Boolean operator precedence 2

Practice 1

Boolean operators have an order of precedence which is taken into account when an expression is evaluated. Some operators have equal precedence.

The groups below contain **sets of operators with equal precedence**. Drag the groups into order so that the group with the highest precedence is at the top, and the group with the lowest precedence is at the bottom.

Available items

- AND, NAND
- Brackets
- NOT
- OR, NOR, XOR

Complete truth table for logic gate 2

Practice 1

Complete the truth table for the logic gate represented by the symbol in **Figure 1**.

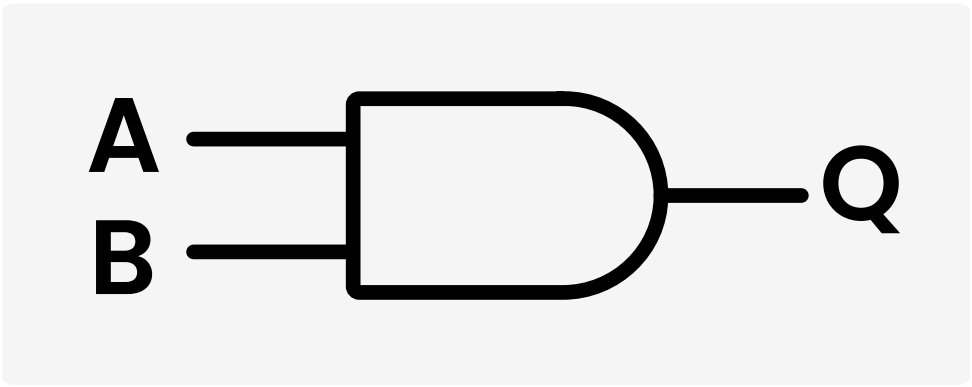

Figure 1
A logic gate symbol

A	B	Q
0	0	
0	1	
1	0	
1	1	

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Complete truth table for logic gate 5

Practice 1

Complete the truth table for the logic gate represented by the symbol in **Figure 1**.

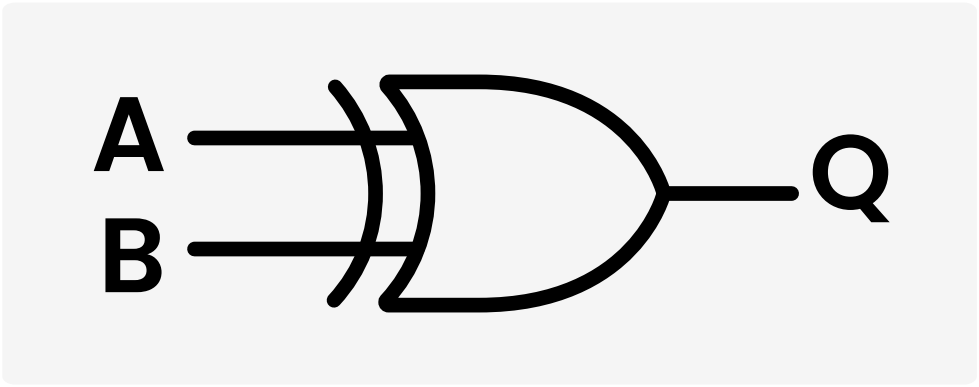

Figure 1
A logic gate symbol

A	B	Q
0	0	
0	1	
1	0	
1	1	

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Select logic gate from truth table 4

Practice 1

Which logic gate does the truth table below represent?

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

- AND
- NOR
- NAND
- XOR

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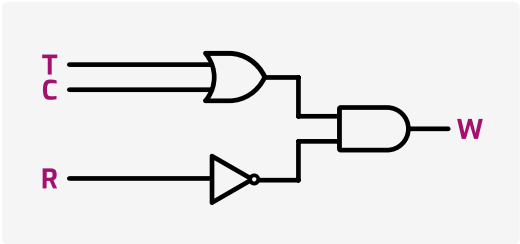
Logic circuit for a problem

Practice 2

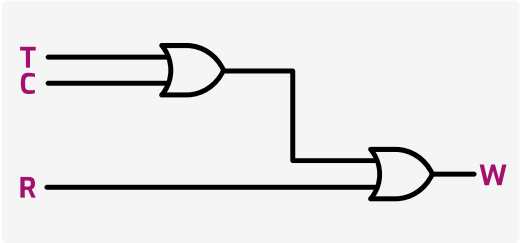
A water sprinkler (W) is on when the timer (T) is set, the temperature (C) exceeds 26° Celsius, and the rain sensor (R) does not detect rainfall.

- The timer (T) is 1 when it has been set
- The temperature sensor (C) is 1 when the temperature is over 26° Celsius
- The rain sensor (R) is 1 when rainfall is detected

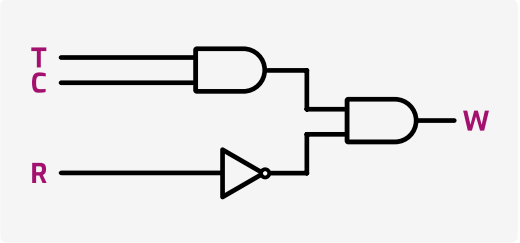
Select the logic circuit diagram that corresponds to the circuit for the sprinkler.



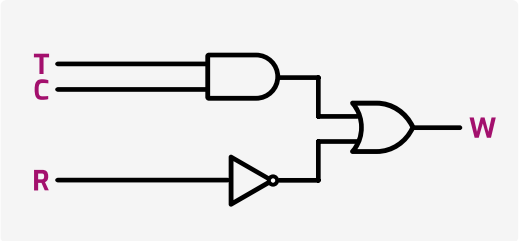
Option A circuit diagram



Option B circuit diagram



Option C circuit diagram



Option D circuit diagram

Select the correct logic diagram for the sprinkler.

- Option A
- Option B
- Option C
- Option D

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Complete truth table for logic circuit 3

Practice 2

Study the logic circuit shown in **Figure 1** and the truth table below.

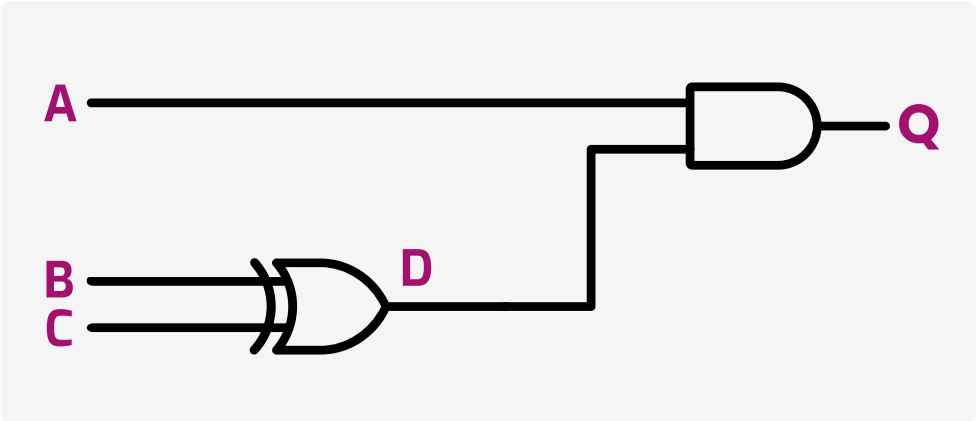

Figure 1: A circuit diagram

Complete the truth table for the logic circuit diagram in **Figure 1**. The column **D** represents the output of the logic gate with inputs B and C. The final output is in column **Q**.

A	**B**	**C**	D	Q
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

Quiz:
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Complete truth table of expression 2

Practice 2

A truth table can be used to check the logic of a Boolean expression. Consider the following expression:

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

Complete the truth table for the Boolean expression above. Each part of the expression has been entered as a separate column heading after the inputs. The final output is in column **Q**.

Inputs				**Output** Q
A	B	C	$B \vee C$	$A \wedge (B \vee C)$
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

Quiz:
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Truth table for expression

Challenge 1

A truth table can be used to check the logic of a Boolean expression. Consider the following expression:

$Q = R \vee (S \wedge \neg T)$

Create a truth table for the expression. There are three rows in the truth table which produce an output (Q) of 0. What are the values of R, S, and T for these three rows?

$R = 1; S = 0; T = 1$

- [ ] $R = 1; S = 1; T = 0$

$R = 1; S = 1; T = 1$

$R = 0; S = 0; T = 0$

- [ ] $R = 0; S = 0; T = 1$

$R = 0; S = 1; T = 1$

$R = 0; S = 0; T = 0$

- [ ] $R = 0; S = 0; T = 1$

$R = 0; S = 1; T = 0$

$R = 1; S = 0; T = 1$

- [ ] $R = 1; S = 0; T = 1$

$R = 1; S = 1; T = 0$

Quiz:
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Truth table to match problem 2

Challenge 2

Human blood can be categorised based on the antigens and antibodies that it contains. There are four main blood types:

- Type O has no antigens
- Type A has A antigens
- Type B has B antigens
- Type AB has both A and B antigens

If you need a blood transfusion, the antigens of your blood type is one of the things that determine the type of blood that you can receive from a donor. For example, blood type O has no antigens and so it cannot receive blood with A or B antigens. A person with blood type O can only get a transfusion with blood type O.

Boolean expressions can be used to represent the rules for which antigens each blood type can receive.

Here variable A represents A antigens and variable B represents B antigens:

- People with blood type O can receive blood with antigens: $\neg A \wedge \neg B$
- People with blood type A can receive blood with antigens: $(A \wedge \neg B) \vee (\neg A \wedge \neg B)$
- People with blood type B can receive blood with antigens: $(B \wedge \neg A) \vee (\neg A \wedge \neg B)$
- People with blood type AB can receive blood with antigens: $A \vee B \vee (\neg A \wedge \neg B)$

Drag each blood type to the column in the truth table that correctly describes which antigens it can receive.

Antigens		**Which antigens can each blood type can receive?**			
A	B				
0	0	1	1	1	1
0	1	0	1	0	1
1	0	0	0	1	1
1	1	0	0	0	1

Items:

A AB B O

Quiz:
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Expression for problem 2

Challenge 1

A library system needs to indicate if a user is allowed to borrow a book. The decision is based on several criteria.

- No one can borrow a book if they have an unpaid fine on their account.
- The maximum number of books a user can borrow is six unless they are an A level student or they have been waiting for the book for more than four weeks.

The following inputs represent the listed conditions:

- F - True if there is an unpaid fine (F) on the account.
- L - True if the account has six or more books on loan (L).
- A - True if the account belongs to an A level (A) student.
- W - True if the book was requested more than 4 weeks (W) ago.

The output B will be True if the student is allowed to borrow the book (B).

Choose the correct Boolean expression to match the logic of the problem statement.

- $B = \neg F \vee (W \vee A \vee \neg L)$
- $B = \neg F \wedge (W \vee A \vee \neg L)$
- $B = F \wedge (W \vee A \vee \neg L)$
- $B = F \wedge (W \vee A \vee L)$
- $B = \neg F \wedge (W \vee A \vee L)$
- $B = \neg F \vee (W \wedge A \wedge \neg L)$