

## CSC 258 midterm

4 November 2008, 6:10

Name (underline surname):

Student number:

Please circle your tutorial section:

surname A-K: BA 3004 (Alicia Grubb)

surname L-P: BA 3008 (Lin Mei)

surname R-Z: BA 3012 (Letao Wang)

**No aids permitted**, but there is a list of algebraic identities attached.

Total: 40 marks.

Time allotted: 45 minutes.

Since time is short, be careful not to get stuck on one question to the exclusion of others. The amount of marks or answer-space allotted does not indicate how long it will take you to complete the question, nor does the size of the answer-space indicate the size of the correct answer.

Answer *all* questions. Answer questions in the space provided.

**Do not open this booklet until you are instructed to.**

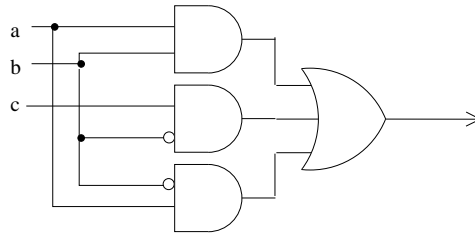
---

1. [10 marks]

a) What function does the following logic gate diagram compute (see top of page 2)?

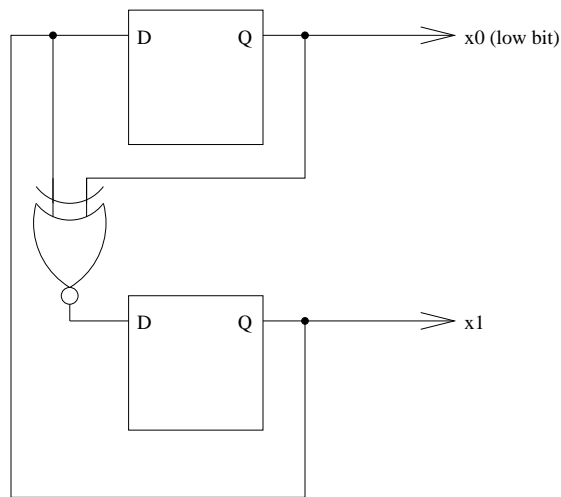
b) Simplify this formula (using any appropriate technique).

Logic gate diagram for question 1:



2. [10 marks]

a) What is the output sequence of the following “counter”, after it gets established in its cycle?



b) Draw a sequential circuit with a clock input and one output. Your circuit will count clock pulses. The output is usually 0, but is 1 for every fourth cycle. That is to say, the sequential outputs of your circuit are 0, 0, 0, 1, 0, 0, 0, 1, ...

**3. [10 marks]**

Illustrate the four-bit addition of  $-4$  plus  $-3$ . State the four-bit values of the two operands, find the four-bit sum, convert the sum to base ten, and state the resulting values of the condition codes N, Z, V, and C.

**4. [10 marks]**

Write assembly-language code (VELMA or similar) to determine which is greater: the contents of R0 or the contents of memory location 1234. Put the maximum of these two values into R2.

Reminder: In VELMA, the instruction “CMP R0, R1” subtracts R1–R0.

## **Appendix: Some Boolean algebra identities**

**identity laws:**

$$a \cdot 1 = a$$

$$a + 0 = a$$

**base laws:**

$$a \cdot 0 = 0$$

$$a + 1 = 1$$

**idempotence:**

$$aa = a$$

$$a + a = a$$

**excluded middle:**

$$a + \bar{a} = 1$$

**non-contradiction:**

$$a \cdot \bar{a} = 0$$

*(continued)*

**double-negation:**

$$\overline{\overline{a}} = a$$

**exclusive-or definition:**

$$a \oplus b = a\overline{b} + \overline{a}b$$

**commutative:**

$$ab = ba$$

$$a + b = b + a$$

$$a \oplus b = b \oplus a$$

**associative:**

$$(ab)c = a(bc)$$

$$(a + b) + c = a + (b + c)$$

$$(a \oplus b) \oplus c = a \oplus (b \oplus c)$$

**distributive:**

$$a(b + c) = ab + ac$$

$$a + bc = (a + b)(a + c)$$

**de Morgan's laws:**

$$\overline{a + b} = \overline{a}\overline{b}$$

$$\overline{ab} = \overline{a} + \overline{b}$$

*etc*

**absorption:**

$$a(a + b) = a$$

$$a + ab = a$$

$$a + \overline{a}b = a + b$$

*no name:*

$$ab + a\overline{b} = a$$

---

Do not write anything in the following table:

	value	grade
1	10	
2	10	
3	10	
4	10	
total	40	