Homework 2 - Logic (Spring 2021)

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Question 1

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

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. $E \lor B$

3. $\neg Q$

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

5. $E \land \neg B$

6. $\neg B \implies E$

7. $Q \implies \neg B$

Question 4

1. $E \implies Q \equiv \neg E \lor Q$
   $\neg E \lor Q$
   $\neg(\neg E \lor Q)$
   $E \land \neg Q$

2. $E \lor B$
   $\neg(E \lor B)$
   $\neg E \land \neg B$

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

4. $\neg(E \lor Q) \equiv \neg E \land \neg Q$
   $\neg(\neg E \land \neg Q)$
   $E \lor Q$

5. $E \land \neg B$
   $\neg(E \land \neg B)$
   $\neg E \lor B$

6. $\neg B \implies E \equiv \neg(\neg B) \lor E$
   $B \lor E$
   $\neg(B \lor E)$
   $\neg B \land \neg E$

7. $Q \implies \neg B \equiv \neg Q \lor \neg B$
   $\neg(\neg Q \lor \neg B)$
   $Q \land B$

Question 5

$\neg p \land (p \lor q) \implies q$
$\neg p \land (p \lor q) \implies q \equiv \neg(\neg p \land (p \lor q)) \lor q$
$\neg p \land (p \lor q) \implies q \equiv p \lor \neg(p \lor q) \lor q$
$\neg p \land (p \lor q) \implies q \equiv p \lor (\neg p \land \neg q) \lor q$
$\neg p \land (p \lor q) \implies q \equiv (p \lor \neg p) \land (p \lor \neg q) \lor q$
$\neg p \land (p \lor q) \implies q \equiv True \land (p \lor \neg q) \lor q$
$\neg p \land (p \lor q) \implies q \equiv True \land q \lor (p \lor \neg q)$
$\neg p \land (p \lor q) \implies q \equiv True \land (q \lor p) \lor (q \lor \neg q)$
$\neg p \land (p \lor q) \implies q \equiv True \land (q \lor p) \lor True$
$\neg p \land (p \lor q) \implies q \equiv True \land True$
$\neg p \land (p \lor q) \implies q \equiv True$
Therefore, $\neg p \land (p \lor q) \implies q$ 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)

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