

c. (20 pts) For the switch configuration shown in Figure (a), implement the flowchart of Figure(b) using an interrupt to handle the button on the RB2 input. Use semaphores controlled by the ISR to tell the *while(1)* loop in the main() program to blink, turn on or turn off the LED.

1. (13 pts) ISR code

2. (7 pts) *main()* code, be sure to configure and enable your interrupt.

d. (7 pts) Assume an asynchronous serial channel with a data format of 1 start bit, 8 data bits, and 2 stop bits between characters. Assume the PIC has an FOSC of 40 MHz. How many instruction cycles will take for the UART on the PIC to overflow for a baud rate of 19200?

e. (7 pts) Write C code that implements the *char getch(void)* function (read one character from the serial port). *No interrupts are enabled.*

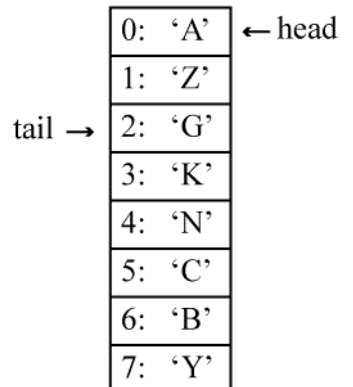
f. (9 pts) Assume the definitions of a circular buffer that we have used in lab (i.e, the head pointer is used to place data into the buffer, the tail pointer is used to take data out of the buffer, the buffer is empty when head is equal to tail, and that pointers are incremented and wrapped before used to access the buffer).

f1. From figure F, how many characters are currently *available* in the buffer? (this is not the total number of locations in the buffer) _____

f2. From figure F, what character is returned if the buffer is read?

f3. From figure F, what location is modified if one character is written to the buffer? _____

Problem (f)



g. (9 pts) Given the code below and Figure (g), answer the questions – assume that the switches do NOT bounce. You MUST JUSTIFY your answer or no credit is given.

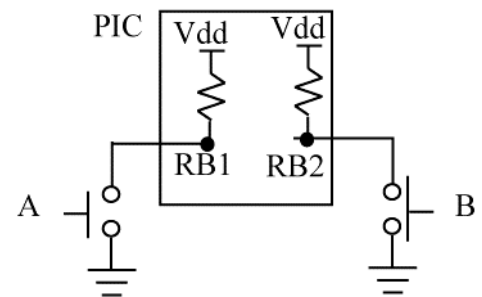
g.1 Assume the PIC is powered on, and then Button A is pressed and released, then Button B is pressed and released. At this point, what is the value of count?

g.2 Assume the PIC is powered on, and then Button B is pressed and released *twice*, then Button A is pressed and released. At this point, what is the value of count?

g.3 Assume the PIC is powered on, and then Button A is pressed and released *twice*, then Button B is pressed and released. At this point, what is the value of count?

```
interrupt isr() {
    if (INT1IF) {
        INT1IF = 0; INT1IE = 0; INT2IE = 1;
        count++;
    }
    if (INT2IF) {
        INT2IF = 0; INT2IE = 0; INT1IE = 1;
        count++;
    }
}
main() {
    RBPU = 0; TRISB = 0xFF;
    IPEN = 0; INTEDG1 = 1; INTEDG2 = 1;
    INT1IF = 0; INT2IF = 0;
    INT1IE = 0; INT2IE = 1;
    count = 0;
    PEIE = 1; GIE = 1;
    while (1){
    }
}
```

Problem (g)

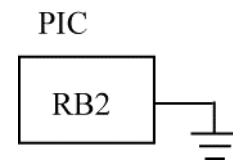


- h. (8 pts) In the code below, there are two possibilities about what can happen, depending upon how fast the user hits a key after the message is printed. Explain both scenarios.

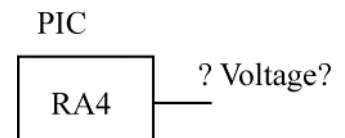
```
main() {
    char c;
    serial_init(95,1); // 19200 in HSPLL mode, crystal = 7.3728 MHz
    printf("Howdy!"); pcrLf();
    while (1) {
        printf("Hit any key: ");
        SWDTEN = 1;
        getch();
        asm("sleep");
        SWDTEN=0;
        pcrLf();
    } //end while()
} //end main()
```

Part II: (20 pts) Answer 5 out of the next 7 questions. Cross out the 2 questions that you do not want graded. Each question is worth 4 pts.

1. In the diagram below, Port RB2 is configured as an OUTPUT. If I write a '1' to RB2, using "RB2 = 1", what is returned (0 or 1) if I read RB2? if I read LATB2?



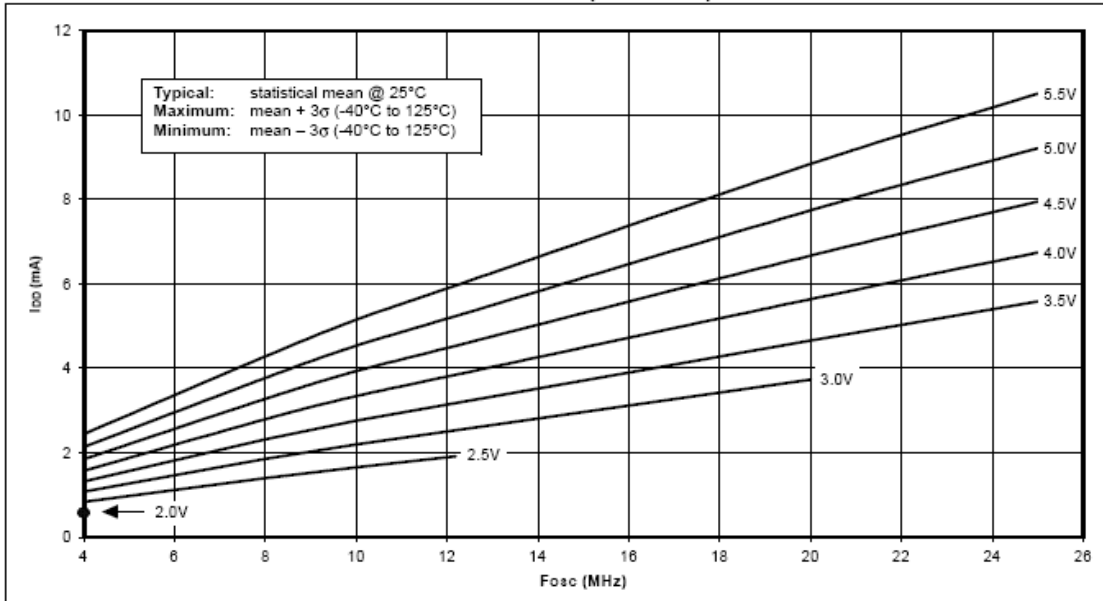
2. Assume that RA4 has been configured to be a digital output. RA4 is an OPEN-DRAIN output on the PIC. If I write a '0' to RA4 (RA4 = 0), what voltage will I read on the output? If I write a '1' to RA4 (RA4 = 1), what voltage will I read on the output?



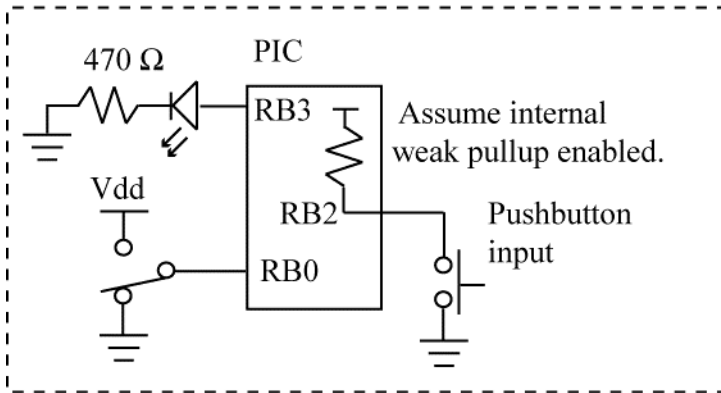
6. Draw a diagram that clearly shows how you monitor TOTAL current draw in your breadboard PIC18 system.

7. In the diagram below, it is clear that lowering the voltage and lowering the clock frequency reduces current draw. Why does the graphs for 2.5V, 3.0V not extend past 24MHz like the other curves? Explain.

FIGURE 23-1: TYPICAL I_{DD} vs. F_{OSC} OVER V_{DD} (HS MODE)



Problem (a)



Problem (b)

