Homework 2 - Logic (Spring 2021)

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Question 1

p	q	r	$r \vee p$	$q \wedge (r \vee p)$	$\neg p$	$\neg p \vee (q \wedge (r \vee p))$
T	T	T	T	T	F	T
T	T	F	T	T	F	T
T	F	T	T	F	F	F
T	F	F	T	F	F	F
F	T	T	T	T	T	T
F	T	F	F	F	T	T
F	F	T	T	F	T	T
F	F	F	F	F	T	T

Question 2

This proposition is True since the antecedent is False; there are no two integers that fit the criteria to make it True. Therefore, it does not matter if the right side, the consequence, is True or not.

Question 3

1. $E \implies Q$

2. $E \vee B$

3. $\neg Q$

4. $\neg(E \vee Q)$

5. $E \wedge \neg B$

6. $\neg B \implies E$

7. $Q \implies \neg B$

Question 4

1. $E \implies Q$
   $\neg(E \implies Q)$
   $E \wedge \neg Q$

2. $E \vee B$
   $\neg(E \vee B)$
   $\neg E \wedge \neg B$

3. $\neg Q$
   $\neg(\neg Q)$
   Q

4. $\neg(E \vee Q) \equiv \neg E \wedge \neg Q$
   $\neg(\neg E \wedge \neg Q)$
   $E \vee Q$

5. $E \wedge \neg B$
   $\neg(E \wedge \neg B)$
   $\neg E \vee B$

6. $\neg B \implies E \equiv \neg(\neg B) \vee E$
   $B \vee E$
   $\neg(B \vee E)$
   $\neg B \wedge \neg E$

7. $Q \implies \neg B \equiv \neg Q \vee \neg B$
   $\neg(\neg Q \vee \neg B)$
   $Q \wedge B$

Question 5

$\neg p \wedge (p \vee q) \implies q$
$\neg p \wedge (p \vee q) \implies q \equiv \neg(\neg p \wedge (p \vee q)) \vee q$
$\neg p \wedge (p \vee q) \implies q \equiv p \vee \neg(p \vee q) \vee q$
$\neg p \wedge (p \vee q) \implies q \equiv p \vee (\neg p \wedge \neg q) \vee q$
$\neg p \wedge (p \vee q) \implies q \equiv (p \vee \neg p) \wedge (p \vee \neg q) \vee q$
$\neg p \wedge (p \vee q) \implies q \equiv True \wedge (p \vee \neg q) \vee q$
$\neg p \wedge (p \vee q) \implies q \equiv True \wedge q \vee (p \vee \neg q)$
$\neg p \wedge (p \vee q) \implies q \equiv True \wedge (q \vee p) \vee (q \vee \neg q)$
$\neg p \wedge (p \vee q) \implies q \equiv True \wedge (q \vee p) \vee True$
$\neg p \wedge (p \vee q) \implies q \equiv True \wedge True$
$\neg p \wedge (p \vee q) \implies q \equiv True$
Therefore, $\neg p \wedge (p \vee q) \implies q$ is a Tautology

Question 6

if not ((a $<$ b) **or** even(a)) **or** (**not**(a $<$ b) **and** even(a))
    c = a $-$ b
else:
    c = b $-$ a

Let p = (a $<$ b)
Let q = even(a)

$\neg(p \vee q) \vee (\neg p \wedge q)$
$(\neg p \wedge \neg q) \vee (\neg p \wedge q)$
$\neg p \wedge (\neg q \vee q)$
$\neg p \wedge True$
$\neg p$