Short Answer: (16 points)

1. (4 points) Write a one sentence definition for each of the following:
   a. Tool Chain
      A tool chain is a set of programs commonly run together to compile/perform a task. Each program commonly requires the output from the preceding program.
   b. Makefile
      A Makefile is a recipe (script) for compiling a program.

2. (4 points) What do the following register and bit names stand for in reference to the AT90USB USART datasheet (attached)? Describe what each one does with one sentence in your own words.
   a. RXEn
      Receiver Enable - USART
      This bit in the register enables the USART receiver.
   b. TXCn
      Transmission Complete Flag - USART
      When the USART finishes a transmission, this flag is set in the register.

3. (2 points) Explain in a few sentences the differences between using the UDRE1 bit and the TXC1 bit for knowing if data has been/can be sent using USART1.
   UDRE1 flags if the USART is ready for new data. TXC1 flags once data has completed sending. One says "I'm ready" the other says "I'm done".

4. (4 points) What do the following register and bit names stand for in reference to the AT90USB datasheet (attached)? Also for each write one sentence, in your own words, what each does.
   a. OCR0A
      Output Compare Register A (Timer 0)
   b. CS02:0
      Clock Select (Timer 0)

5. (2 points) Describe the difference between = and == in C.
   = : assigns a value
   == : compares two values for equal
ECE152 Assignment 2

Coding: (80 points)

6. (8 points) Write C statement(s) that will accomplish each of the following:
   a. Clear only bit 3 of register UCSR1A
      \[ \text{UCSR1A} &= \text{Ob1111011} \text{ or } \text{UCSR1A} &= \text{(1<3)} \]
   b. Set only bit 7 of register UCSR1B
      \[ \text{UCSR1B} &= \text{(1<7)} \]
   c. Make only the lowest 3 bits of TCNT0 a 0b101
      \[ \text{TCNT0} &\neq \text{Ob1111100} \]
      \[ \text{TCNT0} &\neq \text{Ob00000101} \]

7. (4 points) Give the proper C syntax for an enum of type states with the options of: idle, running, walking

   \[ \text{typedef enum states} \{ \text{idle, running, walking} \} \]

8. (8 points) Write the correct syntax for a while loop in C that will loop if the value of x is less than 23.

   \[ \text{while}(x < 23) \{ \]
   \[ \quad \]}
   \[ \quad \]}

9. (10 points) Write the correct syntax for an if statement with an else condition. The if condition should be executed if variable y is equivalent to the character q or the character Q. y should be reassigned to the character of z if true and the character a if not true.

   \[ \text{if}(\text{y} = \text{'q'} \) || (\text{y} = \text{'Q'}) \]
   \[ \quad \text{y} = \text{'z'}; \]
   \[ \text{else} \]
   \[ \quad \text{y} = \text{'a'}; \]

10. (12 points) What is the result for each of the following in the format specified? ASCII chart is attached

<table>
<thead>
<tr>
<th>Expression</th>
<th>Binary</th>
<th>ASCII</th>
</tr>
</thead>
<tbody>
<tr>
<td>(0b10101010</td>
<td>0b11110000) &amp; 0b11001100</td>
<td>0b11001000</td>
</tr>
<tr>
<td>0b11111111 &amp; (~1&lt;&lt;4)</td>
<td>0b11101111</td>
<td></td>
</tr>
<tr>
<td>(0b11111111 &amp; 0b11111000)</td>
<td>0b00000010</td>
<td>0b11111010</td>
</tr>
<tr>
<td>'a' &amp; 0b11011111</td>
<td>ASCII: 'A'</td>
<td></td>
</tr>
</tbody>
</table>
11. (14 Points) For every line of the code below, explain what each line does in details. **Do not skip any lines.**

```c
unsigned char SendByteUART (unsigned char data){
    if (0 != (UCSRA & (1 << UDRE1))){
        UDRL = data;
        return(0);
    }
    else{
        return(1);
    }
}

unsigned char SendStringUART(unsigned char *data){
    unsigned char i;
    for (i=0;i<strlen(data);i++)
        SendByteUART(data[i]);
    return(0);
}
```

12. (6 points) Assuming the code in question 11, what would happen if the main function attempted to send the string “All your base are belong to us!” using the SendStringUART() function as written? The system clock is 1MHz (fast) and the USART baud rate is 9600 (slow).

SendStringUART() does not check the exit (return) for SendByteUART(), The first character 'A' would be sent while it was still sending, SendString would quickly attempt to send all other byte with success.

13. (8 Points) How would you change the code in question 11 to allow for proper transmission of the string, “All your base are belong to us!”

Make the SendByteUART() call &
while (SendByteUART(data[i]));
14. (10 points) Write a function that will setup Timer 0 to function with a divide by 256 clock setting and trigger a timer compare match A at a count of 101. The timer should also be set to CTC mode. Leave the external OCOA pin disconnected.

```c
void Init_Timer()
{
    TCRRFA = 0b00000010;
    TCCRB = 0b00000100;
    OCRFA = 101;
}
```

Extra Credit:

1. (4 points) In complete sentences, please explain the hardest thing so far in the course and the easiest.

   **Con**: It is way too early in the morning!

   **Pro**: I love the power of pointers and what I can do with them.