Sussanna 76 → 3, 4, 7, 8, 11

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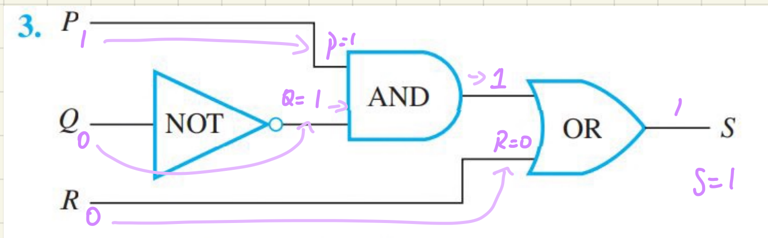
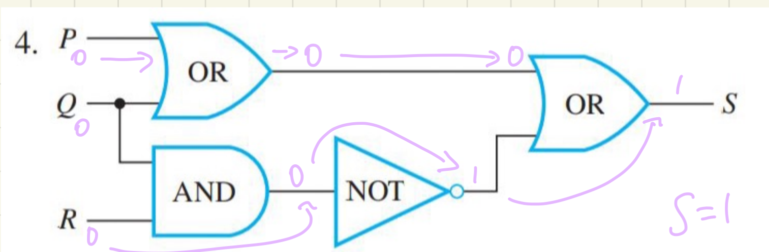
Give Output signals

3.



input signals: $P = 1$, $Q = 0$, $R = 0$

4.



input signals: $P = 0$, $Q = 0$, $R = 0$

Find the Boolean expression of:

(11) Exercise 3

$P = 1$ $\quad P \land Q = 1$

$Q = 0$

$R = 0$ $\quad (P \land Q) \lor (R) = 1$

$P \land \neg Q \lor R$

(12) Exercise 4

$P = 0$ $\quad P \lor Q = 0$ $\quad (P \land Q) \lor (\neg(Q \land R)) = 1$

$Q = 0$

$R = 0$ $\quad Q \land R = 0$ $\quad \neg(Q \land R) = 1$

$(P \land Q) \lor (\neg(Q \land R))$

Write I/O table for

(7) Exercise 3:

P	q	r	¬q	(P∧¬q)	(P∧¬q)∨r
T	T	T	F	F	T
T	T	F	F	F	F
T	F	T	T	T	T
T	F	F	T	T	T
F	T	T	F	F	T
F	T	F	F	F	F
F	F	T	T	F	T
F	F	F	T	F	F

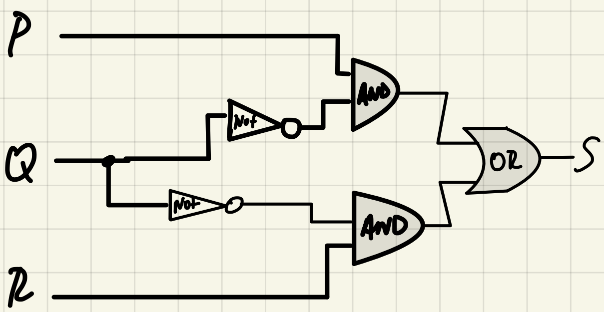
8) Exercise 4

P	q	r	¬q	P∨q	q∧r	(¬(q∧r))	(p∨q)∨(¬(q∧r))
T	T	T	F	T	T	F	T
T	T	F	F	T	F	F	T
T	F	T	T	T	F	T	T
T	F	F	T	T	F	F	T
F	T	T	F	T	T	F	T
F	T	F	F	T	F	F	T
F	F	T	T	F	F	T	T
F	F	F	T	F	F	F	F

Pág 76 {17, 19, 28, 31, 34}

Construct Circuits For

(17) $(P \wedge \neg Q) \vee (\neg P \wedge R)$

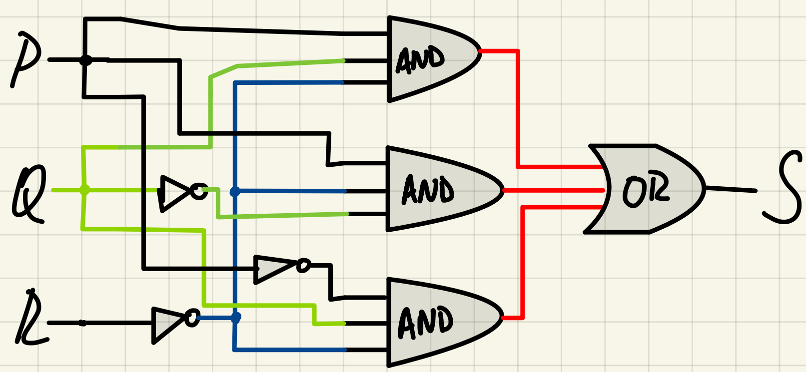


Construct a Boolean expression and circuit for:

$S = (P \wedge Q \sim R) \vee (P \wedge \sim Q \wedge \sim R) \vee (\sim P \wedge Q \wedge \sim R)$

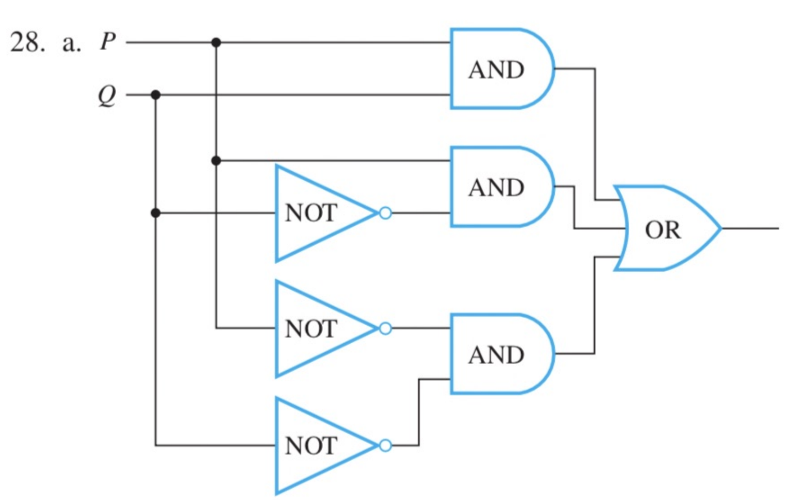
(19)

P	Q	R	S	
1	1	1	0	
1	1	0	1	$\to P \wedge Q \wedge \sim R$
1	0	1	0	
1	0	0	1	$\to P \wedge \sim Q \wedge \sim R$
0	1	1	0	
0	1	0	1	$\sim P \wedge Q \wedge \sim R$
0	0	1	0	
0	0	0	0	

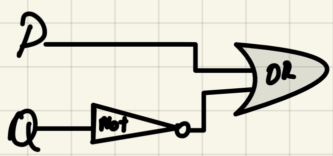


Use the properties listed in Theorem 2.1.1 to show that each pair of circuits in 26–29 have the same input/output table. (Find the Boolean expressions for the circuits and show that they are logically equivalent when regarded as statement forms.)

28. a.



a)



$(P \wedge Q) \vee (P \wedge \sim Q) \vee (\sim P \wedge \sim Q)$

$\equiv (P \wedge Q) \vee (P \wedge \sim Q) \vee (\sim P \wedge \sim Q)$ ← Associative

$\equiv (P \wedge (Q \vee \sim Q)) \vee (\sim P \wedge \sim Q)$ ← Distributive

$\equiv (P \wedge T) \vee (\sim P \wedge \sim Q)$ ← Negation

$\equiv P \vee (\sim P \wedge \sim Q)$ ← Identity

$\equiv (P \vee \sim P) \wedge (P \vee \sim Q)$ ← Distributive

$\equiv T \wedge (P \vee \sim Q)$ ← Negation

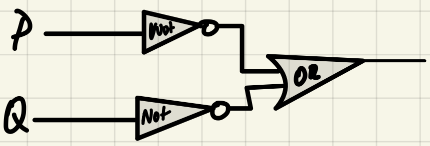
$\equiv (P \vee \sim Q) \wedge T$ ← Commutative

$\equiv P \vee \sim Q$ ← Identity

$(P \wedge Q) \vee (P \wedge \sim Q) \vee (\sim P \wedge \sim Q) \equiv P \vee \sim Q$

For the circuits corresponding to the Boolean expressions in each of 30 and 31 there is an equivalent circuit with at most two logic gates. Find such a circuit.

(31) $(\sim P \wedge \sim Q) \vee (\sim P \wedge Q) \vee (P \wedge \sim Q)$



(34) Show that the following logical equivalences hold for the Pierce arrow $\downarrow$, where
$P \downarrow Q \equiv \sim(P \vee Q)$

c) $P \wedge Q \equiv (P \downarrow P) \downarrow (Q \vee Q)$

$P \wedge Q \equiv (P \downarrow P) \downarrow (Q \vee Q)$
$\equiv \sim(\sim(P \vee P)) \vee \sim(Q \vee Q)$ → Definition of $\downarrow$
$\equiv \sim(\sim(P \vee P)) \wedge \sim(\sim(Q \vee Q))$ → De Morgan's Law
$\equiv (P \vee P) \wedge (Q \vee Q)$ → Double Complementation
$\equiv P \wedge Q$ → Idempotent Law