

5. **b** (DeMorgan's is done incorrectly)

6. **a** This is material implication.

7.

p	q	$p \leftrightarrow q$	$\neg(p \leftrightarrow q)$	$\neg q$	$p \leftrightarrow \neg q$	Conclusion
T	T	T	F	F	F	T
T	F	F	T	T	T	T
F	T	F	T	F	T	T
F	F	T	F	T	F	T

Conclusion: Since the two columns $\neg(p \leftrightarrow q)$ and $p \leftrightarrow \neg q$ are identical, $\neg(p \leftrightarrow q) \equiv p \leftrightarrow \neg q$.

8.

Step	Statement	Rule
5	$p \rightarrow r$	contrapositive of 2.
6	p	disjunctive syllogism (4. and 1.)
7	r	modus ponens (6. and 5.)
8	s	modus ponens (3. and 7.)

\therefore Using the rules of inference and premises, we have shown s .

9. $\forall y \exists x_1 \exists x_2 (M(y) \rightarrow ((T(x_1, y) \wedge C(x_1)) \wedge (T(x_2, y) \wedge F(x_2))))$

10. $\forall x \exists y (F(x) \rightarrow (T(x, y) \wedge M(y)))$

11. $\exists x (F(x) \wedge C(x))$

12. $\exists x_1 \exists x_2 \forall x_3 (C(x_1) \wedge C(x_2) \wedge (x_1 \neq x_2) \wedge ((x_1 \neq x_3) \wedge (x_2 \neq x_3)) \rightarrow \neg C(x_3))$