LESSON MAKER PRO

Logic in Action

Translate statements and test when they are true.

HIGH SCHOOL · FM.LR.A.1

FM.LR.A.1 "Represent logic statements in words, with symbols, and in truth tables, including conditional, biconditional, converse, inverse, contrapositive, and quantified statements."

NAME _____ DATE _____

THE BIG IDEA

A conditional p -> q is false only when p is true and q is false. Swap p and q for the converse, negate both for the inverse, or swap and negate both for the contrapositive. A biconditional p <-> q is true when p and q have the same truth value.

WORKED EXAMPLE

Complete the truth table for p -> q. Read the rows from top to bottom.

p	q	p -> q
T	T	
T	F	
F	T	
F	F	

1. When p and q are both T, write T.
2. When p is T and q is F, write F.
3. When p is F, write T in both remaining rows.

Answer: T, F, T, T

PRACTICE 4 problems

1 Let p mean 'The gym is open' and q mean 'The team practices.' Write the converse of p -> q in words.

ANSWER _____

2 Write the inverse of p -> q in symbols. Use ~ for 'not.'

ANSWER _____

3 Let p mean 'The file is saved' and q mean 'The file is backed up.' Write the contrapositive of p -> q in words.

ANSWER _____

4 For (p, q) = (T, T), (T, F), (F, T), (F, F), list the truth values of p <-> q in order.

ANSWER _____

APPLY IT Show your work

1 A club says, 'Every student who signs up gets a shirt.' The domain is students. Let S(x) mean 'x signs up' and T(x) mean 'x gets a shirt.' Write the claim using ∀, meaning 'for every,' and ->. Then negate the claim in words.

WORK SPACE

ANSWER _____

2 A music app says, 'If your plan is active, you can download songs.' A free trial lets users download songs without an active plan. Write the converse. Does the free trial disprove it?

WORK SPACE

ANSWER _____

CHALLENGE One step up

Complete both columns, reading top to bottom. Are ~(p -> q) and 'p and not q' always the same? Explain in one sentence.

p	q	~(p -> q)	p and not q
T	T		
T	F		
F	T		
F	F		

WORK SPACE AND ANSWER

Logic in Action

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Let p mean 'The gym is open' and q mean 'The team practices.' Write the converse of p -> q in words.	**If the team practices, then the gym is open.**
2	Write the inverse of p -> q in symbols. Use ~ for 'not.'	**~p -> ~q**
3	Let p mean 'The file is saved' and q mean 'The file is backed up.' Write the contrapositive of p -> q in words.	**If the file is not backed up, then the file is not saved.**
4	For (p, q) = (T, T), (T, F), (F, T), (F, F), list the truth values of p <-> q in order.	**T, F, F, T**

PART 2 · APPLY IT

1. **∀x(S(x) -> T(x)). Negation: At least one student signs up and does not get a shirt.** The claim applies to every student who signs up. To make it false, one student must sign up without getting a shirt.
2. **Converse: If you can download songs, then your plan is active. Yes, the free trial disproves the converse.** Swap the two parts to form the converse. A free-trial user can download songs without an active plan, so the converse is false.

CHALLENGE

Both columns: F, T, F, F. Yes, they always match because each is true only when p is true and q is false.

Accept equivalent wording that preserves the order and negation of each statement. For the quantified claim, the domain must be students.