Student Information

Full Name : Yavuz Selim YEŞİLYURT
Id Number : 2259166

Answer 1

1)

p	q	$\neg q$	$p \to q$	$\neg q \wedge (p \to q)$	$\neg p$	$(\neg q \wedge (p \to q)) \to \neg p$
T	T	F	T	F	F	T
T	F	T	F	F	F	T
F	T	F	T	F	T	T
F	F	T	T	T	T	T

2)

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

Answer 2

$$
\begin{aligned}
(p \to q) \vee (p \to r) &\equiv (\neg p \vee q) \vee (p \to r) && \textit{table } 7, \textit{Equivalence } 1 \\
&\equiv (\neg p \vee q) \vee (\neg p \vee r) && \textit{table } 7, \textit{Equivalence } 1 \\
&\equiv (q \vee r) \vee (\neg p \vee \neg p) && \textit{table } 6, \textit{Associative Law} \\
&\equiv (q \vee r) \vee \neg p && \textit{table } 6, \textit{Idempotent Law} \\
&\equiv \neg(q \vee r) \to \neg p && \textit{table } 7, \textit{Equivalence } 3 \\
&\equiv (\neg q \wedge \neg r) \to \neg p && \textit{table } 6, \textit{De Morgan's Second Law}
\end{aligned}
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Answer 3

1. (a) All cats are friends with at least one dog.
   (b) Some cats are friends with all dogs.

2. (a) $\forall x \forall y((Eats(x,y)z \wedge Meal(y)) \rightarrow Customer(x))$
   (b) $\exists x \exists y(Chef(x) \wedge Meal(y) \wedge \neg Cooks(x,y))$
   (c) $\exists x \forall y \exists z(((Cooks(x,y) \wedge Chef(x)) \rightarrow Meal(y)) \rightarrow (Eats(z,y) \wedge Customer(z)))$
   (d) $\forall x \exists y \exists z((Chef(z) \wedge Chef(x) \wedge (x \neq z) \wedge Meal(y) \wedge \neg Cooks(x,y) \wedge Cooks(z,y)) \rightarrow Knows(x,z))$

Answer 4

$\neg p$ and $p \rightarrow q$ are given as premises and $\neg q$ is given as conclusion. Since $\neg p$ is given as true, the lefthandside of $p \rightarrow q$ is (p) false. For situations which p is false (third and fourth rows on Table 1) $p \rightarrow q$ returns true. But its truth value does not depend on q. q can be true or false. Therefore we can not deduce that $\neg q$ is true. So this argument cannot be a deduction rule in a sound deductive system.

Table 1: Truth table for $p \rightarrow q$

p	q	$p \rightarrow q$
T	T	T
T	F	F
F	T	T
F	F	T

Answer 5

1. $p \implies q$ *premise*
2. $q \implies r$ *premise*
3. $r \implies p$ *premise*
4. q *assumed*
5. r $\implies e, 2, 4$
6. p $\implies e, 3, 5$
7. $q \implies p$ $\implies i, 4-6$
8. $p \iff q$ $\iff i, 1, 7$
9. p *assumed*
10. q $\implies e, 1, 9$
11. r $\implies e, 2, 10$
12. $p \implies r$ $\implies i, 9-11$
13. $p \iff r$ $\iff i, 3, 12$
14. $(p \iff q) \wedge (p \iff r)$ $\wedge i, 8, 13$

Answer 6

1. $\forall x(Q(x) \implies R(x))$ *premise*
2. $\exists x(P(x) \implies Q(x))$ *premise*
3. $\forall x(P(x))$ *premise*

4.	$P(c) \implies Q(c)$	*assumed*
5.	$P(c)$	$\forall e, 3$
6.	$Q(c)$	$\implies e, 4, 5$
7.	$Q(c) \implies R(c)$	$\forall e, 1$
8.	$R(c)$	$\implies e, 6, 7$
9.	$P(c) \wedge R(c)$	$\wedge\, i, 5, 8$
10.	$\exists x(P(x) \wedge R(x))$	$\exists i, 9$

11. $\exists x(P(x) \wedge R(x))$ $\exists e, 2, 4-10$