Student Information

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Answer 1

a)

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

Contradiction

b)

$p \to ((q \vee \neg q) \to (p \wedge q))$
$p \to (T \to (p \wedge q))$ (Table 6 - Negation Laws - Line 1)
$p \to (F \vee (p \wedge q))$ (Table 7 - Line 1)
$p \to (p \wedge q)$ (Table 6 - Identity Laws - Line 2)
$\neg p \vee (p \wedge q)$ (Table 7 - Line 1)
$(\neg p \vee p) \wedge (\neg p \vee q)$ (Table 6 - Distributive Laws - Line 1)
$T \wedge (\neg p \vee q)$ (Table 6 - Negation Laws - Line 1)
$(\neg p \vee q)$ (Table 6 - Identity Laws - Line 1)

Answer 2

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

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

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

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

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

f) $\forall x \forall y ((x \neq y) \to \neg \exists p (W(x, p) \wedge W(y, p)))$

g) $\exists x \exists y \exists p ((x \neq y) \wedge W(x, p) \wedge W(y, p) \wedge \forall z (((z \neq x) \wedge (z \neq y)) \to \neg W(z, p))$

Answer 3

1	$p \rightarrow q$	
2	$(q \wedge \neg r) \rightarrow s$	
3	$\neg s$	
4	p	
5	q	$\Rightarrow$E, 1, 4
6	$\neg r$	
7	$(q \wedge \neg r)$	$\wedge$I, 5, 6
8	s	$\Rightarrow$E, 2, 7
9	$\neg s$	R, 3
10	$\bot$	$\neg$E, 8, 9
11	$\neg\neg r$	$\neg$I, 6–10
12	r	$\neg\neg$E, 11
13	$p \rightarrow r$	$\Rightarrow$I, 4–12

Answer 4

1	p	
2	$p \rightarrow (q \wedge r)$	
3	$r \rightarrow s$	
4	$(q \wedge r)$	$\Rightarrow$E, 1, 2
5	q	$\wedge$E, 4
6	r	$\wedge$E, 4
7	s	$\Rightarrow$E, 3, 6
8	$(s \rightarrow \neg q)$	
9	$\neg q$	$\Rightarrow$E, 7, 8
10	$\bot$	$\neg$E, 5, 9
11	$\neg(s \rightarrow \neg q)$	$\neg$I, 8–10

Answer 5

1	$\forall x(P(x) \rightarrow (Q(x) \rightarrow R(x)))$		
2	$\exists x P(x)$		
3	$\forall x(\neg R(x))$		
4	c	$P(c)$	
5		$\neg R(c)$	$\forall$E, 3
6		$P(c) \rightarrow (Q(c) \rightarrow R(c)))$	$\forall$E, 1
7		$Q(c) \rightarrow R(c)$	$\Rightarrow$E, 4, 6
8		$\quad Q(c)$	
9		$\quad R(c)$	$\Rightarrow$E, 7, 8
10		$\quad \bot$	$\neg$E, 5, 9
11		$\neg Q(c)$	$\neg$I, 8–10
12		$\exists x(\neg Q(x))$	$\exists$I, 11
13	$\exists x(\neg Q(x))$		$\exists$E, 2, 4–12