

# Student Information

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## Answer 1

a)

$p$	$q$	$\neg q$	$p \rightarrow q$	$p \wedge \neg q$	$p \rightarrow q \oplus p \wedge \neg q$
T	T	F	T	F	T
T	F	T	F	T	T
F	T	F	T	F	T
F	F	T	T	F	T

b)

$$\begin{aligned} p \rightarrow ((q \vee \neg p) \rightarrow r) &\equiv \neg p \vee ((q \vee \neg p) \rightarrow r) && \text{table 7, Equivalence 1} \\ &\equiv \neg p \vee (\neg(q \vee \neg p) \vee r) && \text{table 7, Equivalence 1} \\ &\equiv \neg p \vee ((\neg q \vee \neg \neg p) \vee r) && \text{table 6, De Morgan's Second Law} \\ &\equiv \neg p \vee ((\neg q \vee p) \vee r) && \text{table 6, Double Negation Law} \\ &\equiv (\neg p \vee (\neg q \vee p)) \vee r && \text{table 6, Associative Law} \\ &\equiv ((\neg p \vee \neg q) \wedge (\neg p \vee p)) \vee r && \text{table 6, Distributive Law} \\ &\equiv ((\neg p \vee \neg q) \wedge (T)) \vee r && \text{table 6, Negation First Law} \\ &\equiv (\neg p \vee \neg q) \vee r && \text{table 6, Identity First Law} \\ &\equiv \neg(p \wedge q) \vee r && \text{table 6, De Morgan's Second Law} \\ &\equiv (p \wedge q) \rightarrow r && \text{table 7, Equivalence 3} \end{aligned}$$

c)

1. F
2. F
3. F
4. T
5. T

## Answer 2

- a)  $\exists x(P(Can, x) \wedge T(x, L))$   
b)  $\forall x(T(x, S) \rightarrow \exists y(N(y, Turkish) \wedge P(y, x)))$   
c)  $\forall x \exists y \exists z(T(x, S) \wedge R(x, y) \wedge T(y, S) \wedge R(x, z) \wedge T(z, S) \wedge (y = z))$   
d)  $\forall y \exists z(W(M, y) \rightarrow \neg(P(z, y) \wedge N(z, English)))$   
e)  $\exists x \exists y((x \neq y) \wedge N(x, Turkish) \wedge N(y, Turkish) \wedge P(x, G) \wedge P(y, G) \wedge \forall z(P(z, G) \rightarrow (z = x \vee z = y)))$   
f)  $\exists x \exists y \exists z(T(x, y) \wedge T(x, z) \wedge (y \neq z))$

## Answer 3

$p \rightarrow q, (r \wedge s) \rightarrow p, (r \wedge \neg q) \vdash \neg s$		
1.	$p \rightarrow q$	<i>premise</i>
2.	$(r \wedge s) \rightarrow p$	<i>premise</i>
3.	$(r \wedge \neg q)$	<i>premise</i>
4.	$r$	$\wedge e, 3$
5.	$\neg q$	$\wedge e, 3$
6.	$r \wedge s$	<i>assumption</i>
7.	$p$	$\rightarrow e, 2, 5$
8.	$q$	$\rightarrow e, 1, 6$
9.	$\perp$	$\neg e, 5, 8$
10.	$\neg(r \wedge s)$	$\neg i, 6 - 9$
11.	$s$	<i>assumption</i>
12.	$r \wedge s$	$\wedge i, 4, 11$
13.	$\perp$	$\neg e, 10, 12$
14.	$\neg s$	$\neg i, 11 - 13$

## Answer 4

- a)
- (*First premise*)  $\exists x(P(x) \rightarrow S(x))$
  - (*Second premise*)  $\forall x(P(x))$
  - (*Claim*)  $\exists y S(y)$
- b)

$$\exists x(P(x) \rightarrow S(x)), \forall x(P(x)) \vdash \exists yS(y)$$


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1.	$\exists x(P(x) \rightarrow S(x))$	<i>premise</i>
2.	$\forall x(P(x))$	<i>premise</i>
3.	$P(c) \rightarrow S(c)$	<i>assumption</i>
4.	$P(c)$	$\forall e$ 2
5.	$S(c)$	$\rightarrow e$ 3, 4
6.	$\exists yS(y)$	$\exists i$ 5
7.	$\exists yS(y)$	$\exists e$ 3 – 6