Question 0: Stop… Do not proceed until you have read the entire lab in detail. The following questions come from all parts of the lab. When you meet with a TA to get this worksheet graded they will ask you questions that refer to the entire lab.

Question 1: How much is the "Duty Cycle Change per g" of the accelerometer? _____

Question 2: What is the largest Duty Cycle Change you should theoretically see assuming that you ignore noise (see hints)? _____

Question 3: Record the period and the min/max duty cycle for each axis of the accelerometer using only the affect of gravity (+1g of acceleration).

X-axis:
Period _____ Min Duty-Cycle _____ Max Duty-Cycle_____

Y-axis:
Period _____ Min Duty-Cycle _____ Max Duty-Cycle_____

How do these values compare to the values/formulas in the accelerometer datasheet?

_____
_____
_____

Question 4: What is the highest positive duty cycle you can obtain on both the x-axis and y-axis of the accelerometer at the same time?

X-axis: _____ Y-axis: _____

What is the lowest positive duty cycle you can obtain on the x-axis and the y-axis of the accelerometer at the same time?

X-axis: _____ Y-axis: _____

Question 5: How many possible values are available for the positive duty cycle of a PWM given that we will be using Timer1? _____. Using Timer2? _____.

Question 6: Given that we want a period of 4 ms for the accelerometer, how many counter increments will occur during the period of your accelerometer (See Question 3) given the following prescalars:

Clk/1 _____

Clk/8 _____

Clk/32 _____

Clk/64 _____

Clk/128 _____

Clk/256 _____

Clk/1024 _____

Question 7: Given that we want a period of <15 ms (smaller will eliminate flicker) for outputting your PWM, how many counter increments will occur during the period of your PWM given the following prescalars:

Clk/1 _____

Clk/8 _____

Clk/64 _____

Clk/256 _____

Clk/1024 _____

Question 8: If all the interrupts fired at the exact same time, which interrupt should be serviced first in regards to the needs of the lab? (The interrupts are: Timer0 Output Compare, Timer1 Input Capture, External Interrupt 0, ADC)

Question 9: To generate a PWM we want to use a scale of 0 to X, where X is the highest value equaling a 100% duty cycle. For example we could use 0 to 255, 0 to 64, 0 to 100, where the value of 255, 64, and 100 should equate to a duty cycle of 100%. For all the parts assume you are using Timer0 and that you are using a prescaler of clk/8 assuming the crystal on your prototyping board. Hint: You will need to use a counter value to keep track of the number of output compare interrupts.

A. Derive a formula to determine the time between output compare interrupts (defined as IT) in terms of the OCR0 value. Assume a prescaler of clk/8 and use the crystal value from your prototyping board.

B. Derive a formula to determine the PWM period in terms of IT (time between output compare interrupts) and X.

C. Derive a formula in terms of X to determine the Output Compare Value for Timer0 so that the period of 15ms is maintained. Use a prescaler of clk/8 assuming the crystal on your prototyping board. NOTE: X must be greater than 54 because the prescaler value used above fixes the time between interrupts to ~0.28 ms and 15ms / 0.28 ms per interrupt = 54 interrupts. To fix this limitation you can change the prescaler (which is NOT required for this question).