

Question 1

a) $[p \wedge (q \vee \sim r)] \rightarrow (\sim p \wedge q)$

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p	q	r	$\sim r$	$q \vee \sim r$	$p \wedge (q \vee \sim r)$	$\sim p$	$(\sim p \wedge q)$	$[p \wedge (q \vee \sim r)] \rightarrow (\sim p \wedge q)$
T	T	T	F	T	T	F	F	F
T	T	F	T	T	T	F	F	F
T	F	T	F	F	F	F	F	T
T	F	F	T	T	T	F	F	F
F	T	T	F	T	F	T	T	T
F	T	F	T	T	F	T	T	T
F	F	T	F	F	F	T	F	T
F	F	F	T	T	F	T	F	T

not

b) Since all possible values for proposition variables are true, so it is ^{not} a tautology.

Question 2

a) i) $\sim p \wedge q$

ii) $p \vee \sim q$

b) i) $\sim p \wedge q$

$\sim$ true $\wedge$ false

false $\wedge$ false

false

ii) $p \vee \sim q$

True $\vee$ false

True $\vee$ True

True

Question 3

a) $(\exists x \text{ EA})(x+3=10)$

= False

b) $(\forall x \text{ EA})(x+3 < 10)$

= True

c) $(\exists x \text{ EA})(x+3 \leq 5)$

= True

d) $(\forall x \text{ EA})(x+3 \leq 7)$

= False

Question 4

Step 1: $p = It \text{ is } \textcircled{\text{not}} \text{ Sunny this afternoon}$ $q = It \text{ is colder than yesterday}$ $r = \text{we will go swimming}$ $s = \text{we will play basketball}$ $t = \text{we will go home early}$

Step 2 = Premis

 $p \rightarrow It \text{ is Sunny this afternoon}$ $q \rightarrow It \text{ is colder than yesterday}$ $r \rightarrow \text{we will go swimming}$ $s \rightarrow \text{we will play basketball}$ $t \rightarrow \text{we will go home early}$ ~~Conclusion: we will go home early~~Hypotheses

1. $\sim p \wedge q$

2. $r \rightarrow p$

3. $\sim r \rightarrow s$

4. $s \rightarrow t$

Step 3 : inferences

Hypothesis	Step	Reason
$\neg p \wedge q$ ✓	1	$\neg p \wedge q$ Premise
$\neg p$ ✓	2	$\neg p$ simplification using (1) and (2)
$r \rightarrow p$ ✓	3	$r \rightarrow p$ Premise
$\neg r$ ✓	4	modus tollens using (2) and (3)
$\neg r \rightarrow s$ ✓	5	premise
s ✓	6	modus ponens using (4) and (5)
$s \rightarrow t$ ✓	7	$s \rightarrow t$
conclusion t ✓	8	modus ponens using (6) and (7)

Hypothesis

(1) $\rightarrow$ using Simplification(2) $\rightarrow$ using modus tollens(3) $\rightarrow$ using modus ponens(4) $\rightarrow$ using modus ponensConclusion $\rightarrow$ we go home early

Follow the ways suggested.