Sample Midterm 1 Exam

1. (4 points) Fill in the truth table for the two boolean functions,

$$f(x, y, z) = \sum m(1, 3, 4, 6) \quad \text{and} \quad g(x, y, z) = \prod M(1, 2, 6, 7)$$
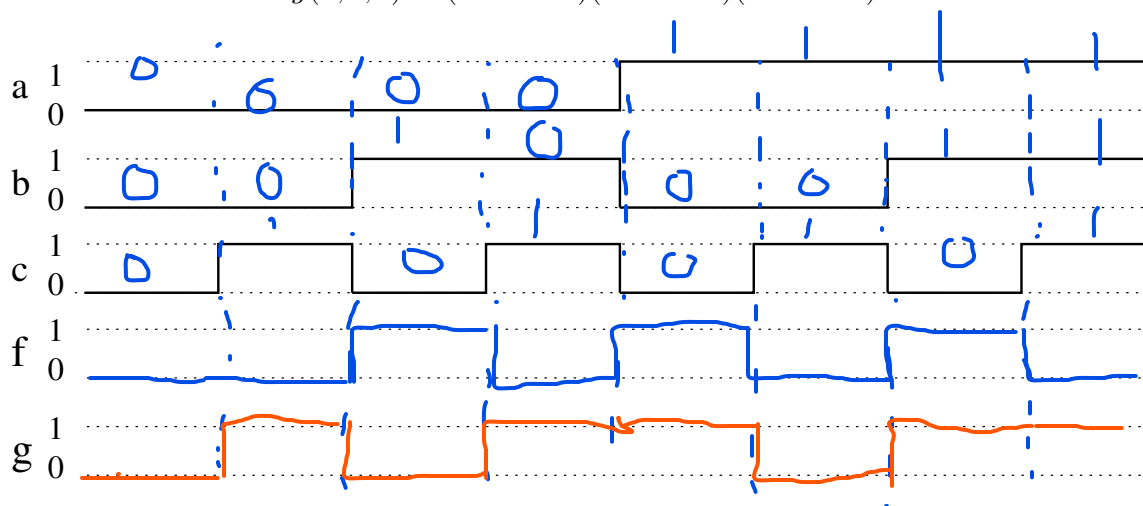
(You do not need to show intermediate columns.)

	X	Y	Z	f
0	0	0	0	0
1	0	0	1	1
2	0	1	0	0
3	0	1	1	1
4	1	0	0	1
5	1	0	1	0
6	1	1	0	1
7	1	1	1	0

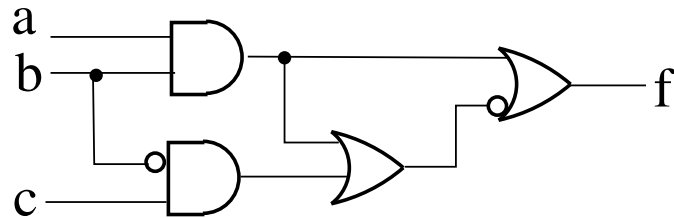| X	Y	Z	g
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

2. (6 points) Fill in the waveform for the output f and g where the value of f and g are given by

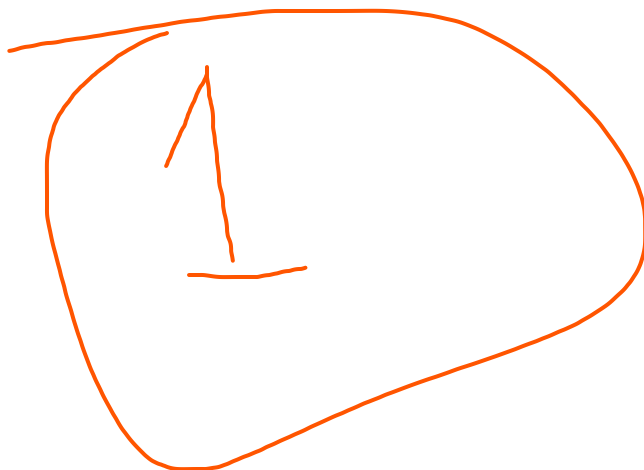$$f(a, b, c) = \bar{a}\,b\,\bar{c} + a\,\bar{b}\,\bar{c} + a\,b\,\bar{c}$$

$$g(a, b, c) = (a + b + c)(a + \bar{b} + c)(\bar{a} + b + \bar{c})$$

3. (8 points) Obtain a boolean expression for the output (f) of the schematic below in terms of its inputs, a, b, c and simplify it.

$$\left((AB) + (\overline{B}C) \right) + \overline{(AB + \overline{B}C)} + AB$$

(circled) 1

4. (two parts)

$\overline{a}\,\overline{c} + B\overline{c} + A\overline{B}c$

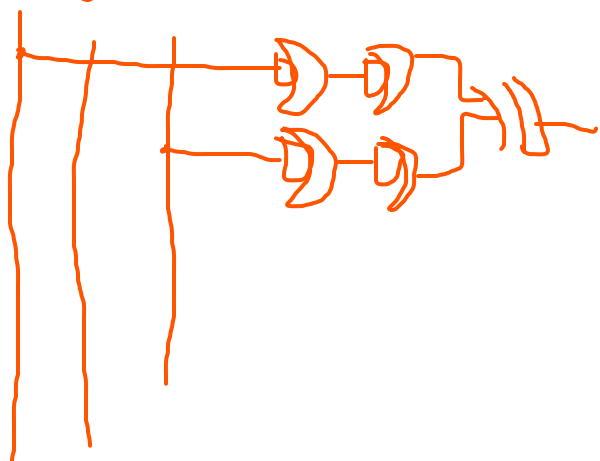(a) (5 points) Implement the function

$$g(a, b, c) = \sum m(0, 3, 4, 5)$$

with a NOR-NOR network.

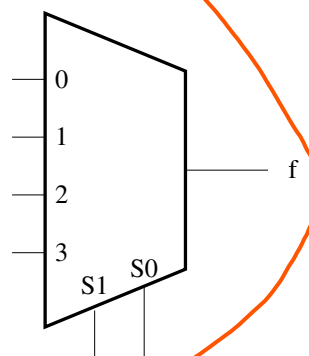You may assume that the inputs, a, b, c, are available in both complemented and uncomplemented form.

A B C

(b) (5 points) Implement the function

$$f(a, b, c) = \sum m(2, 5, 7)$$

using the 4-to-1 multiplexer below and no additional gates.
(For 2 points off you may use an inverter.)

5. (12 points) Simplify the expressions below as much as possible **using the laws of Boolean Algebra**.

   (a) (5 points)
   $$(x + y + z)(x + \overline{y} + z) + \overline{z}$$

   (b) (7 points)
   $$\overline{\overline{x}\,y + (y + \overline{z})\overline{(x + yz)}}$$

6. (15 points) Obtain both minimal SOP and POS forms for the function below. Use separate K-maps for the SOP and POS forms. Draw and list **all** prime implicants and identify which ones are essential.

$$f(a, b, c, d) = \prod M(2, 3, 4, 6, 7, 10, 12)$$

7. (15 points) Obtain both minimal SOP and POS forms for the incompletely specified function below. Use separate K-maps for the SOP and POS forms. Draw and list **all** prime implicants and identify which ones are essential.

$$f(a, b, c, d) = \sum m(0, 2, 4, 5, 7, 9, 10, 13) + D(6, 8, 14)$$