Midterm is **one hour, ten minutes** long, closed book, closed notes, no calculators. To receive full credit on a question show all your work. Incorrect answers may receive partial credit only if the work is shown. The exam must be turned in to the instructor before he leaves the classroom at the end of the exam period.

1. (9 points) **Microcontroller Registers**
   Three registers are associated with each of the general purpose I/O ports of the ATmega328 microcontroller on the Arduino Uno. List these registers and describe their purpose.
   a. __________
   
   b. __________
   
   c. __________

2. (9 points) **Binary Representations**
   Find the decimal equivalent of the following bit patterns in the given binary representation system:
   a. System: 2's complement
      Bits: 10011011
   
   b. System: Unsigned
      Bits: 01100111
   
   c. System: 2's complement
      Bits: 01100111
EE 109 - Fall 2014

12:30 TTh

Midterm Exam

Last name: ____________________________
First name: ____________________________
Signature: ____________________________

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1. (10 points) Controlling an I/O port bit

Write code for the Arduino that will generate the following output waveform on I/O pin PD6. Include any code needed to configure the I/O port properly. You may use the delay functions that we have used in lab assignments.

![Waveform Diagram]

2. (8 points) Number conversions

Perform the following number conversions:

a. $101101101110_2$ to base 16 (hexadecimal)

b. $A5C_{16}$ to base 2 (binary)

c. $117_{10}$ to base 2 (binary)

d. $352_6$ (base 6) to base 10