CS 210 Homework 2

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Solve the following problems. Show all of your work. Clearly indicate your final answers (e.g., by $\boxed{\text{boxing}}$ them).

1. Demonstrate the validity of the following identities by means of truth tables.
   (a) DeMorgan's theorem for three variables: $(xyz)' = x' + y' + z'$.
   (b) The distributive law: $x + yz = (x + y)(x + z)$.
   (c) The consensus theorem: $xy + x'z + yz = xy + x'z$.
2. Simplify the following Boolean expressions to a minimum number of literals.
   (a) $x'y' + xy + x'y$
   (b) $(x + y)(x + y')$
   (c) $x'y + xy' + xy + x'y'$
   (d) $x' + xy + xz' + xy'z'$
   (e) $xy' + y'z' + x'z'$ (use the consensus theorem, Problem 1c)
3. We can perform logical operations on strings of bits by considering each pair of corresponding bits separately (called *bitwise operation*). Given two eight-bit strings $A =$ `10110001` and $B =$ `10101100`, evaluate the eight-bit result of the following bitwise operations.
   (a) `AND`
   (b) `OR`
   (c) `XOR`
   (d) `NOT` A
   (e) `NOT` B
4. Recall that the exclusive-`OR` (a.k.a. `XOR`) of x and y is denoted $x \oplus y$ and is defined by $xy' + x'y$.
   (a) Prove that the dual of $x \oplus y$ is equal to its complement.
   (b) Prove that `XOR` is commutative and associative.
5. The *inhibition* operator is defined by $x/y = xy'$.
   Prove that the inhibition operator is neither commutative nor associative.