

Name _____

CM _____

Section _____

ME430 - Mechatronics

Examination I

January 5, 2010

Problem	Score
1	/ 15
2	/ 30
3	/ 15
4	/ 40
Total	/100

For the written portion of the exam, you may use only:

- Any paper notes (such as notes on the videos) you brought to the exam, so long as those notes were written by you or your lab partner.
- A pencil/pen.

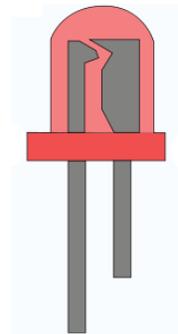
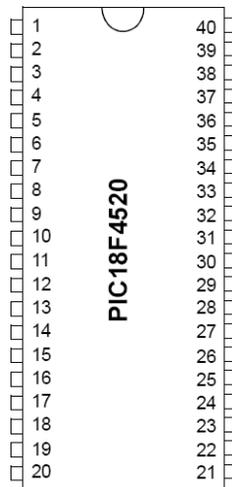
For the computer portion of the exam, you may use only:

- Your computer running MPLAB
- Any electronic notes or code residing on your local (C:) hard drive, so long as those notes/code were written by you or your lab partner.
- The course website. (This is the only approved use of the internet for this exam.)
- A calculator (optional).
- ANGEL for code submission.

Anything not specifically allowed is prohibited. In particular, you may not use notes or code written by someone outside your lab group.

**Problem 1 – Wiring and Resistor Sizing
(15 pts)**

Control an LED using a pushbutton and NPN transistor. Show all resistor sizes necessary with clear labels (showing your work may help with partial credit). Assume the LED is different from the ones we use in class and has a maximum current of 4 mA so we will target using 2 mA of current. Additionally the LED has a 0.9 volt forward voltage drop. The PIC is programmed for RB0 to be an output controlling the LED and RB1 to be an input for the basic switch circuit. The only power source is 5 volts (show power/ground for PIC as well). Use real resistor sizes. You must connect to the physical devices show (ie don't just draw schematic symbols for them).



**Problem 2– Short answer
(30 pts)**

2.1) (4 pts) $x = -8$; If x is defined as a char, how would it display as a binary number in the watch window?

2.2) (4pts) $x = 'A'$ If x is defined as a char, how would it display as a binary number in the watch window?

2.3) (6 pts) Write the C code to perform the following: create an array, named *allTen*, of 5 int variables where each element in the array is set to 10:

2.4) (6 pts) Create an if statement (or switch statement) based on the first element in the array named *allTen*. If the first element is 10 print “The first element is 10” to the screen, otherwise print “The first element is NOT 10” to the screen.

2.5) (10 pts) Determine the output of this code:

(ie If you were using the simulator UART capture window, what would appear in the window?)

```
#include <stdio.h>

int g(int a, int b);
void f(int n);

void main()
{
    f(3);
    printf("Goodbye!");
    while(1);
}

void f(int n)
{
    int i,result;
    for ( i=1 ; i<=n ; i++)
    {
        result = g(i,n);
    }
    printf("\nSum = %d\n" , result);
}

int g(int a, int b)
{
    printf("( %d of %d)  ", a,b);
    return a+b;
}
```



When you finish the written portion of the test, turn it in to receive the computer portion.

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Computer Portion of Exam 1:**Problem 3 – Clock and SFRs code
(15 pts)**

This problem is the code for the previous wiring problem. Start with the template.c file. Rename the file Problem3.c. Have your code flash the LED connected to RB0 when the pushbutton (connected to RB1) is pressed. Set the clock to use 500 kHz and have the light be off for .5 seconds then on for .75 seconds when it is flashing. Hint: It will require multiple delay functions to get the value accurate.

When you finish the problem submit it on Angel to the Problem3.c dropbox. (Note: don't use Chrome to do this; it doesn't work!) If you worry about messing up the upload to Angel you can also email the files to your instructor at the end of the exam.

Problem 4 – C Programming (40 pts)

Start by creating a new project and downloading the triangles.c source code from Angel.
Angel -> Lessons -> Exam 1 -> triangles.c

In your new project set the Debugger to the simulator and capture UART messages.
Debugger -> Select Tool -> MPLAB SIM
Debugger -> Settings... Uart1 IO -> Enable Uart1 IO Output->Window

This problem deals with manipulations of an array named triangle. The triangle array has 6 int elements. The first int element corresponds to the x value of Point 1. The next element corresponds to the y value of Point 1 on the triangle and so on in this pattern:

triangles = [(Point 1 X), (Point 1 Y), (Point 2 X), (Point 2 Y), (Point 3 X), (Point 3 Y)]

In this problem you will find the main function is complete as well as a helper function named `distance` is complete. You may not make changes to those functions. However the functions `perimeter`, `centerX`, and `top` are all blank. You will be writing the code for these three functions.

When you complete all three functions you should see this output:

```
The sampleDistance (as int) = 13
The perimeter (as int) = 16
The x center of the triangle (as int) = 3
The top of the triangle is 4
```

4.1) (10 pts) Function calls - `perimeter`

First you need to write the code in the `perimeter` function. The `perimeter` function receives the triangle array and calculates the total length of the perimeter. I would strongly recommend you make use of calling the `distance` function for this part.

4.2) (15 pts) For Loop - `centerX`

Next you need to write the code in the `centerX` function. The `centerX` function receives the triangle array and calculates the x value for the centroid of the triangle. The x value of the centroid is simply the average of all 3 point's x values.

This problem could certainly be done without a for loop since there are only 3 points. **However** the goal of this part is to prove you can use a for loop. So you **MUST** use a for loop to go through the triangle array to access the x values to get full credit.

4.3) (15 pts) If statement - `top`

Finally you need to write the code in the `top` function. The `top` function receives the triangle array and returns the greatest y value of the triangle array. You are not required to use a for loop this time, but you must use at least one if statement.

Please submit your code to the Problem 4 dropbox on Angel.