Worksheet 1: Boolean logic

**Task 1**

Study each of the Boolean logic statements below and for each one say if they return **TRUE** (Binary 1) or **FALSE** (Binary 0).

1. 8 > 10 =
2. NOT(TRUE) =
3. (12 > 14) AND (13 > 11) =
4. NOT (TRUE) OR (9 < 7) =
5. (47 > 100) OR (5 > 34) OR (6 > 5) =
6. T > G =
7. (100 = 100) AND (45 < 44) =
8. NOT(NOT(TRUE)) =
9. NOT(TRUE) OR (15 > 25) =

**Challenge:**

1. NOT (T AND (F)) =

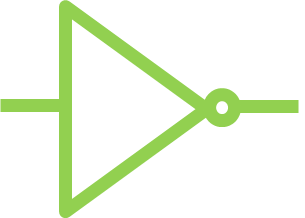
**Task 2**

1. Study the logic diagrams below and complete the truth tables and the Boolean Algebra that should go with them.

**What sort of logic gate**

INPUT A

OUTPUT P

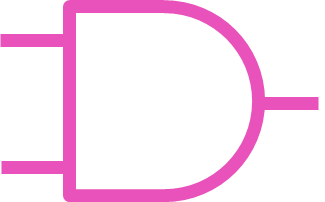


**is this?**

|  |  |
| --- | --- |
| A | P |
| 1 |  |
| 0 |  |

**Truth Table**

**What sort of logic gate**



INPUT A

INPUT B

OUTPUT P

**is this?**

|  |  |  |
| --- | --- | --- |
| A | B | P |
| 0 | **0** |  |
| 0 | **1** |  |
| 1 | **0** |  |
| 1 | **1** |  |

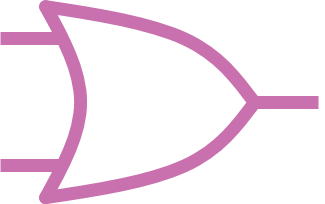
**Truth Table**

**What sort of logic gate**

INPUT A

INPUT B

OUTPUT P



**is this?**

|  |  |  |
| --- | --- | --- |
| A | B | P |
| 0 | **0** |  |
| 0 | **1** |  |
| 1 | **0** |  |
| 1 | **1** |  |

**Truth Table**

1. An electric lawn mower will not start unless the lever operated by the right hand is squeezed AND the safety button is pressed.

Complete the truth table below and draw the logic circuit diagram showing inputs and outputs.

**Truth Table**

|  |  |  |
| --- | --- | --- |
| Lever squeezed (L) | Safety button pressed (B) | Lawn mower starts (S) |
| 0 | **0** |  |
| 0 | **1** |  |
| 1 | **0** |  |
| 1 | **1** |  |

**Logic circuit:**

1. A boiler shuts down automatically if either the temperature (T) exceeds its safe value *x* or the pressure (P) exceeds its safe value *y*.

Complete the truth table below and draw the logic circuit diagram showing inputs and outputs.

**Truth Table**

|  |  |  |
| --- | --- | --- |
| T > x | P > y | Shut down (S) |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**Logic circuit:**

**Task 3**

14. A motor, Z, opens windows in the roof of a greenhouse when it receives a signal Z = 1.

The inputs are:

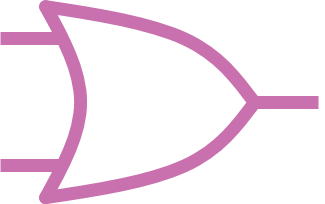
|  |  |  |
| --- | --- | --- |
| Input | Binary value | Condition |
| A | 0 | Temperature < 40ºC |
| 1 | Temperature >= 40ºC |
| B | 0 | Humidity < 75% |
| 1 | Humidity >= 75% |
| C | 1 | Night time = YES |
| 0 | Night time = NO |

The motor, Z, has a value of 1 and opens the greenhouse window if:

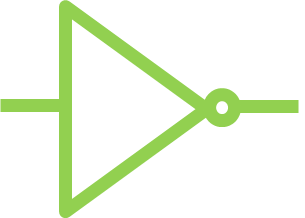
**Either** the temperature >= 40ºC OR humidity >=75%

**However** the motor should never open the window at night time.

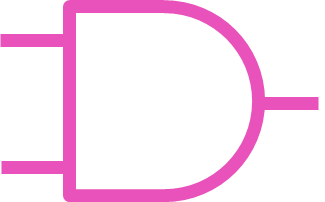
Draw the logic circuit for the above system using these logic gates.



OR



NOT



AND

A

Z

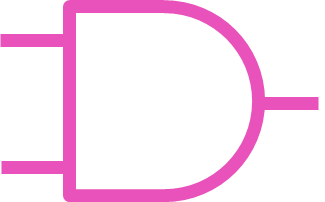
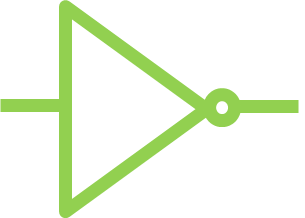
C

B

Complete the truth table for this automated greenhouse system.

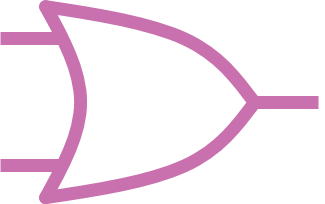
|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| A | B | C | Working space | | Z | |
|  |  |  |  |  | |  |
| 0 | 0 | 0 |  |  | |  |
| 0 | 0 | 1 |  |  | |  |
| 0 | 1 | 0 |  |  | |  |
| 0 | 1 | 1 |  |  | |  |
| 1 | 0 | 0 |  |  | |  |
| 1 | 0 | 1 |  |  | |  |
| 1 | 1 | 0 |  |  | |  |
| 1 | 1 | 1 |  |  | |  |

15. Determine the output **P** for each of the following logic circuits:



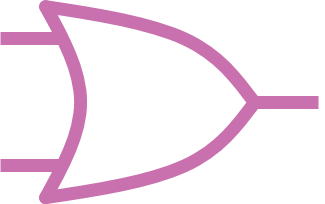
1

1

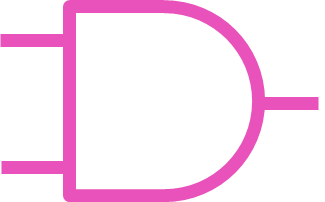


1

0

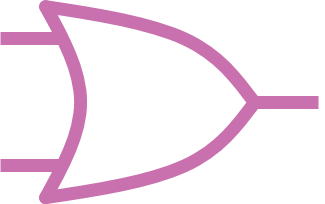


P



1

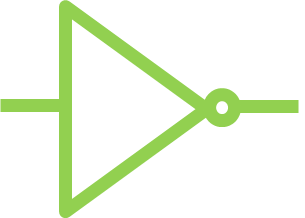
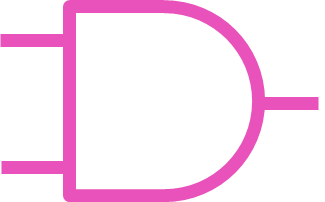
1



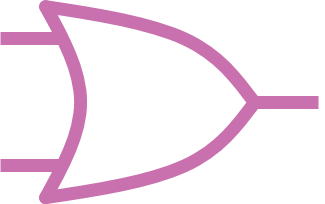
1

0

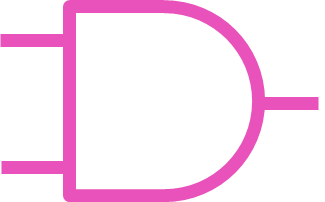
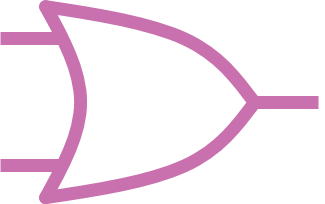
P



0



16. Complete the truth table for the following logic circuit:



A

B

P

C

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **A** | **B** | **C** | **A OR B (=R)** | **P** |
| 0 | 0 | 0 |  |  |
| 0 | 0 | 1 |  |  |
| 0 | 1 | 0 |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |