**T62 Tutorial 2**

Enter the following program and save as “T62-tut2-2.asm”. **X(0)** is the last digit of your student ID number. **Y(8)** is the second last digit of your student ID number. Make sure that the simulation clock frequency is set to 4 MHz.

LIST P=18F4520

#include <P18F4520.INC>

ORG 0x0000

Main: movlw 0x2**0**

xorlw 0x04

addlw 0x16

movlw 0x6**8**

andlw 0x49

movlw 0x00

nop

nop

bra Main

END

* 1. Copy the contents of the program memory.

(2 marks)

|  |  |  |  |
| --- | --- | --- | --- |
| Line | Address | Opcode | Disassembly |
| 1 | 0000 | 0E20 | MOVLW 0x20 |
| 2 | 0002 | 0A04 | XORLW 0x4 |
| 3 | 0004 | 0F16 | ADDLW 0x16 |
| 4 | 0006 | 0E68 | MOVLW 0x68 |
| 5 | 0008 | 0B49 | ANDLW 0x49 |
| 6 | 000A | 0E00 | MOVLW 0 |
| 7 | 000C | 0000 | NOP |
| 8 | 000E | 0000 | NOP |
| 9 | 0010 | D7E7 | BRA 0 |

* 1. Use “Step Over” button to run the program in the step-by-step manner for one round. Write a table to show, for each step, all the observations in WREG and PC (*in Watch window*), Instruction Cycles and Time (*in Stopwatch window*).

(9 marks)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| step | WREG | PC | Instruction Cycles | Time (us) |
| 1 | 0x20 | 0x000002 | 1 | 1 |
| 2 | 0x24 | 0x000004 | 2 | 2 |
| 3 | 0x3A | 0x000006 | 3 | 3 |
| 4 | 0x68 | 0x000008 | 4 | 4 |
| 5 | 0x48 | 0x00000A | 5 | 5 |
| 6 | 0x00 | 0x00000C | 6 | 6 |
| 7 | 0x00 | 0x00000E | 7 | 7 |
| 8 | 0x00 | 0x000010 | 8 | 8 |
| 9 | 0x00 | 0x000000 | 10 | 10 |

* 1. Explain why in question 2, you observe the specific value in WREG in step 3.

(1 mark)

⸪ 24 + 16 = 3A

* 1. Explain why in question 2, you observe the specific value in WREG in step 5.

(1 mark)

* 1. Explain why in question 2, you observe the specific values in PC, Instruction Cycles and Time in step 9.

(6 marks)

PC is 0x000000, because “BRA main” operates as jumping the address to “main”, so

PC becomes 0x000000. Instruction Cycles and Time is 10, because “BRA” is a two-cycle instruction so the Instruction Cycles is 8 + 2 = 10, which consumed 2us, so time is 8 + 2 = 10.

* 1. What is the clock period of the processor? Show the calculation.

(1 mark)

clock period = 1 / 4MHz = 0.25us

* 1. What is the duration for one instruction cycle?

(1 mark)

1us

* 1. How many clocks cycles for the instruction movlw? Show the calculation.

(2 marks)

1 / 0.25 = 4

* 1. How many clocks cycles for the instruction bra? Show the calculation.

(2 marks)

2 / 0.25 = 8

**Submission**

Enter your name, student ID number, and the answers in the MS Word document file. Re-name the file with your student ID number, e.g. 12345678.docx. **Deduct 4 marks for wrong file name.**

Submit the file by e-mail ([itklchan@cityu.edu.hk](mailto:itklchan@cityu.edu.hk)) before 3:00 pm. **Late submission will not be accepted.**