LESSON MAKER PRO

Logic Switches

Test and rewrite if-then statements

HIGH SCHOOL · FM.LR.A.3.a

FM.LR.A.3.a "Determine whether statements are equivalent and construct equivalent statements."

NAME _____ DATE _____

EQUIVALENT STATEMENTS

An 'if p, then q' statement is false only when p is true and q is false. It is equivalent to 'if not q, then not p' and to 'not p or q.' Switching p and q gives the converse, which may not be equivalent.

WORKED EXAMPLE

Write an equivalent statement: If an animal is a dolphin, then it is a mammal.

1. Let p mean 'the animal is a dolphin' and q mean 'the animal is a mammal.'
2. Rewrite 'if p, then q' as 'if not q, then not p.'
3. Replace p and q with their meanings.

Answer: If an animal is not a mammal, then it is not a dolphin.

PRACTICE 6 problems

1 Write the contrapositive: If an integer is divisible by 8, then it is even.

ANSWER _____

2 Which statement is equivalent to 'If x < -2, then x < 5'? A. If x < 5, then x < -2. B. If x >= 5, then x >= -2. C. If x >= -2, then x >= 5.

ANSWER _____

3 Rewrite using 'or': If the school bus is late, then the first bell has rung.

ANSWER _____

4 Complete an equivalent statement: If a file is larger than 20 MB, then it must be compressed before upload. If the file does not need to be compressed before upload, then _____.

ANSWER _____

5 For x = 3, give the truth value of each statement. A: If x > 6, then x > 1. B: If x > 1, then x > 6.

ANSWER _____

6 Compare these statements: 'If x is divisible by 15, then x is divisible by 5' and 'If x is not divisible by 15, then x is not divisible by 5.' Are they equivalent? Give a value of x that supports your answer.

ANSWER _____

APPLY IT Show your work

1 An event rule says, 'If you buy a VIP ticket, then you can enter early.' A friend claims, 'If you can enter early, then you bought a VIP ticket.' Is the friend's claim equivalent to the rule? Give a possible case that shows your answer.

WORK SPACE

ANSWER _____

2 A game app's rule says, 'If an account earns at least 10 badges, then it unlocks a bonus level.' Write two equivalent statements: one using 'or' and one using 'if...then.'

WORK SPACE

ANSWER _____

CHALLENGE One step up

For whole numbers x, compare A: 'If x is divisible by 18, then x is divisible by 9'; B: 'If x is not divisible by 9, then x is not divisible by 18'; and C: 'If x is divisible by 9, then x is divisible by 18.' Which pair is equivalent? Give a value of x that shows why C is not equivalent to the other statements.

WORK SPACE AND ANSWER

ANSWER KEY

Logic Switches

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Write the contrapositive: If an integer is divisible by 8, then it is even.	**If an integer is not even, then it is not divisible by 8.**
2	Which statement is equivalent to 'If x < -2, then x < 5'? A. If x < 5, then x < -2. B. If x >= 5, then x >= -2. C. If x >= -2, then x >= 5.	**B. If x >= 5, then x >= -2.**
3	Rewrite using 'or': If the school bus is late, then the first bell has rung.	**The school bus is not late, or the first bell has rung.**
4	Complete an equivalent statement: If a file is larger than 20 MB, then it must be compressed before upload. If the file does not need to be compressed before upload, then _____.	**it is not larger than 20 MB.**
5	For x = 3, give the truth value of each statement. A: If x > 6, then x > 1. B: If x > 1, then x > 6.	**A is true. B is false.**
6	Compare these statements: 'If x is divisible by 15, then x is divisible by 5' and 'If x is not divisible by 15, then x is not divisible by 5.' Are they equivalent? Give a value of x that supports your answer.	**No. At x = 5, the first statement is true and the second is false.**

PART 2 · APPLY IT

1. **No. A performer could enter early without buying a VIP ticket.** The friend switched the two parts of the rule. A person who enters early for another reason shows that the friend's claim can be false while the rule is true.
2. **The account earns fewer than 10 badges, or it unlocks a bonus level. If the account does not unlock a bonus level, then it earned fewer than 10 badges.** Let p mean the account earns at least 10 badges and q mean it unlocks a bonus level. Use 'not p or q' and 'if not q, then not p.'

CHALLENGE

A and B are equivalent. At x = 9, A and B are true, but C is false.

Accept equivalent wording that preserves each statement's meaning. In the challenge, x = 27 is another valid counterexample.