

1. Use truth tables to verify these equivalences.

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| a) $p \wedge \mathbf{T} \equiv p$          | b) $p \vee \mathbf{F} \equiv p$          |
| c) $p \wedge \mathbf{F} \equiv \mathbf{F}$ | d) $p \vee \mathbf{T} \equiv \mathbf{T}$ |
| e) $p \vee p \equiv p$                     | f) $p \wedge p \equiv p$                 |

5. Use a truth table to verify the distributive law

$$p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r).$$

7. Use De Morgan's laws to find the negation of each of the following statements.

- a) Jan is rich and happy.
- b) Carlos will bicycle or run tomorrow.
- c) Mei walks or takes the bus to class.
- d) Ibrahim is smart and hard working.

11. Show that each of these conditional statements is a tautology by using truth tables.

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|---|---|
| a) $(p \wedge q) \rightarrow p$           | b) $p \rightarrow (p \vee q)$                   |
| c) $\neg p \rightarrow (p \rightarrow q)$ | d) $(p \wedge q) \rightarrow (p \rightarrow q)$ |
| e) $\neg(p \rightarrow q) \rightarrow p$  | f) $\neg(p \rightarrow q) \rightarrow \neg q$   |

27. Show that  $(p \rightarrow r) \wedge (q \rightarrow r)$  and  $(p \vee q) \rightarrow r$  are logically equivalent.

65. Determine whether each of these compound propositions is satisfiable.

- a)  $(p \vee \neg q) \wedge (\neg p \vee q) \wedge (\neg p \vee \neg q)$
- b)  $(p \rightarrow q) \wedge (p \rightarrow \neg q) \wedge (\neg p \rightarrow q) \wedge (\neg p \rightarrow \neg q)$
- c)  $(p \leftrightarrow q) \wedge (\neg p \leftrightarrow q)$