p	q	$\sim q$	$p \wedge q$	$p \wedge \sim q$	$(p \wedge q) \vee (p \wedge \sim q)$
T	T	F	T	F	T
T	F	T	F	T	T
F	T	F	F	F	F
F	F	T	F	F	F

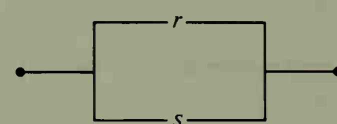
Notice that the first and last columns of the truth table are identical. This means that the complicated circuit shown can be replaced by a simpler circuit that contains just switch p! In other words, logic can be used to replace a complex electrical circuit by a simpler one.

Exercises

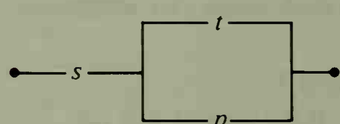
Symbolize each circuit using $\wedge$, $\vee$, $\sim$, and letters given for the switches in each diagram.

1.

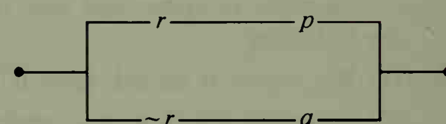
2.



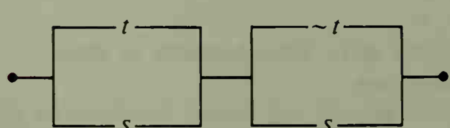
3.



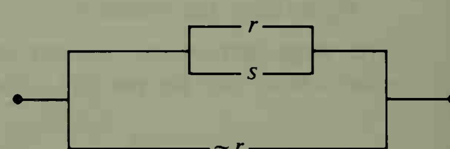
4.



5.



6.



7. Draw a diagram for the circuit $p \wedge \sim p$; also for the circuit $p \vee \sim p$. Electricity can always pass through one of these circuits and can never pass through the other. Which is which?
8. According to the commutative rule, $p \wedge q \equiv q \wedge p$. This means that the circuit $p \wedge q$ does the same thing as the circuit $q \wedge p$. Make a diagram of each circuit.
9. According to the associative rule, $(p \vee q) \vee r \equiv p \vee (q \vee r)$. Draw diagrams for each circuit.
10. The distributive rule says that $p \wedge (q \vee r) \equiv (p \wedge q) \vee (p \wedge r)$. Draw diagrams for each circuit.
11. Make both a diagram and a truth table for the circuit $(p \vee q) \vee \sim q$. Notice that the last column of your table is always T so that current always flows. This means that all of the switches could be eliminated.
12. Make both a diagram and a truth table for the circuit $(p \vee q) \wedge (p \vee \sim q)$. Describe a simpler circuit equivalent to this circuit.