Name : Muhammed Ömer

ID: 2683142

Answer 1

a)

p	q	$\neg q$	$\neg p$	$\neg p \land q$	$p \lor q$	$p \land (p \lor q)$	$(p \land (p \lor q)) \land \neg q$	$(\neg p \lor q) \lor ((p \land (p \lor q)) \land \neg q)$
T	T	F	F	F	T	T	F	F
T	F	T	F	F	T	T	T	T
F	T	F	T	T	T	F	F	T
F	F	T	T	F	F	F	F	F

Neither.

b)

$$\begin{aligned}
p \lor (\neg q \rightarrow (p \land r)) &\equiv p \lor (q \lor (p \land r)) && \text{(İmplication Elimination Law)} \\
&\equiv (p \lor q) \lor (p \land r) && \text{(Association Laws)} \\
&\equiv (q \lor p) \lor (p \land r) && \text{(Communitative Laws)} \\
&\equiv q \lor (p \lor (p \land r)) && \text{(Association Laws)} \\
&\equiv q \lor ((p \land T) \lor (p \land r)) && \text{(Identity Laws)} \\
&\equiv q \lor (p \land (T \lor r)) && \text{(Distributive Laws)} \\
&\equiv q \lor (p \land T) && \text{(Domination Laws)} \\
&\equiv q \lor p && \text{(Identity Laws)} \\
&\equiv p \lor q && \text{(Communitative Laws)}
\end{aligned}$$

Answer 2

a)

$$\forall x \forall y (S(x) \land C(y) \land E(x,y) \rightarrow \forall z \, (C(z) \land R(z,y) \rightarrow P(x,z)))$$

b)

$$\exists x (S(x) \land \exists y \, (C(y) \land E(x,y) \land \forall z \, (C(z) \land E(x,z) \rightarrow (y = z))))$$

c)

$$\forall y \, ((C(y) \rightarrow \forall x (S(x) \land P(x,y) \rightarrow \forall z (C(z) \land R(z,y) \rightarrow P(x,z))))$$

d)

$$\exists x(S(x) \land \exists y\,(C(y) \land E(x,y) \land \neg P(x,y)))$$

e)

$$\exists y\,(C(y) \land \forall x(S(x) \to \neg P(x,y)))$$

f)

$$\forall y(C(y) \to \exists x\,(S(x) \land (E(x,y) \lor P(x,y))))$$

Answer 3

1. $p \to (q \lor r)$	Premise
2. $\neg r \land \neg s$	Premise
3. $q \to s$	Premise

4. p	Assumption
5. $q \lor r$	$\to$ e, 1, 4
6. q	Assumption
7. s	$\to$ e, 3, 6
8. $\neg s$	$\land$e, 2
9. $\bot$	$\neg$e, 7, 8
10. r	Assumption
11. $\neg r$	$\land$e, 2
12. $\bot$	$\neg$e, 10, 11
13. $\bot$	$\lor$e, 6–9, 10–12

14. $\neg p$	$\neg$i, 4-13

Answer 4

a)

1. $\exists x(S(x) \wedge P(x))$
2. $\forall x(P(x) \rightarrow K(x))$
3. $\exists x(S(x) \wedge K(x))$

b)

1. $\exists x(S(x) \wedge P(x))$	Premise
2. $\forall x(P(x) \rightarrow K(x))$	Premise
3. $P(c) \wedge S(c)$	Assumption (c, Skolem constant)
4. $P(c)$	$\wedge$e, 3
5. $S(c)$	$\wedge$e, 3
6. $P(c) \rightarrow K(c)$	$\forall$e, 2
7. $K(c)$	$\rightarrow$ e, 4, 6
8. $S(c) \wedge K(c)$	$\wedge$i, 5, 7
9. $\exists x(S(x) \wedge K(x))$	$\exists$i, 8
10. $\exists x(S(x) \wedge K(x))$	$\exists$e, 1, 2, 3-9