Q1

	00110110	10101001
Binary	54	169
One's complement	54	-86
Two's complement	54	-87

<u>00110110</u>

Calculated the same way for binary, one's complement and two's complement because the most significant bit is zero

$00110110_2 = 2^1 + 2^2 + 2^4 + 2^5 = 2 + 4 + 16 + 32 = 54_{10}$

<u>10101001</u>

Binary: $10101001_2 = 2^0 + 2^3 + 2^5 + 2^7 = 1 + 8 + 32 + 128 = 169_{10}$

One's Complement: 10101001_2 is negative. Flip bits to get $01010110_2 = -(2^1 + 2^2 + 2^4 + 2^6) = -(2 + 4 + 16 + 64) = -86_{10}$

Two's Complement: 10101001_2 is negative. Subtract 1 from $10101001_2 - 1 = 10101000_2$. Flip bits to get $01010111_2 = -(2^0 + 2^1 + 2^2 + 2^4 + 2^6) = -(1 + 2 + 4 + 16 + 64) = -87_{10}$

Or, treat the MSB as representing a negative number

$10101001_2 = 2^0 + 2^3 + 2^5 - 2^7 = 1 + 8 + 32 - 128) = -87_{10}$

Q2 Truth Table:

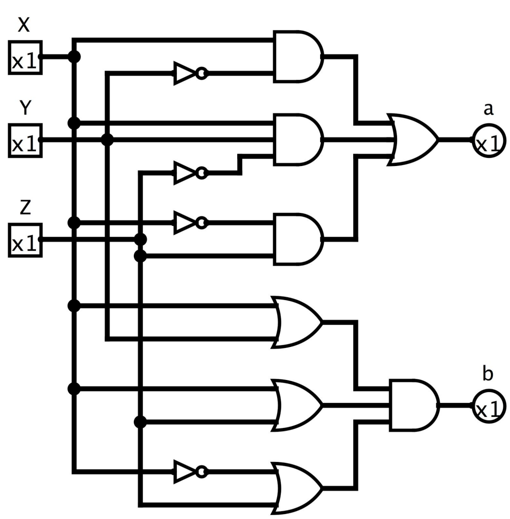
X	Y	Z	a	b
0	0	0	0	0
0	0	1	1	0
0	1	0	0	0
0	1	1	1	1
1	0	0	1	0
1	0	1	1	1
1	1	0	1	0
1	1	1	0	1

Evaluate each function for each different value of X, Y and Z. Example: Row 2, X = 0, Y = 0, Z = 1

$a \;=\; (0 \cdot \neg 1) + (0 \cdot 0 \cdot \neg 1) + (\neg 0 \cdot 1) \;=\; 0 + 0 + 1$ ---> a evaluates to 1.

$b \;=\; (0 + 0)(0 + 1)(\neg 0 + 1) = 0 \cdot 1 \cdot 1$ ---> b evaluates to 0.

For the curious:



Q3

(a) F = !W!XY!Z + !WX!YZ + !WXYZ + W!XY!Z + WX!Y!Z + WX!YZ + WXYZ

(b) Karnaugh Map

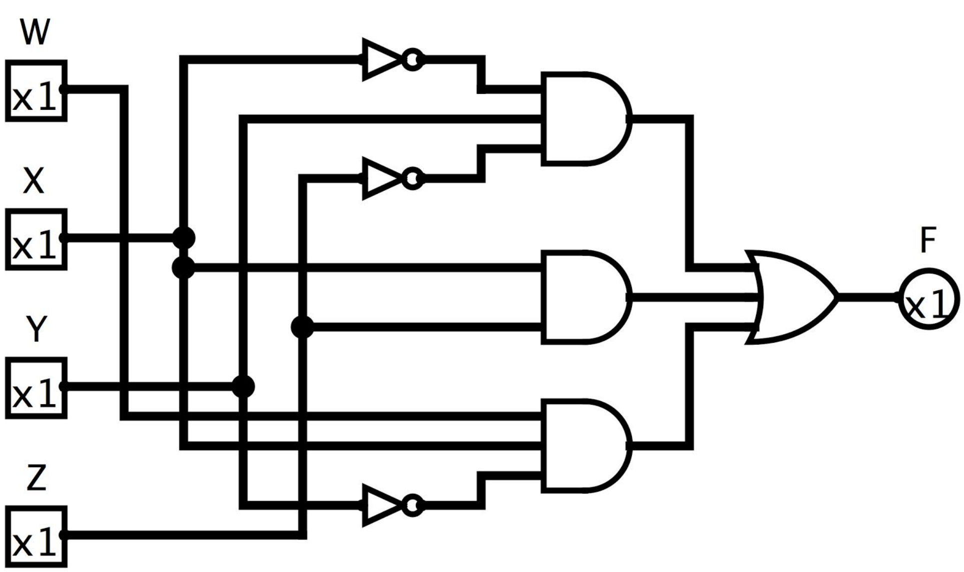
0	0	0	1
0	1	1	0
1	1	1	0
0	0	0	1

(c) F = XZ + WX!Y + !XY!Z

(Relevant sections for each term highlighted below)

0	0	0	1
0	1	1	0
1	1	1	0
0	0	0	1

(d) Sum-of-products

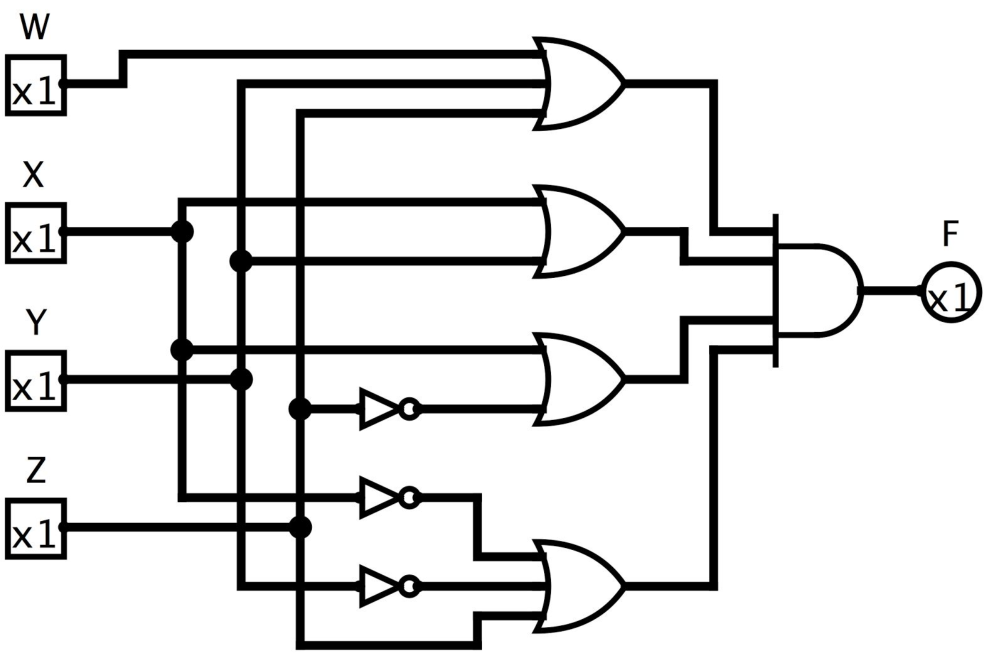


(e) F = (X + !Z)(X + Y)(W + Y + Z)(!X + !Y + Z)

(Relevant sections for each term highlighted below - I tried to approximate overlapping colors. Hopefully it's not too confusing.)

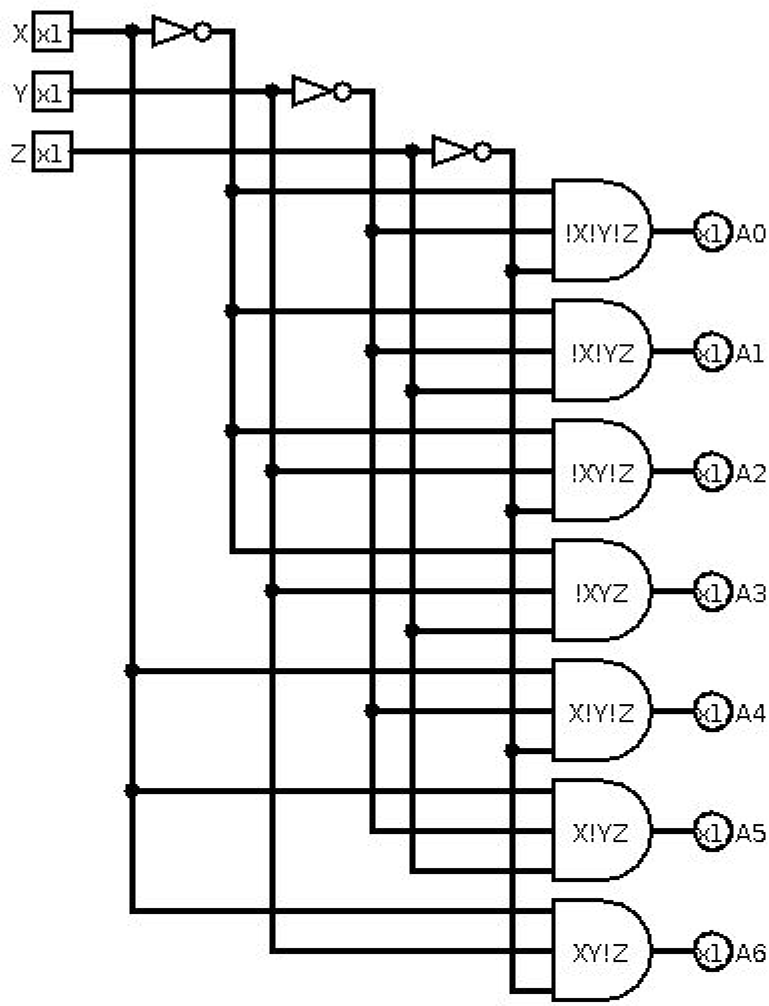
0	0	0	1
0	1	1	0
1	1	1	0
0	0	0	1

(f) Product-of-Sums



Q4 Here is the truth table, including the corresponding minterms

X	Y	Z	A0	A1	A2	A3	A4	A5	A6	minterm
0	0	0	1	0	0	0	0	0	0	!X!Y!Z
0	0	1	0	1	0	0	0	0	0	!X!YZ
0	1	0	0	0	1	0	0	0	0	!XY!Z
0	1	1	0	0	0	1	0	0	0	!XYZ
1	0	0	0	0	0	0	1	0	0	X!Y!Z
1	0	1	0	0	0	0	0	1	0	X!YZ
1	1	0	0	0	0	0	0	0	1	XY!Z
1	1	1	0	0	0	0	0	0	0	XYZ

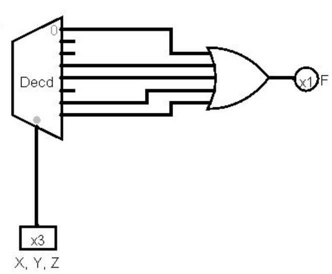


5.

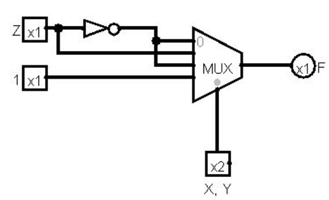
X	Y	Z	F
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

X	Y	F
0	0	¬Z
0	1	Z
1	0	¬Z
1	1	1

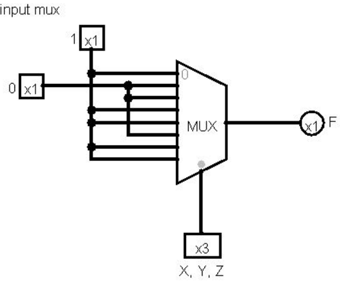
A) 3-to-8 decoder and an OR gate



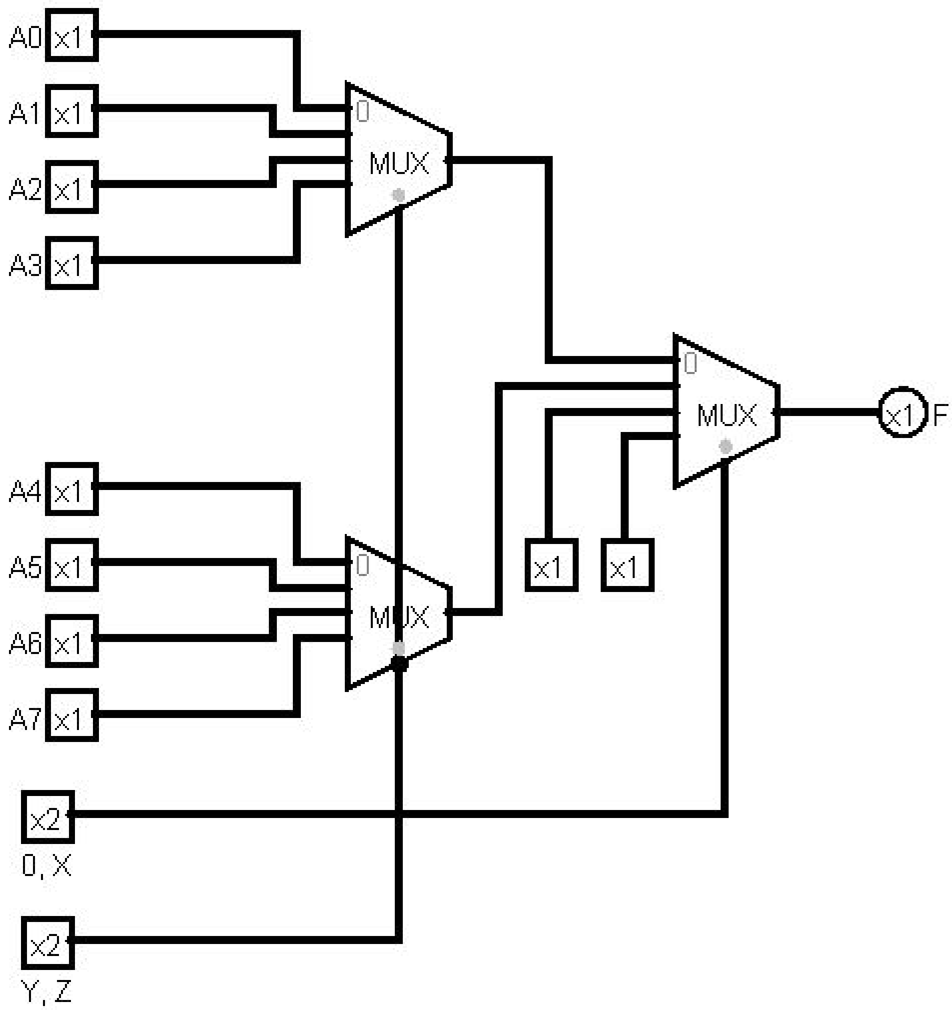
C) 4 input mux and an inverter



B) an 8 input mux



6. Use 2 four-input muxes with Y, Z as the selects. Then use a four-input mux that takes X and a constant 0 as selects. Since the second value is a 0, only the inputs corresponding to the 0 or 1 will become the output. The other two inputs are irrelevant.



7. Here is the truth table for the combinational logic of the counter. Note that the output is don't-cares for inputs 6 and 7:

X	Y	Z	A	B	C
0	0	0	0	0	1
0	0	1	0	1	0
0	1	0	0	1	1
0	1	1	1	0	0
1	0	0	1	0	1
1	0	1	0	0	0
1	1	0	X	X	X
1	1	1	X	X	X

Here are the Karnaugh maps for A, B, and C

0	0	1	0
1	0	X	X

0	1	0	1
0	0	X	X

1	0	0	1
1	0	X	X

A = Y Z + X !Z   B = !X !Y Z + Y !Z   C = !Z