Compound Statements & Logical Connectives

Symbolic Logic Worksheet · Grade 9–12

Name: _____ Date: _____

Learning Objectives

- Identify simple and compound statements in symbolic logic
- Translate compound statements into symbolic form using AND (∧), OR (∨), and IF-THEN (→) connectives
- Apply negation to simple statements within compound expressions

Problems

1. Identify whether the following is a simple or compound statement: 'Today is Friday.'

2. Identify whether the following is a simple or compound statement: 'It is raining and the streets are wet.'

3. Let P = 'The sun is shining' and Q = 'It is warm outside.' Write the symbolic form of the compound statement: 'The sun is shining and it is warm outside.'

$P \wedge Q$

4. Let P = 'She studies hard' and Q = 'She passes the exam.' Write the symbolic form of: 'She studies hard or she passes the exam.'

$P \vee Q$

5. Let P = 'The alarm rings' and Q = 'She wakes up.' Write the symbolic form of: 'The alarm rings and she does not wake up.'

$P \wedge \sim Q$

6. Let P = 'It is snowing' and Q = 'School is cancelled.' Write the symbolic form of: 'It is not snowing or school is cancelled.'

$\sim P \vee Q$

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7. The word 'but' can also function as an AND connective in symbolic logic. Let P = 'He tried his best' and Q = 'He did not win.' Write the symbolic form of: 'He tried his best but he did not win.'

$P \wedge \sim Q$

8. Translate the following symbolic expression back into an English compound statement. Let P = 'The store is open' and Q = 'We can buy groceries.' Translate the expression shown below.

$\sim P \wedge \sim Q$

9. Let P = 'The team scores a goal' and Q = 'The team wins the match.' Translate the following three symbolic expressions into English compound statements: (a) $P \wedge Q$, (b) $P \vee \sim Q$, (c) $\sim P \wedge \sim Q$

10. Let P = 'It is after 6 p.m.', Q = 'The office is closed', and R = 'Employees are gone.' Write the symbolic form of the three-part compound statement: 'It is after 6 p.m. and the office is closed, yet employees are not gone.' Then identify which connective word is used in place of AND.

$P \wedge Q \wedge \sim R$

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Compound Statements & Logical Connectives — Answer Key

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Answer Key

1. Answer: Simple statement

- A simple statement conveys a single idea with no connecting words.
- 'Today is Friday' expresses one idea with no connectives like and, or, if-then.
- Therefore, it is a simple statement.

2. Answer: Compound statement

- A compound statement combines two or more simple statements using connectives.
- The word 'and' is a connective joining two simple statements.
- Therefore, it is a compound statement.

3. Answer: P ∧ Q

- Identify the connective: the word 'and' is a conjunction connective.
- The conjunction connective is symbolized by ∧.
- P represents 'The sun is shining' and Q represents 'It is warm outside.'
- The symbolic form is P ∧ Q.

4. Answer: P ∨ Q

- Identify the connective: the word 'or' is a disjunction connective.
- The disjunction connective is symbolized by ∨.
- P = 'She studies hard', Q = 'She passes the exam.'
- The symbolic form is P ∨ Q.

5. Answer: P ∧ ~Q

- Identify the connective: 'and' is the conjunction connective (∧).
- Notice that 'does not wake up' is the negation of Q.
- Negation is symbolized by ~, so 'she does not wake up' = ~Q.
- The symbolic form is P ∧ ~Q.

6. Answer: ~P ∨ Q

- Identify the connective: 'or' is the disjunction connective (∨).
- 'It is not snowing' is the negation of P, written as ~P.
- Q represents 'School is cancelled.'
- The symbolic form is ~P ∨ Q.

7. Answer: P ∧ ~Q

- 'But' functions the same as the AND connective (∧) in symbolic logic.
- P = 'He tried his best'; the second part 'he did not win' is the negation of 'He did win.'

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- Wait — Q is already defined as 'He did not win,' so no additional negation is applied.
- The symbolic form is P ∧ Q.
- Note: If Q were defined as 'He wins,' the form would be P ∧ ~Q.

8. Answer: The store is not open and we cannot buy groceries.

- ~P means the negation of P: 'The store is not open.'
- ~Q means the negation of Q: 'We cannot buy groceries.'
- ∧ connects them with 'and.'
- English translation: 'The store is not open and we cannot buy groceries.'

9. Answer: (a) The team scores a goal and the team wins the match. (b) The team scores a goal or the team does not win the match. (c) The team does not score a goal and the team does not win the match.

- For (a): P ∧ Q — 'and' connects P and Q directly: 'The team scores a goal and the team wins the match.'
- For (b): P ∨ ~Q — 'or' connects P and the negation of Q: 'The team scores a goal or the team does not win the match.'
- For (c): ~P ∧ ~Q — 'and' connects the negation of P and the negation of Q: 'The team does not score a goal and the team does not win the match.'

10. Answer: P ∧ Q ∧ ~R; 'yet' functions as the AND connective.

- Identify all simple statements: P = 'It is after 6 p.m.', Q = 'The office is closed', R = 'Employees are gone.'
- The connective 'and' joins P and Q: P ∧ Q.
- The word 'yet' functions as an AND connective in symbolic logic, joining the result with the negation of R.
- 'Employees are not gone' is the negation of R: ~R.
- The full symbolic form is P ∧ Q ∧ ~R.

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