LESSON MAKER PRO

Truth Table Trail

Test statements one row at a time.

HIGH SCHOOL · MA.912.LT.4.2

MA.912.LT.4.2 "Determine truth values of simple and compound statements using truth tables."

NAME _____ DATE _____

TRUTH TABLE RULES

A truth table lists every possible true and false combination for the statements. ¬ reverses a truth value, ∧ is true only when both parts are true, ∨ is true when at least one part is true, and → is false only when a true statement leads to a false statement.

WORKED EXAMPLE

Construct a truth table for $p \leftrightarrow q$.

COMPLETED WORKED TRUTH TABLE

p	q	p ↔ q
T	T	T
T	F	F
F	T	F
F	F	T

1. List the four possible truth-value pairs for p and q.
2. A biconditional is true when p and q have matching truth values.
3. Fill the final column.

Answer: Final column: T, F, F, T for rows TT, TF, FT, FF.

PRACTICE 5 problems

1 Let p be the statement, "A triangle has three sides." Determine the truth value of p.

ANSWER _____

2 Let p be the statement, "All squares are circles." Determine the truth value of ¬p.

ANSWER _____

3 If p is true and q is false, determine the truth value of $p \wedge q$.

ANSWER _____

4 Construct a truth table for $p \wedge \neg q$.

PRACTICE 4: COMPLETE THE LAST COLUMN

p	q	$p \wedge \neg q$
T	T	
T	F	
F	T	
F	F	

ANSWER _____

5 If p is false and q is false, determine the truth value of $(p \vee q) \rightarrow \neg q$.

ANSWER _____

APPLY IT Show your work

1 Maya can publish a club event when she has teacher approval and submits the event by Friday, or when she is the club president. Let a mean approval, s mean submission by Friday, and p mean club president. If a is false, s is true, and p is false, determine the truth value of $(a \wedge s) \vee p$.

WORK SPACE

ANSWER _____

2 A student may join an esports tournament if the student has a team, or if the student signed a waiver and paid the fee. Let t mean has a team, w mean signed waiver, and f mean paid fee. If t is false, w is true, and f is true, determine the truth value of $t \vee (w \wedge f)$.

WORK SPACE

ANSWER _____

CHALLENGE One step up

Complete a truth table for $(p \wedge q) \rightarrow (p \vee q)$. Then explain in one sentence whether the statement is always true.

CHALLENGE: COMPLETE THE LAST COLUMN

p	q	$(p \wedge q) \rightarrow (p \vee q)$
T	T	
T	F	
F	T	
F	F	

WORK SPACE AND ANSWER

ANSWER KEY # Truth Table Trail

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Let p be the statement, "A triangle has three sides." Determine the truth value of p.	**True.**
2	Let p be the statement, "All squares are circles." Determine the truth value of ¬p.	**True.**
3	If p is true and q is false, determine the truth value of $p \wedge q$.	**False.**
4	Construct a truth table for $p \wedge \neg q$.	**F, T, F, F in TT, TF, FT, FF order; see the aligned teacher table.**
5	If p is false and q is false, determine the truth value of $(p \vee q) \rightarrow \neg q$.	**True.**

PART 2 · APPLY IT

1. **False.** Substitute the values: $(F \wedge T) \vee F$. Both parts are false, so the compound statement is false.
2. **True.** Substitute the values: $F \vee (T \wedge T)$. The second part is true, so the disjunction is true.

CHALLENGE

Every row is T. The statement is always true because $p \wedge q$ can never be true while $p \vee q$ is false. See the aligned teacher table.

Accept T and F in place of true and false. For the challenge, accept "tautology" if the student also correctly identifies that every row is true.

Practice 4: completed truth table

PRACTICE 4 SOLUTION

p	q	$p \wedge \neg q$
T	T	F
T	F	T
F	T	F
F	F	F

Challenge: completed truth table (all four rows true)

CHALLENGE SOLUTION

p	q	$(p \wedge q) \rightarrow (p \vee q)$
T	T	T
T	F	T
F	T	T
F	F	T