

Midterm Test

3 October 2019

Time allowed: 1 hour 30 mins

Student No:

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Instructions (please read carefully):

1. Write down your **student number** on the question paper. **DO NOT WRITE YOUR NAME ON THE ANSWER SET!**
2. This is **an open-book test**. While you are allowed to bring any physical materials and notes, with the exception of a **non-programmable calculator**, no other electronic devices such as tablets and laptops are allowed.
3. This paper comprises **THREE (3) questions** and **EIGHT (8) pages**. The time allowed for solving this test is **1 hour 30 mins**.
4. The maximum score of this test is **40 marks**. The marks for each question is given in square brackets beside the question number.
5. Note that the marks and order of the questions do not necessarily correspond to the level of difficulty of the question.
6. All questions must be answered correctly for the maximum score to be attained.
7. The pages marked “scratch paper” in the question set may be used as scratch paper.
8. You are allowed to un-staple the sheets while you solve the questions. Please make sure you staple them back in the right order at the end of the test.
9. You are allowed to use pencils, ball-pens or fountain pens, as you like as long as it is legible (no red colour, please).

ALL THE BEST!

EXAMINER’S USE ONLY

Question	Marks
Q1	/ 12
Q2	/ 20
Q3	/ 8
Total	/ 40

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It may be used as scratch paper.

Question 1: C/C++ Expressions [12 marks]

There are several parts to this question which are to be answered independently and separately. Each part consists of a fragment of C/C++ code. Write the exact output produced by the code in **the answer box**. If an error occurs, or it enters an infinite loop, state and explain why.

You may show workings **outside the answer box** in the space beside the code. Partial marks may be awarded for workings if the final answer is wrong.

Assume that all appropriate preprocessor directives e.g., `#include <iostream>`, etc. have already been defined.

A. `double f(int x, double y) {`[4 marks]
 `x = (int)(x / y);`
 `return x * y;`
`}`

```
void main() {
    int x = 10;
    double y = 2.7;
    cout << f(f(x, y), y) << endl;
}
```

B. `int a = 42;`[4 marks]
`if (a % 7) // Note the lack of braces`
 `cout << "Best ";`
 `a /= 7;`
`if (a < 7)`
 `cout << "of ";`
`if (a)`
 `cout << "both ";`
`else`
 `cout << "worlds";`

C. `int i = 0, j = 0;` [4 marks]
`for (int i = 0; i < 10; i += 2) {`
 `printf("%d,", i);`
 `if (i % 3) {`
 `continue;`
 `} else if (i < j) {`
 `break;`
 `} else {`
 `j += 1;`
 `}`
 `}`
 `printf("%d,%d\n", i, j);`

Provide an implementation for the function `inc`. You are to decide on the appropriate return type and parameters for the function. You may assume the `pow(b, e)` function from the math library is available for use. [5 marks]

D. Implement the function `int advance(int combi, int steps)` that takes a combination as an input, along with the number of steps to increment the dials, and returns a new combination. The position of each digit in `steps` corresponds to the dial in the combination.

For example, if the `combi` \rightarrow 9012 and `steps` \rightarrow 8015, then the function `advance` will return a combination with the dials advanced, from left to right, by 8, 0, 1 and 5 steps, respectively. Thus, it will return 7027.

Hint: You may wish to define a helper function to increment a dial by n positions. [5 marks]

```
int advance(int combi, int steps) {
```

```
}
```

Question 3: Computing Topics [8 marks]

A. Computer Organisation and Compilation

Indicate whether each of the statements are TTrue or FFalse by **circling** the respective letter. Each answer carries equal weightage. [2 marks]

- In a von Neumann architecture, program code must be moved from memory [T / F] into the CPU using the BUS.
- In a load-store architecture, operands are loaded directly from the memory into [T / F] the ALU and the result is directly stored back into memory.
- All high-level programming languages has to be compiled into the native ISA [T / F] before it can be executed.
- The linking process allows code from other sources to be incorporated into a [T / F] program.

B. Data Representation

Answer the following Multiple Choice Questions by **circling** the appropriate option. Each question carries equal weightage. [2 marks]

- The word size of a computer refers to the size of its registers and pointers. What is the approximate maximum addressable memory size on a computer with 16-bit word size?

Note: kilo = 1,000; mega = 1,000 kilo; giga = 1,000 mega

A) 256 bytes B) ≈ 65 kilobytes C) ≈ 16 megabytes D) ≈ 4.3 gigabytes

- A microcontroller uses 12-bits to store its integer type using 2's complement. What is the range that the integer can represent?

A) -4069 to 4096 B) -2048 to 2048 C) -2048 to 2047 D) -2047 to 2048

C. Number Bases

Write your answer in the respective boxes. Each question carries equal weightage. [4 marks]

- | | |
|---|----|
| i. Express the decimal number 47_{10} in base-3 (ternary). | 3 |
| ii. Express the base-5 number 1010_5 in decimal (base-10) | 10 |
| iii. Express the base-3 number 2112010_3 in base-9. | 9 |
| iv. Express the hexadecimal (base-16) number DAD_{16} in base-4. | 4 |

— END OF PAPER —