
HIGHER LEVEL
PAPER 1**

Thursday 19 May 2011 (afternoon)

2 hours 15 minutes

INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Section A: answer all the questions.
- Section B: answer all the questions.

SECTION A

Answer *all* the questions.

1. State **two** ways in which the functioning of a compiler differs from that of an interpreter. *[2 marks]*

2. Outline **one** application for each of the following methods of data input.
 - (a) OCR (Optical Character Recognition) *[2 marks]*
 - (b) touchscreen *[2 marks]*

3. Outline the following functions of an operating system.
 - (a) memory management *[2 marks]*
 - (b) security *[2 marks]*

4. (a) Convert the decimal number 17 into 6-bit two's complement. *[1 mark]*
(b) Convert the decimal number -17 into 6-bit two's complement. *[1 mark]*

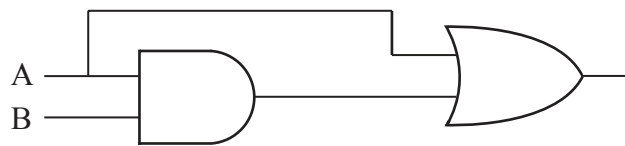
5. Outline **one** reason for using defragmentation software. *[2 marks]*

6. Consider the method `test()` shown below.

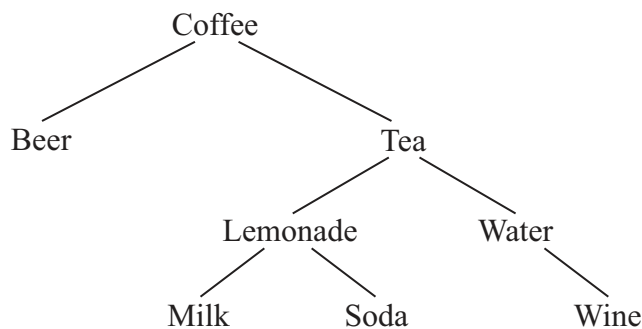
```
public static double test(int x, int y)
{
    if (y != 0)
    {
        return (double) (x % y) / y;
    }
    else
    {
        return 0;
    }
}
```

- (a) State the value that would be returned after the call `test(11, 2)`. *[1 mark]*
- (b) Identify a reason for the line `if (y != 0)`. *[1 mark]*
- (c) Suggest a reason for the code `(double)` that appears in the line
`return (double) (x % y) / y;` *[2 marks]*

- 7. Explain **two** ways of reducing the time required to transmit data in a computer network. [4 marks]
- 8. (a) Define the term *truncation error*. [2 marks]
(b) Outline a situation in which a truncation error might occur. [2 marks]
- 9. (a) Construct the truth table for a 2-input **nand** operation. [2 marks]
(b) State the Boolean expression that corresponds exactly (without simplification) to the following circuit. [1 mark]



- (c) Simplify the expression from part (b). [1 mark]
- 10. Within a computer system, state where the processing might utilize
 - (a) a *stack*; [1 mark]
 - (b) a *queue*. [1 mark]
- 11. Outline the role of a *gateway* in a Wide Area Network. [2 marks]
- 12. (a) Define the term *handshaking*. [2 marks]
(b) Define the term *polling*. [2 marks]
- 13. Perform a *pre-order traversal* on the binary tree shown below, stating the name at each node as it is traversed. [2 marks]



SECTION B

Answer *all* the questions.

14. A business is considering computerizing its operations and has employed a team of system analysts to investigate possible solutions. The first task of this team is to clearly define the problem.

- (a) Outline the benefits of **two** methods of data collection that will help them to clearly define the problem. [4 marks]

Once the problem is defined, the analysis team will produce different types of documentation.

- (b) Outline the documentation that would be presented to
- (i) the business; [2 marks]
 - (ii) the design team. [2 marks]
- (c) Outline **one** additional piece of documentation that would be produced after the analysis stage. [2 marks]

15. A single machine instruction takes a value from the memory and adds it to another value stored in one of the processor's registers.

- (a) With reference to the above instruction, explain the roles of the following registers.
- (i) the *accumulator* [2 marks]
 - (ii) the *instruction register* [2 marks]
 - (iii) the *program counter* [2 marks]
- (b) Describe the roles played by the buses in the operation of the above instruction. [4 marks]

16. Consider the algorithm shown below, which performs a *recursive binary search* on the integer array `nums`.

```

public int binarySearch(int target, int[] nums, int low, int high)
{
    // Starts with low = 0, high = nums.length - 1.
    // If found, returns the index, else returns -1.
    int middle = (low + high) / 2;
    if (low > high)
    { return -1; }
    else if (target == nums[middle])
    { return middle; }
    else if (target < nums[middle])
    { return binarySearch(target, nums, low, middle - 1); }
    else
    { return binarySearch(target, nums, middle + 1, high); }
}

```

- (a) Identify the feature in the code that shows it to be recursive. [1 mark]
- (b) By copying and completing the table started below, trace the algorithm for the following call,

`binarySearch(9, nums, 0, 6);`

where `int[nums] = {3, 8, 9, 10, 13, 15, 18}`. [3 marks]

target	low	high	middle	return value
9	0	6		

- (c) Explain why the method's parameters must change each time that the method is called. [2 marks]
- (d) State the BigO notation for
 - (i) a binary search; [1 mark]
 - (ii) a linear search. [1 mark]
- (e) Suggest why a binary search is more efficient than a linear search when searching an array with a large number of sorted values. [2 marks]

17. A modern hospital has extensive computer systems controlling all parts of the hospital's operations, including staff and patient affairs and the monitoring of different equipment.

- (a) For **each** of the following, outline a hospital system that would make use of this type of processing.
 - (i) batch processing [2 marks]
 - (ii) on-line (interactive) processing [2 marks]
 - (iii) real-time processing [2 marks]
- (b) Discuss the implications of systems failure on the systems identified in your answer to part (a). [4 marks]

18. *Fixed-point* binary numbers can be used to represent fractions. Consider a fixed-point representation that uses 8 bits in total, 6 bits for the integer part and 2 bits for the fraction part.

For example:

010001.01 would represent the decimal (base 10) number $17\frac{1}{4}$.

- (a) Express the decimal number $6\frac{3}{4}$ as a binary fraction, using the representation described above. [1 mark]
- (b) Explain, with the help of an example, how the use of this representation can lead to a loss of precision. [2 marks]
- (c) Describe the effects of increasing the number of bits in the fraction part (the total number of bits remains at 8). [2 marks]

An alternative system is *floating-point* representation.

- (d) Convert to decimal the floating-point binary number 010011 0100, if 6 bits are allocated to the mantissa and 4 bits to the exponent. [2 marks]
- (e) Convert the decimal number $2\frac{1}{4}$ to a normalized floating-point binary number, if 6 bits are allocated to the mantissa and 4 bits to the exponent. [3 marks]

19. *Packet switching* over the Internet makes use of *standard protocols* during its operation.

- (a) Define the term *standard protocol*. [2 marks]
 - (b) Outline the main differences between *data security* and *data integrity*. [2 marks]
 - (c) Outline how packet switching
 - (i) helps to provide better security for the data being sent; [2 marks]
 - (ii) is less likely to be affected by network failure. [2 marks]
 - (d) Describe how the packets are correctly reassembled by the receiving computer. [2 marks]
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