

S3 Technological Studies: Homework 16: Logic.

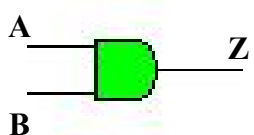
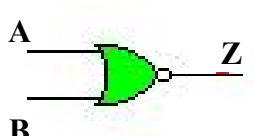
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Name: _____ Class: _____ Date: _____

1. Logic gates are digital electronic switching devices, describe what is meant by a “digital” device.

1
0

2. Complete the following table showing the five basic forms of logic gate, their symbols and their Boolean expression.

Logic symbol	Name	Boolean Expression
	NOT	$Z = \bar{A}$
		
		$Z = A + B$
	NAND	$Z = \overline{A \cdot B}$
		

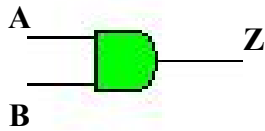
8
7
6
5
4
3
2
1
0

3. For each of the following examples...

(i) Complete the truth table for the logic system.

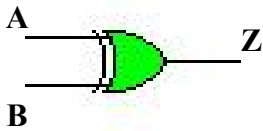
(ii) Write a Boolean expression that describes the logic system.

(a)



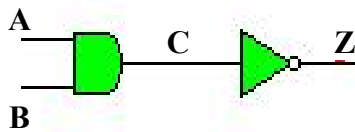
A	B	Z
0	0	
0	1	
1	0	
1	1	

(b)



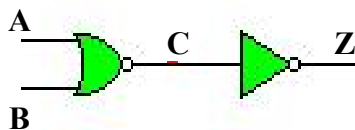
A	B	Z
0	0	
0	1	
1	0	
1	1	

(c)



A	B	C	Z
0	0		
0	1		
1	0		
1	1		

(d)



A	B	C	Z
0	0		
0	1		
1	0		
1	1		

3
2
1
0

3
2
1
0

5
4
3
2
1
0

5
4
3
2
1
0

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1. (a) Describe what is meant by combinational logic.

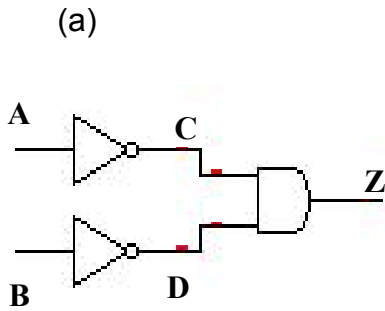
(b) How many possible input conditions can be generated for a logic system with...

(i) 2 inputs

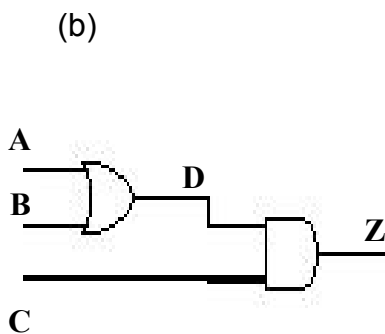
(ii) 3 inputs

(iii) 4 inputs

2. Complete the truth tables for the following combinational logic systems.



A	B	C	D	Z
0	0			
0	1			
1	0			
1	1			



A	B	C	D	Z
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

2
1
0

1
0

1
0

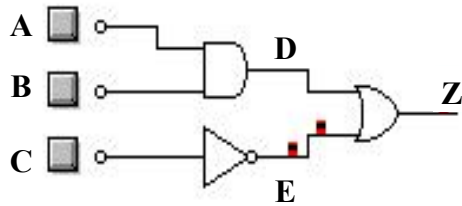
1
0

6
5
4
3
2
1
0

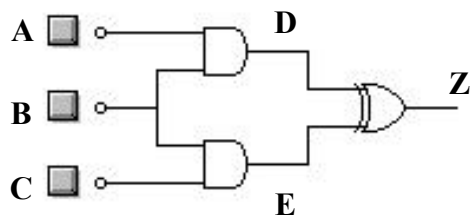
8
7
6
5
4
3
2
1
0

3. For each of the following examples, draw a truth table to describe the operation of the logic system and derive a Boolean expression for the system.

(a)



(b)



13
12
11
10
9
8
7
6
5
4
3
2
1
0

13
12
11
10
9
8
7
6
5
4
3
2
1
0

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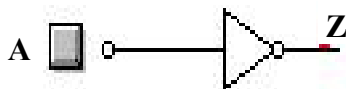
1. We can use NAND equivalence circuitry when designing logic systems for manufacture in industry.

Describe two advantages of using NAND gate technology in manufacture.

2
1
0

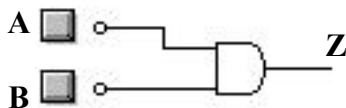
2. Draw the NAND equivalence circuits for the following logic gates.

(a)



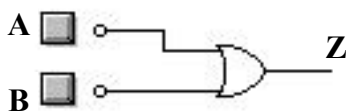
1
0

(b)



2
1
0

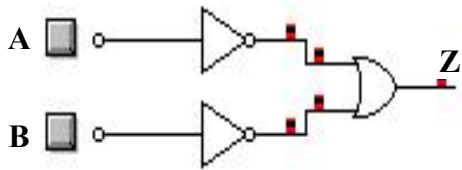
(c)



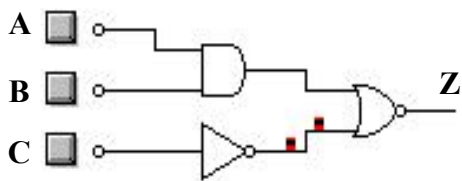
3
2
1
0

3. For the following combinational logic circuits draw and simplify the NAND equivalence circuit for each example.

(a)



(b)



6
5
4
3
2
1
0

8
7
6
5
4
3
2
1
0

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For each of the problems on the page, use the truth table to create a Boolean expression and develop a logic system to solve the problem.

1.

A	B	Z
0	0	0
0	1	1
1	0	0
1	1	1

2.

A	B	Z
0	0	1
0	1	0
1	0	0
1	1	1

5
4
3
2
1
0

5
4
3
2
1
0

3.

A	B	C	Z
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	0

4.

A	B	C	Z
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

5
4
3
2
1
0

6
5
4
3
2
1
0

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1. A logic system is required that will allow a machine (M) to operate only when a guard (G) is down and a button (B) has been pressed by the machines operator.

In addition, the machine should not operate unless the component to be machined is in place, this is detected by a light beam (L) being broken giving a logic 0 signal...

(a) Develop a Boolean expression that describes the solution to this problem.

(b) Draw a logic diagram that will allow the machine to operate as described above...

(c) Develop a truth table to show all the possible output conditions of your logic system.

2
1
0

3
2
1
0

8
7
6
5
4
3
2
1
0

2. A system for controlling the alarm in a new car has been designed using a logic system. The alarm should operate if...

Either the driver or passenger doors are opened without the driver having the key for the car in his pocket when the doors are opened.

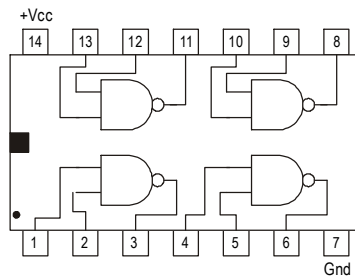
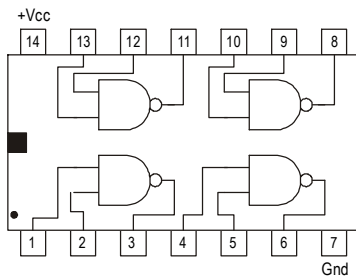
The Driver and passenger doors are at logic 1 when they are closed, the remote signal from the key will give a logic 1 signal when the driver is next to the car.

(a) Using appropriate labels, write a Boolean expression for the alarm system described.

(b) Draw a logic diagram that would allow the alarm to operate efficiently...

(c) Draw and simplify the NAND equivalence circuit that could be used to manufacture this chip.

(d) On the diagram below, complete the wiring of the NAND circuit using 7400 chips.



3
2
1
0

7
6
5
4
3
2
1
0

4
3
2
1
0

4
3
2
1
0