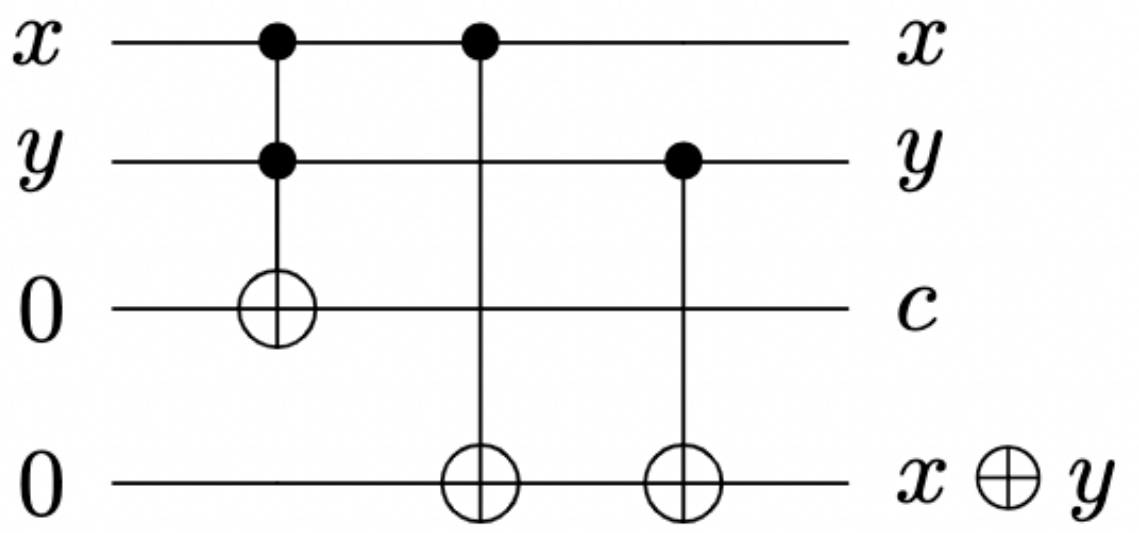
Exercise 3.31

We could construct the following circuit with classical Toffoli gate and XOR gate (classical CNOT gate). The circuit is shown below.



The truth table of above circuit is given by

Input $(x, y, 0, 0)$	**Output** $(x, y, c, x \oplus y)$
$(0, 0, 0, 0)$	$(0, 0, 0, 0)$
$(0, 1, 0, 0)$	$(0, 1, 0, 1)$
$(1, 0, 0, 0)$	$(1, 0, 0, 1)$
$(1, 1, 0, 0)$	$(1, 1, 1, 0)$

From the table, we could conclude that the given circuit performs an addtion $x \oplus y$. Note that we have an additional bit c to check whether the $x \oplus y = 0$ corresponds to $x = 0, y = 0$ or $x = 1, y = 1$; if $c = 0$ and $x \oplus y = 0$ then $x = 0, y = 0$; if $c = 1$ and $x \oplus y = 0$ then $x = 1, y = 1$.

Note that the input and output bits are both 4, and from the table, one input only matches one particular output. So the given circuit is reversible.