1 [10] Using two different methods, prove that the following circuits are functionally equivalent.

\[ a \leq c \neq b \leq c \lor ((a \leq b) \triangle (b \leq a)) \land c \]

2 [10] Simplify the following boolean expression. Show your work.

\[ ((a \leq c) \neq (b \leq c)) \lor ((a \leq b) \triangle (b \leq a)) \land c \]

3 Show that
(a) [5] \{\leq\} is not complete.
(b) [5] Using only 2-input \(\triangle\) gates, one can build the circuit \(a \leq b\).

4 [15] Consider the encrypt/decrypt function \(f(x) = 3x \mod 8\).

For any integer \(0 \leq x < 8\), \(y = f(x)\) is a number that can be considered the encrypted code of \(x\). For example, the encryption of 2 is \(f(2) = (3 \times 2) \mod 8 = 6\), \(i.e.,\, 2\) is encrypted into 6.

To decrypt, simply apply the function to the encrypted code \(y\), and obtain \(x = f(y)\). For the example above, \(f(6) = (3 \times 6) \mod 8 = 18 \mod 8 = 2\), \(i.e.,\, 6\) is decrypted and the original number 2 is obtained.

Design a circuit that computes, for any integer input \(0 \leq x < 8\), the encrypt/decrypt function \(f(x)\).