COMS12200 problem set #1

Within this problem slot, the idea is that you attempt to solve the set of pencil-and-paper, exam-style questions presented below; in doing so, you can (optionally) use an interactive system to anonymously register your solutions. More concretely, optionally start by installing the Socrative client, e.g.,

- for Chrome

  http://chrome.google.com/webstore/detail/socrative-student/nblhpecglllndfihipmpdoikimcmgkha

- for Android

  http://play.google.com/store/apps/details?id=com.socrative.student

- for iOS

  http://itunes.apple.com/gb/app/socrative-student/id477618130

or using the web-based application at

http://www.socrative.com,

then entering the 9-character "room name" which should be displayed top-center on the projector screen. Then, we will alternate as follows:

1. solve the current question, and optionally register your solution using Socrative,
2. wait until everyone is finished (or say ∼ 5 minutes elapse), at which point we will discuss the questions and solutions using any collated Socrative results as a starting point.

Q1. From the following list

A: $(x \wedge y) \oplus z$
B: $(\neg x \vee y) \oplus z$
C: $(x \vee \neg y) \oplus z$
D: $\neg(x \vee y) \oplus z$
E: $\neg\neg(x \vee y) \oplus z$

identify **each** Boolean expression that evaluates to 1 given the assignment $x = 0$, $y = 0$ and $z = 1$.

Q2. **One** of the following equivalences

A: $(x \wedge y) \wedge z \equiv x \wedge (y \wedge z)$
B: $x \vee 1 \equiv x$
C: $x \vee \neg x \equiv 1$
D: $\neg(x \vee y) \equiv \neg x \wedge \neg y$
E: $\neg\neg x \equiv x$

is incorrect: identify which.

Q3. The Boolean expression

$$(x \vee (z \vee y)) \wedge \neg(\neg y \wedge \neg z)$$

is equivalent to which of the following alternatives?

A: $y \vee z$
B: $((x \vee z) \vee y)) \wedge (x \vee z)$
C: $(x \wedge y) \vee (x \wedge z)$
D: $(x \vee y) \wedge \neg(x \vee z)$
E: $(x \wedge z) \vee (x \wedge y)$

Q4. The Boolean expression

$$(x \vee y) \vee (x \wedge z)$$

is equivalent to which of the following alternatives?

A: $(x \vee y) \wedge (x \vee z)$
B: $(x \vee y) \wedge z$
C: $(x \vee y) \wedge (x \wedge z)$
D: $x \vee y$
E: $(x \wedge y) \vee x$

Q5. A given set of Boolean operators may be termed functionally complete (or universal): this means *any* Boolean function can be expressed using a Boolean expression involving elements of the set alone. For example, because we know the NAND operator is functionally complete, we can also term the sets $\{ \overline{\wedge} \}$ and $\{\wedge, \neg\}$ functionally complete. Noting that $\not\equiv$ and $\not\Rightarrow$ denote the inverse of equivalence and implication respectively (i.e., not equivalent, and does not imply), which of the following sets

A: $\{\oplus, \vee\}$
B: $\{\Rightarrow, \not\equiv\}$
C: $\{\Rightarrow, \not\Rightarrow\}$
D: all of the above
E: none of the above

is/are functionally complete?

Q6. How many n-input, 1-output Boolean functions are there?

A: 1
B: n
C: 2^n
D: 2^{2^n}
E: $2^{2^{2^n}}$