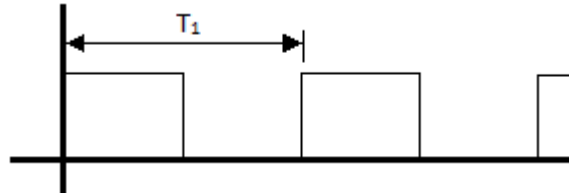1. The program below runs on the AT89C51CC03 and produces the signal shown on P3.2.  If $T_1 = 84\mu sec$ what is the crystal speed.  For full credit show all work.

```
#include<at89c51cc03.h>
void Timer();
void main(void)
   {CKCON = 0x01;
    TMOD = 0x02;
    TH0 = 128;
    TR0 = 1;
    ET0 = 1;
    EA = 1;
    while(1);
   }
//

void Timer() interrupt 1 using 1
  {P3 = P3 ^ 4;
  }
```



2. The character 'U' has an ASCII code of 0x55 = 0101 0101.  An AT89c51CC03 has been set up to send 'U' continuously to the serial port.  An oscilloscope shows that the serial port has the signal shown.  Answer the questions below.  For full credit show your work.
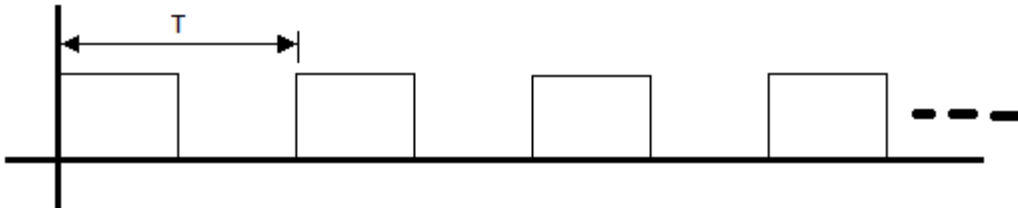


   A) If T = 416.667 µsec what is the baud rate?


   B) Assuming that the baud rate is 1200 baud what value would need to be loaded into RCAP2H, RCAP2L if the system is double clocked and the crystal is 24 MHz?


3. Show how to declare an array of type unsigned char named *data* that has 10 rows and 6 columns in external data memory using C for the AT89C51CC03.

4. What, if anything, is wrong with the following C sequence running on the AT89C51CC03?

```
code int x = 0x1234;
void main()
  {unsigned char y = 34;
   x = y;
   P1 = y;
   ...
  }
```

5.  Rewrite each of the following using bit operators.

A) `P1 = P1 & 0xF9;` | B) `P2 = P2 ^ 0x5;` | C) `P3 = P3 | 0x81;`

6. A potentiometer is connected to the A/D converter on channel 0.  The pot voltage varies from 0 to 2.5 volts and the reference voltage for the A/D is also 2.5 volts.  If the potentiometer is at 1.398 volts and we do a 10 bit A/D conversion what will be the numbers in ADDH and ADDL?

7. If I want to declare a one-dimensional array of N elements on the AT89C51CC03 I can use one of the following to do so:

```
        a) code unsigned char x[N];
        b) xdata usngined char x[N];
        c) unsigned char x[N];
```

Suppose I choose to use option a).  What are the implications for the data stored in x?

8. Write a C language sequence to output the upper byte of the unsigned integer variable $x$ to port P1 and lower byte to port P0.

9. In the diagram below assume that 8 LEDs have been connected to $x_7 - x_0$ which are driven by the port pins shown. Write a *function* named SendX which returns a void and accepts an single unsigned char argument named *b*. Your function should assign the bits of the argument *b* to the appropriate port so that $b_7 \to x_7$, $b_6 \to x_6$ ... $b_0 \to x_0$. Your function should not alter any other bits on P1 or P3.

```
P3.0
P3.1

P1.0
P1.1
P1.2
P1.3
P1.4
P1.5
P1.6
P1.7

          X7  X6  X5  X4  X3  X2  X1  X0
```
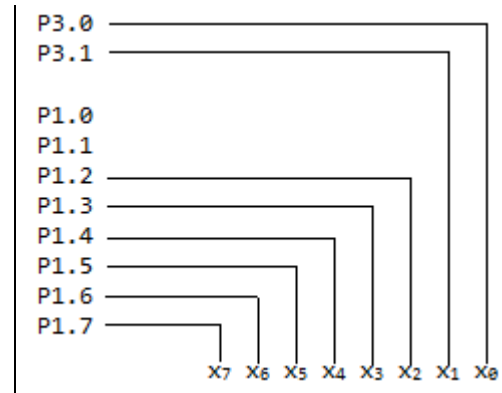
10. An array named *data* has been declared an initialized in code memory as:
code unsigned char data[] = {5,4,9, 33, … };
The array has 500 values. Write a program to send the data in this array sequentially to P2 every 2 milliseconds. You may assume that you can get a 2 msec delay by calling the function *Delay(2);*