University of California at Berkeley
College of Engineering
Department of Electrical Engineering and Computer Sciences

EECS150 J. Wawrzynek
Spring 2000 E. Caspi

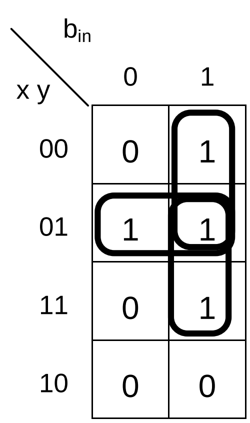
Quiz #9 – Solution

(a) The 1-bit subtractor computes: $d = x - y - b_{in}$, passing a borrow b_{out} to the right. The truth table for d and b_{out} follows:

x	y	b_{in}	d	b_{out}
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

The difference output d is identical to the sum output of a full adder. It is expressed most simply using XORs: $d = x \oplus y \oplus b_{in}$.

The borrow output b_{out} is not so familiar. We derive its reduced expression using a Karnaugh map: $b_{out} = x'bin + x'y + yb_{in}$.



(b) A ripple subtractor can be formed by cascading several 1-bit subtractors with a *borrow-chain*. This construction is similar to a ripple adder with a *carry-chain*.