# Truth Tables: Negation, Conjunction & Disjunction

Logic & Reasoning Worksheet · Grade 9–11

Name: _____ Date: _____

**Learning Objectives**

- Construct and interpret truth tables for negation, conjunction, and disjunction
- Determine the truth value of compound statements using logical operations
- Combine negation with conjunction and disjunction to evaluate complex compound statements

## Problems

**1.** Complete the truth table for the negation of P.

| p | ¬p |
|---|---|
| T | |
| F | |

**2.** Complete the truth table for the conjunction of P and Q.

| p | q | p ∧ q |
|---|---|---|
| T | T | |
| T | F | |
| F | T | |
| F | F | |

**3.** Complete the truth table for the disjunction of P and Q.

| p | q | p ∨ q |
|---|---|---|
| T | T | |
| T | F | |

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| p | q | p ∨ q |
|---|---|---|
| F | T | |
| F | F | |

**4.** Let p = '10 is greater than 4' (True) and q = '3 is less than 5' (True). Find the truth value of the compound statement: p AND q.

**5.** Let p = '10 is greater than 4' (True) and q = '3 is less than 5' (True). Find the truth value of: NOT p AND q.

**6.** Let p = '10 is greater than 4' (True) and q = '3 is less than 5' (True). Find the truth value of: p OR NOT q.

**7.** Let p = '10 is greater than 4' (True) and q = '3 is less than 5' (True). Find the truth value of: NOT p OR NOT q.

**8.** Complete the truth table that includes both the conjunction and the negation of the conjunction.

| p | q | p ∧ q | ¬(p ∧ q) |
|---|---|---|---|
| T | T | | |
| T | F | | |
| F | T | | |
| F | F | | |

**9.** Complete the full truth table showing negations of each variable alongside their conjunction and disjunction.

| p | q | ¬p | ¬q | p ∧ q | p ∨ q |
|---|---|---|---|---|---|
| T | T | | | | |
| T | F | | | | |

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| p | q | ¬p | ¬q | p ∧ q | p ∨ q |
|---|---|---|---|---|---|
| F | T | | | | |
| F | F | | | | |

**10.** Complete the three-variable truth table for the compound statement: p AND q AND r, along with NOT p and the disjunction of NOT p and r.

| p | q | r | ¬p | p ∧ q | p ∧ q ∧ r | ¬p ∨ r |
|---|---|---|---|---|---|---|
| T | T | T | | | | |
| T | T | F | | | | |
| T | F | T | | | | |
| T | F | F | | | | |
| F | T | T | | | | |
| F | T | F | | | | |
| F | F | T | | | | |
| F | F | F | | | | |

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# Truth Tables: Negation, Conjunction & Disjunction — Answer Key

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## Answer Key

### 1. Answer: See completed table

| p | ¬p |
|---|---|
| T | F |
| F | T |

- Negation reverses the truth value of a statement.
- If p is True, then ¬p is False; if p is False, then ¬p is True.

### 2. Answer: See completed table

| p | q | p ∧ q |
|---|---|---|
| T | T | T |
| T | F | F |
| F | T | F |
| F | F | F |

- Conjunction (AND) is only TRUE when BOTH p and q are TRUE.
- All other combinations (TF, FT, FF) produce a FALSE result.

### 3. Answer: See completed table

| p | q | p ∨ q |
|---|---|---|
| T | T | T |
| T | F | T |
| F | T | T |
| F | F | F |

- Disjunction (OR) is only FALSE when BOTH p and q are FALSE.
- All other combinations (TT, TF, FT) produce a TRUE result.

### 4. Answer: True

- p is TRUE and q is TRUE.

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- Using the conjunction truth table, T ∧ T = TRUE.

**5. Answer: False**

- p is TRUE, so ¬p is FALSE. q is TRUE.
- Using the conjunction truth table, F ∧ T = FALSE.

**6. Answer: True**

- p is TRUE. q is TRUE, so ¬q is FALSE.
- Using the disjunction truth table, T ∨ F = TRUE.

**7. Answer: False**

- p is TRUE so ¬p is FALSE. q is TRUE so ¬q is FALSE.
- Using the disjunction truth table, F ∨ F = FALSE.

**8. Answer: See completed table**

| p | q | p ∧ q | ¬(p ∧ q) |
|---|---|---|---|
| T | T | T | F |
| T | F | F | T |
| F | T | F | T |
| F | F | F | T |

- First fill in the p ∧ q column using the conjunction rule: only T when both are T.
- Then negate each value in the p ∧ q column to get ¬(p ∧ q).

**9. Answer: See completed table**

| p | q | ¬p | ¬q | p ∧ q | p ∨ q |
|---|---|---|---|---|---|
| T | T | F | F | T | T |
| T | F | F | T | F | T |
| F | T | T | F | F | T |
| F | F | T | T | F | F |

- Fill ¬p and ¬q by reversing p and q respectively.
- Fill p ∧ q: only T when both p and q are T.
- Fill p ∨ q: only F when both p and q are F.

**10. Answer: See completed table**

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| p | q | r | ¬p | p ∧ q | p ∧ q ∧ r | ¬p ∨ r |
|---|---|---|---|---|---|---|
| T | T | T | F | T | T | T |
| T | T | F | F | T | F | F |
| T | F | T | F | F | F | T |
| T | F | F | F | F | F | F |
| F | T | T | T | F | F | T |
| F | T | F | T | F | F | T |
| F | F | T | T | F | F | T |
| F | F | F | T | F | F | T |

- List all 8 combinations of T/F for p, q, r.
- ¬p: reverse p's value in each row.
- p ∧ q: TRUE only when both p and q are TRUE.
- p ∧ q ∧ r: TRUE only when p ∧ q is TRUE AND r is TRUE (only row 1).
- ¬p ∨ r: FALSE only when both ¬p is FALSE (p is TRUE) and r is FALSE.

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