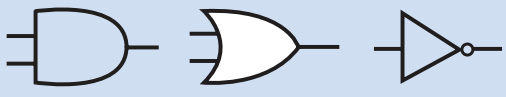
Logic gates AND, OR, NOT

Teacher's Notes

Lesson Plan

Length	60 mins	Specification Link	2.1.2e	Logic Gates
Learning objective		Logic Gates AND OR NOT		

Time (min)	Activity	Further Notes
5	Remind students that data and instructions are based on a binary system which uses two states ON or OFF, True or False, 1 or 0. Introduce the topic.	What is a logic gate: Logic gates perform basic logical functions and are they are the fundamental building blocks of digital integrated circuits. Most logic gates take an input of two binary (previous video) values, and output a single value of a 1 or 0.
5	Watch the set of videos. Pause at 2 mins before the AND gate. Ask the students about the different components of the circuits. This is to reinforce that they are working hardware and not magic.	The video script suggests that this video could be played with pauses to enable interim discussion with the students. The teacher should make their own judgement whether they wish to play it straight through or stop for discussion.
5	Tell the class that there are several different gates and that they will be looking at AND, OR and NOT. Ask the students to write down what they think each gate means. This is to be used as a discussion for the Plenary: Comparing answers following learning.	Answer kept private and discussed after the video.
5–10	Define each of the gates. Get the students to draw out the gates on paper; in some exams they will be asked to draw the logic gate. The AND and the OR gate can look similar if not drawn with a little bit of care. Now show students the activity video which shows other students working on similar tasks and how they are using their logic gates.  AND OR NOT	Use this opportunity to circulate and assess pupils' responses to gauge understanding, and to provide additional support or challenge to those who need it.
15	**Worksheet 1** In pairs or groups give students the task of defining one gate and feeding back to the rest of the class. Students could create a short 30-second video explaining the gate that they are working on, like those in the video activity they have just watched.	The time for this activity varies depending on the class. Allow less able students the time to continue working. Understanding is key.

Time (min)	Activity	Further Notes
5	Submission of Worksheet 1. There are several options for this: 1. Each group selects a spokesperson who feeds back to the class a summary of the group's responses, or the answer to one of their questions. 2. Feedback by creating a resource for the class that is reviewed for homework.	
15	Tell students the gates can be represented visually or with a logical expression and that it has an associated truth table. Truth tables will be covered in another lesson. **Worksheet 2 – Exam style questions** Each pupil to answer their questions individually and to submit for marking.	It is extremely beneficial for students to be able to gain an experience of exam style questions early on. It allows them to get used to the nature of the exam, and provides them with opportunities to perfect their exam technique as well as generating plenty of revision material.
	Extension Challenge/Homework Challenge: Change the use of A / B to two other letters such as J / K. Students find the change in letters a little challenging.	Challenge: Logical expression for AND , OR and NOT.
5	**Plenary** The three gates are used to perform simple, logical calculations. You can use these three gates together to make some more complex logic circuits. For example a CPU uses a lot of gates.	Use the exam board's glossary as a reference for key terms.

WORKSHEET 1 ANSWERS

1 **What does the term Boolean mean?**

Boolean, or Boolean logic, is a subset of algebra used for creating true/false statements. Boolean expressions use the operators AND, OR, XOR, and NOT to compare values and return a true or false result. These Boolean operators are described in the following four examples:

- **a AND b** – returns True if both a and b are true; returns False if either a or b are false.
- **a OR b** – returns True if either a or b, or both a and b are true; returns False only if a and b are both false.
- **a XOR b** – returns True if only a or b is true; returns False if a and b are both true or both false.
- **NOT a** – returns True if a is false (or null); returns False if a is true.

2 **Create *four* different diagrams with *two* or *three* logic gate symbols in each one.**

Answers will vary.

WORKSHEET 2 ANSWERS

1 The following logic circuit can be written as Q = NOT (A AND B).

Using the notation from Worksheet 1 write this expression again:

$$Q = \overline{(A.B)}$$

2 Rewrite the following expression using the notation from Worksheet 1.

Q = (A OR B) AND C

$$Q = (A \vee B) \wedge C$$

$$Q = (A+B).C$$

3 Draw the logic circuit for the above expression.