1.3.1 Logic gates

Monday, 25 January 2021 7:55 PM

1.3.1 Logic gates

Topic: 1.3.1 Logic gates

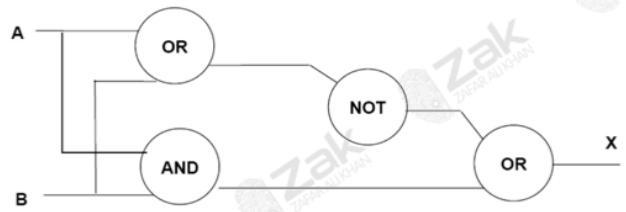
Other Questions:

In questions 1 to 6, produce truth tables from the given logic networks. Remember that if there are TWO inputs then there will be four (22) possible outputs and if there are THREE inputs there will be eight (23) possible outputs.
i.e.

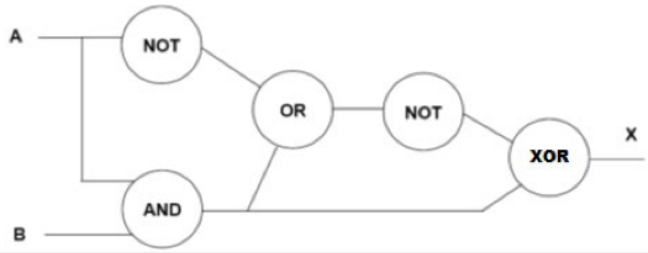
A	B	C	X
1	1	1	
1	1	0	
1	0	1	
1	0	0	
0	1	1	
0	1	0	
0	0	1	
0	0	0	

A	B	X
1	1	
1	0	
0	1	
0	0	

(1)



(2)



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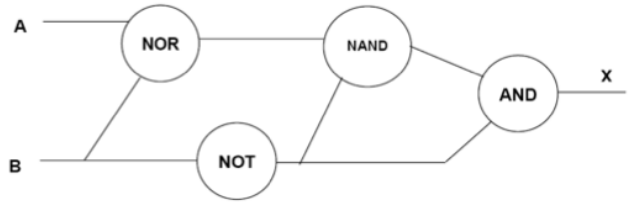
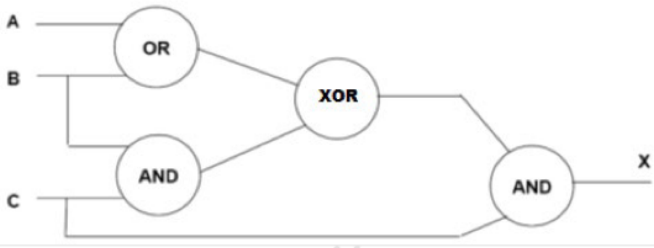
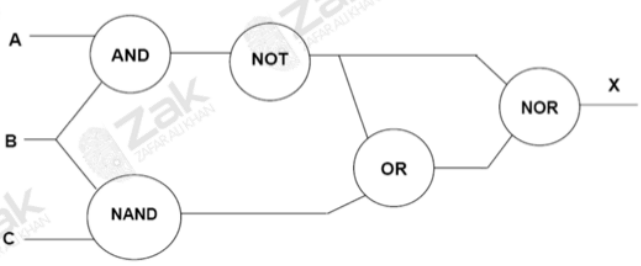
(3)


A
B
NOR
NOT
NAND
AND
X

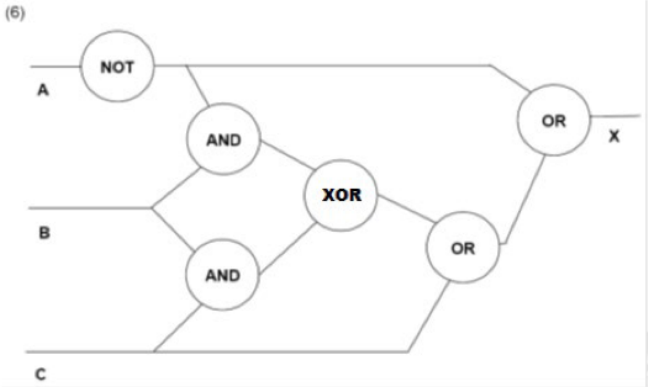
(4)


A
B
C
OR
AND
XOR
AND
X

(5)


A
B
C
AND
NOT
NAND
OR
NOR
X

(6)


A
B
C
NOT
AND
AND
XOR
OR
OR
X

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Topic: 1.3.1 Logic gates

Questions 7 to 10 require both the logic network to be created and also the truth table. The truth table can be derived from the logic network, but also from the problem. This is a check that the logic network actually represents the original problem.

(7) A computer will only operate if three switches P, S and T are correctly set. An output signal (X = 1) will occur if P and S are both ON or if P is OFF and S and T are ON. Design a logic network and draw the truth table for this network.

(8) A traffic signal system will only operate if it receives an output signal (D = 1). This can only occur if:
either (a) signal A is red (i.e. A = 0)
or (b) signal A is green (i.e. A = 1) and signals B and C are both red (i.e. B and C are both 0)
Design a logic network and draw a truth table for the above system.

(9) A chemical plant gives out a warning signal (W = 1) when the process goes wrong. A logic network is used to provide input and to decide whether or not W = 1.

Input	Binary Value	Plant Status
C	1	Chemical Rate = 10 m³/s
	0	Chemical Rate < 10 m³/s
T	1	Temperature = 87 C
	0	Temperature > 87 C
X	1	Concentration > 2 moles
	0	Concentration = 2 moles

A warning signal (W = 1) will be generated if
either (a) Chemical Rate < 10 m3/s
or (b) Temperature > 87 C and Concentration > 2 moles
or (c) Chemical rate = 10 m3/s and Temperature > 87 C
Draw a logic network and truth table to show all the possible situations when the warning signal could be received.

(10) A power station has a safety system based on three inputs to a logic network. A warning signal (S = 1) is produced when certain conditions occur based on these 3 inputs:

Input	Binary Value	Plant Status
T	1	Temperature > 120C
	0	Temperature ≤ 120C
P	1	Pressure > 10 bar
	0	Pressure ≤ 10 bar
W	1	Cooling Water > 100 l/hr
	0	Cooling Water ≤ 100 l/hr

A warning signal (S = 1) will be generated if:
either (a) Temperature > 120C and Cooling Water < 100 l/hr
or (b) Temperature < 120C and (Pressure > 10 bar or Cooling Water < 100 l/hr)

Topic: 1.3.1 Logic gates

Draw a logic network and truth table to show all the possible situations when the warning signal could be received.

Past Papers Questions:

May/June 2011. P11

10 (a) Two logic gates are the AND gate and the OR gate. Complete the truth tables for these two gates:

AND gate

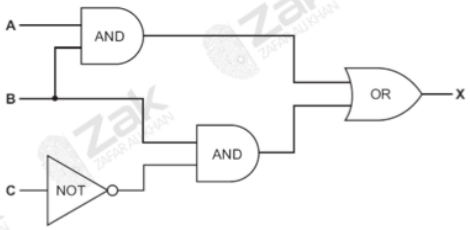
A	B	X
0	0	
0	1	
1	0	
1	1	

OR gate

A	B	X
0	0	
0	1	
1	0	
1	1	

[2]

(b) Complete the truth table for the following logic circuit:



A	B	C	X
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

[4]

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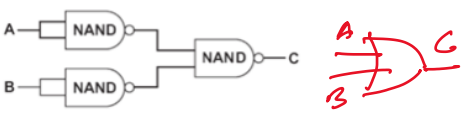
Topic: 1.3.1 Logic gates

May/June 2011. P12

11 (a) (i) Complete the truth table for the following logic circuit:



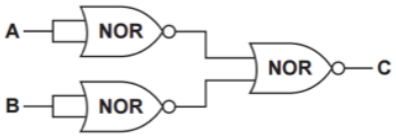
A	B	C
0	0	
0	1	

1	0	
1	1	

[2]

(ii) Which single logic gate has the SAME function as the above logic circuit? [1]

(b) (i) Complete the truth table for the following logic circuit:



A	B	C
0	0	
0	1	
1	0	
1	1	

[2]

(ii) Which single logic gate has the SAME function as the above logic circuit? [1]

Oct/Nov 2011. P11

14 An alarm, X, gives a signal (i.e. X = 1) when a car fuel injection system gives certain fau conditions. The inputs are:

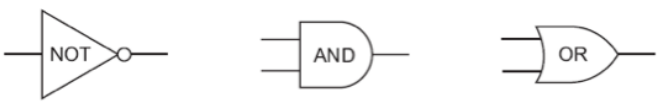
input	binary value	condition
P	0	pressure < 5 bar
	1	pressure >= 5 bar
R	0	revs > 8000 rpm
	1	revs <= 8000 rpm
T	0	temp > 120 °C
	1	temp <= 120 °C

The alarm returns a value of 1 if:

either (i) pressure < 5 bar AND revs > 8000 rpm

or (ii) revs <= 8000 rpm AND temp > 120 °C

(a) Draw the logic circuit for the above system using these logic gates.



(b) Complete the truth table for this alarm system.

P	R	T	X
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	

1	0	1	
1	1	0	
1	1	1	

[4]

Oct/Nov 2011. P13

14 An alarm, Y, sends a signal (Y = 1) when certain fault conditions in a chemical process are detected. The inputs are:

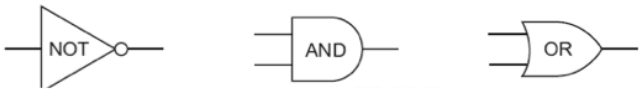
Input	Binary value	Condition
A	1	acidity > 5
	0	acidity <= 5
T	1	temperature >= 120°C
	0	temperature < 120°C
S	1	stirrer bar ON
	0	stirrer bar OFF

The alarm, Y, returns a value of 1 if:

either (i) temperature >= 120°C AND stirrer bar is OFF

or (ii) acidity > 5 AND temperature < 120°C

(a) Draw the logic circuit for the above system using these logic gates.



(b) Complete the truth table for this alarm system.

A	T	S	Y
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

[4]

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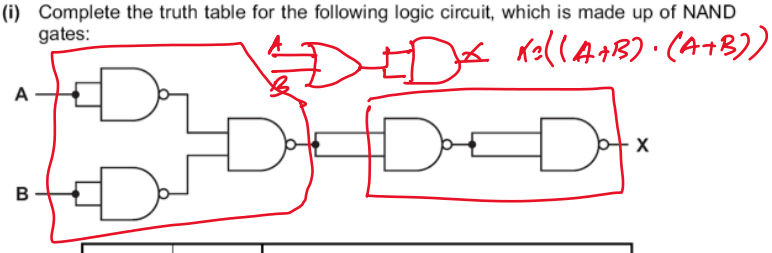
Topic: 1.3.1 Logic gates

12 (a) (i) Complete the truth table for the following logic circuit, which is made up of NAND gates:



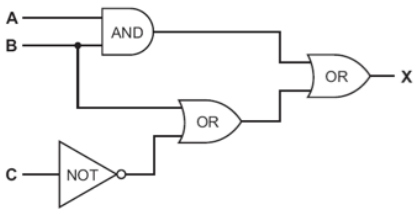
A	B	X
0	0	
0	1	
1	0	
1	1	

[2]

(ii) What single logic gate has the same function as the above logic circuit?

..... [1]

(b) Complete the truth table for the following logic circuit:



A	B	C	X
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

[4]

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Topic: 1.3.1 Logic gates

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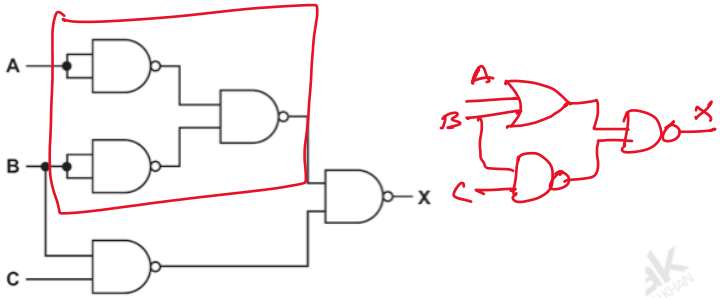
10 (a) Complete the truth table for the following logic circuit, which is made up of NAND gates:



A	B	C	X
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

[4]

(b) Name **two** other types of logic gate and complete their associated truth tables:

Gate 1: .....

A	B	X
0	0	
0	1	
1	0	
1	1	

Gate 2: .....

A	B	X
0	0	
0	1	
1	0	
1	1	

[4]

Topic: 1.3.1 Logic gates

Oct/Nov 2012.P12

11 An alarm sounds when certain conditions occur in a nuclear reactor.

The output, X, of a logic circuit that drives the alarm must have a value of 1 if:

either carbon dioxide pressure too low **and** temperature < = 300°C

or water pressure > 10 bar **and** temperature > 300°C

The inputs to the system are:

Input	Binary	Condition
P	0	carbon dioxide pressure too low
	1	carbon dioxide pressure acceptable
T	0	temperature > 300°C
	1	temperature < = 300°C
W	0	water pressure > 10 bar
	1	water pressure < = 10 bar

(a) Draw the required logic circuit using AND, OR and NOT gates only.

[5]

(b) Complete the truth table for the above system.

P	T	W	X
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

[4]

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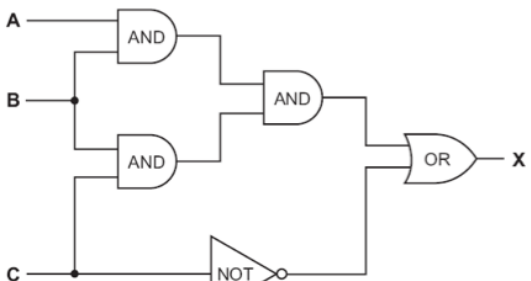
Topic: 1.3.1 Logic gates

Oct/Nov 2012. P13

15 (a) Complete the truth table for the following logic circuit:



A	B	C	X
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

[4]

Topic: 1.3.1 Logic gates

(b) The above logic circuit uses AND, OR and NOT gates.
Name another logic gate and complete its truth table.

Name of gate .....

A	B	X
0	0	
0	1	
1	0	
1	1	

[3]

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Topic: 1.3.1 Logic gates

May/June 2013. P12

15 (a) Draw the logic circuit represented by the logic statement:

X = 1 if (B is NOT 1 AND S is NOT 1) OR (P is NOT 1 AND S is 1)

[6]

(b) Complete the truth table for the above logic statement.

B	S	P	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

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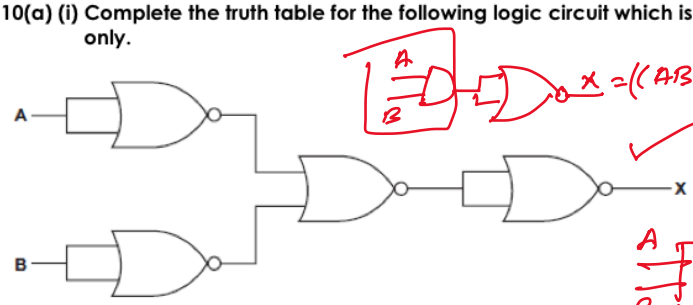
Topic: 1.3.1 Logic gates

Oct/Nov 2013. P12

10(a) (i) Complete the truth table for the following logic circuit which is made up of NORgates only.



A	B	Working space	X
0	0		
0	1		
1	0		
1	1		

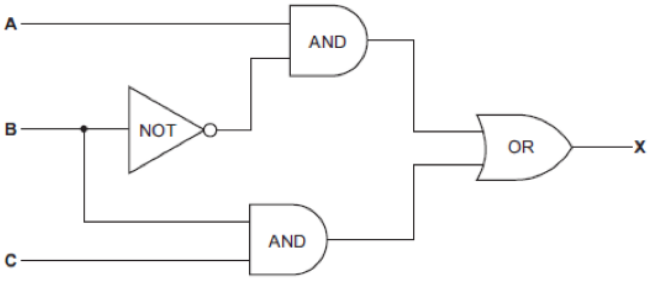
[2]

(ii) What single logic gate has the same function as the above circuit? [1]

.....

.....

(b) Complete the truth table for the following logic circuit.

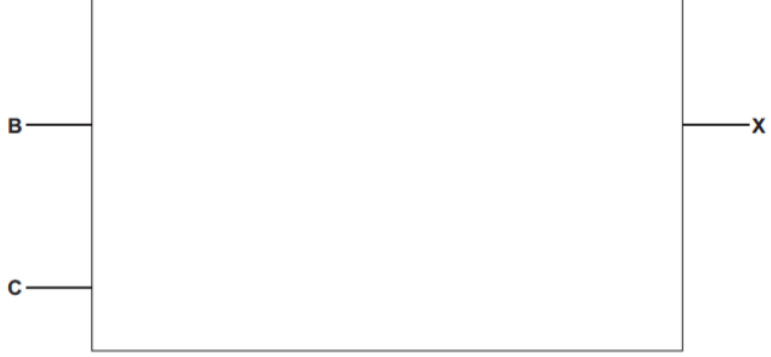


A	B	C	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

Oct/Nov 2013. P13

11 (a) Draw the logic circuit for the following logic statement:
X = 1 if [A is NOT 1 AND B is 1] AND [B is 1 OR C is 1]



[4]

(b) Complete the truth table for the above logic circuit.

A	B	C	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

May/June 2014. P11

7 (a) Draw the logic circuit for the logic statement:
X = 1 if (L is NOT 1 AND F = 1) OR (F is NOT 1 AND A is 1)

[5]

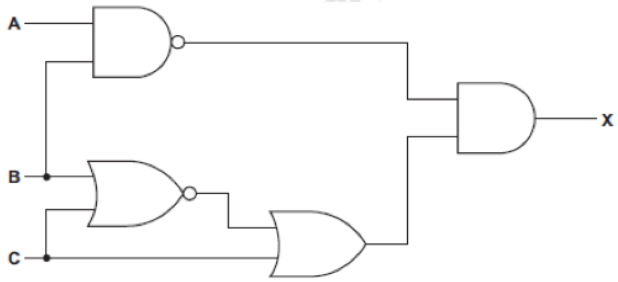
(b) Complete the truth table for the above system.

L	F	A	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

May/June 2014. P12

17 (a) Complete the truth table for the following logic circuit:



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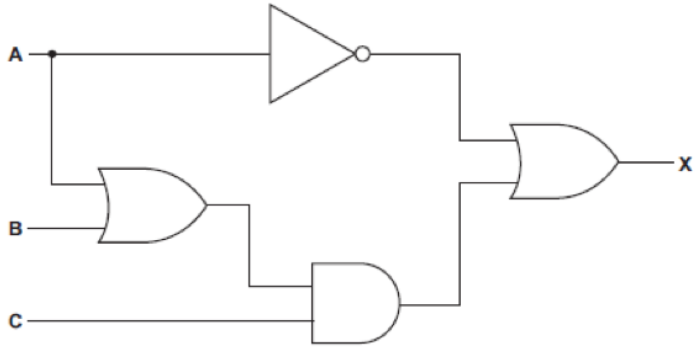
A	B	C	Working	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

(b) Write the logic statement to describe the following logic circuit:



.....

.....

.....

..... [3]

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Topic: 1.3.1 Logic gates

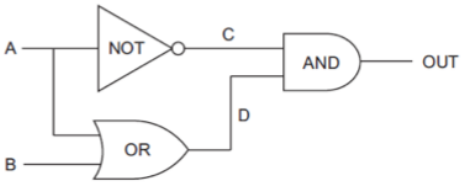
Past Papers Questions:

A Level

Section 1.10: Logic Gates

May/June 2011. P11

6. Complete the table for this circuit of logic gates.

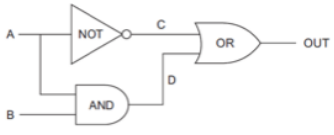


A	B	C	D	OUT
0	0			
0	1			
1	0			
1	1			

[6]

May/June 2011. P13

6. Complete the table for this circuit of logic gates.



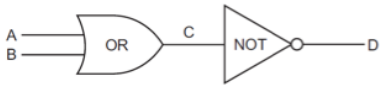
A	B	C	D	OUT
0	0			
0	1			

1	0			
1	1			

[6]

Oct/NOV 2011. P11

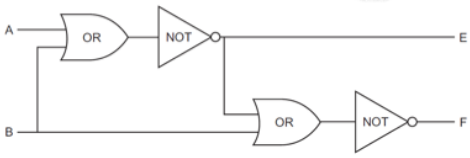
9 (a) Complete the table to show the outputs for the possible inputs to this circuit.



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

[2]

(b) Complete the table to show the outputs for the possible inputs to this circuit.



A	B	E	F
0	0		
0	1		
1	0		
1	1		

[4]

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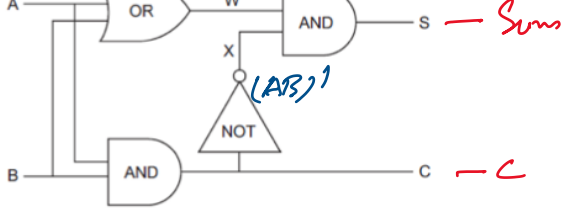
Topic: 1.3.1 Logic gates

Oct/NOV 2011. P12

9 (a) Complete the table to show the outputs for the possible inputs to this circuit.



A	B	W	X	C	S
0	0	0	1	0	0
0	1	1	1	0	1
1	0	1	1	0	1
1	1	1	0	1	0

[5]

(b) State a possible use for this circuit in a processor. [1]

It adds two bits.

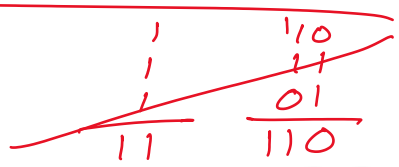
Exists in ALU.

ALU

1 1 1

Adds Two bits = Half Adder

" Three bits = full Adder.



Topic: 1.3.1 Logic gates

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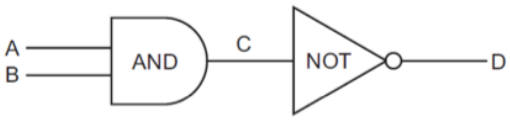
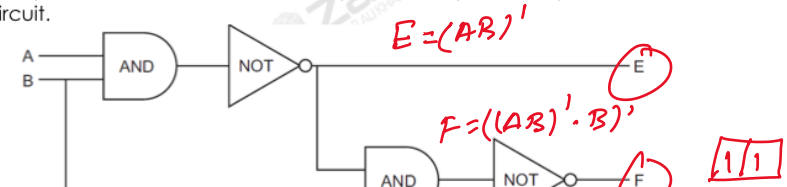
9 (a) Complete the table to show the outputs for the possible inputs to this circuit.



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

[2]

(b) Complete the table to show the outputs for the possible inputs to this circuit.



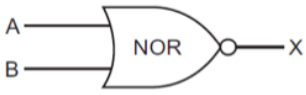
A	B	E	F
0	0		
0	1		
1	0		
1	1		

[4]

Topic: 1.3.1 Logic gates

May/June 2012. P11/12

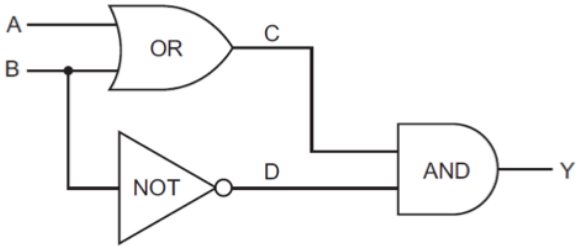
9 (a) Complete the truth table to show the output from the logic gate shown.



A	B	X
0	0	
0	1	
1	0	
1	1	

[2]

(b) Complete the truth table to show the outputs from the logic circuit shown.

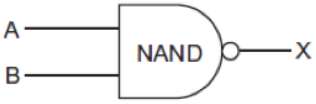


A	B	C	D	Y
0	0			
0	1			
1	0			
1	1			

[4]

May/June 2012. P13

9 (a) Complete the truth table to show the output from the logic gate shown. **[2]**



A	B	X
0	0	
0	1	
1	0	
1	1	

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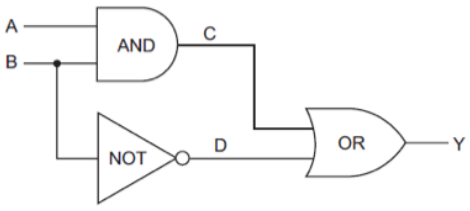
ZAFAR ALI KHAN

Topic: 1.3.1 Logic gates

(b) Complete the truth table to show the outputs from the logic circuit shown.



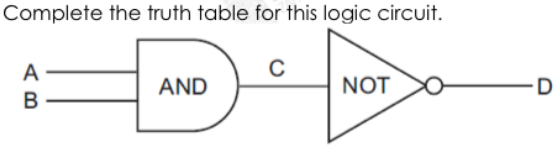
A	B	C	D	Y
0	0			
0	1			

1	0			
1	1			

[4]

Oct/NOV 2012. P11

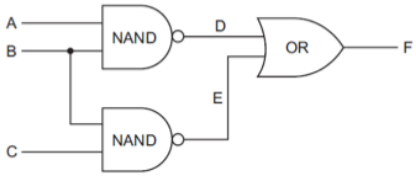
10 (a) (i) Complete the truth table for this logic circuit. [1]



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

Topic: 1.3.1 Logic gates

(ii) State a single logic gate which would have the same final outcome as this pair of logic gates. [1]



A	B	C	D	E	F
0	0	0			
0	0	1			
0	1	0			
0	1	1			

[4]

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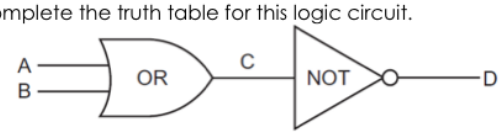
Topic: 1.3.1 Logic gates

Oct/NOV 2012. P12

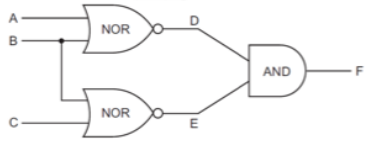
10 (a) (i) Complete the truth table for this logic circuit. **[1]**



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

(ii) State a single logic gate which would have the same final outcome as his pair of logic gates. **[1]**

(b) Complete the truth table for this logic circuit.



A	B	C	D	E	F
0	0	0			
0	0	1			
0	1	0			
0	1	1			

[4]

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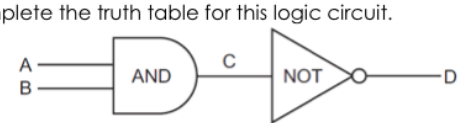
Topic: 1.3.1 Logic gates

Oct/NOV 2012. P13

10 (a) (i) Complete the truth table for this logic circuit.

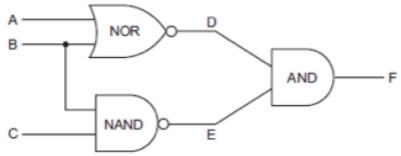


A	B	C	D
0	0		
0	1		
1	0		
1	1		

[1]

(ii) State a single logic gate which would have the same final outcome as this pair oflogic gates. **[1]**

(b) Complete the truth table for this logic circuit.



A	B	C	D	E	F
0	0	0			
0	0	1			
0	1	0			
0	1	1			

[4]

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Topic: 1.3.1 Logic gates

May/June 2013. P11/P12

9 (a) Draw the logic circuit corresponding to the following logic statement:
X = 1 IF (A is 1 AND B is 1) OR (B is 1 OR C is NOT 1)

[4]

(b) Complete the truth table for the above logic statement:

			Working space	
A	B	C		X

A	B	C		X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

May/June 2013. P13

6 (a) Draw the logic circuit corresponding to the following logic statement:
X = 1 IF ((A is NOT 1 AND B is 1) OR (B is 1 AND C is 1)) OR (C is 1)

[5]

(b) Complete the truth table for the above logic statement:

A	B	C	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

Topic: 1.3.1 Logic gates

Oct/NOV 2013. P13

11 (a) Draw the logic circuit for the following logic statement:
X = 1 if [A is NOT 1 AND B is 1] AND [B is 1 OR C is 1]

[4]

(b) Complete the truth table for the above logic circuit.

A	B	C	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

Topic: 1.3.1 Logic gates

May/June 2014. P11/12

8 A car has an engine management system (EMS). The EMS outputs the following signals.

signal	value	description
A	0	temperature within limits
	1	temperature too high (fault condition)
B	0	pressure within limits
	1	pressure too high (fault condition)
C	0	carbon emissions within limits
	1	carbon emissions too high (fault condition)

	1	carbon emissions too high (fault condition)

Topic: 1.3.1 Logic gates

(a) (i) Draw a logic circuit for the following fault condition:
All three signals (A = 1, B = 1 and C = 1) indicate a fault. The driver is warned to stop the engine – output X = 1.

[2]

(ii) Draw a logic circuit for the fault condition:
Either (A = 1 and B = 1) or (B = 1 and C = 1) indicate a fault. The driver is warned that the engine needs a service – output Y = 1.

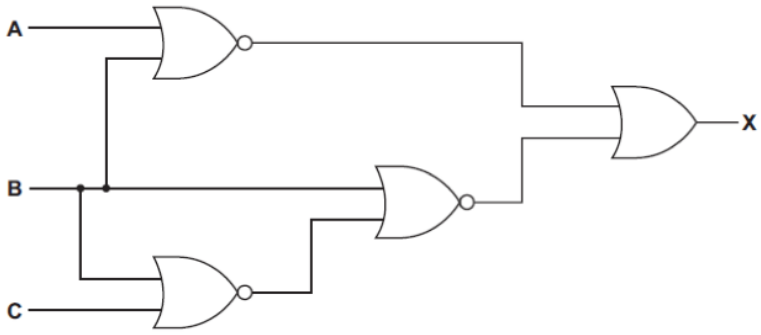
[2]

(iii) Draw a logic circuit for the fault condition:
Either A = 1 or B = 1 or C = 1 indicate a fault. A red warning light shows up on the dashboard – output Z = 1.

[2]

May/June 2014. P13

8 (a) Complete the truth table for the following logic circuit:



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Zak ZAFAR ALI KHAN
Topic: 1.3.1 Logic gates

A	B	C	working	X
0	0	0		
0	0	1		
0	1	0		

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

[4]

(b) Draw a logic circuit corresponding to the following logic statement:

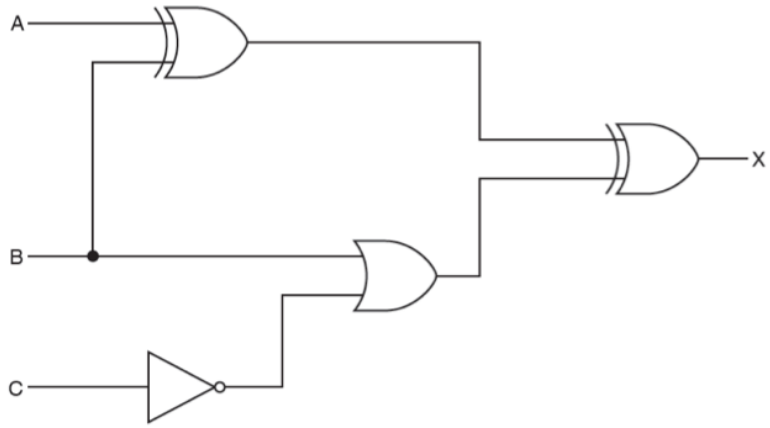
X = 1 if (A = NOT 1 OR B = 1) AND (B = NOT 1 AND C = NOT 1)

[6]

Topic: 1.3.1 Logic gates

May/June 2015. P11

3 (a) Complete the truth table for the following logic circuit:



A	B	C	Workspace	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		

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

[4]

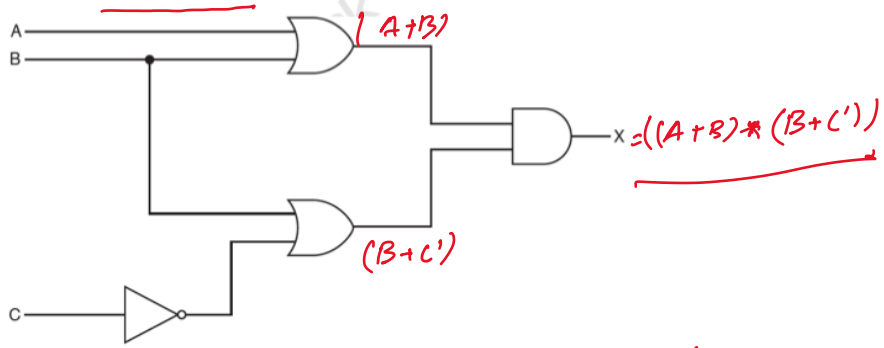
Topic: 1.3.1 Logic gates

(b) Draw a logic circuit which corresponds to the following logic statement:

X = 1 if ((A is NOT 1 OR B is 1) AND C is 1) OR (B is NOT 1 AND C is 1)

[3]

(c) Write a logic statement which corresponds to the following logic circuit:



X = 1, IF ((A OR B) AND (B OR NOT C))

[3]

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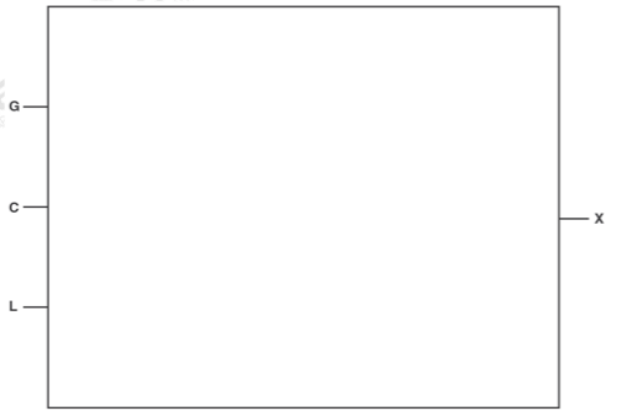
6 A gas fire has a safety circuit made up of logic gates. It generates an alarm (X = 1) in response tocertain conditions.

Input	Description	Binary value	Conditions
G	gas pressure	1	gas pressure is correct
		0	gas pressure is too high
C	carbon monoxide level	1	carbon monoxide level is correct
		0	carbon monoxide level is too high
L	gas leak detection	1	no gas leak is detected
		0	gas leak is detected

The output X = 1 is generated under the following conditions:
gas pressure is correct AND carbon monoxide level is too high
OR
carbon monoxide level is correct AND gas leak is detected

(a) Draw a logic circuit for this safety system.



[5]

Topic: 1.3.1 Logic gates

(b) Complete the truth table for the safety system.

G	C	L	Workspace	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

(c) Complete the truth table for the XOR gate:

A	B	C
0	0	
0	1	
1	0	
1	1	

[1]

Topic: 1.3.1 Logic gates

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5 A computer-controlled machine produces plastic sheets. The thickness of each sheet must be within a certain tolerance. The sheets are kept below 50 °C as they move over rollers at 10 metres per second.
Three parameters need to be monitored all the time.

Parameter	Description	Binary value	Conditions
D	sheet thickness	1	thickness of sheet in tolerance
		0	thickness of sheet out of tolerance
S	roller speed	1	roller speed = 10 metres/second
		0	roller speed <> 10 metres/second
T	temperature	1	temperature < 50°C
		0	temperature >= 50°C

An alarm, **X**, will sound if:
thickness is in tolerance AND (roller speed <> 10 metres/second OR temperature >= 50 °C)
OR
roller speed = 10 metres/second AND temperature >= 50 °C

(a) Draw a logic circuit to represent the above monitoring system.

[6]

Topic: 1.3.1 Logic gates

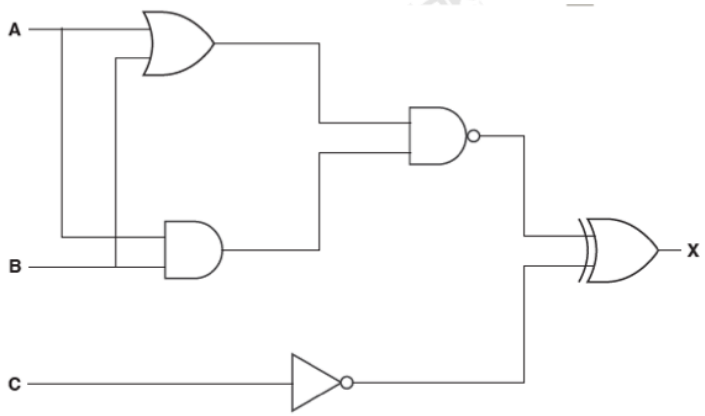
(b) Complete the truth table for the monitoring system.

D	S	T	Working Space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

May/June 2016. P12

7 (a)



Complete the truth table for this logic circuit.

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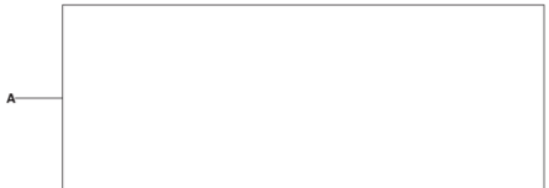
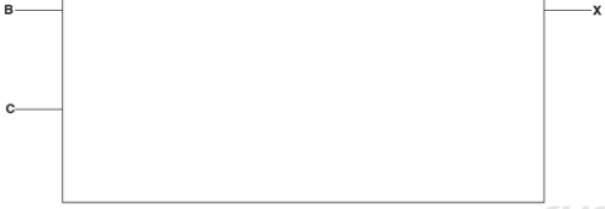
Topic: 1.3.1 Logic gates

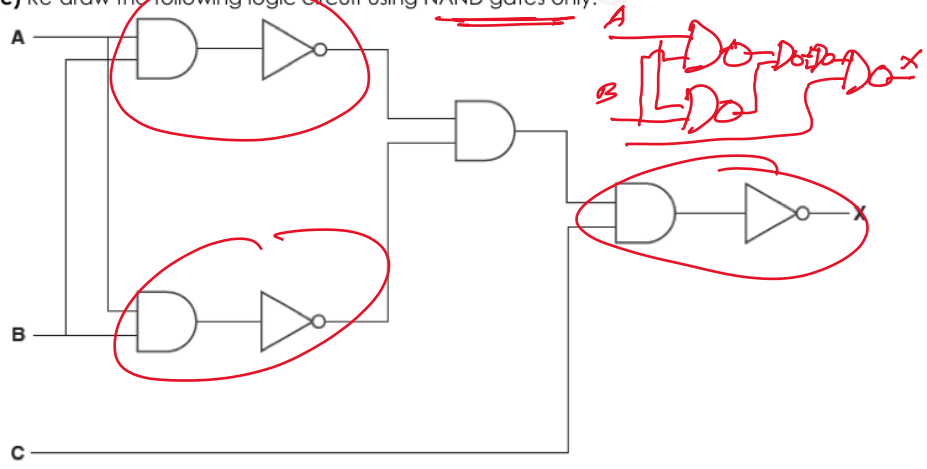
(b) Draw a logic circuit corresponding to the following logic statement:
X = 1 if ((A is 1 OR B is 1) AND (A is 1 AND B is 1)) OR (C is NOT 1)





[5]

(c) Re-draw the following logic circuit using NAND gates only.



Topic: 1.3.1 Logic gates

Logic circuit re-drawn:

[4]

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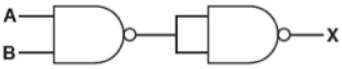
7 (a) Complete the truth tables and name the single logic gate that could replace each logic circuit:

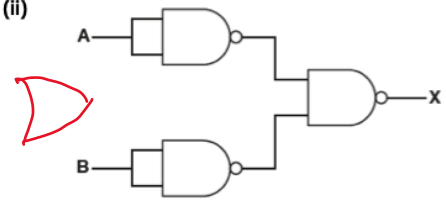
(i)



A	B	Working space	X
0	0		
0	1		
1	0		
1	1		

Single logic gate ..... [3]

(ii)



A	B	Working space	X
0	0		
0	1		
1	0		
1	1		

Single logic gate ..... OR ..... [3]

Topic: 1.3.1 Logic gates

(b) (i) Draw a logic circuit to represent the following logic statement:

X = 1 if (A = 1 AND B = 1) OR ((B = NOT 1) AND C = 1)

[4]

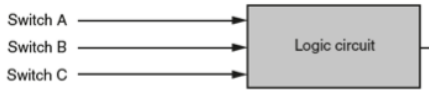
(ii) Complete the truth table for the logic statement in **part (b)(i)**.

A	B	C	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

Oct/Nov 2016. P13

5 Three switches, A, B and C, each send values of 0 or 1 to a logic circuit. Value X is output from the logic circuit.



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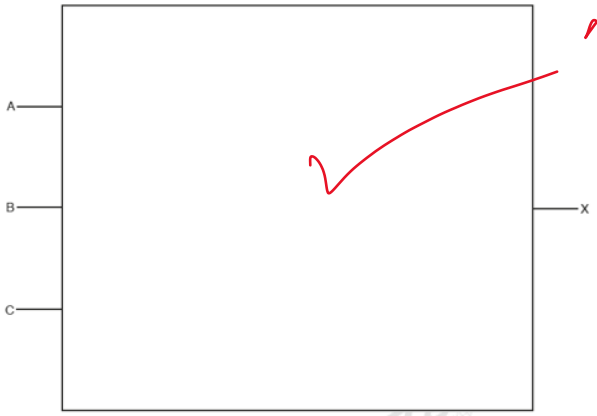
Output X has a value of 1 depending on the following conditions:
Switch A sends value 1 AND Switch B sends value 0
OR
Switch B sends value 1 AND Switch C sends value 0

(a) Draw a logic circuit to represent the conditions above.



[5]

(b) Complete the truth table for the conditions given at the start of question 5.

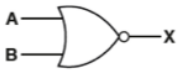
A	B	C	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

Topic: 1.3.1 Logic gates

May/June 2017. P11

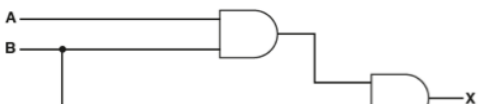
10 (a) Complete the truth table for the NOR gate.

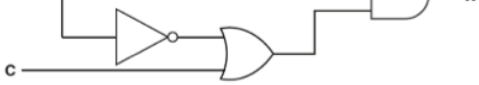


A	B	Output (X)
0	0	
0	1	
1	0	
1	1	

[1]

(b) Write a logic statement that corresponds with the following logic circuit.





X = [3]

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10 For this logic statement:

X = 1 if ((A is 1 AND B is 1) OR (A is NOT 1 AND C is 1)) [4]

(b) Complete the truth table for the given logic statement

A	B	C	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

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Topic: 1.3.1 Logic gates

Oct/Nov 2017 P12(2210)

7 Draw a logic circuit to represent the logic sta tement:

X = 1 if (A is NOT 1 AND B is 1) AND (A is NOT 1 AND C is NOT 1) OR (B is 1 AND C is 1) [7]

Oct/Nov 2017 P13(2210)

5 (a) Draw a logic circuit for the logic statement:

X = 1 if ((A is 1 AND B is 1) OR (B is 1 AND C is NOT 1))

[4]

(b) Draw the symbol for an **XOR** gate and explain the function of this logic gate. [5]

May/June 2018. P11

6 Consider the logic statement:

X = 1 if ((A is NOT 1 OR B is 1) NOR C is 1) NAND ((A is 1 AND C is 1) NOR B is 1)

(a) Draw a logic circuit to represent the given logic statement. [6]

(b) Complete the truth table for the given logic statement.

A	B	C	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

Topic: 1.3.1 Logic gates

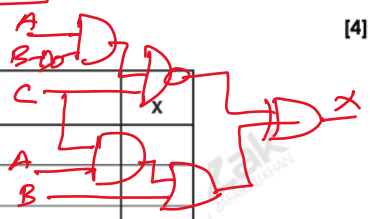
May/June 2018. P12

7 Consider the logic statement: $X = ((AB').C)' \oplus ((AC)+B)$ MATHEMATICAL

X = 1 if ((A is 1 AND B is NOT 1) NAND C is 1) XOR ((A is 1 AND C is 1) OR B is 1)

(a) Draw a logic circuit to represent the given logic statement. BOOLEAN/LOGIC. **[6]**

(b) Complete the truth table for the given logic statement. **[4]**



A	B	C	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

B'

Topic: 1.3.1 Logic gates

Oct/Nov 2018 P12 (2210)

3

A greenhouse uses a system to monitor the conditions that plants need to grow.

The inputs to the system are:

Input	Binary value	Condition
W	1	Window is open
	0	Window is closed
T	1	Temperature >=26 °C

	0	Temperature <26 °C
H	1	Humidity >=50%
	0	Humidity <50%

The system will sound an alarm when certain conditions are detected.

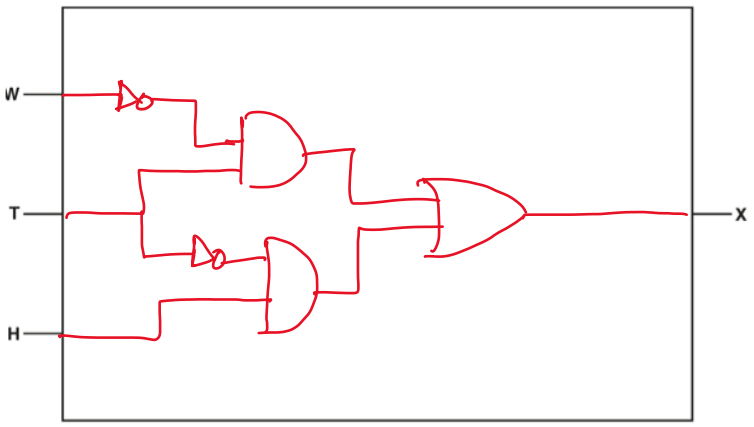
Alarm (X) will sound (=1) when:

window is closed and temperature >=26 °C

or

temperature <26 °C and humidity >=50%

Draw a logic circuit to represent the system.



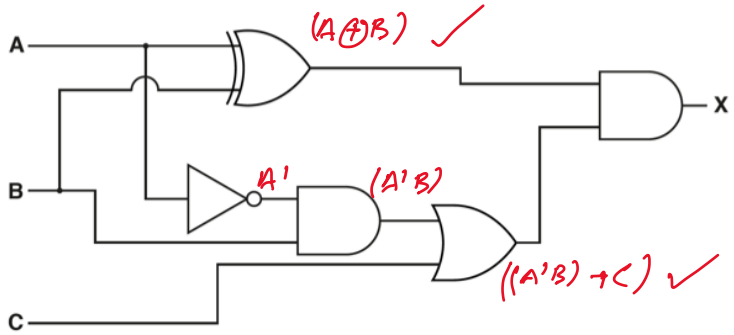
[5]

Topic: 1.3.1 Logic gates

Oct/Nov 2018 P13 (2210)

10

A logic circuit is shown:



(a) Complete the truth table for the given logic circuit.

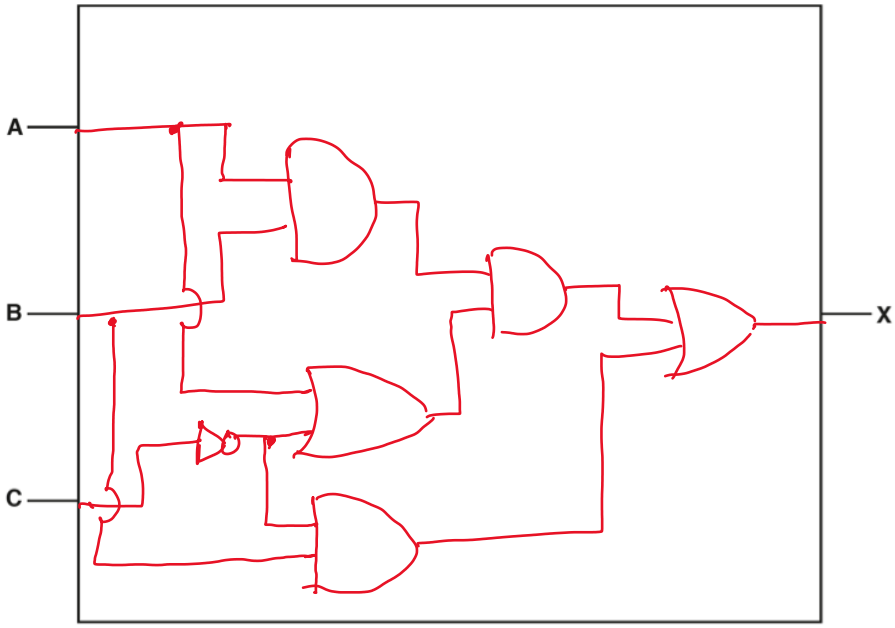
A	B	C	Working space	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

(b)

Draw a logic circuit corresponding to the logic statement:

X = 1 if ((A is 1 AND B is 1) AND (A is 1 OR C is NOT 1)) OR (B is 1 AND C is NOT 1)



[6]

12-2-21