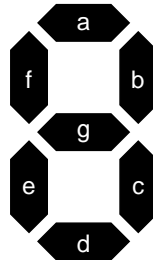
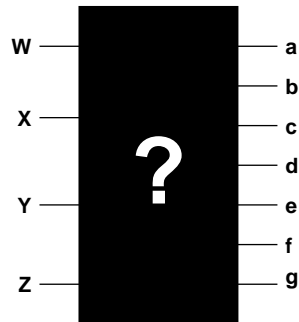


7-segment decoder

Given is the seven segment display below. Each segment represents one logic function (a,b,c,...). If the logic function is true(1) the segment lights up.



Given is the black box below. This black box has four inputs and the seven logic functions as outputs.



The functionality of this black box is given below:

W	X	Y	Z		W	X	Y	Z		W	X	Y	Z	
0	0	0	0	0	0	1	1	0	6	1	0	1	1	b
0	0	0	1	1	0	1	1	1	7	1	1	0	0	c
0	0	1	0	2	1	0	0	0	8	1	1	0	1	d
0	0	1	1	3	1	0	0	1	9	1	1	1	0	e
0	1	0	0	4	1	0	1	0	a	1	1	1	1	f
0	1	0	1	5										

7-segment decoder

Questions:

1. Draw the truth table for this black box.

W	X	Y	Z	a	b	c	d	e	f	g
0	0	0	0							
0	0	0	1							
0	0	1	0							
0	0	1	1							
0	1	0	0							
0	1	0	1							
0	1	1	0							
0	1	1	1							
1	0	0	0							
1	0	0	1							
1	0	1	0							
1	0	1	1							
1	1	0	0							
1	1	0	1							
1	1	1	0							
1	1	1	1							

2. Give the smallest representation for the functions using the method of the Karnaugh diagrams. Use for the functions **a**, **c**, **f**, and **g** the *max terms* and for the others the *min terms*.

a=_____

b=_____

c=_____

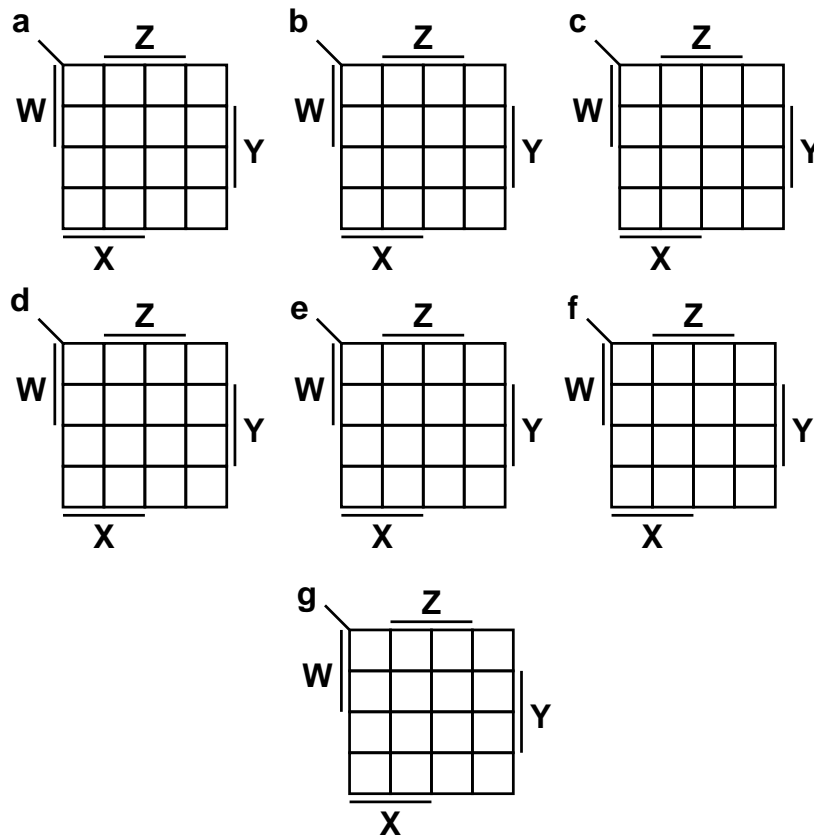
d=_____

e=_____

7-segment decoder

f=_____

g=_____



3. Draw the gate implementation of these functions using only AND, OR, and NOT gates. Verify the correct functionality using logisim.
4. Draw and verify the gate implementation of function **a** using only NOR-gates (use logisim).
5. Draw and verify the gate implementation of function **b** using only NAND-gates (use logisim).
6. Draw and verify the gate implementation of function **c** using only OR and XOR-gates (use logisim).
7. Draw and verify the gate implementation of function **e** using the conjunctive canonical form [*product of sums*] (use logisim).