ECE 376 - Test #2: Name ______________________

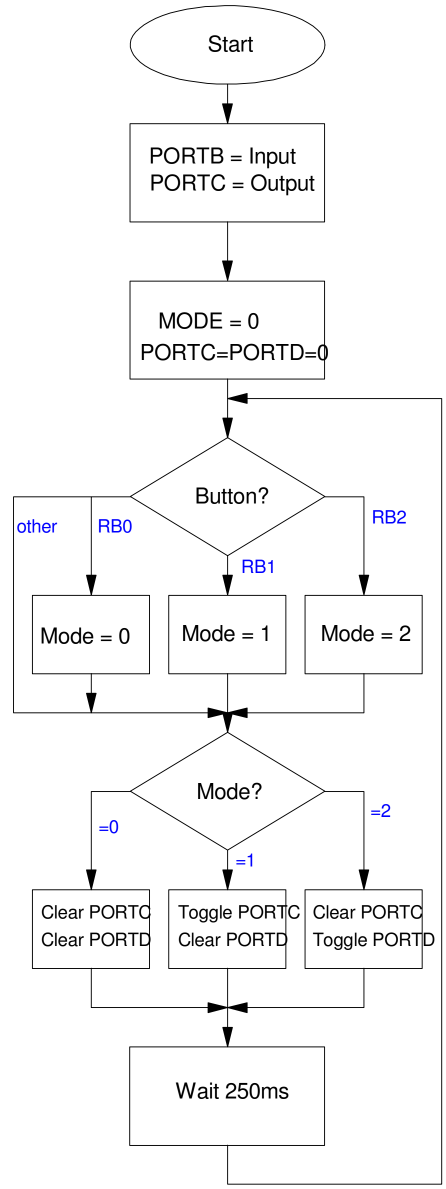
C-Programming on a PIC Processor

Flow-Charts & C Programming

1) (25pt) The following flow chart turns your PIC into a tail-light controller:

- When RB0 is pressed, the lights on PORTC and PORTD turn off.
- When RB1 is pressed, the lights on PORTC blink every 250ms (left turn)
- When RB2 is pressed, the lights on PORTD blink every 250ms (right turn)

Write the corresponding C code



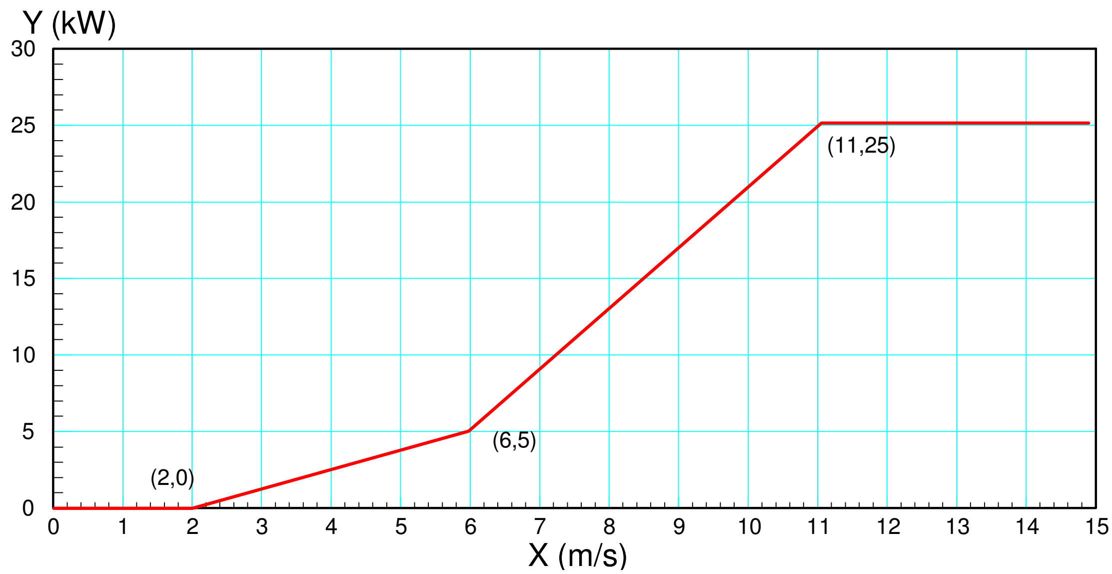

```
void main(void) {

     unsigned int Mode;

     TRISB = 0xFF;
     TRISC = 0;
     ADCON1 = 0x0F;

     Mode = 0;
     PORTC = 0;
     PORTD = 0;

     while(1) {

          if(RB0) Mode = 0;
          if(RB1) Mode = 1;
          if(RB2) Mode = 2;

          if(Mode == 0) {
               PORTC = 0;
               PORTD = 0;
               }
          if(Mode == 1) {
               PORTC = !PORTC;
               PORTD = 0;
               }
          if(Mode == 2) {
               PORTC = 0;
               PORTD = !PORTD;
               }

          Wait_ms(250);

          }
```

C-Programming:

2) (25pt) Write a C subroutine which is

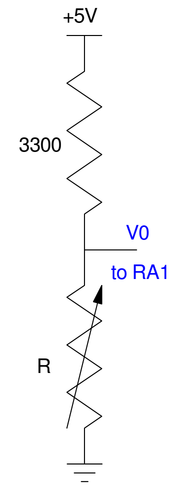
- Passed X (a floating point number in the range of 0.0 to 15.0), and
- Returns Y (a floating point nuber in the range of 0.0 to 25.0)

Assume the relationship between X and Y is as follows:




```
float Problem2(float X) {

     float(Y);

     if(X < 2) Y = 0;

     else if(X < 6) Y = 1.25*X - 2.5;

     else if(X < 11) Y = 4*X - 19;

     else Y = 25;

     return(Y);
```

Analog Inputs



3) (25pt) Assume the A/D input to a PIC processor has the following hardware connection where R is a 3k thermistor where T is the temperature in degrees C

$$R = 2200 \cdot \exp\left(\frac{4100}{T+273} - \frac{4100}{298}\right)\Omega$$

Let T be your birth date (1..31) in degrees C

At this temperature, determine

- The resistance, R,
- The voltage, V0,
- The A/D reading, and
- The smallest change in termperature you can detect

T (degees C) birth date (1..31)	R Ohms	V0 Volts	A/D Reading 0 .. 1023
14	3737.66 Ohms	2.652 V	542

$$R = 2200 \cdot \exp\left(\frac{4100}{T+273} - \frac{4100}{298}\right)\Omega$$

$$R = 3737.66\Omega$$

$$V_0 = \left(\frac{R}{R+3300}\right)5V = 2.652V$$

$$A/D = \left(\frac{V_0}{5}\right)1023 = 542.6$$

t-Tests

4) (13pt) 100,000 poker hands are dealt. The number of hands with a 2-pair are:

- # hands = {4692, 4773, 4646}
- mean = 4703.7
- st dev = 64.30

Based upon this data,

a) What is the 95% confidence interval for the number of times you'll be dealt a 2-pair in 100,000 poker hands (individual test).

From the t-table with 2 degrees of freedom, the t-score with 2.5% tails is 4.303

$$\bar{x} - 4.303s < N < \bar{x} + 4.303s$$

$$4703.2 - 4.303 \cdot 64.3 < N < 4703.7 + 4.303 \cdot 64.3$$

$$\boxed{4426.5 < N < 4979.88}$$

b) What is the 95% confidence interval for the probability of being dealt a 2-pair in poker? (population question)

$$\bar{x} - 4.303\left(\frac{s}{\sqrt{3}}\right) < N < \bar{x} + 4.303\left(\frac{s}{\sqrt{3}}\right)$$

$$4542.45 < N < 4862.94$$

for 100,000 hands. Divide by 100,000 to get probabilities

$$\boxed{4.54245\% < p < 4.86294\%}$$

(from Wikipedia, the actual odds for being dealt a 2-pair are 4.754%)

Student t-Table (area of tail)									
df \ p	0.1%	0.25%	0.5%	1%	2.5%	5%	10%	15%	20%
1	-636.619	-318.309	-63.657	-31.821	-12.706	-6.314	-3.078	-1.963	-1.376
2	-31.599	-22.327	-9.925	-6.965	-4.303	-2.92	-1.886	-1.386	-1.061
3	-12.924	-10.215	-5.841	-4.541	-3.182	-2.353	-1.638	-1.25	-0.979
4	-8.61	-7.173	-4.604	-3.747	-2.776	-2.132	-1.533	-1.19	-0.941
5	-6.869	-5.893	-4.032	-3.365	-2.571	-2.015	-1.476	-1.156	-0.92

Chi-Squared Test

5) (12pt). Suppose there are ten people in class. All ten of you raise your hands to answer a question at the same time, but you're not picked.

Use a chi-squared test to determine how many times you have to be not-picked before you can be 95% certain that people are not being called on at random (everyone has a 10% chance of being picked)?

Set this up as two bins:

- I'm selected (p = 10%)
- I'm not selected (p = 90%)

bin	p	np	N	chi-squared
selected	0.1	0.1n	0	$\left(\frac{(0.1n-0)^2}{0.1n}\right) = 0.1n$
not selected	0.9	0.9n	n	$\left(\frac{(0.9n-n)^2}{0.9n}\right) = 0.011n$
		Total		$0.1111n$

From a chi-squared table with one degree of freedom, a 95% chance corresponds to a chi-squared score of 3.84

$$0.1111n = 3.84$$

$$n = 34.56$$

If I'm overlooked 34.56 times in a row, I'll be 95% certain that people are not being selected at random.

Chi-Squared Table

Probability of rejecting the null hypothesis

dof	99.5%	99%	97.5%	95%	90%	10%	5%	2.5%	1%	0.5%
1	7.88	6.64	5.02	3.84	2.71	0.02	0	0	0	0
2	10.6	9.21	7.38	5.99	4.61	0.21	0.1	0.05	0.02	0.01
3	12.84	11.35	9.35	7.82	6.25	0.58	0.35	0.22	0.12	0.07
4	14.86	13.28	11.14	9.49	7.78	1.06	0.71	0.48	0.3	0.21
5	16.75	15.09	12.83	11.07	9.24	1.61	1.15	0.83	0.55	0.41