

IN1006 Systems Architecture (PRD1 A 2022/23)

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Started on Thursday, 1 December 2022, 3:53 PM

State Finished

Completed on Thursday, 1 December 2022, 4:13 PM

Time taken 20 mins 3 secs

Grade 10.00 out of 10.00 (100%)

Question 1


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

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 **2**

Correct

Mark 1.00 out of 1.00

Which of the following best describes the composition of a 32-bit register.

Select one:

- ☐ a. 16 D flip-flops and 16 SR flip-flops.
- ☐ b. 32 D flip-flops and 32 SR flip-flops
- ☐ c. 32 SR flip-flops
- ☐ d. Don't know/no answer
- ☒ e. 32 D flip-flops
- ☐ f. 64 D flip-flops.



A n-bit register is built from n-D flip-flops connected by a bus.

The correct answer is: 32 D flip-flops

Question **3**

Correct

Mark 1.00 out of 1.00

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	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

Select one:

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



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

Question **4**

Correct

Mark 1.00 out of 1.00

How many components of MARIE architecture can use the bus simultaneously?

Select one:

- ☐ a. 3 components
- ☐ b. All components
- ☒ c. 1 component
- ☐ d. Don't Know/No answer
- ☐ e. 2 components



Your answer is correct.

The correct answer is: 1 component

Question **5**

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 1110 1101
- ☒ b. 1111 0101 1010
- ☐ c. 0000 1100 0101
- ☐ d. 1110 0100 1000
- ☐ e. Don't know/no answer
- ☐ 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 **6**

Correct

Mark 1.00 out of 1.00

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

Select one:

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



The XOR 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 0100 1000

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
          Subt Z
          Output
Endif,   Halt
X,       Dec 7
Y,       Dec 5
Z,       Dec 2
```

Select one:

- ☐ a. 7
- ☒ b. 5
- ☐ c. 1
- ☐ d. 3
- ☐ e. Don't know/No answer



This program executes the "If, then, else" statement using the Skipcond instruction. In this case, the condition in Skipcond is set to 400 and so IR[11-10] 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 2. The program then continues to execute and the "Output" instruction outputs the value of OutREG and OutREG=AC and AC is X-Z=5 and terminates at "Halt". So the answer is 5.

The correct answer is: 5

Question 8

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

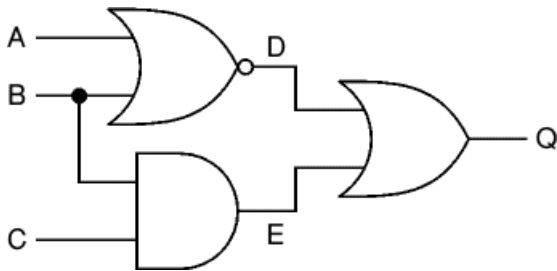
The correct answer is: It will compute the decimal value -5, store it in Y and terminate.

Question 9

Correct

Mark 1.00 out of 1.00

Which of the following is the correct Boolean expression for the logic circuit below (with output Q).



Select one:

- ☐ a. $Q = (AB)' + (B+C)$
- ☐ b. $Q = (A+B) + (BC)$
- ☐ c. Don't know/no answer
- ☐ d. $Q = (A+B)'(BC)$
- ☒ e. $Q = (A+B)' + (BC)$



Output Q is OR of a NOR-gate (D) with inputs A, B and an AND-gate (E) with inputs B, C. This gives the expression:

$$Q = (A+B)' + (BC)$$

The correct answer is: $Q = (A+B)' + (BC)$

Question 10

Correct

Mark 1.00 out of 1.00

Consider the MARIE instructions Skipcond and Clear. Which of the following CPU registers are not used in the execution of any these instructions?

Select one:

- ☐ a. MAR, MBR, InReg, OutReg and PC
- ☐ b. InReg, OutReg
- ☒ c. MAR, MBR, InReg, OutReg
- ☐ d. MAR and MBR
- ☐ e. Don't know/No answer



The execution of the instruction Skipcond uses only the registers AC and PC. The execution of the instruction Clear uses only the register AC.

The correct answer is: MAR, MBR, InReg, OutReg

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