CPSC 121 - NUMBER REPRESENTATION

Problem 1. [Number Representation]

(1) Represent 1609_{10} in unsigned binary notation with the minimum number of bits necessary to represent the number.
(2) Represent 11000111_2 in decimal notation Assume this is an unsigned binary number.
(3) Find the 16-bit two's complement of 410_{16}.
(4) Find the hexadecimal number whose 16-bit two's complement is 1011 0000 1001 1111.
(5) What is the binary representation of the decimal value -15 in 8 bits?
(6) What decimal value is represented by the 8-bit unsigned binary number 11110010?
(7) What decimal value is represented by the 8-bit signed binary number 11110010?

Problem 2. Extra Propositional Logic and Circuit Design Problem:

Design a circuit that takes in two 4-bit unsigned numbers and returns true if and only if the two numbers are equal, or, if the two numbers differ by 8 and are both odd. The two input numbers can be represented by x_3, x_2, x_1, x_0 and by y_3, y_2, y_1, y_0, the x_i's representing one number and the y_i's representing the other number.

(1) First design an expression, and ultimately, a small piece of circuitry that takes in two inputs and returns true if and only if both inputs are the same, that is they are both true or they are both false. Hint, begin with the expression $p \leftrightarrow q$ and try applying the logical equivalence rules or utilizing a truth table in order to represent this expression in a concise circuit.

(2) Now construct the circuit that solves the problem. You may find it helpful to use the result from part one when you need to compare whether the two bits are the same. You may find it helpful to represent the circuit as $c_1 \vee c_2$, where c_1 corresponds to the first condition, both numbers are equal, and c_2 corresponds to the second condition where both numbers are odd and differ by 8.