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

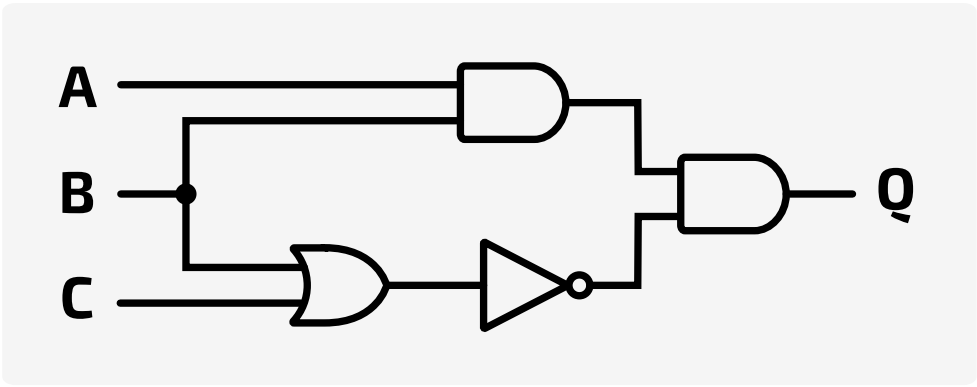
- NOT
- BRACKETS
- OR, NOR, XOR
- AND, NAND

Logic circuit for expression

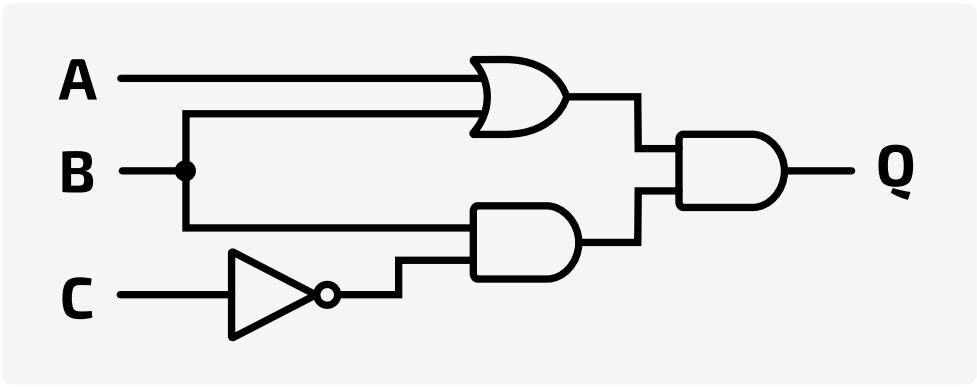
Challenge 2

Which of the circuits below represents the following Boolean expression?

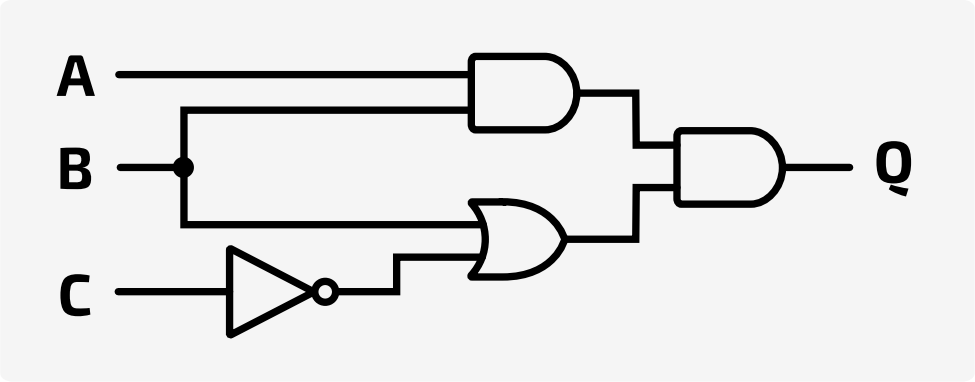
$Q = (A \wedge B) \wedge (\neg C \vee B)$



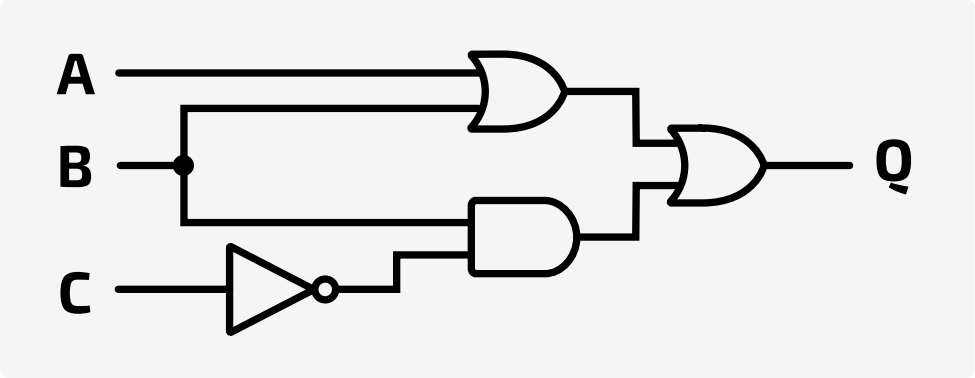
Option A



Option B



Option C



Option D

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

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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?

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

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Boolean identities and laws 1

Challenge 1

Boolean expressions can be manipulated using basic Boolean identities and laws. A Boolean identity is a statement of equivalence where the expression on the left of the equals sign has the same logic as the expression on the right.

Which of the following identities is **not** True?

- $A \vee 0 = A$
- $A \wedge \neg A = 0$
- $A \vee \neg A = 1$
- $A \wedge \neg A = 1$

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Simplify Boolean expression 9

Challenge 2

A Boolean expression can often be expressed using different logic, often in much simpler form.

Three of the following Boolean expressions are correct (in that the left part has the same logic as the right part). Select the **three** correct options.

- [ ] $A \vee 1 = 1$
- [ ] $A \vee B = \neg(\neg A \wedge \neg B)$
- [ ] $A \wedge 1 = 1$
- [ ] $A \wedge (A \vee B) = B$
- [ ] $A \wedge \neg A = 1$
- [ ] $A \wedge (A \vee B) = A$

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Simplify Boolean expression 3

Challenge 2

Using the laws of Boolean algebra, simplify this Boolean expression:

$B \wedge (A \vee A) \vee B \wedge \neg A$

The expression simplifies to:

- B
- True (1)
- A
- False (0)

Quiz:
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Simplify Boolean expression 7

Challenge 2

Using the laws of Boolean algebra, simplify this Boolean expression:

$\neg(A \vee \neg B) \wedge (\neg\neg A \wedge C) \wedge \neg(C \wedge A)$

What does the expression simplify to?

- $A \wedge B \vee C$
- $\neg A \wedge B \vee C$
- False (0)
- $A \wedge B \vee \neg C$

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Simplify Boolean expression 4

Challenge 2

Use the laws of Boolean algebra to simplify the Boolean expression below.

$(B \vee \neg B) \wedge (B \vee A)$

Which of the following options shows the simplest equivalent logic?

- 0
- 1
- $B \vee A$
- $B \vee \neg B \wedge A$

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Boolean identities and laws 7

Challenge 2

Marco was asked to use the rules of Boolean algebra to simplify a Boolean expression and to show his work. This is the expression he was given:

$(\neg A \vee B) \wedge \neg(A \vee \neg(B \vee A))$

Marco presented the following work to demonstrate how he simplified the expression:

Marco's work

$= (\neg A \vee B) \wedge (\neg A \wedge (B \vee A))$

$= (\neg A \vee B) \wedge (\neg A \wedge B \vee \neg A \wedge A)$

$= (\neg A \vee B) \wedge (\neg A \wedge B)$

$= \neg A \wedge \neg A \wedge B \vee B \wedge \neg A \wedge B$

$= \neg A \wedge B \vee \neg A \wedge B$

$= \neg A \wedge B$

Marco took the following steps to simplify the expression:

- use of identity $X \vee X = X$
- distributive law
- application of De Morgan's law
- distributive law
- use of identity $X \wedge X = X$ [twice]
- use of identities $X \wedge \neg X = 0$ and $X \vee 0 = X$

The steps listed are **not** in the same order as the workings.

Marco provided the steps in a random order and his teacher asked him to review his answer and to write the steps in the correct order he has used it.

Available items

application of De Morgan's law

use of identity X OR X = X

distributive law

use of identity X AND X = X [twice]

distributive law

use of identities X AND NOT X = 0 and X OR 0 = X

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Simplify the Karnaugh map 6

Challenge 2

The truth table for a Boolean expression has been put into the Karnaugh map shown in **Figure 1**.

AB / CD	00	01	11	10
00	0	0	0	0
01	1	0	0	1
11	1	0	0	1
10	0	0	0	0

Figure 1
A four-input Karnaugh map

Which of the following options shows the correctly simplified Boolean expression for the map?

- $A \wedge \neg B \wedge D$
- $(A \wedge \neg B \wedge D) \vee (\neg A \wedge \neg B \wedge D)$
- $\neg B \wedge D$
- $\neg B \vee D$