

Place your answers on pages 5 and 6.

For questions 1-7, the definition is given and you are asked to give the correct term described by that definition. Since there are more terms than definitions, not all terms will be used. *Answer each as A through Z.*

- | | | | |
|---------------------|-----------------------|------------------|-------------------|
| A) high-speed CMOS | H) buffered I/O | O) stabilization | V) nonintrusive |
| B) Schottky | I) polled interrupt | P) I/O bound | W) invasive |
| C) atomic | J) vectored interrupt | Q) CPU bound | X) intrusive |
| D) reentrant | K) fixed-point | R) instrument | Y) open collector |
| E) volatile | L) desk check | S) blind cycle | Z) latency |
| F) busy waiting | M) nonvolatile | T) real-time | |
| G) critical section | N) friendly | U) tristate | |

(5) Question 1. A condition when the bandwidth of the system, which is the amount of data processed per second, is limited by the speed of the input device.

(5) Question 2. An interrupt scheme where each individual flag that can request an interrupt has a unique interrupt vector.

(5) Question 3. A condition when the debugger itself significantly alters the operation of software/hardware system.

(5) Question 4. A debugging technique that fixes all its inputs to specific values and can be repeated over and over.

(5) Question 5. A type of logic that can be high, low or off.

(5) Question 6. The time between new input being ready and the time when the new input is read.

(5) Question 7. An I/O interfacing technique that uses a FIFO queue to pass data between the foreground and the background.

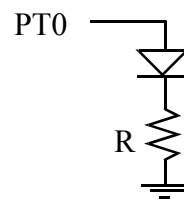
(5) Question 8. Consider the situation where interrupt-driven I/O uses a FIFO to transmit data between the foreground and the background. The producer generates data and puts it into the FIFO, concurrently with the consumer getting data from the FIFO and processing it. Observations of the system reveal the FIFO becomes full. Which best describes the situation?

- A)** The problem can always be solved by increasing the size of the FIFO.
- B)** The problem can never be solved by increasing the size of the FIFO.
- C)** Sometimes the problem can be solved by increasing the size of the FIFO, but other times it will be necessary to increase the consumer rate or decrease the producer rate.
- D)** The problem can always be solved by increasing the producer rate.
- E)** The problem can always be solved by increasing the interrupt rate.

(5) **Question 9.** The resolution of an 8-bit unsigned binary fixed-point number is 2^{-2} , which equals $1/4$. What is the value of the number if the integer stored in memory is 21?

(5) **Question 10.** Assume you are going to use a 16-bit signed decimal fixed-point number system to represent the values from -10 to +10. What is the smallest fixed-point resolution you could use?

(5) **Question 11.** You are given the 6812 voltage and current parameters for PT0: V_{OH} , V_{OL} , V_{IH} , V_{IL} , I_{OH} , I_{OL} , I_{IH} , and I_{IL} . The desired LED voltage is V_D and the desired current is I_D . Assume the LED current is small enough, so the LED can be interfaced directly to the 6812 PT0 pin as shown. Give the equation to calculate the resistance R in terms of V_D , I_D , V_{OH} , V_{OL} , V_{IH} , V_{IL} , I_{OH} , I_{OL} , I_{IH} , and I_{IL} .



(5) **Question 12.** List the events in proper order as a **RTI** interrupt causes the computer to switch from foreground to background? Do not include events explicitly caused by executing software in either the foreground or in the background, just the hardware events occurring during the context switch.

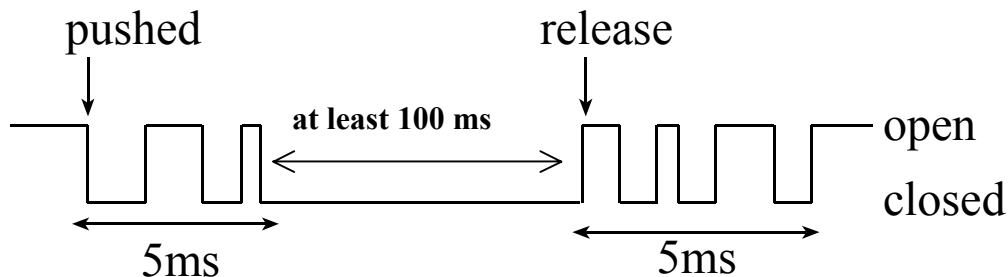
- A) The **RTI** interrupts are armed by setting the **RTIE** bit in the **CRGINT** register
- B) The PC, Y, X, B, A, CC registers are pulled from the stack
- C) The CC, A, B, X, Y, PC registers are pushed on the stack
- D) The **I** bit is set to one (disable)
- E) The PC is set equal to **\$FFF0**
- F) A write with bit 7=0 occurs to **CRGFLG**, clearing **RTIF**
- G) A write with bit 7=1 occurs to **CRGFLG**, clearing **RTIF**
- H) The periodic timer clock times out, setting **RTIF**
- I) The **I** bit is cleared to zero (enable)
- J) The PC is loaded with the 16-bit contents of **\$FFF0**

(5) **Question 13.** A signed fixed point system has a range of values from -50 to +50 with a resolution of 2^{-8} . Note: 2^{-8} equals $1/256$. With which of the following data types should the software variables be allocated? When more than one answer is possible choose the most space efficient type.

- | | | |
|-------------------|----------|-----------|
| A) unsigned char | D) char | G) float |
| B) unsigned short | E) short | H) double |
| C) unsigned long | F) long | |

(35) Question 14. You will be using the switch attached to PAD7 and the LED attached to PT0. The LED should be initially off, and the LED should be turned on (and left on) when the operator pushes the switch five (5) times. The goal of this question is to write RTI interrupt-based software that counts the number of times the switch is pushed, and turns the LED on if the switch is pushed five (5) times.

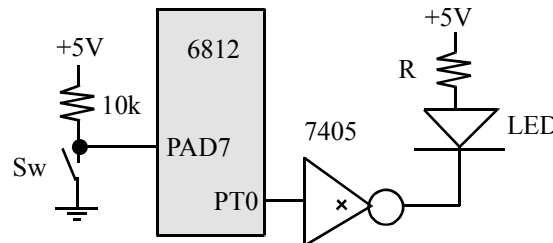
When the switch is pushed, the input on PAD7 is low. When the switch is released the PAD7 input will be high. A count requires the switch to first be pushed then to be released. The switch bounces for about 5ms each time it is pushed and each time it is released.



When your software writes a '1' to the PT0 output, the LED will come on. The main program is fixed as

```
void main(void) {
    RTIinit();
    while(1) {};
}
```

and can not be changed.



Your **RTIinit** will initialize any required global variables, turn off the LED, arm RTI, and enable interrupts. Select the RTI interrupt period to be $16384\mu\text{s}$ by setting $m=1$ and $n=7$ in the following equation $64\mu\text{s}*(m+1)*2^n$.

Your **RTIhandler** will test the value of the switch, counting the number of times it has been pushed and released. When the count goes to 5, the LED is turned on.

In this system, there is no software other than my main program, your ritual, and your RTI interrupt service routine. Nevertheless, your software must be friendly.

Jonathan W. Valvano First: _____ Last: _____
March 1, 2006, 1:00pm-1:50pm. This is a closed book exam. You have 50 minutes, so please
allocate your time accordingly. ***Please read the entire quiz before starting.*** Only this piece of
paper (pages 5 and 6) will be turned in.

(5) Question 1.	
(5) Question 2.	
(5) Question 3.	
(5) Question 4.	
(5) Question 5.	
(5) Question 6.	
(5) Question 7.	
(5) Question 8.	
(5) Question 9.	
(5) Question 10.	
(5) Question 11.	
(5) Question 12.	
(5) Question 13.	

(35) Question 14. Show your **RTInit()** and any required global variables

Show your **RTHandler()**