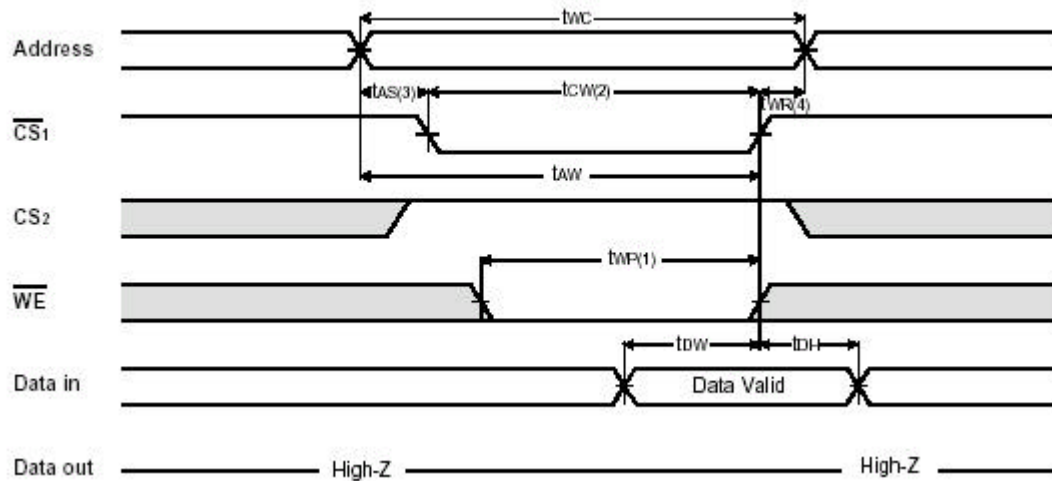Jonathan W. Valvano   First Name: _____ Last Name:_____
November 12, 2003, 1 to 1:50pm
        This is an open book, open notes exam. You may put answers on the backs of the pages, but please don't turn in any extra sheets.

(30) Question 1. Assume the 6812/RAM hardware interface is the same as the one used in Lab25.

TIMING WAVEFORM OF WRITE CYCLE(2) ($\overline{CS}_1$ Controlled)

If t_{DW} were to be 100ns and t_{DH} were to be 0, how many cycle stretches would be required to satisfy the write timing? Show your work.

(15) Question 2. Write C code that reads a 16-bit value from ROM location $FFEE and writes it to RAM location $0910. Use regular C, do not embed assembly language.

(25) Question 3. The goal of this problem is to implement the following digital filter. The sampling rate is 1000Hz, and the ADC is a 10-bit signed -5 to +5V range converter.
$$y(n) = 0.12x(n) + 0.92x(n\text{-}3) - 0.6y(n\text{-}2)$$

(10) Part a) Show the fixed-point equation that implements this filter. No floating point is allowed. Choose integer constants that give an exact implementation with the smallest possible single denominator. (no C code, just a fixed-point equation)

(5) Part b) Assuming the input samples are 10-bit signed numbers (-512 to +511), what precision is required during the calculation of the filter? In particular circle one of the following options:
```
char
short
long
double
```
justify your answer.

(10) Part c) Calculate the DC gain of this filter.

(30) Question 4. The objective of this question is to design the analog electronics to interface a transducer to the 0 to +5V built-on ADC of the 6812. The transducer output is a single voltage (relative to ground, not differential), with a range of 0.5 to 1.0 volts.

(10) Part a) Derive a linear equation that maps the full-scale transducer output to the full-scale ADC input.

(20) Part b) Build this circuit with one op amp and a REF03 2.50V analog reference. You do not need to show the power connections or include an analog low pass filter.