LESSON MAKER PRO

Logic Switchboard

Turn statements into symbols and truth values.

HIGH SCHOOL · MA.912.LT.4.4

MA.912.LT.4.4 "Represent logic operations, such as AND, OR, NOT, NOR, and XOR, using logical symbolism to solve problems."

NAME _____ DATE _____

LOGIC SYMBOLS AT WORK

Use ∧ for AND, ∨ for OR, ¬ for NOT, ¬(p ∨ q) for NOR, and ⊕ for XOR. AND is true only when both statements are true, OR is true when at least one is true, NOR is true when both are false, and XOR is true when exactly one is true.

WORKED EXAMPLE

Let p be "13 is odd" and q be "6 > 20." Evaluate ¬p ⊕ q.

1. p is true.
2. q is false.
3. ¬p is false.
4. F ⊕ F is false.

Answer: F

PRACTICE 6 problems

1 Let p be "7 is prime" and q be "10 is odd." Write p AND q in symbols and give its truth value.

ANSWER _____

2 Let p be "15 is divisible by 3" and q be "8 > 11." Write p OR q in symbols and give its truth value.

ANSWER _____

3 Let r be "14 is a multiple of 5." Write NOT r in symbols and give its truth value.

ANSWER _____

4 Let a be true and b be false. Evaluate a NOR b. Then write it using ∨ and ¬.

ANSWER _____

5 Let m be false and n be false. Evaluate m XOR n.

ANSWER _____

6 Let f mean "you submitted a club form" and o mean "you attended orientation." Write the symbol for "f or o, but not both."

ANSWER _____

APPLY IT Show your work

1 At a coding-club event, a bonus level unlocks when a member completes the debugging challenge or the design challenge, but not both. Let d mean "the debugging challenge is complete" and g mean "the design challenge is complete." Maya completed the debugging challenge but did not complete the design challenge. Write the condition in symbols and decide whether the bonus level unlocks.

WORK SPACE

ANSWER _____

2 On a student podcast platform, recording tools are available only when neither a live broadcast, l, nor maintenance, m, is active. This afternoon, l is false and m is true. Write the condition in symbols and decide whether the recording tools are available.

WORK SPACE

ANSWER _____

CHALLENGE One step up

Let p be true, q be false, and r be true. Evaluate (p XOR q) AND (r NOR p). Explain your reasoning with truth values.

WORK SPACE AND ANSWER

ANSWER KEY # Logic Switchboard

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Let p be "7 is prime" and q be "10 is odd." Write p AND q in symbols and give its truth value.	**p∧q=F**
2	Let p be "15 is divisible by 3" and q be "8 > 11." Write p OR q in symbols and give its truth value.	**p∨q=T**
3	Let r be "14 is a multiple of 5." Write NOT r in symbols and give its truth value.	**¬r = T**
4	Let a be true and b be false. Evaluate a NOR b. Then write it using ∨ and ¬.	**¬(a ∨ b) = F**
5	Let m be false and n be false. Evaluate m XOR n.	**m⊕n=F**
6	Let f mean "you submitted a club form" and o mean "you attended orientation." Write the symbol for "f or o, but not both."	**f⊕o**

PART 2 · APPLY IT

1. **d ⊕ g = T, so the bonus level unlocks.** "Or, but not both" is XOR. Since d is true and g is false, d ⊕ g is true.
2. **¬(l ∨ m) = F, so the recording tools are unavailable.** "Neither l nor m" is NOR, written ¬(l ∨ m). Because m is true, l ∨ m is true, so its negation is false.

CHALLENGE

F. p ⊕ q is T, r NOR p is F because ¬(r ∨ p) is F, and T ∧ F is F.

Accept T or true, and F or false. Accept equivalent forms such as ¬(a ∨ b) for "a NOR b" and words that correctly state "or, but not both" for XOR.