

Problem 1 – Binary Mysteries

We know 7 out of the 8 bits for the **signed char** values shown below. If the missing bit was a 0, what would the decimal value be? If the missing bit was a 1, what would the decimal value be? Put the two possible decimal values in the boxes.

16 8 4 2 1
0 0 0 _ 1 1 1 1

Missing bit is a 0:

15

Missing bit is a 1:

31

40
32 16 8 4 2 1
_ 0 1 0 1 0 1 0

Missing bit is a 0:

42

Missing bit is a 1:

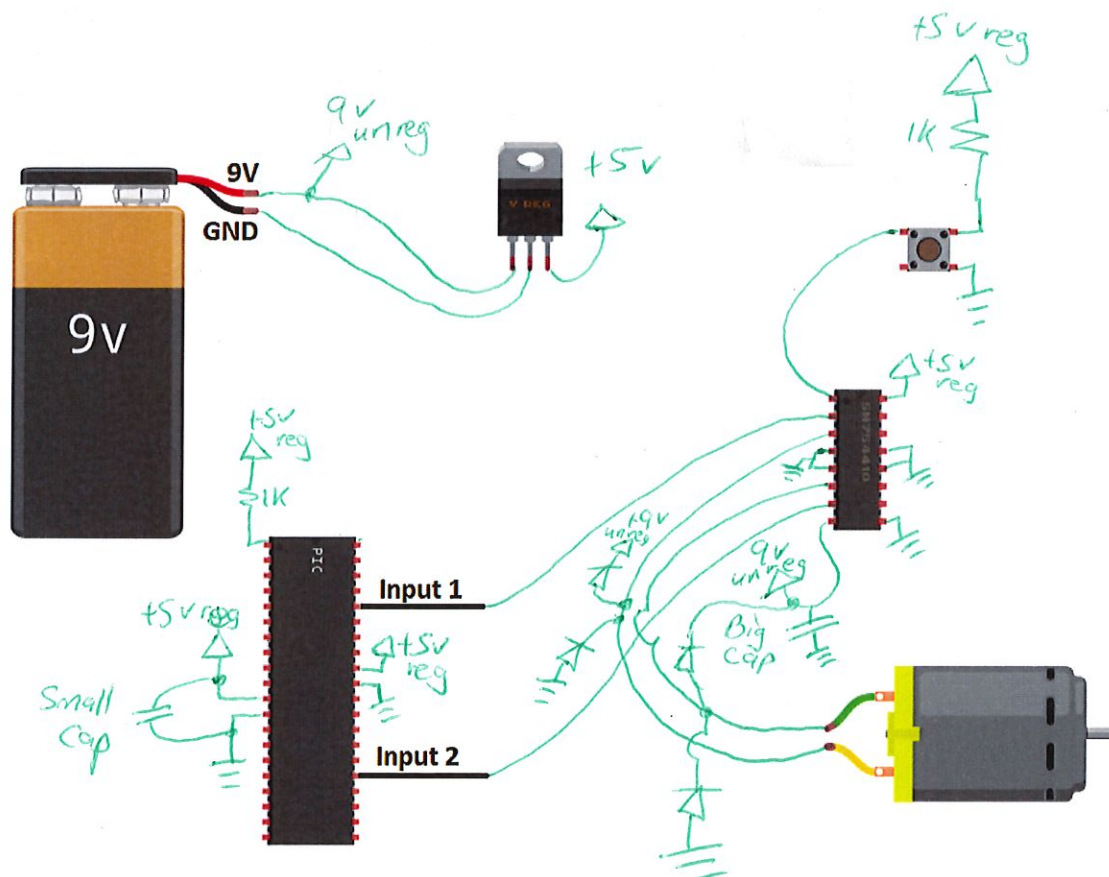
-86

10101010
01010110 → -86
64 32 16 8 4 2 1
80 6

Problem #2
moved around
(see problem #4 in
this file)

Problem 2 – H-Bridge

Below you will find a 9 volt battery, pushbutton, H-bridge, voltage regulator, PIC, and a DC motor. Properly connect the basic switch circuit to the H-bridge enable line, such that the motor is off when the button is pressed regardless of the Input 1 and Input 2 values. Otherwise the two digital control lines, Input 1 and Input 2, from the PIC should be used to control the motor. Properly connect all components to correctly build the circuit. Connect the PIC pins as needed to allow it to run (assume it is already programmed). You may label nodes for ground, unregulated 9V, and regulated 5V to help make your circuit neater (use a symbol for GND, use a symbol plus text for the positive voltage supplies). Additionally make sure you have protection against inductive kick. You may add resistors, capacitors, and diodes as needed. You are not required to label the size of those added components.



Problem 3 – BJT Resistor sizing

You have a 60Ω motor running on a 12V power supply that you wanted to control from a PIC using a BJT. What size resistor would you need between the PIC and BJT? **Show your work**, then place your answers in the box below.

Motor current

$$V = i R$$

$$12 = i \cdot 60$$

$$i = 0.2 A$$

$$\frac{1}{10} (0.2 A) = 0.02 A$$

Pic

$$V = i R$$

$$5 = 0.02 R$$

$$R = 250 \Omega$$

Exact BJT resistor value calculated

250 Ω

Real BJT resistor value (use E24 series)

240 Ω

Options

220
240
270

Problem 4 – Operators

Fill in the binary values that are stored for each value below and the decimal value that would be displayed if x was printed.

char x = 5 / 10 * 20;

Value stored in binary

0

Decimal value if printed

char x = -4 ^ 3 ;

Value stored in binary

Decimal value if printed

char x = 50 + 50 + 50;

Value stored in binary

-106

Decimal value if printed

150

01101010

*Move to
Problem 2*

Problem 5 – C debugging

Consider the code scrap shown below.

#include <stdio.h>

```

void main(void) {
    int a = 4;
    int b = 3;

    for (i = 0; i < 4; i++) {
        a = a + b;
        if (i == 1) {
            fprintf("b + 2 = %d\n", b + 2);
            b = 10;
        } else {
            fprintf("a = %d b = %d\n", a, b);
        }
    }
    fprintf("i = \n", i);

    while (1) {
    }
}

```

Handwritten annotations: "Declare i" above the for loop, "int i;" next to the for loop, "==" next to the if condition, and "%d" next to the while loop.

a	b	i
4	3	0
7	10	1
10		2
20		3
30		

- a. This code contains 3 errors (2 syntax errors and a common mistake), mark each error with an arrow and indicate how it should be fixed.
- b. If the errors were fixed what would this code print? Write your answer in the box below.

a = 7	b = 3
b + 2 = 5	
a = 20	b = 10
a = 30	b = 10
i = 4	

Problem 6 – C Programming

Create a new project in MPLABx that uses the Simulator. Starting from template.c, create a file called "lastname_firstname.c".

In that file, write a program that will loop over all the numbers from 0 to 200 and calculate the sum of all numbers that meet these criteria:

- The number **ends in the digit 4**.
- The number is **not** a multiple of 3.

If your program finds a number that meets the criteria, it should print that number to a new line in the UART1 window. Recall that you learned how to **enable the UART1 window** in the day 4 lecture "Intro to MPLABx" in the "Hello World Program". Once the program has finished the loop, it should print how many numbers matched the criteria and the sum of those numbers as follows:

There are ____ values that meet the criteria. The sum of these values is ____.

You are required to use a for loop to solve this problem and will receive no credit for hard-coded solutions. Assume that we will later test your code with a different maximum value, so make sure that your program works for other values if that number was changed.

When you complete this problem and have it running, call your instructor over to check it off on the front sheet.

Regardless of whether you finish or not, submit your code into the Moodle dropbox (just the lastname_firstname.c file).

```

/** Header Files *****/
#include <stdio.h>

/** Define Constants Here *****/
#define FINAL_VALUE 200

/** Global Variables *****/
int totalCount = 0;
int totalSum = 0;
int i;

void main(void) {
    printf("\n\nExam 1 - Problem 6\n");
    for (i = 0; i <= FINAL_VALUE; i++) {
        if (i % 10 == 4 && i % 3 != 0) {
            totalCount = totalCount + 1;
            totalSum = totalSum + i;
            printf("%d\n", i);
        }
    }

    printf("There are %d values that meet the criteria. The sum of these values is %d.\n", totalCount, totalSum);

    while (1) {
        // This area loops forever
    }
}

```