Student Information

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Answer 1

a)

p	q	$\neg q$	$p \to q$	$p \land \neg q$	$(p \to q) \oplus (p \land \neg q)$
T	T	F	T	F	T
T	F	T	F	T	T
F	T	F	T	F	T
F	F	T	T	F	T

b)

$$\begin{aligned}
p \to ((q \lor \neg p) \to r) &\equiv \neg p \lor ((q \lor \neg p) \to r) && \textit{table 7, Equivalence 1}\\
&\equiv \neg p \lor (\neg(q \lor \neg p) \lor r) && \textit{table 7, Equivalence 1}\\
&\equiv \neg p \lor ((\neg q \land \neg\neg p) \lor r) && \textit{table 6, De Morgan's Second Law}\\
&\equiv \neg p \lor ((\neg q \land p) \lor r) && \textit{table 6, Double Negation Law}\\
&\equiv \neg p \lor (r \lor (\neg q \land p)) && \textit{table 6, Commutative Laws}\\
&\equiv \neg p \lor ((r \lor \neg q) \land (r \lor p)) && \textit{table 6, Distributive Laws}\\
&\equiv (\neg p \lor (r \lor \neg q)) \land (\neg p \lor (r \lor p)) && \textit{table 6, Distributive Laws}\\
&\equiv (\neg p \lor (r \lor \neg q)) \land (\neg p \lor (p \lor r)) && \textit{table 6, Commutative Laws}\\
&\equiv (\neg p \lor (r \lor \neg q)) \land ((\neg p \lor p) \lor r) && \textit{table 6, Associative Laws}\\
&\equiv (\neg p \lor (r \lor \neg q)) \land (\mathbf{T} \lor r) && \textit{table 6, Negation Laws}\\
&\equiv (\neg p \lor (r \lor \neg q)) \land \mathbf{T} && \textit{table 6, Domination Laws}\\
&\equiv \neg p \lor (r \lor \neg q) && \textit{table 6, Identity Laws}\\
&\equiv \neg p \lor (\neg q \lor r) && \textit{table 6, Commutative Laws}\\
&\equiv (\neg p \lor \neg q) \lor r && \textit{table 6, Associative Laws}\\
&\equiv \neg(p \land q) \lor r && \textit{table 6, De Morgan's First Law}\\
&\equiv (p \land q) \to r && \textit{table 7, Equivalence 1}
\end{aligned}$$

c)

- F
- F
- F
- T
- T

Answer 2

- (a) $\exists x(P(Can, x) \land T(x, L))$
- (b) $\forall x(T(x, S) \rightarrow \exists y(P(y, x) \land N(y, Turkish)))$
- (c) $\forall x \exists y(T(x, S) \rightarrow (T(y, S) \land R(x, y) \land \forall z((T(z, S) \land R(x, z)) \rightarrow y = z)))$
- (d) $\forall x(W(M, x) \rightarrow \neg \exists y(P(y, x) \land N(y, English)))$
- (e) $\exists x \exists y(x \neq y \land P(x, G) \land P(y, G) \land N(x, Turkish) \land N(y, Turkish) \land \forall z((P(z, G) \land N(z, Turkish)) \rightarrow (z = x \lor z = y)))$
- (f) $\exists x \exists y \exists z(T(x, y) \land T(x, z) \land y \neq z)$

Answer 3

$p \to q, (r \land s) \to p, r \land \neg q \vdash \neg s$

1.	$p \to q$	*premise*
2.	$(r \land s) \to p$	*premise*
3.	$r \land \neg q$	*premise*
4.	r	$\land e, 3$
5.	$\neg q$	$\land e, 3$
6.	p	*assumed*
7.	q	$\to e, 1, 6$
8.	$\bot$	$\neg e, 5, 7$
9.	$\neg p$	$\neg i, 6-8$
10.	$r \land s$	*assumed*
11.	p	$\to e, 2, 10$
12.	$\bot$	$\neg e, 9, 11$
13.	$\neg(r \land s)$	$\neg i, 10-12$
14.	s	*assumed*
15.	$r \land s$	$\land i, 4, 14$
16.	$\bot$	$\neg e, 13, 15$
17.	$\neg s$	$\neg i, 14-16$

Answer 4

a)

- $\exists x(P(x) \to S(x))$ (1st premise)
- $\forall x(P(x))$ (2nd premise)
- $\exists x(S(x))$ (claim)

b)

$\exists x(P(x) \to S(x)), \forall x(P(x)) \vdash \exists x(S(x))$

1.	$\exists x(P(x) \to S(x))$	*premise*
2.	$\forall x(P(x))$	*premise*
3.	$P(c) \to S(c)$	*assumed*
4.	$P(c)$	$\forall e, 2$
5.	$S(c)$	$\to e, 3, 4$
6.	$\exists x(S(x))$	$\exists i, 5$
7.	$\exists x(S(x))$	$\exists e, 3-6$