

Student Information

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Answer 1

a)

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

Thus, $(p \wedge q) \leftrightarrow (\neg p \vee \neg q)$ is a *contradiction*.

b)

1	$p \rightarrow ((q \vee \neg q) \rightarrow (p \wedge q))$	
2	$\equiv p \rightarrow (T \rightarrow (p \wedge q))$	Negation Law
3	$\equiv p \rightarrow (F \vee (p \wedge q))$	Table 7.1
4	$\equiv p \rightarrow (p \wedge q)$	Identity Law
5	$\equiv \neg p \vee (p \wedge q)$	Table 7.1
6	$\equiv (\neg p \vee p) \wedge (\neg p \vee q)$	Distributive Law
7	$\equiv T \wedge (\neg p \vee q)$	Negation Law
8	$\equiv (\neg p \vee q)$	Identity Law

Answer 2

a) $\forall x \exists y W(x, y)$

b) $\exists x \exists y F(x, y)$

c) $\forall x(W(x, P) \rightarrow A(Ali, x))$

d) $\exists x(W(Busra, x) \wedge F(TUBITAK, x))$

e) $\exists x \exists y \exists z (S(x, y) \wedge S(x, z) \wedge \neg(y, z))$

f) $\forall y \forall z \forall x (W(x, z) \wedge W(y, z) \rightarrow (x = z))$

g) $\exists y \exists z \exists x ((W(z, x) \wedge W(y, x) \wedge \neg(z = y) \wedge \forall n (W(n, x) \rightarrow ((n = y) \vee (n = z))))$

Answer 3

1	$p \rightarrow q$	<i>premise</i>
2	$(q \wedge \neg r) \rightarrow s$	<i>premise</i>
3	$\neg s$	<i>premise</i>
4	$q \wedge \neg r$	<i>assumption</i>
5	s	$\rightarrow_e, 2, 4$
6	\perp	$\neg_e, 3, 5$
7	$\neg(q \wedge \neg r)$	$\neg_i 4 - 6$
8	p	<i>assumption</i>
9	q	$\rightarrow_e, 1, 8$
10	$\neg r$	<i>assumption</i>
11	$q \wedge \neg r$	$\wedge_i, 9, 10$
12	\perp	$\neg_e, 7, 11$
13	$\neg \neg r$	$\neg_i, 10 - 12$
14	r	$\neg \neg_e, 13$
15	$p \rightarrow r$	$\rightarrow_i, 8 - 14$

Answer 4

1	p	<i>premise</i>
2	$p \rightarrow (q \wedge r)$	<i>premise</i>
3	$r \rightarrow s$	<i>premise</i>
4	$q \wedge r$	$\rightarrow_e, 1, 2$
5	q	$\wedge_{e1}, 4$
6	r	$\wedge_{e2}, 4$
7	s	$\rightarrow_e, 3, 6$
8	$s \rightarrow \neg q$	<i>assumption</i>
9	$\neg q$	$\rightarrow_e, 7, 8$
10	\perp	$\neg_e, 5, 9$
11	$\neg(s \rightarrow \neg q)$	$\neg_i, 8 - 10$

Answer 5

1	$\forall x(P(x) \rightarrow (Q(x) \rightarrow R(x)))$	<i>premise</i>
2	$\exists x(P(x))$	<i>premise</i>
3	$\forall x(\neg R(x))$	<i>premise</i>
4	$P(x_0)$	<i>assumption</i>
5	$P(x_0) \rightarrow (Q(x_0) \rightarrow R(x_0))$	$\forall_{x_e}, 1$
6	$Q(x_0) \rightarrow R(x_0)$	$\rightarrow_e, 5, 4$
7	$Q(x_0)$	<i>assumption</i>
8	$R(x_0)$	$\wedge_i, 5, 6$
9	\perp	$\neg_e, 3, 8$
10	$\neg Q(x_0)$	$\neg_i, 7 - 9$
11	$\exists x(\neg Q(x))$	$\exists_{x_i}, 4 - 10$