East Los Angeles College
Department of Mathematics
Math 230
Test 3

76r
solutions

Construct a truth table for the following compound statements and determine which statements are tautologies, self-contradictions, or neither.

1. $(\sim p \vee q) \leftrightarrow \sim q$

$(\sim p \vee q)$	$\leftrightarrow$	$\sim q$
T	F	F
F	F	T
T	F	F
T	F	T

Neither

2. $(p \wedge \sim q) \leftrightarrow \sim(p \rightarrow q)$

$(p \wedge \sim q)$	$\leftrightarrow$	$\sim (p \rightarrow q)$
F	T	F
T	T	T
F	T	F
F	T	F

Tautologies

3. $(\sim p \vee q) \leftrightarrow (p \wedge \sim q)$

$(\sim p \vee q)$	$\leftrightarrow$	$(p \wedge \sim q)$
T	F	F
F	F	T
T	F	F
T	F	F

Self contradiction

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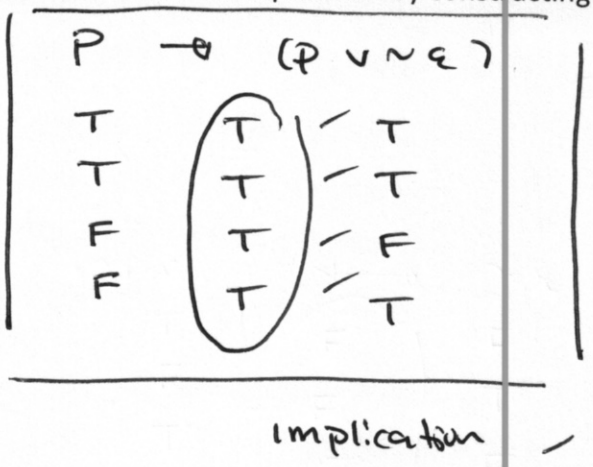
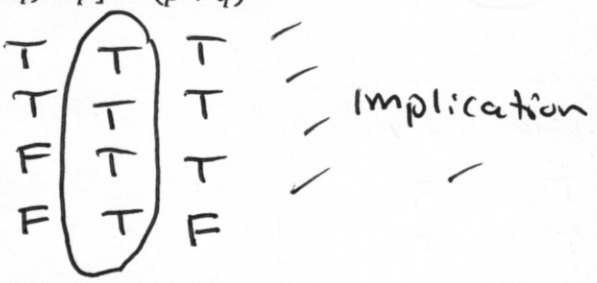
Determine whether the statement is an implication by constructing a truth table.

4. $p \rightarrow (p \vee \sim q)$

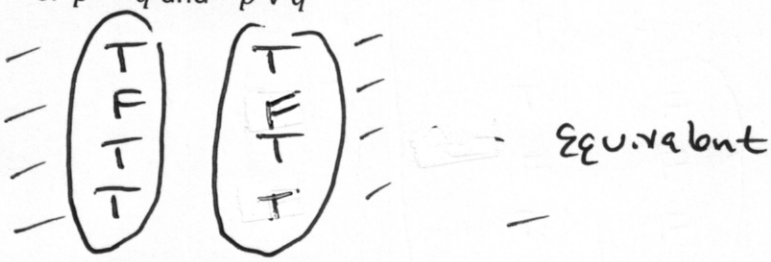


5. $[(p \vee q) \wedge p] \rightarrow (p \vee q)$

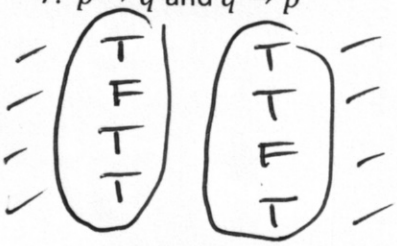


Determine which statements are equivalent by constructing a truth table.

6. $p \rightarrow q$ and $\sim p \vee q$

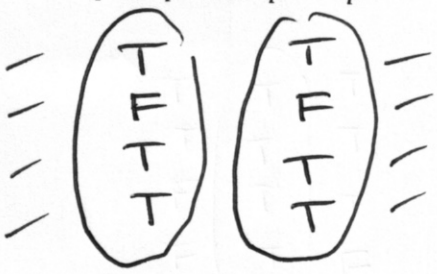


7. $p \to q$ and $q \to p$



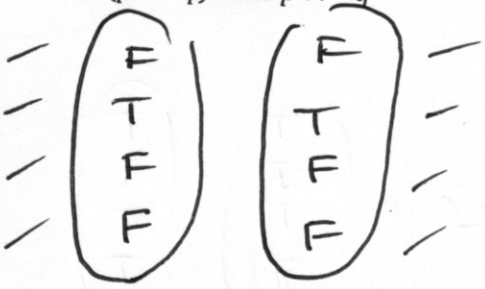
not Equivalent

8. $p \to q$ and $\sim q \to \sim p$



Equivalent

9. $\sim(p \to q)$ *and* $p \wedge \sim q$



Equivalent

Use De Morgan's Laws to Determine whether the following statements are equivalent. Do not use Truth Tables.

10. $\sim(p \vee q)$ *and* $\sim p \vee \sim q$

$\sim(p \vee q) \equiv \sim p \wedge \sim q \not\equiv \sim p \vee \sim q$

not equivalent

11. $\sim(p \wedge q)$ and $\sim p \vee q$

$\sim(p \wedge q) \equiv \sim p \vee \sim q \not\equiv \sim p \vee q$

not equivalent

12. $\sim(p \vee q)$ and $\sim p \wedge \sim q$

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

equivalent

13. $(\sim p \vee \sim q) \rightarrow r$ and $\sim(p \wedge q) \rightarrow r$

$\sim(p \wedge q) \equiv \sim p \vee \sim q$;

So, $(\sim p \vee \sim q) \rightarrow r \equiv \sim(p \wedge q) \rightarrow r$

equivalent

14. $q \rightarrow \sim (p \wedge \sim r)$ and $q \rightarrow (\sim p \vee r)$

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

So, $q \rightarrow \sim(p \wedge \sim r) \equiv q \rightarrow (\sim p \vee r)$

equivalent

15. What is your name?

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① $(\sim p \vee q) \leftrightarrow \sim q$

p	q	$\sim p$	$\vee$	q	$(\sim p \vee q)$	$\leftrightarrow$	$\sim q$
T	T	F	T	T	T	F	F
T	F	F	F	F	F	F	T
F	T	T	T	T	T	F	F
F	F	T	T	F	T	T	T

Neither

② $(p \wedge \sim q) \leftrightarrow \sim(p \rightarrow q)$

p	q	$p \wedge \sim q$			$p \rightarrow q$			$(p \wedge \sim q) \leftrightarrow \sim(p \rightarrow q)$		
T	T	T	F	F	T	T	T	F	T	F
T	F	T	T	T	T	F	F	T	T	T
F	T	F	F	F	F	T	T	F	T	F
F	F	F	F	T	F	T	F	F	T	F

tautologies

③ $(\sim p \vee q) \leftrightarrow (p \wedge \sim q)$

p	q	$\sim p$	$\vee$	q	$p \wedge \sim q$			$(\sim p \vee q) \leftrightarrow (p \wedge \sim q)$		
T	T	F	T	T	T	F	F	T	F	F
T	F	F	F	F	T	T	T	F	F	T
F	T	T	T	T	F	F	F	T	F	F
F	F	T	T	F	F	F	T	T	F	F

Self-contradiction

(4) $p \rightarrow (p \vee \sim q)$

p	q	$p \vee \sim q$			$p \rightarrow (p \vee \sim q)$	
T	T	T	T	F	T	T
T	F	T	T	T	T	T
F	T	F	F	F	F	F
F	F	F	T	T	F	T

implication

(5)

p	q	$p \vee q$	$(p \vee q) \wedge$		p	$(p \vee q) \wedge p \rightarrow (p \vee q)$		
T	T	T	T	T	T	T	T	T
T	F	T	T	T	T	T	T	T
F	T	T	T	F	F	F	T	T
F	F	F	F	F	F	F	T	F

implication

(6) $p \rightarrow q \overset{?}{\equiv} \sim p \vee q$

p	q	$p \rightarrow q$			$\sim p$	$\vee$	q
T	T	T	T	T	F	T	T
T	F	T	F	F	F	F	F
F	T	F	T	T	T	T	T
F	F	F	T	F	T	T	F

equivalent

(7)

p	q	p → q			q → p	
T	T	T	T	T	T	T
T	F	T	F	F	T	T
F	T	F	T	T	F	F
F	F	F	T	F	T	F

not equivalent

(8)

p	q	p → q			~q → ~p	
T	T	T	T	T	F	F
T	F	T	F	F	T	F
F	T	F	T	T	F	T
F	F	F	T	F	T	T

equivalent

(9)

p	q	p → q			~(p → q)		p ∧ ~q		
T	T	T	T	T	F		T	F	F
T	F	T	F	F	T		T	T	T
F	T	F	T	T	F		F	F	F
F	F	F	T	F	F		F	F	T

equivalent

(10) ~(p ∨ q) and ~p ∧ ~q

$\sim(p \vee q) \equiv \sim p \wedge \sim q \not\equiv \sim p \vee \sim q$

not equivalent