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Answer 1

a)

$\varphi = ((p \to \neg q) \iff (p \to q))$

p	q	$\neg q$	$p \to \neg q$	$p \iff q$	φ
T	T	F	F	T	F
T	F	T	T	F	F
F	T	F	T	F	F
F	F	T	T	T	T

b)

$\varphi = (((p \vee q) \wedge (p \to r) \wedge (q \to r)) \to r)$

p	q	r	$p \vee q$	$p \to r$	$q \to r$	$(p \vee q) \wedge (p \to r) \wedge (q \to r)$	φ
T	T	T	T	T	T	T	T
T	T	F	T	F	F	F	T
T	F	T	T	T	T	T	T
T	F	F	T	F	T	F	T
F	T	T	T	T	T	T	T
F	T	F	T	T	F	F	T
F	F	T	F	T	T	F	T
F	F	F	F	T	T	F	T

Answer 2

$$
\begin{array}{llll}
\neg p \to (q \to r) & \equiv & \neg\neg p \vee (q \to r) & \textit{table 7 - first row} \\
\neg\neg p \vee (q \to r) & \equiv & p \vee (q \to r) & \textit{double negation} \\
p \vee (q \to r) & \equiv & p \vee (\neg q \vee r) & \textit{table 7 - first row} \\
p \vee (\neg q \vee r) & \equiv & (\neg q \vee r) \vee p & \textit{commutative law} \\
(\neg q \vee r) \vee p & \equiv & \neg q \vee (p \vee r) & \textit{associative law} \\
\neg q \vee (p \vee r) & \equiv & q \to (p \vee r) & \textit{table 7 - first row}
\end{array}
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Answer 3

$a)\forall x L(x, Burak)$

$b)\forall y L(Hazal, y)$

$c)\forall x \exists y L(x, y)$

$d)\neg \exists x \forall y L(x, y)$

$e)\exists x \forall y L(x, y)$

$f)\neg \exists x (L(x, Burak) \wedge L(x, Mustafa))$

$g)\exists x \exists y \exists z (L(Ceren, x) \wedge L(Ceren, y) \wedge (x \neq y) \wedge (L(Ceren, z) \rightarrow (z = x \vee z = y)))$

$h)\forall x \exists y \exists z (L(x, y) \wedge (L(x, z) \rightarrow (z = y))$

$i)\forall x \neg L(x, x))$

$j)\exists x \exists y \exists z (L(x, y) \wedge L(x, x) \wedge (x \neq y) \wedge (L(x, z) \rightarrow ((z = x) \vee (z = y))))$

Answer 4

1	p	*premise*
2	$p \rightarrow (r \rightarrow q)$	*premise*
3	$r \rightarrow q$	$\rightarrow_e, 1, 2$
4	$\neg q$	*assumption*
5	$\neg r$	$\rightarrow_e, 3, 4$
6	$\neg q \rightarrow \neg r$	$\rightarrow_i, 4, 5$
7	$\neg q \rightarrow (s \vee \neg r)$	$\vee_i, 4$

Answer 5

1		$\forall x(p(x) \to q(x))$	*premise*
2		$\exists y p(y) \vee r(a)$	*premise*
3		$\neg \exists z(z)$	*premise*
4	x_0	$r(x_0)$	*assumption*
5		$\exists z r(x_0)$	$\exists_i, 4$
6		$\bot$	*contradiction, 3, 5*
7		$\neg r(x_0)$	$\neg_i, 4, 6$
8		$\forall z \neg r(z)$	$\forall_i, 7$
9		$r(a)$	*assumption*
10	a	$\neg r(a)$	$\forall_e, 8$
11		$\bot$	*contradiction, 9, 10*
12		$\exists y p(y)$	$\vee_e, 9 - 11$
13	x_1	$p(x_1)$	*assumption*
14		$p(x_1) \to q(x1)$	$\forall_e, 1$
15		$q(x_1)$	$\to_e, 9, 10$
16		$\exists z q(z)$	$\exists_i, 9 - 11$