

# IN1006 Systems Architecture (PRD1 A 2022/23)

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**Started on** Thursday, 1 December 2022, 4:00 PM

**State** Finished

**Completed on** Thursday, 1 December 2022, 4:07 PM

**Time taken** 6 mins 29 secs

**Grade** 10.00 out of 10.00 (100%)

## Question 1

Correct

Mark 1.00 out of 1.00

What is the effect of a bitwise-NAND operation on the following two 12-bit words: 1000 1010 1101, 0110 1110 0101 ?

Select one:

- ☐ a. 1110 0100 1000
- ☐ b. 0000 1100 0101
- ☐ c. Don't know/no answer
- ☐ d. 1110 1110 1101
- ☒ e. 1111 0101 1010
- ☐ f. 0001 0001 0010



Your answer is correct.

The NAND operation is applied to each of the pairs of bits at the same position in each word, moving from left to right.

The correct answer is: 1111 0101 1010

## Question 2

Correct

Mark 1.00 out of 1.00

What is the effect of a bitwise-OR operation on the following 12-bit words: 1000 1010 1101, 0110 1110 0101?

Select one:

- ☐ a. Don't know/no answer
- ☒ b. 1110 1110 1101
- ☐ c. 1111 0011 1010
- ☐ d. 0001 0001 0010
- ☐ e. 0000 1100 0101
- ☐ f. 1110 0100 1000



Your answer is correct.

The OR operation is applied to each of the pairs of bits at the same position in each word, moving from left to right.

The correct answer is: 1110 1110 1101

Question **3**

Correct

Mark 1.00 out of 1.00

Consider the following MARIE program. What is the outcome of the program?

```
Load X
Store Sum
LoopC, Skipcond 800
      Jump LoopEnd
Loop,  Subt Y
      Store W
      Add Sum
      Store Sum
      Load W
      Jump LoopC
LoopEnd, Halt
X,      Dec 4
Y,      Dec 1
Sum,    Dec 0
W,      Dec 0
```

Select one:

- ☒ a. The program will compute the sum  $4+3+2+1+0$  and store it in Sum before ending.
- ☐ b. The program will halt immediately after reaching the Skipcond instruction for the first time.
- ☐ c. The program will compute the expression  $4+2+0$  before ending.
- ☐ d. The program will output the values 4, 3, 2, 1 and 0 before ending.
- ☐ e. The program will compute the sum  $4+3+2+1+0$  before ending.



This program executes a "Loop" using the Skipcond instruction. In this case, the condition in Skipcond is set to 10 and so IR[11-10] is 10. Thus, if  $AC > 0$  then PC will become PC+1 and the execution will continue from "Loop". Otherwise, the execution will continue from "LoopEnd". Initially (after the execution of the first two statements) the AC will be 4 ( $> 0$ ) and the value 4 will be stored in Sum. Thus the instruction at the position "Loop" will be executed subtracting 1 from AC, adding its value to Sum and storing the updated value to Sum (this will make the value of Sum equal to 7, i.e.,  $4+3$ ). Then the execution will continue from LoopC (due to the "Jump LoopC" instruction). This time the AC will be 3 so the evaluation of Skipcond will make the program continue from "Loop" again, this time subtracting 1 first from AC and then adding its value (i.e., 2) to Sum. This will continue until AC becomes 0, at which point the program execution will jump to "LoopEnd" and will be halted. Thus, the program will find the sum of values  $4+3+2+1+0$  and store it in the memory position Sum before halting.

The correct answer is: The program will compute the sum  $4+3+2+1+0$  and store it in Sum before ending.

## Question 4

Correct

Mark 1.00 out of 1.00

Which of the following statements is *the most accurate* description for the sum-of-products expression below?

$$F = A'B'C + A'BC' + AB'C'$$

Select one:

- ☐ a. The truth table has three rows where  $F = 1$ , and no zeros need to be in the inputs to return one.
- ☐ b. The truth table has four rows where  $F = 1$  and no more than two zeros must be in the inputs to return one.
- ☐ c. Don't know/no answer
- ☒ d. The truth table has three rows where  $F = 1$  and no more than two zeros must be in the inputs to return one. ✓
- ☐ e. The truth table has three rows where  $F = 1$  and C must be one to return one.
- ☐ f. The truth table has two rows where  $F = 1$  and C must be zero to return one.

The number of OR-ed terms above specifies the number of input cases that lead to a true expression (rows of truth table that give  $F = 1$ ). Each of the barred variables shows where the input needs to be zero for that input case.

The correct answer is: The truth table has three rows where  $F = 1$  and no more than two zeros must be in the inputs to return one.

## Question 5

Correct

Mark 1.00 out of 1.00

Which MARIE instruction is being carried out by the microoperations that follow?

$MAR \leftarrow X$

$MBR \leftarrow M[MAR]$

$AC \leftarrow AC - MBR$

Select one:

- ☐ a. Load X
- ☒ b. Subt X ✓
- ☐ c. Don't know/No answer
- ☐ d. Jump X
- ☐ e. Store X

The correct answer is: Subt X

Which of the following equations correctly reflects the truth table shown below? A,B and C are inputs and F is the output.

A	B	C	F
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

Select one:

- ☐ a.  $F = (AB'C + A'BC' + A'BC' + A'B'C + A'B'C)'$
- ☒ b.  $F = A'BC' + A'BC + AB'C' + ABC' + ABC$
- ☐ c.  $F = AB'C + A'BC' + A'BC' + A'B'C + A'B'C'$
- ☐ d. None of these expressions
- ☐ e. Don't know/no answer
- ☐ f.  $F = (A'BC' + A'BC + AB'C' + ABC' + ABC)'$



Your answer is correct.

The F output is given as a sum-of-products expression where each product (AND) should correspond to a row where F = 1.

The correct answer is:  $F = A'BC' + A'BC + AB'C' + ABC' + ABC$

## Question 7

Correct

Mark 1.00 out of 1.00

Consider the following MARIE code. The code starts at address 000: the first instruction is saved at address 000.

After the execution of this code what is the value (in decimal) stored in the OutREG register?

```
If,      Load X
          Subt Y
          Skipcond 400
          Jump Else
Then,    Load X
          Add Z
          Output
          Jump Endif
Else,    Load X
          Add X
          Subt Y
          Subt Z
          Output
Endif,   Halt
X,       Dec 9
Y,       Dec 5
Z,       Dec 2
```

Select one:

- ☐ a. 18
- ☐ b. 8
- ☒ c. 11
- ☐ d. 7
- ☐ e. 10




This program executes the "If, then, else" statement using the Skipcond instruction. In this case, the condition in Skipcond is 01. So, the statement (if AC=0 then PC=PC+1) is evaluated and the "Else" part of the code is executed since AC equals to 4 after the execution of the first two instructions of the program. The program then continues to execute and the "Output" instruction outputs the value of OutREG and OutREG=AC and AC is  $X+X-Y-Z=11$  and terminates at "Halt". So the answer is 11.

The correct answer is: 11

Which of the following statements is *the most accurate* description for the sum-of-products expression below?

$$F = A'B'C + A'BC' + AB'C'$$

Select one:

- ☐ a. The truth table has three rows where  $F = 1$  and  $C$  must be one to return one.
- ☐ b. Don't know/no answer
- ☐ c. The truth table has four rows where  $F = 1$  and no more than two zeros must be in the inputs to return one.
- ☐ d. The truth table has three rows where  $F = 1$ , and no zeros need to be in the inputs to return one.
- ☒ e. The truth table has three rows where  $F = 1$  and no more than two zeros must be in the inputs to return one. 
- ☐ f. The truth table has two rows where  $F = 1$  and  $C$  must be zero to return one.

The number of OR-ed terms above specifies the number of input cases that lead to a true expression (rows of truth table that give  $F = 1$ ). Each of the barred variables shows where the input needs to be zero for that input case.

The correct answer is: The truth table has three rows where  $F = 1$  and no more than two zeros must be in the inputs to return one.

Question **9**

Correct

Mark 1.00 out of 1.00

Consider the following MARIE code. What does this code do?

```
If,      Load X
          Subt Y
          Skipcond 400
          Jump Else
Then,    Load X
          Add X
          Output
          Jump Endif
Else,    Load Y
          Subt X
          Store Y
Endif,   Halt
X,       Dec 10
Y,       Dec 5
```

Select one:

- ☒ a. It will compute the decimal value -5, store it in Y and terminate.
- ☐ b. It will output the hexadecimal value -5 and terminate.
- ☐ c. It will store the octal value 5 and terminate.
- ☐ d. It will compute and store the decimal value 5.
- ☐ e. It will store the hexadecimal value -5 in the memory address X and terminate.



This program executes an "If, then, else" statement using the Skipcond instruction. In this case, the condition in Skipcond is 01. So, PC will become PC+1 if AC=0 and the "Then" part of the code will be executed. If AC  $\neq$  0 then the "Else" part of the code will be executed. After the execution of the first two statements, AC will be 5, so the "Else" part of the code will be executed. So the program will compute  $Y-X=-5$ , store this value in Y and terminate.

The correct answer is: It will compute the decimal value -5, store it in Y and terminate.

Question **10**

Correct

Mark 1.00 out of 1.00

Consider the next MARIE instructions: Load, Add, Store, Subt, Input and Output. Which of the following MARIE registers is not always used in the FDE cycle of the above instructions?

Select one:

- ☐ a. MAR
- ☐ b. PC
- ☐ c. AC
- ☒ d. InREG

✓ Not used for anything but input (Input instruction)

The correct answer is: InREG

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