

Digital electronics

Digital devices:

Digital devices are devices in which the potential or the voltage is either low(zero) or high(one).No other values are possible in a digital circuit. A digital signal is a sequence of pulses. the voltage is either 1 or 0 with no in-between levels.

Analogue devices:

In analogue circuits, the voltage at any point varies between the maximum and the minimum voltage of the power supply.

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Logic gates:

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OR GATE: An OR gate will give a high output if any of the inputs is high. For example, in a simple lighting circuit with two switches in parallel the lamp will light if either switch is pressed.

SYMBOL



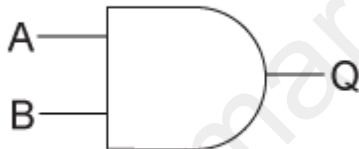
TRUTH TABLE

A	B	Q
0	0	0
0	1	1
1	0	1
1	1	1

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AND GATE: An AND gate will give a high output only if all of the inputs are high. For example, in a simple lighting circuit with two switches in series the lamp will light only if both switches are pressed.

SYMBOL



TRUTH TABLE

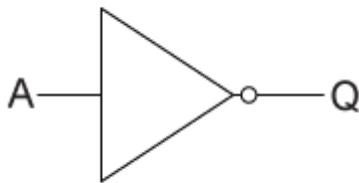
A	B	Q
0	0	0
0	1	0
1	0	0
1	1	1

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NOT GATE : A NOT gate is slightly different because it has just one input. It will give a high output if the input is low. This could be represented by a simple lighting circuit with a push-to-break switch: if the switch is pressed then the lamp will turn off. NOT gates are often used in emergency-stop buttons on machine tools.

SYMBOL



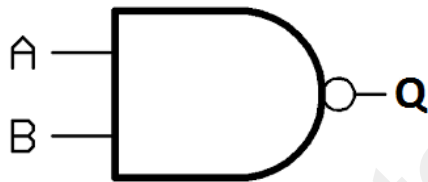
TRUTH TABLE

A	Q
0	1
1	0

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NAND GATE

SYMBOL



TRUTH TABLE

A	B	Q
0	0	1
0	1	1
1	0	1
1	1	0

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NOR GATE

SYMBOL



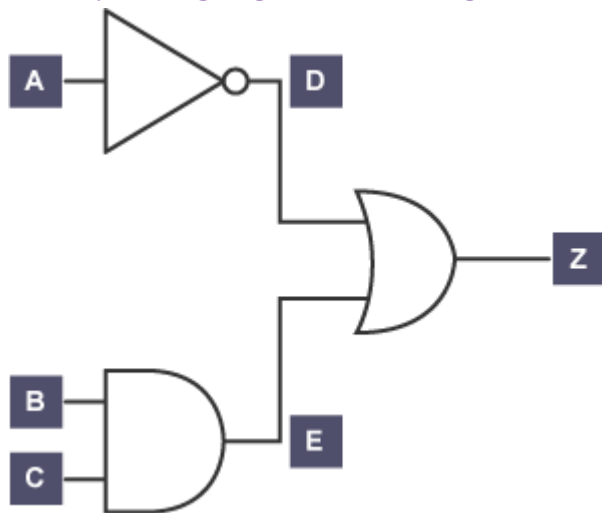
TRUTH TABLE

A	B	Q
0	0	1
0	1	1
1	0	0
1	1	0

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SIMPLE DIGITAL CIRCUITS COMBINING DIFFERENT LOGIC GATES

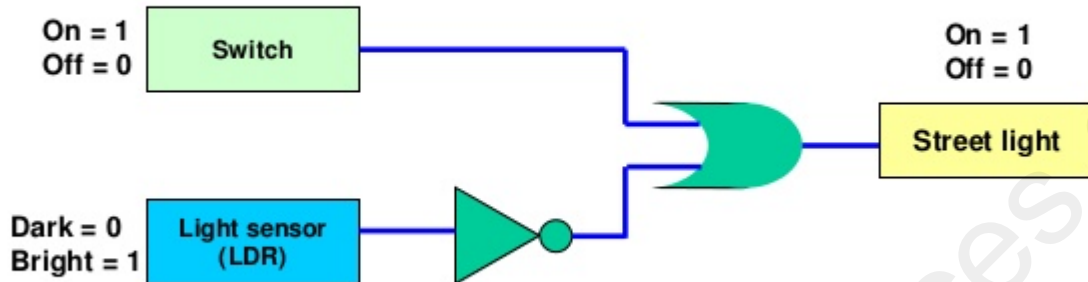
Some logic gates may have more than two inputs. The diagram below shows a complex logic gate combining three simple gates.



- Altogether there are three inputs and eight possible outcomes.
- To solve the truth table below, first find D, then E and finally Z.
- Complete a whole column before moving on to the next column.
- D depends only on A, E depends on B and C, and Z depends on E or D.

A	B	C	D = NOT A	E = B AND C	Z = D OR E
0	0	0	1	0	1
0	0	1	1	0	1
0	1	0	1	0	1
0	1	1	1	1	1
1	0	0	0	0	0
1	0	1	0	0	0
1	1	0	0	0	0
1	1	1	0	1	1

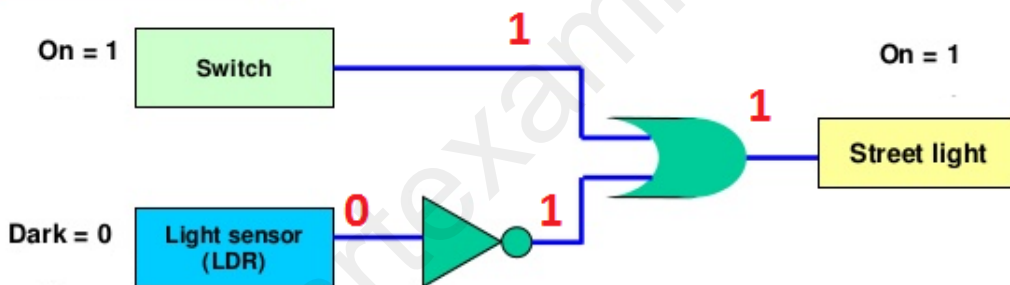
STREET LIGHTS



Interpreting above diagram:

Even when the street light is not turned on manually, the output will be high if the light sensor detects darkness around.

STREET LIGHTS



You may try another combination in the space below.

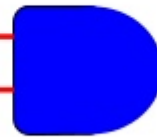
SECURITY ALARM

Dark = 1
Bright = 0

Light sensor

Off (intruder) = 1
On (no intruder) = 0

Infrared sensor



On = 1
Off = 0

Alarm
(siren)

Draw your predicted truth table and see if it matches the one shown below.

Light sensor	Infrared sensor	Alarm
Dark	Intruder	On
Dark	No intruder	Off
Bright	Intruder	Off
Bright	No intruder	Off

Light sensor	Infrared sensor	Alarm
Dark	Intruder	On
Dark	No intruder	Off
Bright	Intruder	Off
Bright	No intruder	Off

APPLICATION BASED QUESTIONS:

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10 (a) In the space below, draw the symbol for a NOR gate.

[1]

(b) Describe the action of a NOR gate in terms of its inputs and output.

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..... [2]

(c) A chemical process requires heating at low pressure to work correctly.

When the heater is working, the output of a temperature sensor is high.

When the pressure is low enough, a pressure sensor has a low output.

Both outputs are fed into a NOR gate. A high output from the gate switches on an indicator lamp.

(i) Explain why the indicator lamp is off when the process is working correctly.

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..... [1]

(ii) State whether the lamp is on or off in the following situations.

1. The pressure is low enough, but the heater stops working.
2. The heater is working, but the pressure rises too high. [2]

[Total: 6]

10 (a) In the space below, draw the symbol for an OR gate. **M/J/11-P33**

[1]

(b) Describe the action of an OR gate in terms of its inputs and outputs.

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.....[2]

(c) A car manufacturer wishes to install an alarm system in a 2-door car to inform the driver if either door is not properly closed. An OR gate is to be used in the construction of this system. Describe suitable input and output arrangements for the gate.

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.....[3]