

# IN1006 Systems Architecture (PRD1 A 2022/23)

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**Grade** 8.90 out of 10.00 (89%)

## Question 1

Correct

Mark 1.00 out of 1.00

What is the difference when executing instructions `LOAD x` and `LOADI x` ?

Select one:

- ☒ a. `LOAD` loads the value at address `x` to the AC; the `LOADI` loads the value found in the location addressed by the value in `x` to the AC ✓
- ☐ b. `LOAD` loads the value `x` to the AC; `LOADI` loads the value found at `x` to the AC
- ☐ c. `LOAD x` loads the value of MBR to AC; `LOADI` loads the value of MAR to AC.
- ☐ d. There is no difference if `x` is the current value of MBR
- ☐ e. `LOAD` loads the value at address `x` to the AC; `LOADI` loads the value `x` to the AC

`LOAD x` loads the value of the memory word with address `x` to the AC whereas `LOADI x` loads the value of the memory word whose address is the value of the memory word with address `x` to the AC.

The correct answer is: `LOAD` loads the value at address `x` to the AC; the `LOADI` loads the value found in the location addressed by the value in `x` to the AC

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

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

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. 1
- ☐ c. 3
- ☒ d. 5
- ☐ 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

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



The correct answer is: Add X

Question **5**

Correct

Mark 1.00 out of 1.00

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

Select one:

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



Your answer is correct.

The correct answer is: 1 component

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 output 4 for three consecutive times before ending.
- ☐ b. The program will compute the expression  $10+6+2$  (i.e., 18) before ending.
- ☐ c. The program will output the decimal numbers 10, 8, 6, 4, 2 and 0 before ending.
- ☐ d. The program will compute the expression 10, 8, 6, 4 and 2 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.

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 SR flip-flops
- ☐ c. 32 D flip-flops and 32 SR flip-flops
- ☐ d. Don't know/no answer
- ☐ e. 64 D flip-flops.
- ☒ f. 32 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 **8**

Incorrect

Mark -0.10 out of 1.00

What is the difference in operation between a LOAD x and a LOADI x instruction?

Select one:

- ☐ a. Don't know/No answer
- ☐ b. The LOAD loads the value at address x to the AC; the LOADI loads the value found in the location addressed by the value in x to the AC
- ☒ c. LOAD loads the value x to the AC; LOADI loads the value found at x to the AC
- ☐ d. There is no difference if x is the same
- ☐ e. The LOAD loads the value at address x to the AC; the LOADI loads the value x to the AC




Your answer is incorrect.

The correct answer is: The LOAD loads the value at address x to the AC; the LOADI loads the value found in the location addressed by the value in x to the AC

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

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

```
If,      Load X
          Add 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 12
```

Select one:

- ☐ a. It will store the decimal value 12 in the memory position X and terminate.
- ☒ b. It will store the decimal value 2 in the memory address Y and terminate. ✓
- ☐ c. It will output the decimal value 2 and terminate.
- ☐ d. It will compute and store the decimal value 3 and terminate.
- ☐ e. It will output the hexadecimal value 2 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 three statements, AC will be 8, so the "Else" part of the code will be executed. So the program will compute  $Y-X=2$ , store this value in memory position Y and will terminate.

The correct answer is: It will store the decimal value 2 in the memory address Y and terminate.

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