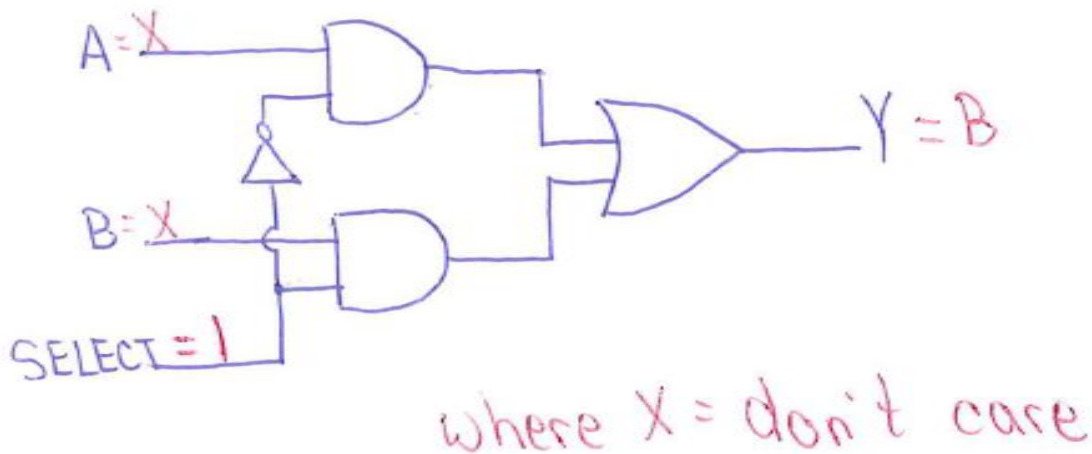


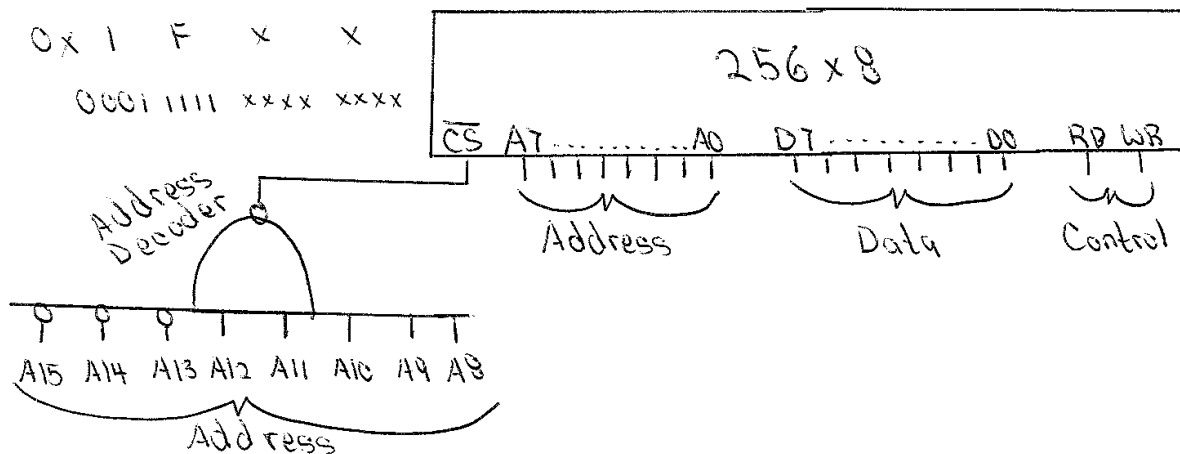
Name: \_\_\_\_\_ Student #: \_\_\_\_\_ Signature: \_\_\_\_\_

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

1. (2 marks) Use logic gates to design a 2 to 1 multiplexer. Label inputs:  $A$ ,  $B$ , and  $SELECT$  and output:  $Y$ ?



2. (5 marks) Draw and label the diagram of a single port **256x8** read write memory chip. Ensure that the memory chip includes **an active low chip select line, all address lines, all data lines, a read line and a write line**. The memory is to be interfaced to a system with a **16-bit address space (use a NAND gate to perform the address decoding)** and this block of memory is to span the address range **0x1F00 to 0x1FFF**.



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3. (1 mark) A faster clock speed translates into a faster computer. Give one example of a limitation that may prevent the clock speed of a computer from being increased to 10x the normal clock rate.

Temperature of processor, speed (access time) of memory

4. (1 mark) Write a single line of assembly code to divide the **signed** value stored in register r4 by 16 and store the result in register r5 using a shift instruction:

srai r5, r4, 4

5. (1 mark) Convert the following decimal value to BCD (show result in binary):

$94058390_{10} =$  1001 0100 0000 0101 1000 0011 1001 0000<sub>2</sub>

6. (5 marks) In the lab you see the following program listing. Carefully examine this listing and answer the questions that follow. *Each question refers to a specific line in the listing*

```
.EQU STORAGE, 0x00001000
# ===== start of code =====
    movia  r6, Y      #line 1
    stw    r6, 0(r6)  #line 2
    or     r6, r0, r0  #line 3
# ===== more code here=====
.ORG STORAGE
W:   .word 9, 8, 7
X:   .half 6, 5
Y:   .skip 4
```

- a) The instruction at line 1 (movia) is an alias for what instruction(s)?

orhi then addi

- b) What binary instruction is generated by the assembler for the instruction at line 3?

0b 00000 00000 00110 010110 00000 111010 / 0x000CB03A

- c) What value is stored by the instruction at line 2 (assuming line 1 has already executed)?

0x00001010

- d) What is the purpose of the instruction at line 3?

to clear register r6 (set r6 equal to 0x00000000)

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7. (5 marks) In each of the separate C-language code segments below, give the final value of a.

unsigned int a=1, b=2; if( !b ) a++;	a = 1
unsigned int a=4, b=2; while( b ) b = 3; a = 0;	a = 4
unsigned int a=3, *b; b = &a; *b = 0;	a = 0
unsigned int a; a = 5; a = a   0x0010;	a = 0x15 = 21 <sub>10</sub>
unsigned int a=3, b=8; while( b ){b = b>>1; a++;}	a = 7

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8. (5 marks) Draw a timing diagram showing the signals (CS, WRITE, READ, d1, and d0) as the following sequence of events occurs:

- Assume both LEDs are off to start and all five signals are zero
- LED1 is turned on while LED0 is turned off
- The data bus (d1 and d0) is used to communicate data to other components not shown
- LED0 is turned on while LED1 is turned off
- Both LEDs are turned off
- At end of timing diagram the state of both LEDs is put onto the data bus

