ECE 376 - Homework #2

Assembler, Binary Inputs, Counters

Assembler Programming

1) Determine the contents of registers W, A, and B after each assembler command:

Command	W	A	B
; Start	13	11	9
addwf A, W	24	11	9
subwf B,W	-15 (241)	11	9
movwf B	-15 (241)	11	-15 (241)
movlw 17	17	11	-15 (241)
subwf A,F	17	-6 (250)	-15 (241)
negf B,F	17	-6 (250)	15

2) Convert the following C code to assembler (8-bit operations)

```
; unsigned char A, B, C;

A       equ     1
B       equ     2
C       equ     3

; C = 4*A - 3*B + 7;

        movlw   7

        addwf   A,W
        addwf   A,W
        addwf   A,W
        addwf   A,W

        movwf   C

        movf    B,W
        subwf   C,F
        subwf   C,F
        subwf   C,F
```

Binary Inputs

A thermistor has the following temperature - resistance relationship:

$$R = 2000 \cdot \exp\left(\frac{3905}{T+273} - \frac{3905}{298}\right)\Omega$$

where T is the temperature in degrees C.

3) Design a circuit which outputs

- 0V when T < 10C
- 5V when T > 10C

Assuming a voltage divider with R = 3.3k

At 10C

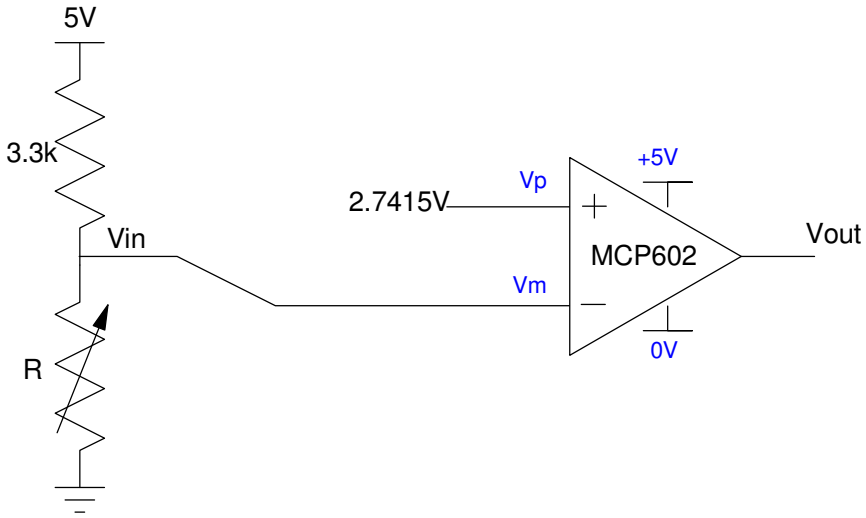
$$R = 4005.65\Omega$$

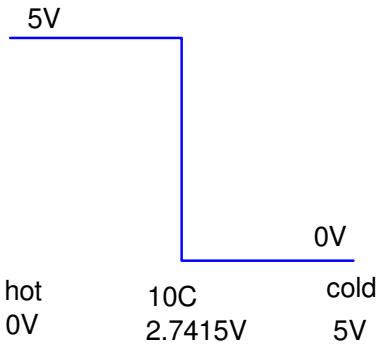
$$V_{in} = 2.7415V$$

When it's really hot...

- R goes to zero
- Vin goes to 0V
- Vout goes to +5V

Connect to the minus input





4) Design a circuit which outputs

- 0V when T < 10C
- 5V when T > 15C
- No change for 10C < T < 15C

Assuming a 3.3k resistor for the volage divider

At 10C (Vout = 0V)

$$R = 4005.65\Omega$$

$$V_{in} = 2.7415V \text{ (Voff)}$$

At 15C (Vout = 5V)

$$R = 3152.35\Omega$$

$$V_{in} = 2.4428V \text{ (Von)}$$

Von < Voff

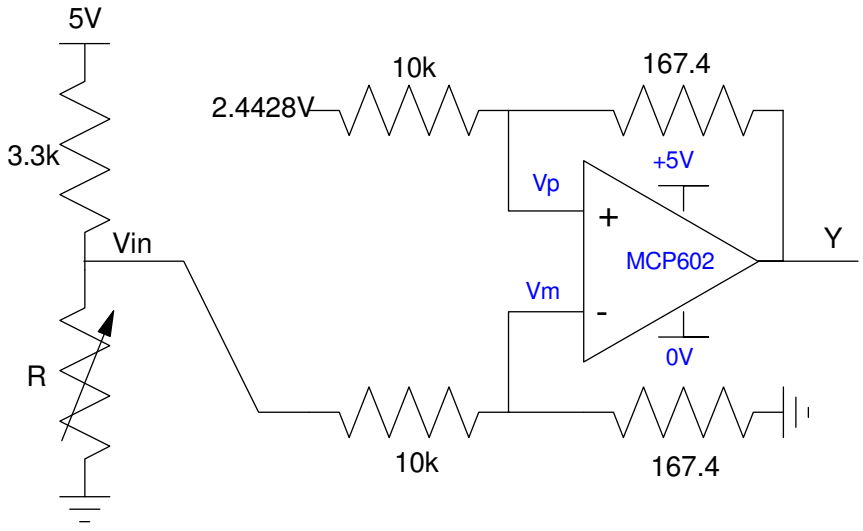
- Connect to the minus input

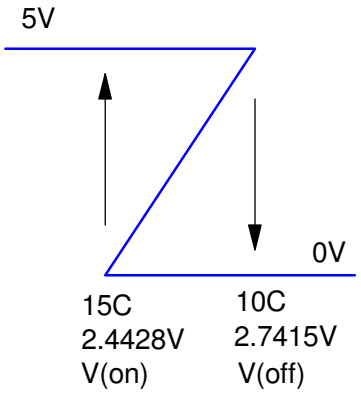
Von = 2.4428V

- make the offset 2.4428V

Gain:

$$gain = \left(\frac{5V-0V}{2.7415V-2.4428V}\right) = 16.74$$





Flow Charts & Counters

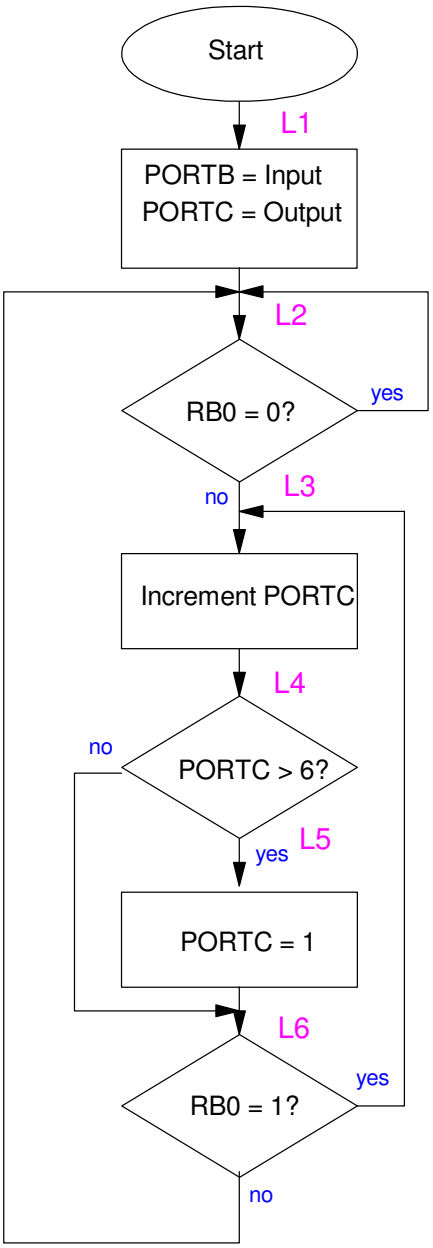
5) The flow chart below turns your PIC into a 6-sided die roll generator

- When you press and release RB0, a random number in the range of (1..6) is displayed on PORTC

Write the corresponding assembler code.

```
org 0x800

        movlw   0x0F
        movwf   ADCON1
L1:
        clrf    TRISC
        movlw   0xFF
        movwf   TRISB
L2:
        btfss   PORTB,0
        goto    L2
L3:
        incf    PORTC,F
L4:
        movlw   6
        cpfsgt  PORTC
        goto    L6
        goto    L5
L5:
        movlw   1
        movwf   PORTC
L6:
        btfsc   PORTB,0
        goto    L3
        goto    L2
```



Problem 5: 6-Dided Die

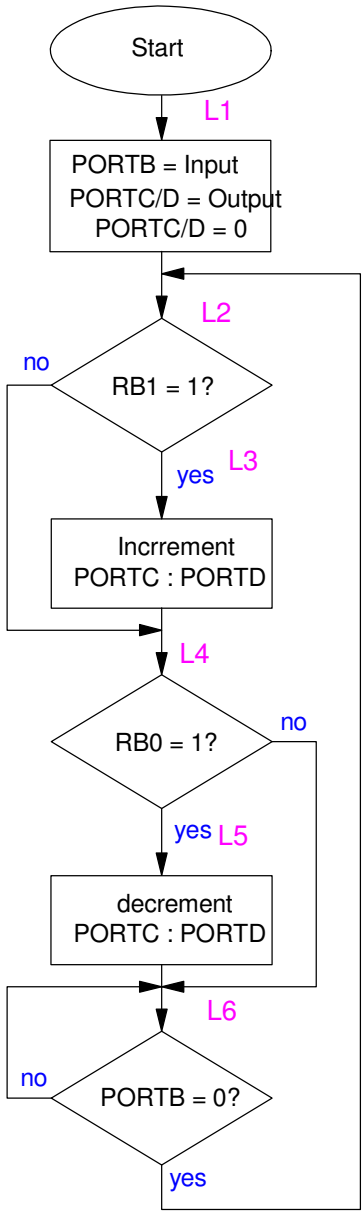
6) The flow chart below turns your PIC into a 16-bit up/down counter

- RB1: Count up by one every time RB1 is pressed and released
- RB0: Count down by one every time RB0 is pressed and released
- PORTC : PORTD display the count as a a 16-bit number (0 - 65,535)

Write the corresponding assembler code

```
org 0x800

        movlw   0x0F
        movwf   ADCON1
L1:
        movlw   0xFF
        movwf   TRISB
        clrf    TRISC
        clrf    TRISD
        clrf    PORTC
        clrf    PORTD
L2:
        btfss   PORTB,1
        goto    L4
L3:
        movlw   1
        addwf   PORTD,F
        movlw   0
        addwfc  PORTC,F
L4:
        btfss   PORTB,0
        goto    L6
L5:
        movlw   1
        subwf   PORTD,F
        movlw   0
        subwfb  PORTC,F
L6:
        movlw   0
        cpfseq  PORTB
        goto    L6
        goto    L2
```



Problem 6: Up/Down Counter