(10) Question 1. Write a C macro that will clear one bit in an I/O port.

#define BIT_CLEAR(port, n) ((port) &= ~(1<<(n)))
#define BIT_CLEAR(port, n) ((port) &= ~bit(n))

The following shows how the macro is expanded.

((PTT) &= ~(1<<7));     // clears PTT bit 7
((PTH) &= ~(1<<3));     // clears PTH bit 3

(5) Question 2. E) All of the above are true.

(5) Question 3. Saying when idle the clock is 1 means use CPOL=1. Since the ADC shifts its new data out on the falling edge of the clock, the 9S12 must shift in on the rising edge.

D) CPOL = 1; CPHA = 1

(35) Question 4. There are two positive-logic switches interfaced to PT1 and PT0.

Part a) Show the initialization ritual.

```c
void Switch_Init(void) {
    asm sei         // make atomic
    DDRP |= 0x03;   // PP1,PP0 are outputs
    PTP &= ~0x03;   // PP1,PP0 are off
    TIOS &= ~0x03;  // PT1,PT0 input captures
    DDRT &= ~0x03;  // PT1,PT0 are inputs
    TSCR1 = 0x80;   // enable TCNT
    TSCR2 = 0x00;   // divide by 1 clock, 42ns resolution is best
    TCTL4 = (TCTL4&0x0F)|0x0A; // falling edges on PT1,PT0
    TFLG1 = 0x03;   // Clear C1F,C0F
    TIE |= 0x03;    // Arm C1F,C0F
    asm cli
}
```

Part b) Show the PT0 input capture0 ISR.

```c
void handleBoth(void){ short difference;
    difference = TC0-TC1;   // which was first?
    if(difference<0){ // PT0 first
        PTP |= 1;         // LED0
    }else if(difference == 0){ // same 42ns
        PTP |= 3;         // both LED0 and LED1
    }else{
        PTP |= 2;         // LED1
    }
}
```

```c
interrupt 8 void TC0handler(void){
    if((TFLG1&0x03) == 0x03){ // both
        handleBoth();
    } else{
        PTP |= 1;  // LED0
    }
    TIE &= ~0x03;  // only first one matters
}
```
Part b) Simple answer handing cases 0,1,2.

interrupt 8 void TC0handler(void) {
  PTP |= 1;       // LED0
  TIE &= ~0x03;   // only first one matters
}

Part c) Show the PT1 input capture1 ISR.

interrupt 9 void TC1handler(void) {
  if((TFLG1&0x03) == 0x03){ // both
    handleBoth();
  } else{
    PTP |= 2;       // LED1
  }
  TIE &= ~0x03;   // only first one matters
}

Part c) Simple answer handing cases 0,1,2.

interrupt 9 void TC1handler(void) {
  PTP |= 2;       // LED1
  TIE &= ~0x03;   // only first one matters
}

(20) Question 5. A signed fixed-point system has a range of values from -99.99 to +99.99 with a resolution of 10^{-2} cm. Note: 10^{-2} equals 0.01.

Part a) The precision is 19999 alternatives, which will fit in 16 bits.
  
  E) short

Part b) Multiply by 0.5 is the same as divide by 2.
  
  Position = Position/2;
  
  With rounding:
  
  if(Position<0){
    Position = (Position-1)/2; // -1.5 rounds to -2
  } else{
    Position = (Position+1)/2; // 1.5 rounds to 2
  }

Part c) The integer part of 4 cm is 400.
  
  Position = Position+400;
  
  With overflow prevention, implementing ceiling:
  
  if(Position<9600){
    Position = Position+400; // normal addition
  } else{
    Position = 9999;         // ceiling
  }

(5) Question 6. A ceramic capacitor has the numbers 123 printed on it.

Part a) Ceramic capacitors are nonpolarized.

Part b) 12*10^3 pF = 12000 pF = 12nF = 0.012 μF.

(20) Question 7. Design an analog circuit with the following transfer function V_{out} = 10*(V_{in}-1).
First, rewrite as \( V_{\text{out}} = 10*V_{\text{in}} - 10 \). Use reference for constant. \( V_{\text{ref}} = 2.5\text{V}. \ V_{\text{out}} = 10*V_{\text{in}} - 4*V_{\text{ref}} \). Use ground to make sum of gains equal to 1. \( V_{g} = 0 \). \ V_{\text{out}} = 10*V_{\text{in}} - 4*V_{\text{ref}} - 5*V_{g} \). \( R_{f}/R_{\text{in}} = 10 \), \( R_{f}/R_{\text{ref}} = 4 \), \( R_{f}/R_{g} = 5 \). A common multiple of 10, 4 and 5 is 100 k\( \Omega \).