4. Answer the following questions about your project solution.

a. On your project, what pin did you use for the de-integrator control?

PB0

b. On your project, what pin did you use to monitor the liquid level capacitor voltage?

PC7

c. On your project, what pin did you use to monitor the light sensor?

PE0

d. Show the code needed to completely configure (system control, GPIO, peripherals) the liquid-level measuring setup.

```
#define PCSEVEN 128
#define DEINT 1
#define DEI (*((volatile uint32_t *)(0x42000000 + (0x400FE108-0x40000000)*32 + 0*4)))

void initHw()
SYSCTL_RCC_R = SYSCTL_RCC_XTAL_16MHZ | SYSCTL_RCC_OSCSRC_MAIN |
SYSCTL_RCC_USESYSDIV | (4 << SYSCTL_RCC_SYSDIV_S);

SYSCTL_RCGCGPIO_R=01;
SYSCTL_RCGCACMP_R=1;
SYSCTL_RCGCTIMER_R |= SYSCTL_RCGCTIMER_R1;
SYSCTL_RCGCGPIO_R |= SYSCTL_RCGCGPIO_R2 | SYSCTL_RCGCGPIO_R
_delay_cycles(3);
GPIO_PORTC_DIR_R &= ~PCSEVEN;
GPIO_PORTC_DEN_R &= ~PCSEVEN;
COMP_ACREFCTL_R = 0x620F;
COMP_ACCTL0_R = 0x040C;
waitMicrosecond(10);
GPIO_PORTB_DIR_R |= DEINT;
GPIO_PORTB_DEN_R |= DEINT;
PEI = 1;
DEI = 0;

TIMER1_CTL_R &= ~TIMER_CTL_TAEN;
TIMER1_CFG_R = TIMER_CFG_32_BIT_TIMER;
TIMER1_TAMR_R = TIMER_TAMR_TACDIR;
TIMER1_TAILR_R = 40000000;
```

e. How long did you deintegrate the capacitor in your Lab 6 submission?

qty = TIMER1_TAV_R;

Long enough just until comparator output read 1, I would have to debug code to check my timer value.

f. What AINx input is associated with the pin for the light sensor?

AIN3 → PE0

g. Show the code needed to completely configure the ADC to use input x to measure the light level

```
SYSCTL_RCGCADC_R |= SYSCTL_RCGCADC_AD0;
_delay_cycles(16);
ADC0_ACTSS_R &= ~ADC_ACTSS_ASEN3;
ADC0_CC_R = ADC_CC_CS_SYSPLL;
ADC0_PC_R = ADC_PC_SR_1M;
ADC0_EMUX_R = ADC_EMUX_EM3_PROCESSOR;
ADC0_SSCTL3_R = ADC_SSCTL3_END0;
ADC0_ACTSS_R |= ADC_ACTSS_ASEN3;
void setADCSS3Mux(uint8_t input)
{
ADC0_ACTSS_R &= ~ADC_ACTSS_ASEN3;
ADC0_SSMUX3_R = input;
ADC0_ACTSS_R |= ADC_ACTSS_ASEN3;
}
```

```
int readADC0SS3()
{
ADC0_PSSI_R |= ADC_PSSI_SS3;
while(ADC0_ACTSS_R & ADC_ACTSS_BUSY);
while(ADC0_SSFSTAT3_R & ADC_SSFSTAT3_EMPTY);
return ADC0_SSFIFO3_R;
}
```

h. Once reading the voltage on AINx in (f), what was the value associated with a dark condition?

0

i. Once reading the voltage on AINx in (f), what was the value associated with a light condition?

700

j. Write your equation to calculate the light-level percentage:

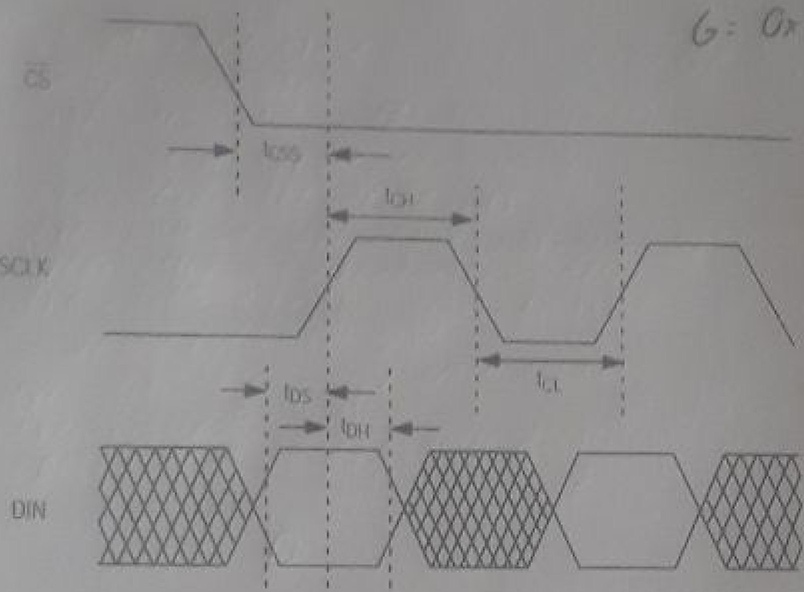
```
float getLightPercentage()
{
float p;
float pp;
setADCSS3Mux(3);
p = readADC0SS3();
pp = (p/7);
return pp;
}
```

Y=2

1 2 3
1 1 1
3 4 5

2. Using SSI port Y, show the system configuration, GPIO (clk, fss, and tx data), and SSI initialization code to clock out data as close as possible to (100+G) kbps with 8 bits data, given fcyc = 20 MHz, and the write only peripheral timing shown below:

G: 0xF7 = 247



Tx=7
FSS=3
clk=4

#define Tx_MASK 128
#define A0_MASK 4
#define FSS_MASK 32
#define CLK_MASK 16

Show all work. Include any other assumptions you make.

100+G = 347 Y = 2

GPIO_PORTB_DIR_R |= TX_MASK | FSS_MASK | CLK_MASK;
GPIO_PORTB_AFSEL_R |= TX_MASK | FSS_MASK | CLK_Mask;
GPIO_PORTB_PCTL_R &= ~(GPIO_PCTL_PB5_M | GPIO_PCTL_PB3_M | GPIO_PCTL_PB0_M);
GPIO_PORTB_PCTL_R |= GPIO_PCTL_PB5_SSI2TX | GPIO_PCTL_PB3_SSI2...
GPIO_PCTL_PB0_SSI2CLK;
GPIO_PORTB_DEN_R |= Tx_MASK | FSS_MASK | CLK_MASK
GPIO_PORTB_PUR_R |= CLK_MASK;

SSI2_CR1_R &= SSI_CR1_SSE
SSI2_CR1_R = 0;
SSI2_CC_R = 0;
SSI2_CPSR_R = 20;
SSI2_CR0_R = SSI_CR0_FRF_MOTO | SSI_CR0_DSS_8;
SSI2_CR1_R |= SSI_CR1_SSE;

3. Suppose the keyboard interrupt example is used. The switch contacts are not perfect, so each key stroke is a sequence of connections and disconnections. Suppose the human performs the same on every key stroke.

5+T = 14

a. Suppose the pattern for the switch contact closure times for each stroke is as follows:

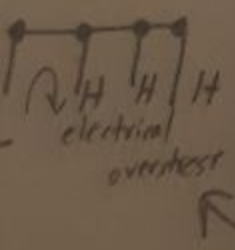
Time for finger to press down and activate key (conduction starts): 40ms
First conduction period of the switch as it is closing for the first time: 10ms
Momentary intermittent switch disconnection after first conduction period: 5+T ms
Stable conduction period of the switch after the momentary disconnection: 50ms
Clean break in contact as finger is removed from switch
Pattern repeats for each key pressed

What is the typing rate of this user? _____

b. To avoid missing keystrokes, what is the slowest rate at which the debounce interrupt could run assuming all other code is unmodified?

c. Explain why open drain outputs are required for driving the keyboard columns.

Open drain output configuration can only pull down the pin, it can't pull up the pin. We use open drain to avoid electrical overstress because for ex: if 2 buttons are pressed in both of these two rows then it shorts.



4. You are asked to use the PWM circuit to drive an active-high load attached to M0PWM output W.

W = 1

a. Completely configure the sys ctrl and GPIO for PWM control.

```
SYSCTL_RCGCPWM_R |= SYSCTL_RCGCPWM_R1;
SYSCTL_RCGCGPIO_R |= SYSCTL_RCGCGPIO_R5;
_delay_cycles(3);
GPIO_PORTF_PCTL_R &= GPIO_PCTL_PF2_M | GPIO_PCTL_PF3_M;
GPIO_PORTF_PCTL_R |= GPIO_PCTL_PF2_M0PWM4 | GPIO_PCTL_PF3_M1PWM
SYSCTL_SRPWM_R = SYSCTL_SRPWM_R1;
SYSCTL_SRPWM_R = 0;
PWM1_2_GENB_R = PWM_1_GENB_ACTCMPBD_ZERO |
PWM_1_GENB_ACTLOAD_ONE;
```

b. Completely configure PWM to control the above pin with a duty cycle resolution of 1%, so that a compare value of 0 is off and 100 is fully on.

```
PWM1_3_GENA_R = PWM_0_GENA_ACTCMPAD_ZERO | PWM_1_GENA_
ACTLOAD_ONE;

PWM1_2_CTL_R = PWM_1_CTL_ENABLE;
PWM1_3_CTL_R = PWM_1_CTL_ENABLE;
```

c. What is the frequency of the PWM signal created in this configuration?

Variable	Value
A	0x1A1049D3
B	0x9290718D
C	0xB83E3215
D	0x3BA1B5F0
E	0x63E3
F	0x2864
G	0xF7
H	0x14
J	0x16
K	0xA
L	0x14
M	0x5E
N	0x67
P	0x57
Q	0xE
R	0x1C
S	0x18
T	9
U	6
V	8
W	1
X	1
Y	2
Z	0