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First: _____ Last: _____

This is an open book, open notes exam. You must put your answers on these pages only, you can use the back. You have 50 minutes, so please allocate your time accordingly.

Please read the entire quiz before starting.

(50) Question 1. Program 6.33 on page 339 measures period with a precision of 16 bits and a resolution of 1 ms. No hardware changes are allowed. Modify this program so that it has a precision of 32 bits and a resolution of 1 second. Just show the changes.

(15) Question 2. Which of the following statements are friendly?

(3) Part a) `TFLG1 |= 0x01;`

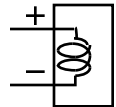
(3) Part b) `DDRT &= ~0x01;`

(3) Part c) `TCTL4 |= 0x03;`

(3) Part d) `TMSK2 = 0x32;`

(3) Part e) `TMSK1 |= 0x01;`

(20) Question 3. Design the hardware interface that allows the computer to control an electromagnetic solenoid. The computer controls the solenoid by driving current (activating the solenoid) or no current (deactivating it) through the coil, which has a resistance of 150 Ω . The solenoid activates when the coil voltage is between 3 and 6 volts (i.e., a coil current between 20 and 40 mA). There will be both positive and negative back EMF voltages, so protect the electronics.



(15) Question 4. The goal of the problem is to determine which of two signals rises first. There are two independent signals connected to timer channels PT1 and PT0. Both are initialized as input capture inputs. They both will request an interrupt on their rising edge. A global flag is initialized to -1 in the ritual. The input capture 1 interrupt service routine will test the flag, if it is -1, then it will set the global to 1. The input capture 0 interrupt service routine will test the flag, if it is -1, then it will set the global to 0.

The two signals have rising edges at similar, but not identical times. The rising edge of one signal occurs at least one TCNT cycle before the other. But, you observe sometimes the global flag is set to the wrong value (the channel with the later rising edge.) Explain how it is possible for one signal to have its rising edge first, but the other channel has its interrupt service routine executed first.