3.4.2 Boolean logic 2

Lesson plan and printable activities

Materials needed

1. 3.4.2 (Lesson 2) Lesson PowerPoint.

2. Quiz and A3 paper for final activity.

Lesson aims

1. To get students to see how logic gates can be combined to produce a collective output differing in nature to those of the original logic gates.

2. See how the outputs of these circuits can be represented using extended truth tables.

Lesson objectives

1. Construct truth tables representing simple logic gate circuits.

2. Interpret the results of simple truth tables.

Starter activity (10 minutes)

1. **Slide 3:** In pairs, ask the students to draw out truth tables from memory for the three basic logic gates previously discussed. AND, OR and NOT. Check students remember that AND and OR gates have two inputs and one output and the NOT gate has one input and one output.
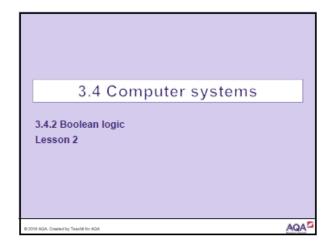
Main activities (25 minutes)

1. **Slide 4:** Introduce objectives and make students aware that today's lesson is going to look at combining logic gates to make a logic circuit. (They need to be able to construct diagrams and truth tables with up to three inputs.)

2. **Slides 5 – 8:** Use the worked example to show a stepwise approach to constructing a truth table for a circuit with three inputs – it uses three gates in total to produce a single output.

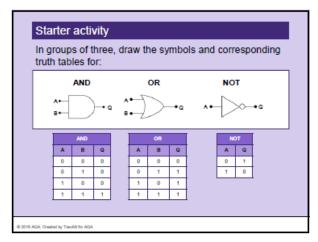3. **Slide 5:** Ask students which gate is which and how many possible inputs there are. (8 or 2^3)

4. **Slide 6:** Ask students to list the possible input combinations for A, B and C.

5. **Slide 7:** Ask students to predict outputs, ie the values in columns D and then E.

6. **Slide 8:** Give students a few minutes to figure out the results in column Q before revealing the answers.

7. **Slide 9:** Complete Quiz and the two extra tasks as described. Direct those students finding these tasks harder to colour in the columns showing intermediate logic states or alternatively, pair up students using one with better understanding to help the other.
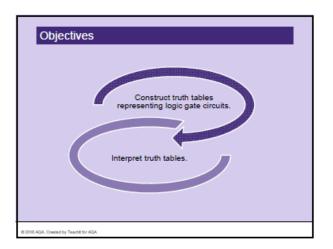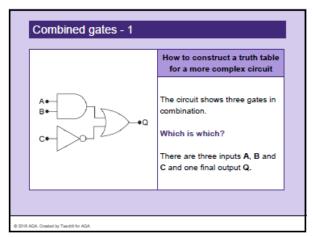
Plenary (5 - 10 minutes)

1. Students can share their own logic circuits and truth tables. Encourage them to comment on the number of TRUE and FALSE values each produces and compare with other students' solutions.
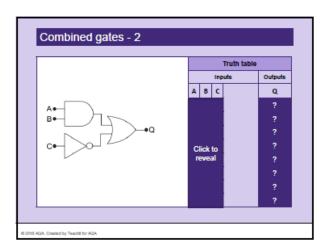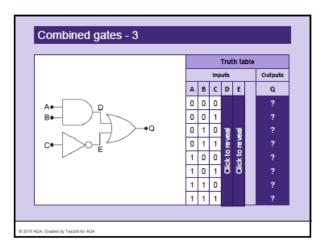
Lesson

Slide 1

3.4 Computer systems

3.4.2 Boolean logic
Lesson 2

AQA

Slide 2

Starter activity

In groups of three, draw the symbols and corresponding truth tables for:

AND   OR   NOT

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

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

NOT	
A	Q
0	1
1	0

Slide 3

Objectives

Construct truth tables representing logic gate circuits.

Interpret truth tables.

Slide 4

Combined gates - 1

How to construct a truth table for a more complex circuit

The circuit shows three gates in combination.

Which is which?

There are three inputs A, B and C and one final output Q.

Slide 5

Combined gates - 2

Truth table				
Inputs			Outputs
A	B	C		Q
				?
				?
				?
Click to reveal				?
				?
				?
				?
				?

Slide 6

Combined gates - 3

Truth table						
Inputs					Outputs
A	B	C	D	E		Q
0	0	0				?
0	0	1				?
0	1	0				?
0	1	1	Click to reveal	Click to reveal		?
1	0	0				?
1	0	1				?
1	1	0				?
1	1	1				?

Lesson

Combined gates - 4

Truth table						
Inputs					Outputs	
A	B	C	D	E	Q	
0	0	0	0	1	1	
0	0	1	0	0	0	
0	1	0	0	1	1	
0	1	1	0	0	0	
1	0	0	0	1	1	
1	0	1	0	0	0	
1	1	0	1	1	1	
1	1	1	1	0	1	

Consolidate your learning

Try the Quiz and once your answers have been checked then work with a partner to:

1. Create a logic circuit diagram with two inputs and construct the truth table for it.

2. Create a logic circuit diagram with three inputs and construct the truth table for it.

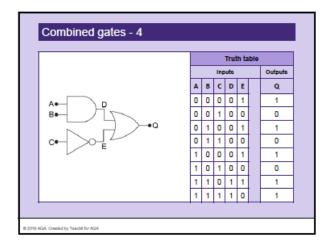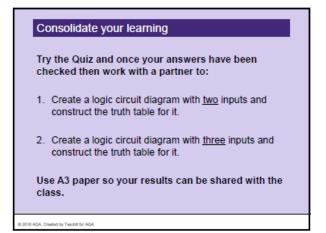Use A3 paper so your results can be shared with the class.

Quiz – Create truth tables for a combined logic gate circuit

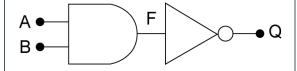| Question 1	Answer
Create a truth table for the following logic gate circuit. Show all your working.	<table><tr><th>A</th><th>B</th><th>F</th><th>Q</th></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr></table> **[3 Marks]**

Question 2	Answer
Create a truth table for the following logic gate circuit. Show all your working.	<table><tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>Q</th></tr></table> **[4 Marks]**

Question 3	Answer
Draw the logic gates for question 1 in the reverse order and then complete a truth table.	

Quiz – Create truth tables for a combined logic gate circuit – answers

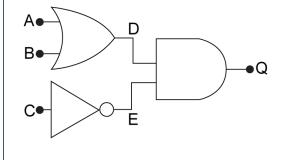| Question 1	Answer
Create a truth table for the following logic gate circuit. Show all your working.	Student should show calculation of intermediate value eg 'I' here.

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

A and **B** Correct **[1 Mark]**, **I** Correct **[1 Mark]**, **Q** Correct **[1 Mark]**

Question 2	Answer
Create a truth table for the following logic gate circuit. Show all your working.	

A	B	C	D	E	Q
0	0	0	0	1	0
0	0	1	0	0	0
0	1	0	1	1	1
0	1	1	1	0	0
1	0	0	1	1	1
1	0	1	1	0	0
1	1	0	1	1	1
1	1	1	1	0	0

A and **B** Correct **[1 Mark]**, **D** Correct **[1 Mark]**, r **E** Correct **[1 Mark]**, **Q** Correct **[1 Mark]**

Question 3	Answer
Draw the logic gates for question 1 in the reverse order and then complete a truth table.	

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

*Students may have alternative lettering to **A**, **B** and **C**.*