DW N° 03

Question 01:

Complete the following diagram: (access to an instruction):

Question 02:

A- Fill in the missing information:

An examination of the functions performed by the processor highlights three sets:

1. The control unit is responsible for:
   - …… ;
   - …… ;
   - …… ;
2. The processing unit must……;
3. The registers allow for :

   …… ;

B- Provide a detailed explanation of the operation of the control unit.

Exercise 01

Performance of the Microprocessor :

A/ A processor with a clock speed of 1.8 GHz executes a program that uses a mix of 5 types of instructions:

Instruction Type	Number of Executed Instructions	Number of Cycles per Instruction
Integer Operation	150000	1
Memory Transfer	45000	2
Floating-Point Operation	55000	2
Control (Branches)	2000	2
Display	500	15

1. How many cycles will the program take to execute?
2. What will be the execution time?
3. Calculate the CPI (Cycles Per Instruction) of this program, defined as the ratio between the total number of cycles required for its execution and the total number of instructions.

B/ Now we are interested in response times.

Maximizing performance (is equivalent to) ⇔ Minimizing execution time.

Assuming machine A executes a program in 10 seconds and machine B executes the same program in 15 seconds, how much faster is A than B?

Exercise 02

Note:

Execution time for a program = Number of cycles for a program / Clock frequency

All computers are built with a clock of constant frequency that determines when events occur in the machine.

Statement:

Our program runs in 10 seconds on A, which has a clock at 100 MHz. We are trying to help build a machine B, which will execute this program in 6 seconds. Assuming an increase in clock frequency is possible, but this increase requires machine B to use 1.2 times more clock cycles than machine A for this program.

What frequency should we provide?

Exercise 03

A/

Note: *The CPI varies with the application. It is sometimes possible to calculate the number of clock cycles by looking at the different types of instructions used and using their clock cycle counts.*

Number of clock cycles = $\sum$ ***(CPIi * Ci) from i=1 to n***

Where Ci is the number of instructions of class i executed, CPIi is the average number of cycles per instruction for that class, and n is the number of instruction classes.

Prompt:

To choose between two code sequences for a given machine, we have the following information:

Instruction Class	Average CPI for this class
A	1
B	2
C	3

There are two code sequences that require the following numbers of instructions:

	Instruction Class Number of Instructions for this Class		
code Sequence	A	B	C
1	2	1	2
2	4	1	1

Which code sequence executes the most instructions? Which one will be faster? What is the CPI of each sequence?

B/

A microprocessor has the following characteristics:

Clock frequency = 3 GHz

Average number of cycles per instruction = 4

1. Calculate the clock cycle time.
2. Calculate the average execution time of an instruction.
3. Calculate the number of millions of instructions this microprocessor can execute per second.

C/

Consider another microprocessor executing a program consisting of N instructions. Each instruction takes an average of 8 cycles to execute. Additionally, each instruction involves an average of 3 memory accesses. Two possible scenarios arise:

1. In the first scenario, the information is in the cache, so there is no waiting. How many cycles does this program take to execute?

2. In the second scenario, the cache is ineffective, and all data is brought from main memory. Fetching an instruction from main memory takes 6 cycles. How many cycles are needed to execute this program?