ECE 376 - Final Exam: Name ____________________

Open-Book, Open Note, Calculators and Matlab permitted. Individual Effort.

1) Binary Inputs: Assume a 6411 NPN transistor (if needed)

- Vbe = 0.7V
- Vce(sat) = 0.2V
- β = 300
- max(Ic) = 6A

1a) Give a circuit which allows a PIC to turn on and off a 20mW LED at 10mA

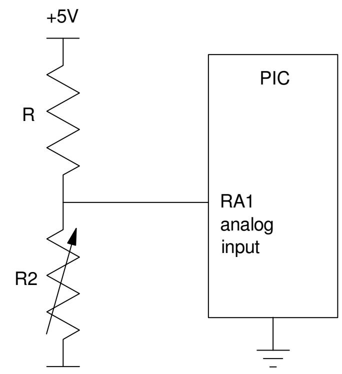
- Id = 10mA
- Vd = 2.0V

1b) Give a circuit which allows a PIC to turn on and off a 30W LED

- Vd = 15.0V
- Id = 2.0A

2) Analog Inputs: A CdS light sensor has the following resistance - lux (light intensity) relationship

$$R_2 = 1000 \cdot \left(\frac{10}{Lux}\right)^{0.6} \text{ Ohms}$$



If the room is 100 Lux, determine

- The resistance,
- The voltage,
- The A/D reading, and
- The resolution (the smallest change in Lux you can detect)

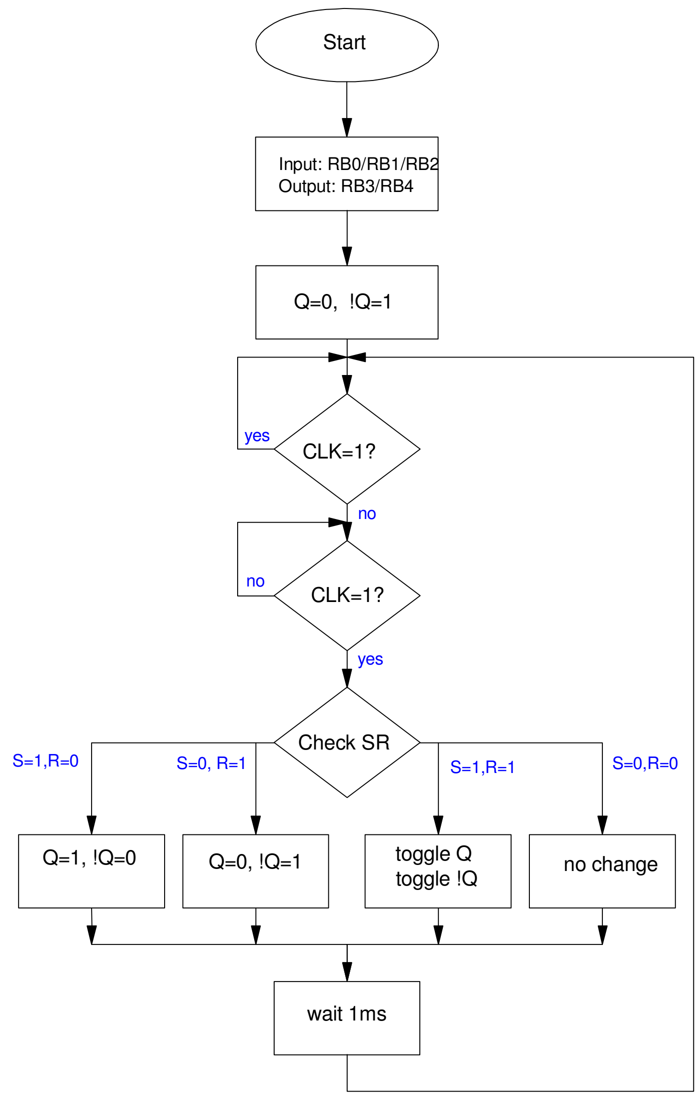
with the following circuit. Assume

- R = 900 + 100*(your birth month) + (your birth date)

R 900 + 100*mo + day	A/D reading 0..1023	Voltage votlage at 100 Lux	R resistance at 100 Lux	Resolution smallest change in Lux you can measure

3) C-Coding: Write a C progra to turn your PIC into a $65 SR flip flop. Assume the following pin assignments

PORTB							
RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0
-	-	-	Q output	!Q output	S input	R input	CLK input



4) C Coding with Analog Inputs: Assume a temperature sensor is connected to a PIC so that the A/D reading is 10x the temperature in degrees F.

Write a C program which turns on and off a fan connected to RC0 based upon the temperature

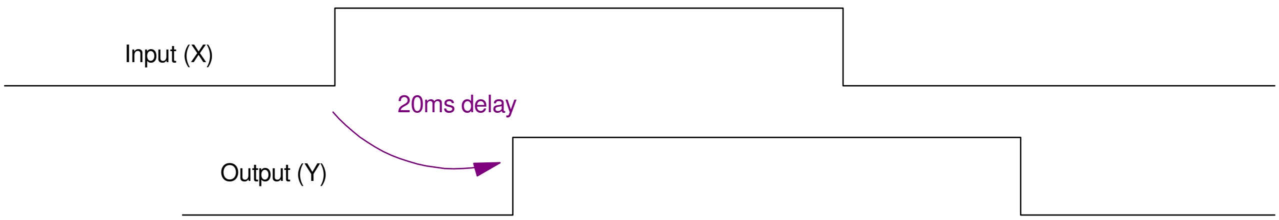
Temperature	A/D reading	% On	On-Time (RC0)	Off-Time (RC0)
T > 85F	850 - 1023	100%	always on	
80F < T < 85F	800 - 849	75%	45 seconds	15 seconds
75 < T <80	750 - 799	50%	30 seconds	30 seconds
70 < T < 75	700 - 749	25%	15 seconds	45 seconds
T < 70	0 - 699	0%	-	always off

```
void main(void)
{

// Initialize the A/D port
   TRISA = 0xFF;
   TRISE = 0x0F;
   ADCON2 = 0x85;
   ADCON1 = 0x07;
   ADCON0 = 0x01;

   while(1) {
```

5) 20ms Delay (take 1): Using one or more Timer and/or INT interrupts, write the interrupt service routine for a C program which

- Reads in X, a TTL signal (0V/5V), and
- Outputs Y, the same waveform with a 20ms delay.

Assume each edge is more than 20ms apart



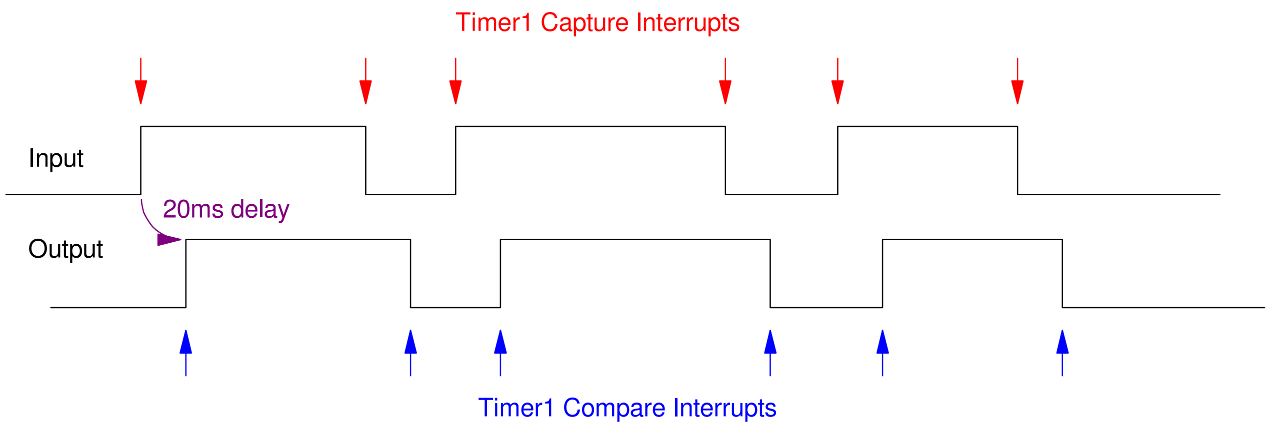
Input Pin (your pick)	Output Pin (your pick)	Pre-scalar assumed if needed

```
// Global Variables (if needed)



// Interrupts service routine

void interrupt IntServe(void) {
```

6) 20ms Delay (take 2 - Capture / Compare Interrupts): Write a program which uses Capture & Compare interrupts to

- Output a waveform (Y) which is identical to X, only
- Y is delayed by 20ms

Assume each edge is more than 20ms apart



Timer1 Interrupt assume pre--scalar = 8	Capture1 (Input)	Compare2 (Output)
`if(TMR1IF) {`	`if (CCP1IF) {`	`if(CCP2IF) {`