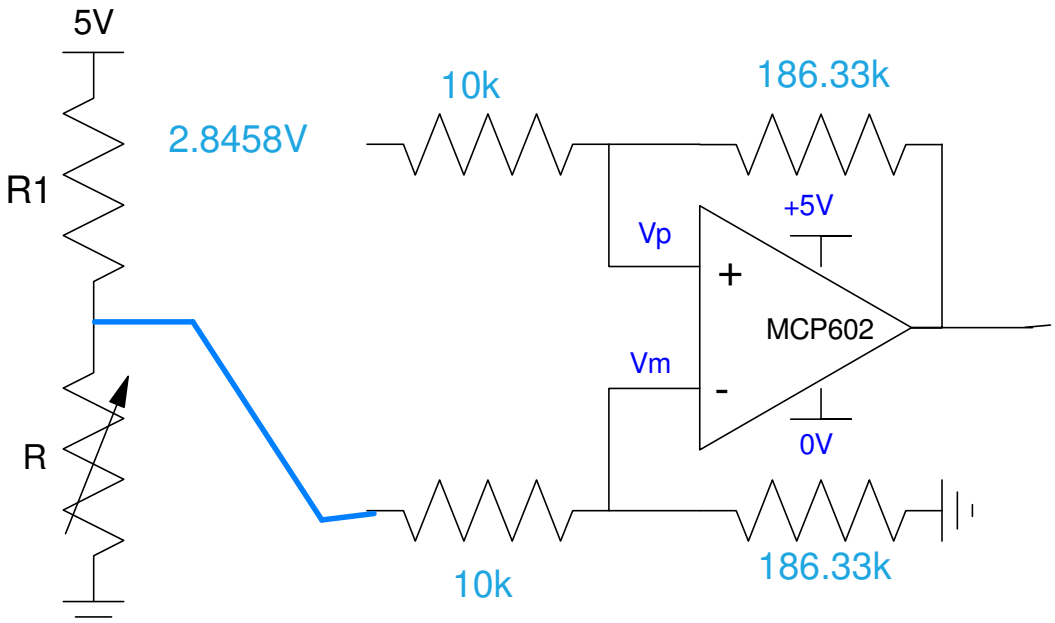
ECE 376 - Test #1: Name _____

1) **Digital Inputs.** Design a circuit which outputs

- 0V when R > 2500 Ohms
- 5V when R < 2000 Ohms

Assume

- R1 = 900 + 100*(your birth month) + (your birth date).
- May 14th, for example, gives R1 = 1414 Ohms



Let R1 = 1514 Ohms

R = 2000 Ohms (on)

$$V = \left(\frac{2000}{2000+1514}\right)5V = 2.8458V$$

R = 2500 Ohms (off)

$$V = \left(\frac{2500}{2500+1514}\right)5V = 3.1141V$$

V(on) < V(off)

- connect to the minus input

V(on) = 2.8458V

- Make the offset 2.8458V

$$gain = \left(\frac{\text{change in output}}{\text{change in input}}\right) = \left(\frac{5V-0V}{3.1141V-2.8458V}\right) = 18.633$$

2) Digital Outputs: Design a circuit which allows your PIC to turn on and off a 20W LED at N Lumens

- N = 900 + 100*(your birth month) + (your birth date)
- N = 1414 Lumens for May 14th, for example

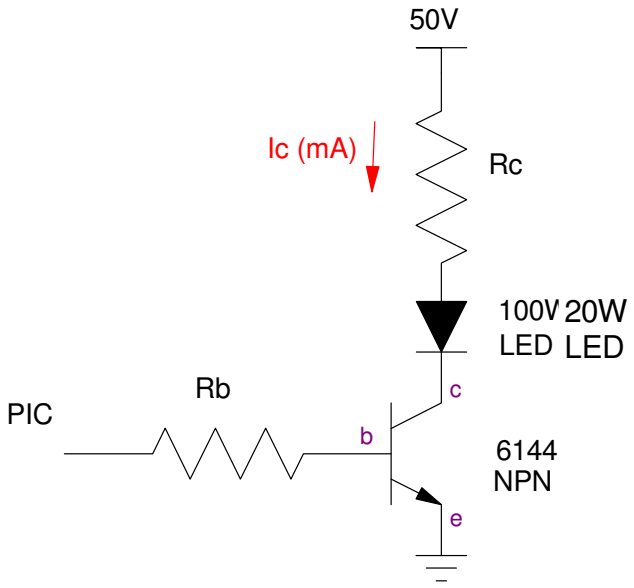
Assume a 20W LED has the following characteristics

- Vf = 36V @ 600mA
- 1800 Lumens @ 600mA

Assume a 6144 NPN transistor

- Vbe = 700mV
- Vce(sat) = 360mV
- Current gain = β = 200

Lumens 900 + 100*Month + Day	Ic (mA)	Rb	Rc
1514 Lumens	**504.67mA**	**430 Ohms**	**27.03 Ohms**



$$I_c = \left(\frac{1514\ \text{Lumens}}{1800\ \text{Lumens}}\right) 600mA = 504.67mA$$

$$R_c = \left(\frac{50V - 36V - 0.36V}{504.67mA}\right) = 27.03\Omega$$

To saturate the transistor

$$I_b > \left(\frac{I_c}{\beta}\right) = \left(\frac{504.67mA}{200}\right) = 2.52mA$$

Let Ib = 10mA

$$R_b = \left(\frac{5V - 0.7V}{10mA}\right) = 430\Omega$$

3) **Assembler:** Determine the contents of the W, PORTB, and PORTC registers after each operation. Assume

- PORTB and PORTC are output.
- Default is decimal

	W	PORTB	PORTC
Start:	Birth Month (1..12) **5**	Birth Date (1..31) **14**	**15**
incf PORTB,F	5	**15**	15
decf PORTC,W	**14**	15	15
addwf PORTB,F	14	**29**	15
andlw 7	**6**	29	15
bsf PORTB,4	6	**29**	15
bcf PORTC,2	6	29	**11**
movlw 7	**7**	29	11
addwf PORTB,F	7	**36**	11
subwf PORTC,F	7	36	**4**
clrf PORTB	7	**0**	4

4) Assembler & Timing:

a) Convert the following C code to assembler.

- Assume A, B, and C are 8-bit numbers

b) How long does your program take to execute?

Clocks =

```
unsigned char A, B, C;

if(A > B)
     C = A;
else
     C = B;
```

```
A    equ       0
B    equ       1
C    equ       2

     movf      B,W
     cmpfsgt   A
     goto      PickB
PickA:
     movff     A,C
     goto      end
PickB:
     movff     B,C
end:
     nop
```

Number of Clocks:

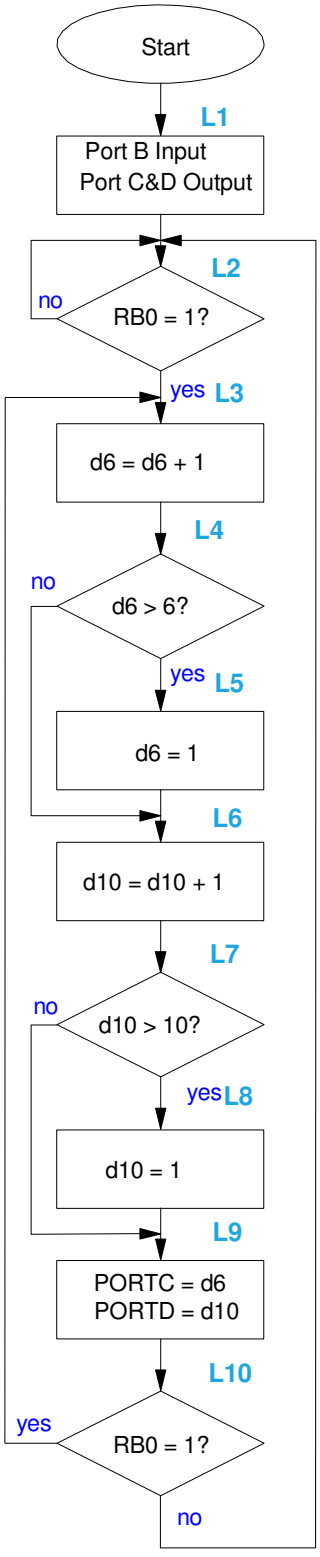
- if (A > B) it takes 7 clocks to execute
- otherwise, it takes 6 clocks to execute

5) Assember & Flow Charts. Write an assembler program that corresponds to the following flow chart. This program turns your PIC processor a 6 and 10 sided die:

- When RB0 is pressed and released
- PORTC displays a random number from 1..6 (six-sided die)
- PORTD displays a random number from 1..10 (ten-sided die)
- d6 and d10 are 8-bit variables in RAM

Test #1: (due Friday) Write the assembler code

Bonus (due Monday): Demonstrate your program on your PIC board




```
#include <p18f4620.inc>

d6   equ       0
d10  equ       1

; Start of Program
     org       0x800

L1:
     movlw     0xFF
     movwf     TRISB
     clrf      TRISC
     clrf      TRISD
L2:
     btfss     PORTB,0
     goto      L2
L3:
     incf      d6,F
L4:
     movlw     6
     cmpfsgt   d6
     goto      L6
L5:
     movlw     1
     movwf     d6
L6:
     incf      d10,F
L7:
     movlw     10
     cpfsgt    d10
     goto      L9
L8:
     movlw     1
     movwf     d10
L9:
     movff     d6,PORTC
     movff     d10,PORTD
L10
     btfsc     PORTB,0
     goto      L3
     goto      L2
```