

IN1006 Systems Architecture (PRD1 A 2022/23)

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Started on Thursday, 1 December 2022, 3:30 PM

State Finished

Completed on Thursday, 1 December 2022, 3:38 PM

Time taken 8 mins 46 secs

Grade 10.00 out of 10.00 (100%)

Question 1

Correct

Mark 1.00 out of 1.00

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

	Clear
	Add X
	Store Sum
LoopC,	Skipcond 800
	Jump LoopEnd
Loop,	Output
	Subt Y
	Jump LoopC
LoopEnd,	Halt
X,	Dec 10
Y,	Dec 2
Sum,	Dec 0

Select one:

- ☐ a. The program will compute the expression 10, 9, 8, 7 and 6 before ending.
- ☐ b. The program will output 2 for five consecutive times before ending.
- ☐ c. The program will compute the expression 10+8+6+4+2 (i.e., 30) before ending.
- ☒ d. The program will output the decimal numbers 10, 8, 6, 4 and 2 before ending.
- ☐ e. The program will output the decimal numbers 10, 8, 6, 4, 2 and 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 10 (>0) and thus the instruction at the position "Loop" will be executed outputting 10 (i.e., the current value of AC). Then 2 will be subtracted from AC and the execution will continue from LoopC (due to the "Jump LoopC" instruction). This time the AC will be 8 so the evaluation of Skipcond will make the program continue from "Loop" again, this time outputting 8 first and then subtracting 2 from it. 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 output the values 10, 8, 6, 4 and 2 before halting.

The correct answer is: The program will output the decimal numbers 10, 8, 6, 4 and 2 before ending.

Question **2**

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



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

Question **3**

Correct

Mark 1.00 out of 1.00

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

```
      Clear
      Add X
      Store Sum
LoopC, Skipcond 800
      Jump LoopEnd
Loop,  Output
      Subt Y
      Jump LoopC
LoopEnd, Halt
X,      Dec 10
Y,      Dec 4
Sum,    Dec 0
```

Select one:

- ☐ a. The program will compute the expression $10, 8, 6, 4$ and 2 before ending.
- ☐ b. The program will output the decimal numbers $10, 8, 6, 4, 2$ and 0 before ending.
- ☐ c. The program will compute the expression $10+6+2$ (i.e., 18) before ending.
- ☐ d. The program will output 4 for three consecutive times before ending.
- ☒ e. The program will output the decimal numbers $10, 6$ and 2 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 10 (>0) and thus the instruction at the position "Loop" will be executed outputting 10 (i.e., the current value of AC). Then 4 will be subtracted from AC and the execution will continue from LoopC (due to the "Jump LoopC" instruction). This time the AC will be 6 so the evaluation of Skipcond will make the program continue from "Loop" again, this time outputting 6 first and then subtracting 4 from it. This will continue until AC becomes -2 , at which point the program execution will jump to "LoopEnd" and will be halted. Thus, the program will output the values $10, 6$, and 2 before halting.

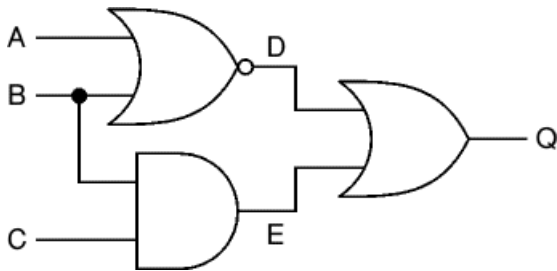
The correct answer is: The program will output the decimal numbers $10, 6$ and 2 before ending.

Question 4

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 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 AC

M [MAR] \leftarrow MBR

Select one:

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



The correct answer is: Store X

Question **6**

Correct

Mark 1.00 out of 1.00

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

$MAR \leftarrow X$

$MBR \leftarrow M[MAR]$

$AC \leftarrow AC - MBR$

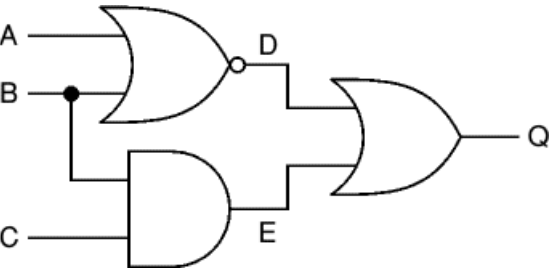
Select one:

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



The correct answer is: Subt X

Given the logic circuit and table below (with output Q), which line of the table does **not** correspond to the behaviour of the logic circuit?



Row	A	B	C	Q
1	0	0	0	1
2	0	0	1	1
3	0	1	0	1
4	0	1	1	1
5	1	0	0	0
6	1	0	1	0
7	1	1	0	0
8	1	1	1	1

Select one:

- ☐ a. Row 2
- ☒ b. Row 3
- ☐ c. All rows are correct
- ☐ d. Row 4
- ☐ e. Row 6
- ☐ f. Row 7
- ☐ g. Row 5
- ☐ h. Row 1
- ☐ i. Row 8
- ☐ j. Don't know/no answer



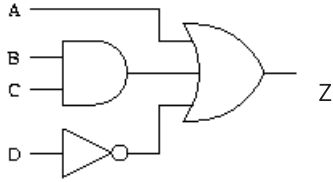
Row 3 is in error as the output of the NOR-gate (D) and AND-gate (E) are zero, leading to an output of the OR-gate (Q) of zero.
The correct answer is: Row 3

Question 8

Correct

Mark 1.00 out of 1.00

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



Select one:

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

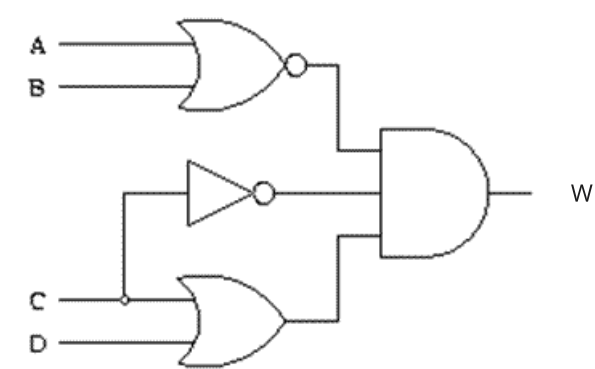


Input D feeds directly into a NOT gate so is inverted to D' . Inputs B and C are AND-ed together. Then all are OR-ed together with A to give the expression:

$$Z = A + (BC) + D'$$

The correct answer is: $Z = A + (B \cdot C) + D'$

Given the logic circuit (with output W) and table below, which line of the table does **not** correspond with the behaviour of the logic circuit?



Row	A	B	C	D	Z
1	0	0	0	0	0
2	0	0	0	1	1
3	0	0	1	0	0
4	0	0	1	1	0
5	0	1	0	0	0
6	0	1	0	1	0
7	0	1	1	0	0
8	0	1	1	1	1
9	1	0	0	0	0
10	1	0	0	1	0
11	1	0	1	0	0
12	1	0	1	1	0
13	1	1	0	0	0
14	1	1	0	1	0
15	1	1	1	0	0
16	1	1	1	1	0

Select one:

- ☐ a. Don't know/no answer
- ☒ b. Row 8
- ☐ c. Row 12
- ☐ d. Row 3
- ☐ e. Row 10
- ☐ f. Row 15
- ☐ g. Row 7
- ☐ h. Row 1
- ☐ i. Row 5



Row 8 is in error as all inputs to the AND gate must be one for W to be one, and this only occurs when the conditions in row two are met.

The correct answer is: Row 8

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



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

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