CHAPTER 6: Logic gates

PASTPAPERS

N.B. These pastpapers may rely on the knowledge gained from the previous chapters.

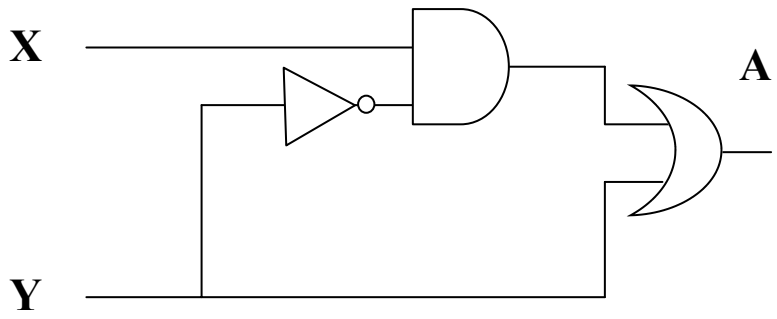
1 SEC'94-PAPER 1-Q2

a. Draw the logic diagram , and then complete the truth table for the following logic expression: **[2,2]**

A = (X and Y) and (not Z)

X	Y	Z	A
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. Draw a logic circuit using ONLY ONE GATE which behaves like the one below: **[3]**



2 SEC'95-PAPER 1-Q4

Using **two** AND gates, **one** NOT gate and **one** OR gate, draw a logic circuit which, given the two inputs A and B, produces the output X according to the following truth table: **[6]**

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

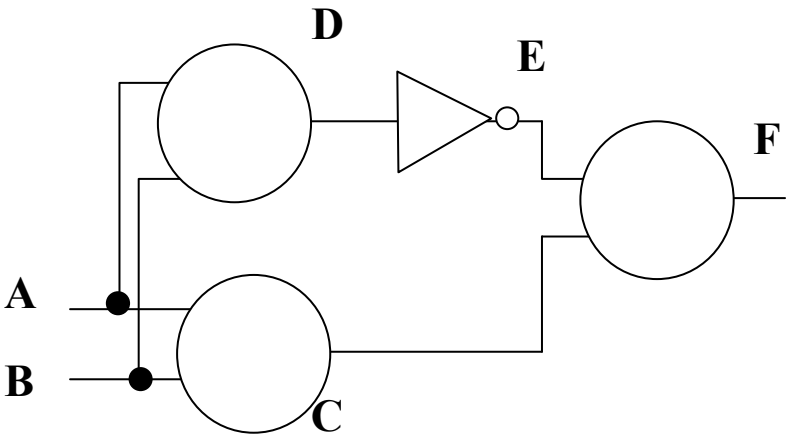
3 SEC'96-PAPER 1-Q4

Draw a logic circuit which, given the two inputs A and B, produces the output X according to the following truth table: **[4]**

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

4 SEC'98-PAPER 1-Q6

Below are a partly drawn **logic circuit** and its incomplete truth table.



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

Logic 1 = TRUE

Logic 0 = FALSE

a. By examining the logic circuit and the truth table, identify and fill in on the diagram the names of the three logic gates. **[3]**

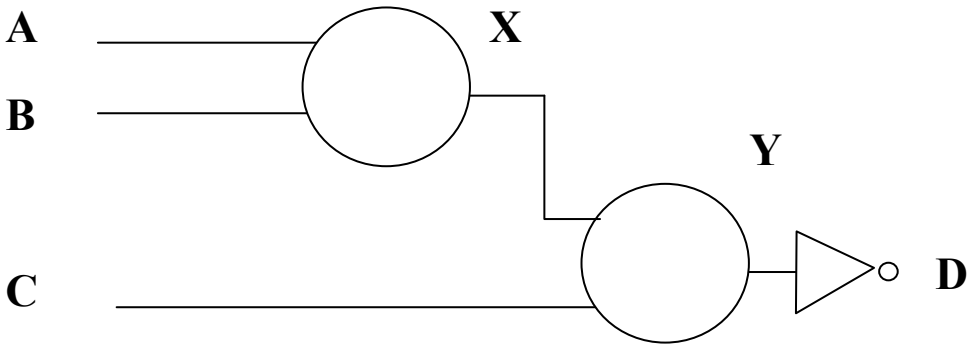
b. Complete the truth table so that it matches the logic circuit. **[3]**

c. Complete the following logic statement to express the function of the logic circuit in terms of inputs A, B. **[1]**

The output **F** is *true* when _____

5 SEC'99-PAPER 1-Q5

Below are a partly drawn ***logic circuit*** and its incomplete ***truth table***, in which TRUE is represented by a 1 and FALSE by a 0.



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

(a) Examine the logic circuit and the truth table to find out what type of gates are represented by the circles. Write down in each circle **AND, OR** or **NOT**. **[2]**

(b) Complete the truth table so that it matches the logic circuit. **[2]**

(c) Complete the following logic statement to express the function of the logic circuit in terms of inputs A, B, C.

The output D is *true* when _____ **[2]**

_____

6 SEC'99-PAPER 2A-Q8 (CONSULT CH 5)

a. There are four possibilities when adding two binary digits *B1* and *B2*. Copy and complete the following table to show the ***SUM*** (5) and the ***CARRY*** (C) when adding each pair of bits *B1* and *B2*. Two rows have been done for you. **[2]**

B1	B2	C	S
0	0	0	0
0	1		
1	0	0	1
1	1		

b. For the table in part a, complete the statement: **The bit C is 1 when…** **[2]**

c. For the table in part a, complete the statement: **The bit S is 1 when…** **[2]**

d. Draw the logic circuit to add two binary digits, ***B1*** and ***B2***, and give two outputs, ***C*** and ***S***. **[4]**

e. When adding binary digits one must also consider the possibility of a carry from the previous lower significant position. For example:

```
  1  0  1  +
     1  1
  1  0  0  0
```

Therefore , a logic circuit which adds together two bits needs *three* inputs ***B1***, ***B2*** and ***CP*** (carry from previous lower significant position). Copy and complete the truth table below for an adding circuit. Two rows have been done for you

B1	B2	CP	C	S
0	0	0	0	0
0	0	1		
0	1	0	0	1
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[3]

For the table in part e, draw a logic circuit which, given the three inputs ***B1***, ***B2***, ***CP***, produces the output ***C*** (ignore ***S*** in your answer). **[4]**

Writing Space for Previous Question

7 SEC '00-PAPER 1-Q5

a. Draw a logic circuit which, given the two inputs A and B, produces the output X according to the following truth table:

[4]

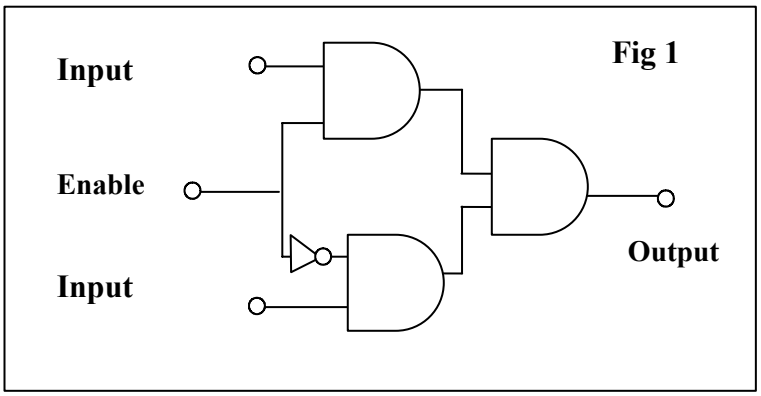
A	B	X
O	O	1
0	1	1
1	0	0
1	1	1

Logic 1 = True

Answer to question 4 should be drawn in this box

b. In the logic diagram shown in **figure 1** alongside, the **Output** will be equal to _____ when **Enable** is _____, and will be equal to _____ when **Enable** is _____.

Fig 1



[4]

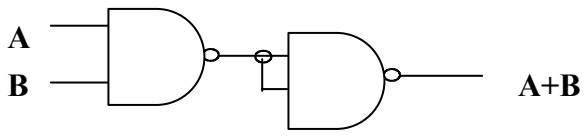
8 SEC '00-PAPER 2A-Q3

(a) What is a truth table? **[1]**

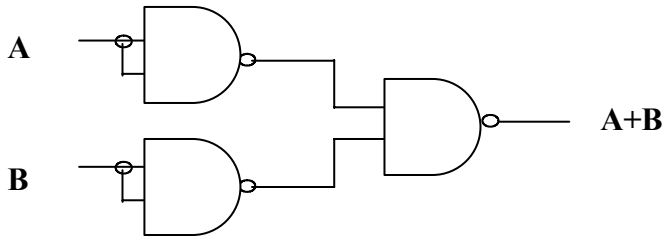
(b) Describe the function of the AND, OR and NOT gates using truth tables. **[3]**

(c) A NAND gate is a logic gate with two or more inputs. The output is logic-0 if all inputs are logic-1. Draw a truth table for the NAND gate with two inputs. The NAND gate can simulate the function of the AND, OR and NOT gate as shown below. **[2]**

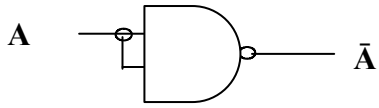
AND:



OR:



NOT:



(d) Prove that these three circuits in fact perform the function of the AND, OR and NOT gates respectively **[3]**

(e) A gate giving access to a car park rises if the car park is not full and a parking ticket has been issued. Draw a truth table of the gate's function with inputs 'full car park' and 'issued ticket'. **[2]**

(f) Draw the circuit for the gate's function obtained in (e). **[3]**

(g) Express the function of the car park gate using NAND gates only. **[3]**

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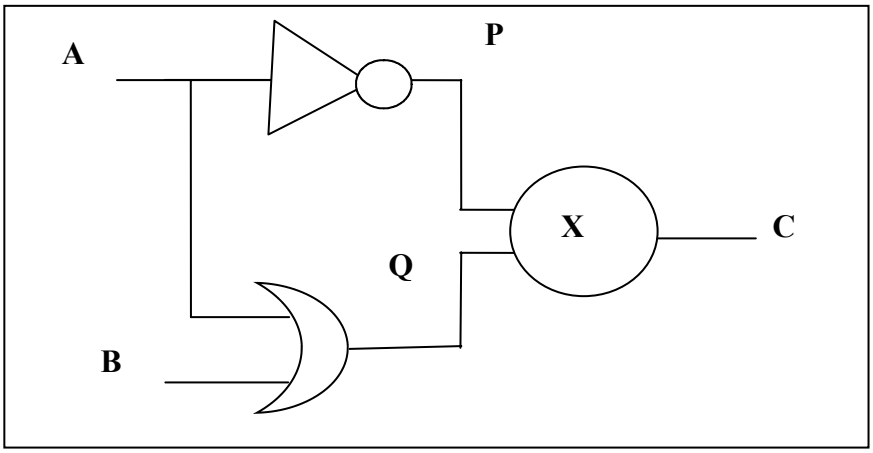
Writing Space for Previous Question

9 SEC '01-PAPER 1-Q6

Shown below are a partly drawn logic circuit and its incomplete truth table.



A	B	P	Q	C
0	0	1		
0	1		0	1
		0	1	1

a. Examine the logic circuit and truth table to find out what type of gate is represented by circle X. Circle X represents a/an _____ gate. **[1]**

b. Complete the truth table according to the logic circuit. **[3]**

c. Explain one use of logic circuits in computers. **[2]**

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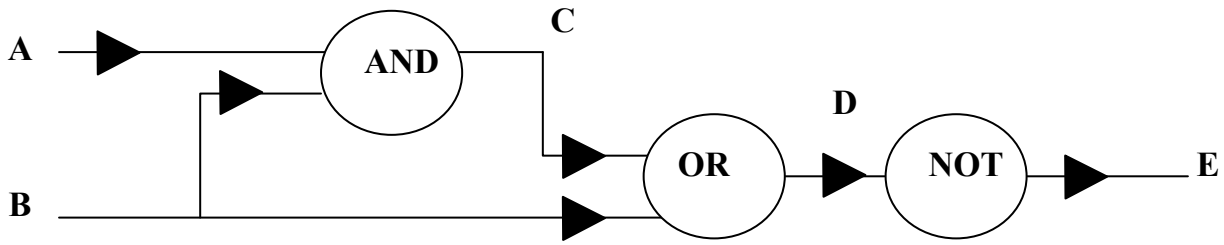
10 SEC '02-PAPER 1-Q6

Consider the logic circuit shown below



Complete the truth table for the four possible inputs A and B.

A	B	C	D	E

[4]

11 SEC '02-PAPER 2A-Q4 A,B,C,D

A given logical circuit has two inputs A1 and A2 and two ouputs P and Q. Output P is one when either one of the two inputs is 1 but not both. Output Q is 1 when the two inputs are 1.

(a) Complete the truth table for this circuit. **[4]**

(b) Using AND, OR, and NOT gates, draw the logic circuit for outputting P and Q given inputs A1 and A2. **[3]**

(c) Write down the two Boolean expressions for obtaining outputs P and Q. **[2]**

(d) Given that A1 and A2 are binary digits, name the arithmetic operation implemented by this logical circuit and hence identify the outputs P and Q. **[2]**

A1	A2	P	Q
0	0		
0	1		
1	0		
1	1		

12 SEC '02-PAPER 2B-Q2 (CONSULT CH 2 & 5)

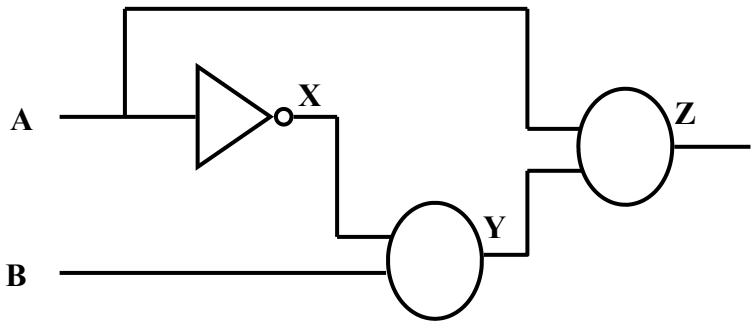
(a) Draw the main components of a computer system (the diagram should include the flow of data and control between the main units). **[5]**

(b) Draw the truth tables for the OR, AND and NOT gates. **[6]**

(c) Can the hexadecimal number AB be stored in a four-bit register. (Hint: convert the hexadecimal number to binary) **[6]**

13 SEC '03-PAPER 1 Q5

Below are a partly drawn logic circuit and its incomplete truth table:



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

Logic 1 = TRUE .
Logic 2 = FALSE

a. By examining the logic circuit and the truth table, identify and fill in the circles Y and Z with suitable logic gate names (NOT, AND, OR). **[2]**

b. Complete the truth table so that it matches the logic circuit. **[2]**

c. Which single logic gate is equivalent to this circuit? **[2]**

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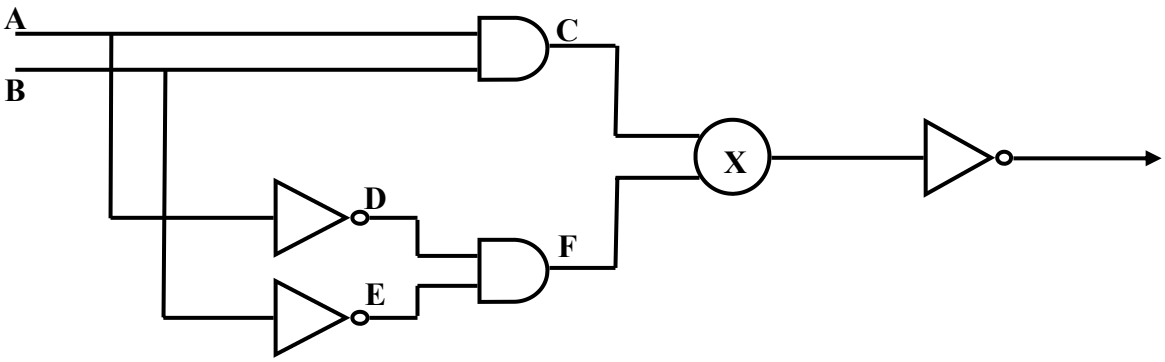
14 SEC '03-PAPER 2A Q8

(a) Complete the truth table corresponding to the logic circuit given below.



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

[10]

(b) Which logic gate does X represent?

[1]

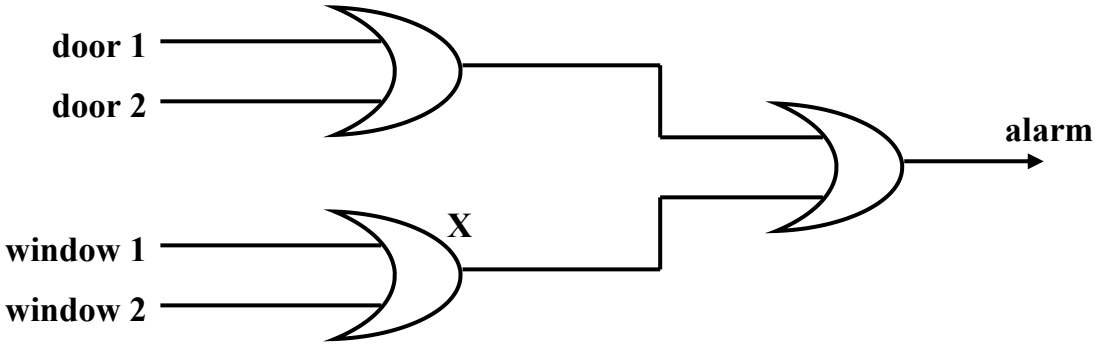
(c) Determine a Boolean expression representing the logic function shown above.

[6]

15 SEC '03-PAPER 2B Q8

(a) Draw the truth tables for the OR and AND gates. **[4]**

(b) A room has two doors and two windows. There is a burglar alarm system wired up using the following logic diagram.



i. When should the alarm sound? **[1]**

ii. Hence explain the purpose of the logic in the diagram. (1=open, 0=closed) **[1]**

iii. What effect will it have on the alarm system if the logic gate labelled X is changed to an AND gate? **[2]**

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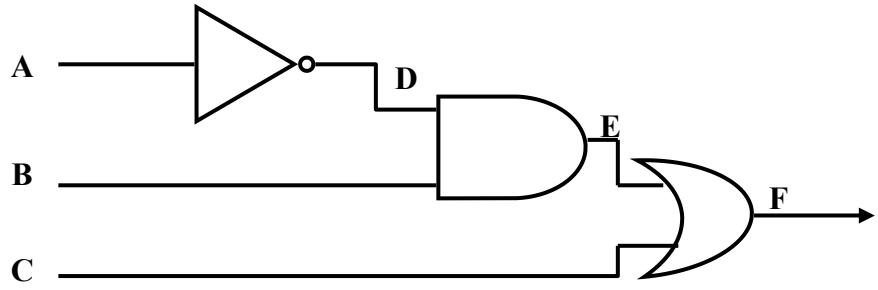
16 SEC '04-PAPER 1 Q6

6. Consider the logic circuit below:

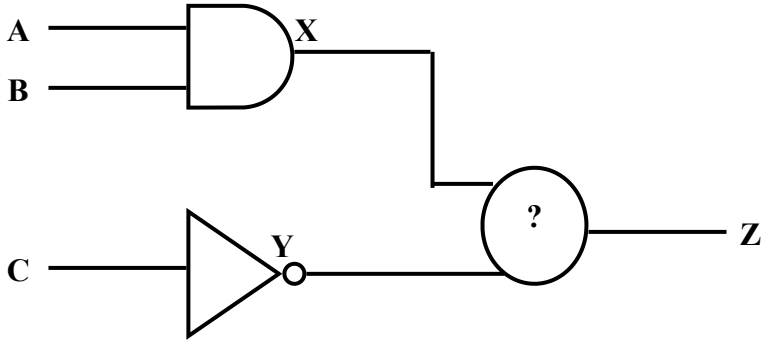


A	B	C	D	E	F
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

Complete the truth table for all the possible inputs of A, B and C. [6]

17 SEC '05-PAPER 1 Q4

Consider the following circuit:



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

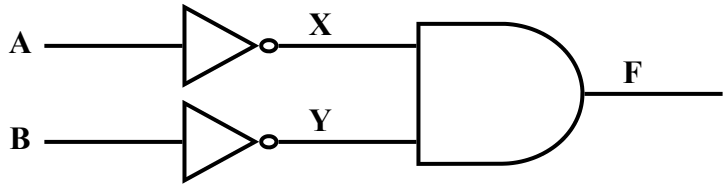
(a) Complete the truth table for all the possible inputs of A, B, C. **[4]**

(b) What is the missing logic gate?

…… **[2]**

18 SEC '05-PAPER 2A Q2

(a) A particular 8-bit computer stores numbers in binary form. Use the following input bit patterns A=10111010, B= 10000111 to determine the output from the logic circuit below. **[3]**



(b) Draw a logic circuit to represent the following Boolean expression: **[4]**

NOT (B or A) AND NOT (B)

(c) Create a truth table to prove that:

(NOT (A) OR B) AND A = NOT (NOT (A) OR NOT (B)) **[7]**

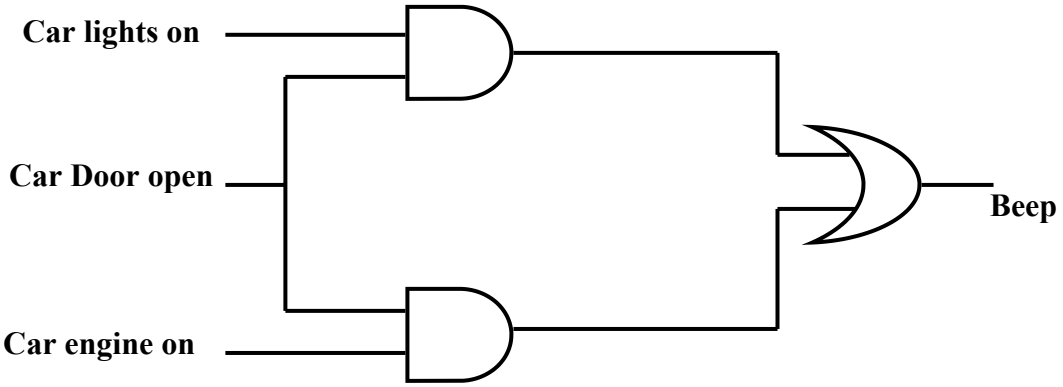
(d) Indicate whether the following statement is TRUE or FALSE. Show how you arrived at your conclusion.

If B is NOT A, then B AND A is 0. **[3]**

19 SEC '05-PAPER 2B Q8A & B

(a) Draw the truth tables for the OR and AND gates. **[4]**

(b) The circuit of a car, intended to sound a beep, is wired up using the following logic diagram.



(i) When should the beep sound? **[1]**
(ii) What would happen if the OR gate was changed into an AND gate? **[2]**
(iii) What would happen if both AND gates where changed into OR gates? **[2]**

20 SEC '06-PAPER 1 Q7

A gate giving access to a car park rises if the car park is not full and a parking ticket is inserted in the machine

Let A represent 'car park full'
Let B represent 'car park ticket inserted'

(a) Complete the following truth table of the gate's function (G), where 0=false and 1=true.

A	B	G
0	0	
0	1	
1	0	
1	1	

[4]

(b) Draw the logic circuit for the car park. **[4]**

21 SEC '07-PAPER 1 Q7

This question refers to Digital Logic

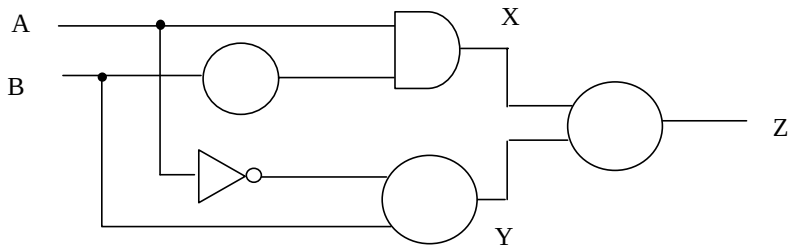
a) Complete the truth table below.

A	B	NOT(A)	NOT(B)	X (A AND NOT(B))	Y (NOT(A) AND B)	Z (X OR Y)
0	0	1		0	0	
0	1	1		0	1	
1	0		1			
1	1		0			

[6]

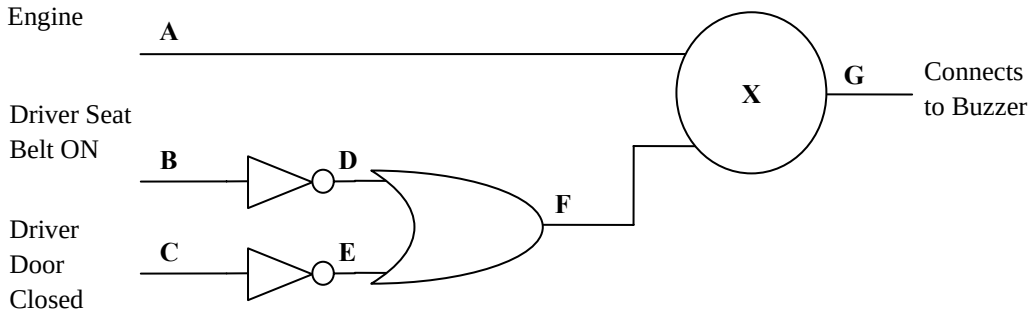
b) Draw the appropriate logic gate symbol in each of the circles provided to complete the equivalent logic circuit.

[3]



22 SEC '07-PAPER 2A Q7

A car safety circuit is designed to beep when the engine is running and either the seat belt is not worn or the driver door is open.



Copy and complete the truth table below, including the values produced by the unknown logic gate **X**.

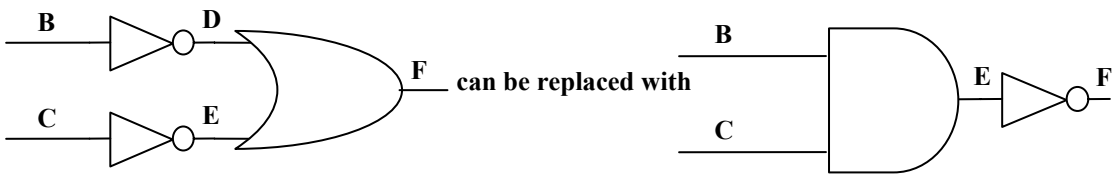
A	B	C	D	E	F	G
0	0	0				
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

[4]

b) What is the logic gate represented by **X**? **[2]**

c) Derive a Boolean expression for **F** in terms of **B** and **C**. **[4]**

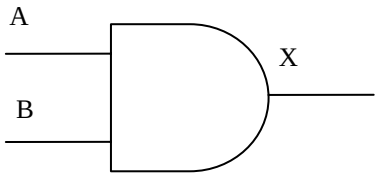
d) Prove using a truth table and by comparing the results produced by **F**, that: **[7]**



Writing Space for Previous Question

23 SEC '07-PAPER 2B Q7

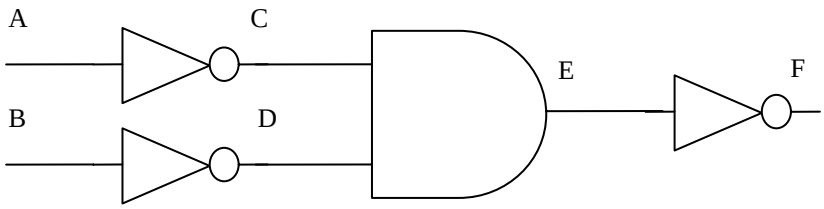
This question is about Logic Circuits.



a i) What is this logic gate called? **[1]**

ii) Write the truth table for this logic gate. **[2]**

b) Consider the following logic circuit.



i) Copy and complete the truth table below.

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

[6]

ii) The logic circuit above can be replaced by a single logic gate. Name and hence draw this logic gate.

[2]

c) Convert the following Binary numbers to decimal

i. 01011011
ii. 01101100
iii. 01111111

[6]

Writing Space for Previous Question