Quiz Tues Feb 6th Section 2.3

2.3 Logical Equivalence Cont'd

Two logical expressions are <u>logically equivalent</u> if they have the same sequence of truth values.

<u>Ex</u>: Is $\sim(p \vee q)$ logically equivalent to $\sim p \wedge \sim q$?

p	q	$p \vee q$	$\sim(p \vee q)$	$\sim p$	$\sim q$	$\sim p \wedge \sim q$
0	0	0	1	1	1	1
0	1	1	0	1	0	0
1	0	1	0	0	1	0
1	1	1	0	0	0	0

Identical?

YES

$$\sim(p \vee q) \iff \sim p \wedge \sim q$$

<u>Ex</u>: Is $\sim(p \oplus q)$ logically equivalent to $\sim p \oplus \sim q$?

p	q	$p \oplus q$	$\sim(p \oplus q)$	$\sim p$	$\sim q$	$\sim p \oplus \sim q$
0	0	0	1	1	1	0
0	1	1	0	1	0	1
1	0	1	0	0	1	1
1	1	0	1	0	0	0

Identical?

No

$$\sim(p \oplus q) \not\Longleftrightarrow \sim p \oplus \sim q$$

Notation

0 is the expression that is always false.

1 " " " " true.

Ex: Simplify $p \wedge \sim p$ using a truth table.

p	$\sim p$	$p \wedge \sim p$
0	1	0
1	0	0

$$p \wedge \sim p \Longleftrightarrow 0$$

Ex: Simplify $p \wedge 1$ using a truth table.

p	1	$p \wedge 1$
0	1	0
1	1	1

Identical

$$p \wedge 1 \Longleftrightarrow p$$

Ex: Simplify $(\sim p \wedge \sim q) \vee (p \wedge \sim q)$ using a truth table.

p	q	$\sim p$	$\sim q$	$\sim p \wedge \sim q$	$p \wedge \sim q$	$(\sim p \wedge \sim q) \vee (p \wedge \sim q)$
0	0	1	1	1	0	1
0	1	1	0	0	0	0
1	0	0	1	0	1	1
1	1	0	0	0	0	0

identical

$$(\sim p \wedge \sim q) \vee (p \wedge \sim q) \Longleftrightarrow \sim q$$

2.4 Boolean Expressions and Gate Representations

Classical symbols	Boolean symbols	
p, q, r	A, B, C	
$\sim p$	$\overline{A}$	(NOT)
$p \wedge q$	AB or $A \cdot B$	(AND)
$p \vee q$	$A + B$	(OR)
$\Longleftrightarrow$	$=$	(LOGICALLY EQUIVALENT)

<u>Ex</u>: Write as a Boolean expression:

$$p \wedge (q \vee \sim r)$$

$$A(B + \overline{C})$$