University of Toronto
csc258— Computer Organization

Midterm Examination

Friday, March 3^{rd} 2006

11:10 - 12:00 (50 minutes)

Name: Solutions _____

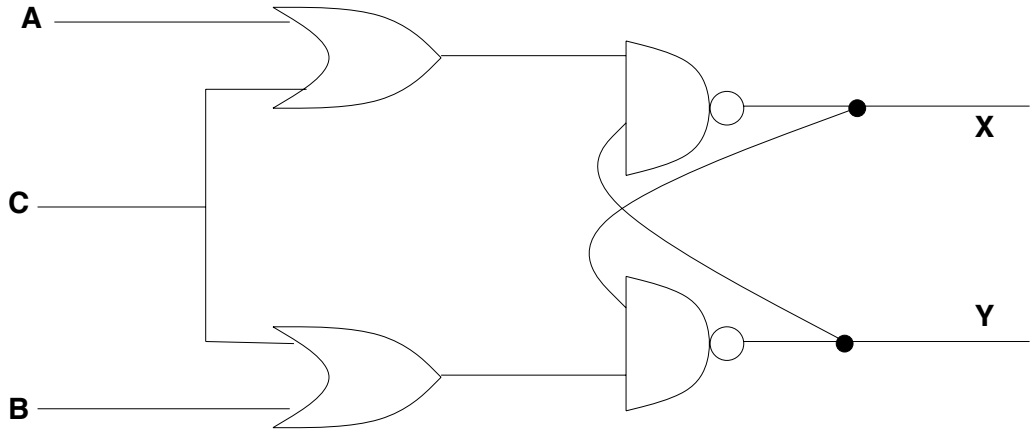
Student Number:_____

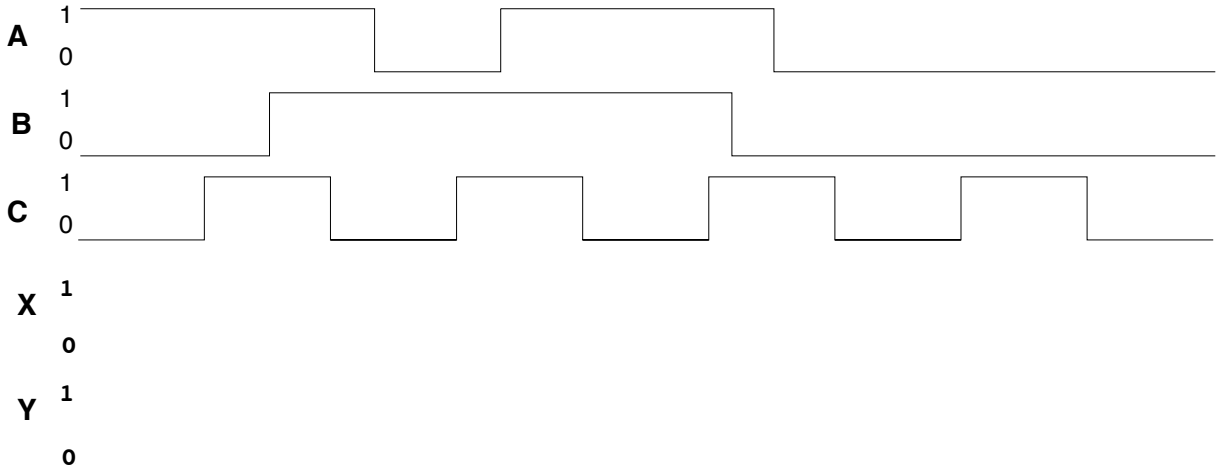
Q1 _____/20
Q2 _____/13
Q3 _____/7
Q4 _____/20
Q5 _____/5

Total _____/65

Question 1 (20 marks)

Consider the circuit diagram shown below. Given the inputs A, B,and C, determine (draw) the outputs for X and Y.





Question 2 (13 marks)

Consider the 1-byte numbers $86, -38, -97$.

1. What is the binary representation of 86:
   (a) in sign and magnitude representation? (1)
   (b) in one's complement representation? (1)
   (c) in two's complement representation? (1)
2. What is the binary representation of -38:
   (a) in sign and magnitude representation? (1)
   (b) in one's complement representation? (1)
   (c) in two's complement representation? (1)
3. What is the binary representation of -97:
   (a) in sign and magnitude representation? (1)
   (b) in one's complement representation? (1)
   (c) in two's complement representation? (1)
4. Add 86 and -38 using two's complement representation.

   (binary)

   86

   + -38

   (1)

   Does it overflow? (1)
5. Add -38 and -97 using two's complement representation.

   (binary)

   -38

   + -97

   (1)

   Does it overflow? (1)

Question 3 (7 marks)

Prove NOR operator is NOT associative. (I.e. prove that the associative property does not hold for the NOR operator). Proof by contradiction

Question 4 (20 marks)

Consider the function $f(w, x, y, z) = w \oplus xy$ with don't care conditions $g(w, x, y, z) = \bar{w}\bar{x}$.

- Implement the function (with don't care conditions) by first minimizing it using a Karnaugh map in the space provided and writing the minimized expression in sum-of-products form (you must use the Karnaugh map and show your work). You may use any other tools (such as truth tables) to aid in this task. (10 marks)
- Given the sum of products form, you may further reduce this form or leave it as it is. Implement the circuit using one NOT gate, one 4:1 multiplexor and one two-input logic gate. (5 marks)
- Implement the resulting circuit using two two-input logic gates. (5 marks)

Question 5 (5 marks)

Implement the XOR function with as few NAND gates as possible. Note, to get full marks, you must implement the function with four NAND gates.