[**Closed book/notes/calculator**] Show all of your work clearly in the space provided. Be sure to **read each problem carefully**. Note that the exam is double sided. If the math becomes too intense, just set up the equations. You don't need to solve them.

1. (5 points) What must be initialized before using the sei instruction?

2. (5 points) When an interrupt service routine is called, what bit in the SREG is cleared automatically?

3. (5 points) Explain why it is useful to define the ports being used in a file separate from lcdlib.asm file you wrote for lab 5.

4. (10 points) The interrupt jump table should make use of the RJMP instruction. What bad things will happen if the RCALL instruction is used instead of the RJMP instruction?

5. (5 points) Name two sources of interrupts on the ATmega32.

6. (10 points) Identify the appropriate registers/ports that must be configured and indicate what values should be written to each in order to configure the ADC subsystem to generate an interrupt each time an analog to digital conversion of the single input voltage on the most significant bit of PORTA completes. Assume that the ISR for the ADC will only look at the 8 most relevant bits of the analog to digital conversion.

7. (5 points) Assume that the ADC configuration described in the previous question is done correctly and that you can initiate an analog to digital conversion in the normal way. An investigation reveals that the ADC is operating correctly and that your program continues to run normally; however, the interrupt service routine is never executed. What is the most likely reason for the ISR not being executed?

8. (15 points) An analog signal has a voltage of 2.5625 volts. The reference voltage is set to 4 volts. Assuming that the ADLAR bit is cleared, show the values that should be present in the ADCH and ADCL registers upon completion of the ADC. You do not need a calculator to do this problem. Show all of your work.

9. (15 points) Explain in English, pseudocode, or flowchart how to implement an interrupt service routine (labelled adcISR) that toggles the LEDs (turns them on if they were off and vice versa) whenvever the most significant bit of the most recent analog to digital conversion differs in value from the most signficant bit of the previous analog to digital conversion.

You may assume that the label: prevValue refers to a byte of data memory that can be used by your ISR for storing information. Also, the interrupt jump vector for the ADC interrupt contains: jmp adcISR.

10. (25 points) Write a complete program that makes use of the lcdlib.asm and delay.asm libraries you used in lab 5 to display the following message on the LCD: "Easy"

Additional work area for any problem. Clearly identify to which problem the work on this page is related.