Name: _____ Student #: _____ Signature: _____

Time limit: 60 min. Calculators not allowed. All programming questions relate to the NIOS II processor.

1. (2 marks) Explain the difference between interrupts and polling.

Polling requires that an input be continually checked for a change in state and when that

change in state is detected the software must perform the appropriate action.

When an input that is associated with an enabled interrupt changes state, the hardware

automatically redirects the software to execute instructions (interrupt service routine) stored at

a specific area of memory.

2. (2 mark) What is an interrupt vector table and does the NIOS II processor have one?

In many processors, different interrupt service routines can be invoked directly by interrupt
number. The address of each ISR is loaded into a long table so that when interrupt-N occurs,
the appropriate routine can be called directly by jumping to the address found in the Nth entry
in the interrupt vector table. The NIOS II processor does not have an interrupt vector table and
there is only one destination for all interrupts.

3. (5 marks) List (in sequence) the 5 events that occur when an interrupt is generated and
    acknowledged on the NIOS II processor:

- Stop the current instruction immediately (the instruction is left unfinished)

- Save the Instruction Pointer (IP) to the processor exception return address register (ea = r29)

- Save the current processor status (including the PIE bit) to the processor estatus register

- Set PIE=0 in the processor status register to disable interrupts while this interrupt is being
serviced

- Branch to address 0x00000020

4. (1 mark) What is the name of the subroutine that is executed when an interrupt occurs?

Interrupt Service Routine (ISR)

5. (1 mark) The **eret** instruction is used to return from the interrupt "subroutine". What must
    first be done to ensure that the NIOS II processor returns to the proper instruction?

Must first subtract four from the ea register to complete the instruction that was left unfinished

Name: _____ Student #: _____ Signature: _____

6.   (1 mark) What does the term **interrupt latency** refer to?

The term interrupt latency refers to how long it takes a device to be serviced after an interrupt is generated.

7.   (4 marks) Using a conditional branch instruction, write the assembly code to repeat a block of code 5 times. The code needs to initially store a value in register r6 and then loop through decrementing that value and repeating the loop until the value in r6 is zero (include comments):

_____ori r6, r0, 5 # r6 = 5 = loop counter_____

_____start: addi r6, r6, -1 # decrement counter_____

_____bne r6, r0 start #repeat whilte counter not zero_____

_____

_____

8.   (4 marks) Write assembly language code to accomplish each of the following *separate* tasks described in C-Language. Maximum 3 lines of code for each part.

unsigned char mycode [4] = {3,2,0,1};
mycode: .byte 3, 2, 0, 1

d = d * 0.75;   // assume r7 is the value of unsigned integer d
Do not use the multiply or divide instruction in this answer. No loops allowed.
srli r5, r7, 1   # r5 = d / 2 srli r6, r7, 2   # r6 = d / 4 add r7, r6, r5   # r7 = d * 0.75