3.4.2 Boolean logic 1

Lesson plan and printable activities

Materials needed

1. 3.4.2 (Lesson 1) Lesson PowerPoint.
2. Logic gates and truth tables student sheet and Quiz.

Lesson aims

1. To get students to think about the role played by logic gates in relation to contributing to the formation of programming languages that are used to write software to control computer hardware.
2. Draw representative symbols for simple logic gates.
3. Construct truth tables for simple logic gates.

Lesson objectives

1. Know what is inside a CPU.
2. Understand what the NOT, AND, OR logic gates do.
3. Construct truth tables for NOT, AND, OR gates.

Starter activity (5 minutes)

1. **Slide 3:** Give students two minutes to arrive at definitions for hardware and software. There is a link on the slide to computerhope.com/issues/ch000039.htm This is a copy of the information from the link:

   Computer hardware is any physical device used in or with your machine, whereas software is a collection of code installed onto your computer's hard drive. For example, the computer monitor you are using to read this text and the mouse you are using to navigate this web page is computer hardware. The Internet browser that allowed you to visit this page and the operating system that the browser is running on is considered software.

   All software utilizes at least one hardware device to operate. For example, a video game, which is software, uses the computer processor (CPU), memory (RAM), hard drive, and video card to run. Word processing software uses the computer processor, memory, and hard drive to create and save documents.

In a computer, hardware is what makes a computer work. A CPU processes information and that information can be stored in RAM or on a hard drive. A sound card can provide sound to speakers and a video card can provide an image to a monitor. All of this is hardware.

On that same computer, software can be installed and allow a person to interact with the hardware. An operating system, like Windows or Mac OS, is software. It provides a graphical interface for people to use the computer and other software on the computer. A person can create documents and pictures using software.

Main activity (35 minutes)

1. **Slides 4 and 5:** Describe the components of the CPU. Link provided on slide 3. youtube.com/watch?v=NKYgZH7SBjk (3 minutes 40 seconds.)

2. **Slide 6:** Describe Boolean logic. This means there are two possible outcomes.

3. **Slide 7:** A first introduction to the three logic gates required for GCSE.

4. **Slide 8:** A link to a BBC Bitesize video which demonstrates the logic gates. bbc.co.uk/education/guides/zc4bb9q/revision/2 (50 seconds.)

5. **Slides 9 – 11:** Introducing truth tables. The first 2 minutes and 47 seconds of this video youtube.com/watch?v=ksBqkJSq1QE reiterates the working of the AND gate with a real-life example and then describes how the truth table is formed. Students will draw the relevant logic gate and then fill in the truth table on their sheets.

Plenary activity (5 minutes)

1. **Slide 12:** Complete Quiz.

Lesson

3.4 Computer systems

3.4.2 Boolean logic

Lesson 1

Objectives

- Know what is inside a CPU.
- Understand what the NOT, AND, OR logic gates do.
- Construct truth tables for NOT, AND, OR gates.

Hardware and software

Computers are composed of **hardware** and **software.**

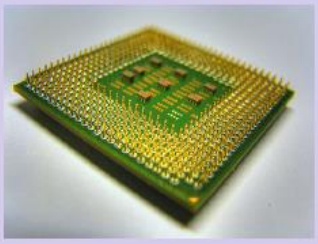
Let's make sure that we understand what these two terms mean.

Term:	Definition:
Computer hardware	Physical components, including electrical circuits, that a computer is assembled from.
Computer software	A sequence of instructions that is understood and executed by computer hardware.

computerhope.com/issues/ch000039.htm

The CPU

Can you identify the parts on this CPU?



What is in the CPU?

A very large number of electric circuits which are referred to as **integrated circuits**.

The circuits form the basis of **logic gates**.

The arrangements of these logic gates allow us to program the CPU.

youtube.com/watch?v=NKYqZH7SBjk

It is the nature of these **logic gates** that we are interested in and the use of **Boolean logic** allows us to characterise their behaviour.

What is Boolean logic?

Boolean logic describes the states of the inputs to and output from the logic gates.

Boolean logic represents all values as TRUE (1) or FALSE (0).

The logic gates we need to know for GCSE

Gate type	Symbol
AND gate	
NOT gate	
OR gate	

How do logic gates work?

bbc.co.uk/education/guides/zc4bb9g/revision/2

AND gate truth table

Each logic gate has a truth table.
It shows the inputs and output that characterise the logic gate.

youtube.com/watch?v=ksBqkJSq1QE

Fill in the AND gate truth table on your sheet.

AND gate	Truth table		
	Inputs		Output
	A	B	Q
	0	0	0
	0	1	0
	1	0	0
	1	1	1

OR gate truth table

Fill in the OR gate truth table on your sheet.

OR gate	Truth table		
	Inputs		Output
	A	B	Q
	0	0	0
	0	1	1
	1	0	1
	1	1	1

Notice how many TRUE outputs there are compared to the AND gate.

NOT gate truth table

Fill in the NOT gate truth table on your sheet.

OR gate	Truth table	
	Input	Output
	A	Q
	0	1
	1	0

This time there is only one input and the output is always the opposite value. We call this 'inverting' the input. The output is always 'NOT' the input!

Summarise what we've learnt

Try Quiz

Logic gates and truth tables

Complete each of the tables below:

AND gate	**Truth table**		
	Inputs		**Output**
	A	**B**	**Q**

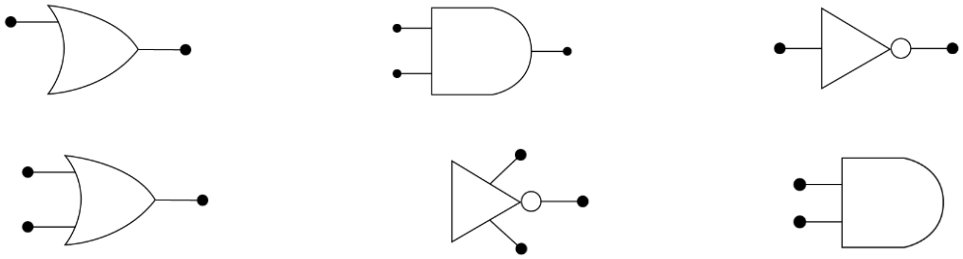
OR gate	**Truth table**		
	Inputs		**Output**
	A	**B**	**Q**

NOT gate	**Truth table**	
	Input	**Output**
	A	**Q**

Quiz - Logic gates and truth tables

Question 1

Circle the correctly drawn logic gates and write a description of what they do.



Question 2

What does ‘Boolean logic’ mean?

Question 3

What is a truth table?

Question 4

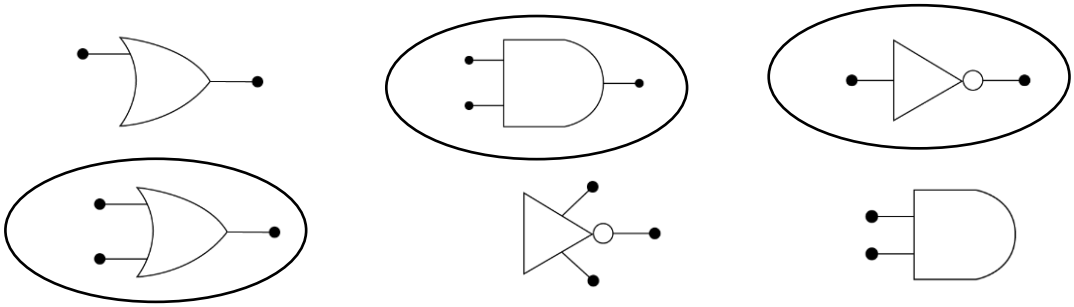
Which logic gate does this truth table describe?

Inputs		Output
A	**B**	**Q**
0	0	0
0	1	1
1	0	1
1	1	1

Quiz - Logic gates and truth tables – answers

Question 1

Circle the correctly drawn logic gates and write a description of what they do.



Question 2

What does ‘Boolean logic’ mean?

Boolean logic describes the states of the inputs and outputs to the logic gates.
Boolean logic represents all values as TRUE (1) or FALSE (0).

Question 3

What is a truth table?

A table showing the output from all possible combinations of input.

Question 4

Which logic gate does this truth table describe?

OR gate.