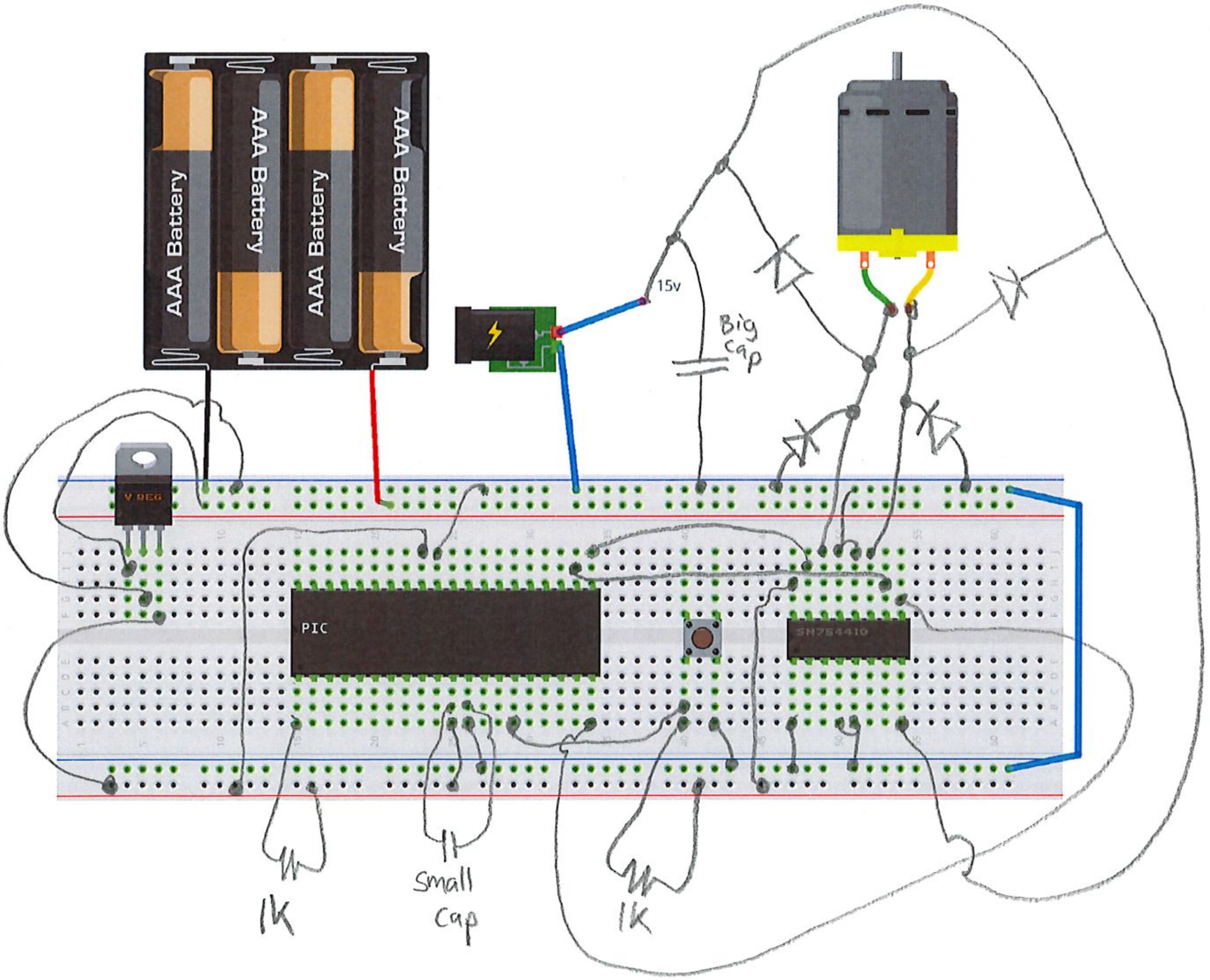
Problem 1 - Bi-Directional DC Motor

Use the components shown below to connect a bi-directional DC motor circuit.

- Assume you want to drive the DC motor at 15v and you have an unregulated 15v power supply available (see image below).
- Assume you also have a battery pack that needs to be regulated to 5 volts.
- Set up a basic switch circuit with the pushbutton and connect the signal line to RC0. Pretend like the PIC is already programmed and pushing the button will cause the motor to perform various actions.
- Connect the PIC pins as needed to allow it to run (assume it is already programmed). Pin 1 is in the lower left corner for both chips below.
- Connect the PIC to the H-bridge as follows:
    - RD2 and RD3 are a pair and need to drive one side of the H-bridge
    - RD1 is a signal that can enable/disable the H-bridge
- Connect other H-Bridge pins as needed to drive the motor at +15v
- Add snubber diodes, decoupling capacitors, and any necessary resistors for the circuit (size all resistors and label values, sizing capacitors is not required).
- Draw lines for wire directly onto the parts below, don't draw new parts.



Problem 2 – C debugging

Consider the code scrap shown below.

SYNTAX

var total=0;

Syntax missing ;

Semantic < Not <=

semantic i=i+1 or i++

semantic total=total+i; or total+=i;

```
#include <stdio.h>

#define MAX 5

int main() {
   int i
   for(0; i <= MAX; i = i + 2) {
      total = i;
      printf("At i = %d, the total is %d.\n", i, total);
   }
   printf("Average = %d.\n", total / MAX);
}
```

SYNTAX

i=0;

a. This code contains syntax errors and won't compile. Mark each syntax error mistake with an arrow, label it as **SYNTAX**, and indicate how it should be fixed. Note: only fix things that *would cause the program to crash* in this step.

b. Additionally the code contains mistakes that make the code run incorrectly. They are not syntax errors that cause a crash, but they cause it not to run as intended. The intended goal of this program is to print:

```
At i = 0, the total is 0.
At i = 1, the total is 1.
At i = 2, the total is 3.
At i = 3, the total is 6.
At i = 4, the total is 10.
Average = 2.
```

However that won't happen even after the syntax errors are fixed. Mark each semantic error with an arrow, label it as **SEMANTIC**, and indicate how it should be fixed.

Problem 3 – Number systems and operators

Determine the output of each expression. Write the value stored as both a binary number and a decimal number. YOU MAY NOT USE MPLAB or other programming tools to enter this code and print results. You may use a calculator or other similar **calculator** programs on your computer (but no MPLAB).

		Value stored in binary	Decimal value if printed
a	char x = -16;	1111 0000	-16
b	int x = -16;	1111 1111 1111 0000	-16
c	char x = 110 + 110;	1101 1100	-36
d	char x = -100 - 100;	0011 1000	56
e	char x = 50 % 5;	0000 0000	0
f	char x = 7 / 4;	0000 0001	1
g	int x = 8 / 10 * 5;	0000 0000	0
h	char x = 8 * 5 / 10;	0000 0100	4

000 | 11001000

11 1 | 00111000 ← -200

0010 1110

32 15 47

1101 1100

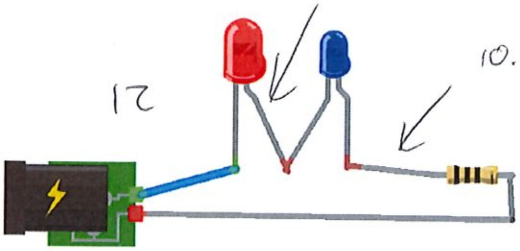
0010 0100

Problem 4 – Resistor sizing

You have 2 LEDs with different specifications and you have decided to run them in a series circuit using a 12 volt power supply.

$12 - 1.9 = 10.1$ V

$10.1 - 2.3 = 7.8$ V



What size resistor do you need if the LEDs have the specifications:

	Forward Voltage Drop	Maximum current
LED 1	1.9 volts	25 mA
LED 2	2.3 volts	30 mA

You'd like to run the circuit safely and choose to target half the smaller max current to play it safe. Calculate the exact target value and then choose the nearest real resistor size from the E12 series. Then determine the color bands that you would expect to find on that resistor

$$V = iR$$

$$7.8 = \frac{0.025}{2} R$$

$$R = 624\ \Omega$$

560 Δ 64

624 ↗

680 Δ 56 ✓

Exact resistor value calculated

624 Ω

Real resistor value

680 Ω

Color bands for that real resistor (for example Yellow-Blue-Yellow):

Blue - Gray - Brown