Let X = (x_6, 0, x_4, x_3, x_2, 0, x_0) be a 7-bit unsigned number in which the indicated bit positions are fixed at 0, and let Y = (y_5, 0, y_3, y_2, 0, y_0) be a 6-bit unsigned number in which the indicated bit positions are fixed at 0. Also, let P=XY be the unsigned product of X and Y.

(a) (0.5 points) In decimal, give the minimum and maximum values for X, Y and P. Also, what is the minimum number of bits needed to represent P?

(b) (1.5 points) Using only AND gates and a minimum number of full adders (each having inputs a, b, c and outputs sum, c_{out}), draw the diagram of a circuit to produce the product P. (You may connect nodes to the constant value 0 as needed.)

(c) (0.8 points) Consider the design of a functional block to compute W = P + 32Z, where Z = (z_7, z_6, 1, 1, 1, z_2, z_1, z_0) is an 8-bit signed number in which the indicated bit positions are fixed at 1 and W is a signed number. (Here, a signed number is one that is represented using the two's complement number system.) In decimal, give the minimum and maximum values for Z and W. Also, what is the minimum number of bits needed to represent W without having any signed overflow?

(d) (1.2 points) Using only full adders, draw the diagram of a circuit to produce W having inputs P and Z, where W has the minimum number of bits as determined in part (c). (You may connect nodes to the constant value 0 or 1 as needed.)