# Lab 0:

**Introduction to the Microcontroller Development System  
  
Name (Print):**\_\_\_\_REZA SHISHEIE\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**ID**\_2708062\_\_\_

Due date: M/W - Mon, Jan 29

T/Th – Tue, Jan 30

Give brief answers to the following questions. You can use this document to insert your answers. They can be typed or handwritten, but they must be neatly written. Only hardcopies will be accepted, no emails. The assignments must be submitted on or before the due date before the beginning of class. The score for late labs will be reduced by 10% if the lab is submitted after class on the due date. The score will be reduced by 20% if submitted by the beginning of the next class day after the due date. After that, the score will be zero.  
  
Calculations should be carried out to four significant digits, and any formulas used should be shown, even if the formula is trivial. This will maximize your potential for partial credit.

1. (1 pt) Do a google search for “machine language” and find the Encyclopedia Britannica article on that topic. According to the article, why is machine language difficult to read and write? (One or two sentences)

**Ans.**  
Machine language is difficult to read and write, since it does not resemble conventional mathematical notation or human language, and its codes vary from computer to computer.

1. (1 pt) Do a google search for “IBM HLASM Language Reference” and click on the *Introduction* link. According to the introduction, what is an assembly language?

**Ans.**  
The assembler language is a symbolic programming language that you can use to code instructions instead of coding in machine language. Because the assembler language lets you use meaningful symbols made up of alphabetic and numeric characters, instead of just the binary digits 0 and 1 used in machine language, you can make your coding easier to read, understand, and change. The assembler must translate the symbolic assembler language into machine language before the computer can run your program. Your program, written in the assembler language, becomes the source module that is input to the assembler. The assembler processes your source module and produces an object module in machine language

1. (1 pt) According to the introduction, why does assembly language make it easier to read, understand, and change code?

**Ans.**

Because the assembler language lets you use meaningful symbols made up of alphabetic and numeric characters, instead of just the binary digits 0 and 1 used in machine language, you can make your coding easier to read, understand, and change.

1. (1 pt) On the HLASM Language Reference home page, click on the *Assembler language* link. According to the article, assembler language is useful in at least **two situations**. What are they?

**Ans.**

The assembler language is useful when:

* You need to control your program closely, down to the byte and even the bit level.
* You must write subroutines for functions that are not provided by other symbolic programming languages, such as COBOL, Fortran, or PL/I.

1. (1 pt) According to the MPASM Assembler Overview section of the MPLAB User’s Guide, the MPASM assembler can be used in **two ways**. What are they?

**Ans.**

* The windows version (mpasmwin.exe).
* The command-line version (mpasm.exe).

1. (1 pt) According to the MPLAB User’s Guide, what is an assemble directive?

**Ans.**  
Directives are assembler commands that appear in the source code but are not usually translated directly into opcodes. They are used to control the assembler: its input, output and data allocation.

1. (1 pt) According to the MPLAB User’s Guide, what is the function of the #include directive?

**Ans.**  
The specified file is read in as source code. The effect is the same as if the entire text of the included file were inserted into the file at the location of the include statement. Upon end-of-file, source code assembly will resume from the original source file.

1. (1 pt) According to the MPLAB User’s Guide, there are three syntaxes to specify an ASCII character in source code. Write two ways to express the character *m*.

**Ans.**

Hex: 6d

Deciaml: 109

1. (1 pt) According to the MPLAB User’s Guide, in what column in the source code should a label start, and are labels case-sensitive?

**Ans.**  
label should be in the first column and it is not case sensitive

1. (1 pt) According to the MPLAB User’s Guide, what file extension does Microchip require for its assembly source code?

**Ans.**   
.asm

1. (1 pt) According to section 5-3 Mid-Range MCU Family Reference Manual, how is the central processing unit (CPU) described? (Three sentences).  
     
   **Ans.**

* The CPU can be thought of as the “brains” of the device. It is responsible for fetching the correct instruction for execution, decoding that instruction, and then executing that instruction.
* The CPU sometimes works in conjunction with the ALU to complete the execution of the instruction (in arithmetic and logical operations).
* The CPU controls the program memory address bus, the data memory address bus, and accesses to the stack.

1. (2 pts) The oscillator (clock) that we will use is rated at a frequency *fosc* of 3.6864 MHz. What is the oscillator period *Tosc* in microseconds. According to the PICmicro Mid-Range MCU Family Reference Manual, how many oscillator cycles comprise one instruction cycle? What is the period *TCY* of one instruction cycle?  
     
   **Ans.**

An “Instruction Cycle” consists of four Q cycles (Q1, Q2, Q3, and Q4)

1. (1 pt) According to the *Core Features* section of the PIC 16F877 datasheet, the operating frequency (oscillator frequency, clock frequency) of the microcontroller lies in what range?  
     
   **Ans.**

DC - 20 MHz clock input

1. (1 pt) According to the datasheet, what are the four oscillator modes that the 16F877 can operate in?  
     
   **Ans.**

• LP Low Power Crystal

• XT Crystal/Resonator

• HS High Speed Crystal/Resonator

• RC Resistor/Capacitor

1. (2 pts) According to the *Electrical Characteristics* section of the datasheet, what is the absolute maximum total power dissipation of the microcontroller? Since the chip operates on a 5.0 volt power supply, what is the absolute maximum current the chip can absorb in mA?  
     
   **Ans.**

absolute maximum total power dissipation: 1.0 W

Maximum current in: 1W/5VDC = 0.2 A = 200 mA