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Biconditional: The statement $p \leftrightarrow q$ is true only when p and q have the same truth value.

The biconditional statement really means:
"if p then q and if q then p " ($p \rightarrow q$) $\wedge$ ($q \rightarrow p$)

	p	q	$(p \rightarrow q) \wedge (q \rightarrow p)$
Case 1	T	T	T
Case 2	T	F	F
Case 3	F	T	F
Case 4	F	F	T

Biconditional		
	p	q
Case 1	T	T
Case 2	T	F
Case 3	F	T
Case 4	F	F

Do they match?



GUIDED PRACTICE for Example 1

Rewrite the conditional statement in if-then form.

1. All 90° angles are right angles.

ANSWER

If the measure of an angle is 90° , then it is a right angle

2. $2x + 7 = 1$, because $x = -3$

ANSWER

If $x = -3$, then $2x + 7 = 1$

Teacher Notes (2020)
Practice Problems

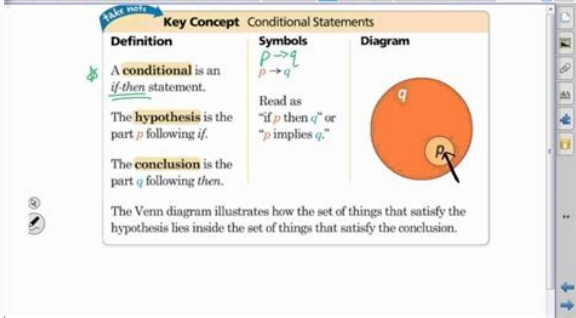
1. Write the conditional statement and its converse as biconditional statements.
If it is not a prime number, it is composite.
If the product is not the identity then it is a 100 point.

2. Write the conditional statement and its converse as biconditional statements.
If the project is not the identity then it is a 100 point.

3. Write the conditional statement and its converse as biconditional statements.
If the project is not the identity then it is a 100 point.
4. Write the conditional statement and its converse as biconditional statements.
If it is not a prime number, it is composite.
If the product is not the identity then it is a 100 point.

5. Write the conditional statement and its converse as biconditional statements.
If the project is not the identity then it is a 100 point.

6. Write the conditional statement and its converse as biconditional statements.
If the project is not the identity then it is a 100 point.



Examples of a conditional statement. Conditional and biconditional statements worksheet answers.

Example 1: Given: p : Ann is on the softball team. q : Paul is on the football team. Problem: What does pq represent? Solution: In Example 1, statement p represents, "Ann is on the softball team" and statement q represents, "Paul is on the football team." The symbol $\wedge$ is a logical connector which means "or." Thus, the compound statement pq represents the sentence, "Ann is on the softball team or Paul is on the football team." The statement pq is a disjunction. Definition: A disjunction is a compound statement formed by joining two statements with the connector OR. The disjunction " p or q " is symbolized by $p \vee q$. A disjunction is false if and only if both statements are false; otherwise it is true. The truth values of pq are listed in the truth table below. $p \vee q$ T T T T F T F T F F F F Example 2: Given: a : A square is a quadrilateral. b : Harrison Ford is an American actor. Problem: Construct a truth table for the disjunction " a or b ." Solution: $a \vee b$ T T T T F T F T F F F F Example 3: Given: r : x is divisible by 2. s : x is divisible by 3. Problem: What are the truth values of rs ? Solution: Each statement given in this example represents an open sentence, so the truth value of rs will depend on the replacement values of x as shown below. If $x = 6$, then r is true, and s is true. The disjunction rs is true. If $x = 8$, then r is true, and s is false. The disjunction rs is true. If $x = 15$, then r is false, and s is true. The disjunction rs is true. If $x = 11$, then r is false, and s is false. The disjunction rs is false. Example 4: Given: p : 12 is prime. false q : 17 is prime. true r : 19 is composite. false Problem: Write a sentence for each disjunction below. Then indicate if it is true or false. 1. $p \vee 12$ is prime or 17 is prime. true 2. $p \vee 12$ is prime or 19 is composite. false 3. $q \vee 17$ is prime or 19 is composite. true Example 5: Complete a truth table for each disjunction below. 1. a or b 2. a or not b 3. not a or b $a \vee b$ T T T T F T F T F F F F $a \vee \neg b$ T T T T F T F T F F F F T T $\neg a \vee b$ T T F T T F F F F T T T F F F T T Students sometimes confuse conjunction and disjunction. Let's look at an example in which we compare the truth values of both of these compound statements. Example 6: Given: x : Jayne played tennis. y : Chris played softball. Problem: Construct a truth table for conjunction " x and y " and disjunction " x or y ." Solution: $x \wedge y$ x y T T T T F T F T F F F F F F With a conjunction, both statements must be true for the conjunction to be true; but with a disjunction, both statements must be false for the disjunction to be false. One way to remember this is with the following mnemonic: 'And' points up to the sand on top of the beach, while 'or' points down to the ore deep in the ground. Summary: A disjunction is a compound statement formed by joining two statements with the connector OR. The disjunction " p or q " is symbolized by $p \vee q$. A disjunction is false if and only if both statements are false; otherwise it is true. Exercises Directions: Read each question below. Select your answer by clicking on its button. Feedback to your answer is provided in the RESULTS BOX. If you make a mistake, choose a different button. 1. Which of the following sentences is a disjunction? 2. Which of the following statements is a disjunction? 3. A disjunction is used with which connector? 4. If a is false and b is true, what is the truth value of $a \sim b$? 5. Given: r : y is prime. s : y is even. Problem: Which of the following is a true statement when y is replaced by 3? 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We can also offer you a custom pricing if you feel that our pricing doesn't really feel meet your needs. Du château de plaisance au musée national Un lieu d'intimité L'art de la perspective Un écrin de verdure L'application gratuite du Château propose des parcours audio accompagnant votre visite du domaine (Château, jardins, domaine de Trianon...) ainsi qu'une carte interactive. Plus d'info Le meilleur de Versailles pour les abonnés ! Pendant toute une année, bénéficiez de nombreux avantages grâce aux cartes SOLO et DUO, et un accès coupe-file en illimité à partir de seulement 55€. Offres d'abonnement Definition: A Conditional Statement is... symbolized by $p \rightarrow q$. It is an if-then statement in which p is a hypothesis and q is a conclusion. The logical connector in a conditional statement is denoted by the symbol $\rightarrow$. The conditional is defined to be true unless a true hypothesis leads to a false conclusion. A truth table for $p \rightarrow q$ is shown below. $p \rightarrow q$ T T T T F F F T T F F T In the truth table above, pq is only false when the hypothesis (p) is true and the conclusion (q) is false; otherwise it is true. Note that a conditional is a compound statement. Now that we have defined a conditional, we can apply it to Example 1. Example 1: Given: p : I do my homework. q : I get my allowance. Problem: What does pq represent? Solution: In Example 1, the sentence, "I do my homework" is the hypothesis and the sentence, "I get my allowance" is the conclusion. Thus, the conditional pq represents the hypothetical proposition, "If I do my homework, then I get an allowance." However, as you can see from the truth table above, doing your homework does not guarantee that you will get an allowance! In other words, there is not always a cause-and-effect relationship between the hypothesis and conclusion of a conditional statement. Example 2: Given: a : The sun is made of gas. b : 3 is a prime number. Problem: Write ab as a sentence. Then construct a truth table for this conditional. Solution: The conditional ab represents "If the sun is made of gas, then 3 is a prime number." $a \vee b$ T T T T F F F T T F F T In Example 2, "The sun is made of gas" is the hypothesis and "3 is a prime number" is the conclusion. Note that the logical meaning of this conditional statement is not the same as its intuitive meaning. In logic, the conditional is defined to be true unless a true hypothesis leads to a false conclusion. The implication of ab is that: since the sun is made of gas, this makes 3 a prime number. However, intuitively, we know that this is false because the sun and the number three have nothing to do with one another! Therefore, the logical conditional allows implications to be true even when the hypothesis and the conclusion have no logical connection. Example 3: Given: x : Gisele has a math assignment. y : David owns a car. Problem: Write xy as a sentence. Solution: The conditional xy represents, "If Gisele has a math assignment, then David owns a car." In the following examples, we are given the truth values of the hypothesis and the conclusion and asked to determine the truth value of the conditional. Example 4: Given: r : 8 is an odd number. false s : 9 is composite. true Problem: What is the truth value of rs ? Solution: Since hypothesis r is false and conclusion s is true, the conditional rs is true. Example 5: Given: r : 8 is an odd number. false s : 9 is composite. true Problem: What is the truth value of rs ? Solution: Since hypothesis r is false and conclusion s is true, the conditional rs is true. Example 6: Given: p : 72 = 49. true q : A rectangle does not have 4 sides. false r : Harrison Ford is an American actor. true s : A square is not a quadrilateral. false Problem: Write each conditional below as a sentence. Then indicate its truth value. 1. pq If 72 is equal to 49, then a rectangle does not have 4 sides. false 2. qr If a rectangle does not have 4 sides, then Harrison Ford is an American actor. true 3. pr If 72 is equal to 49, then Harrison Ford is an American actor. true 4. qs If a rectangle does not have 4 sides, then a square is not a quadrilateral. true 5. $r \sim p$ If Harrison Ford is an American actor, then 72 is not equal to 49. false 6. $\sim rp$ If Harrison Ford is not an American actor, then 72 is equal to 49. true Note that in item 5, the conclusion is the negation of p . Also, in item 6, the hypothesis is the negation of r . Summary: A conditional statement, symbolized by $p \rightarrow q$, is an if-then statement in which p is a hypothesis and q is a conclusion. The conditional is defined to be true unless a true hypothesis leads to a false conclusion. Exercises Directions: Read each question below. Select your answer by clicking on its button. Feedback to your answer is provided in the RESULTS BOX. If you make a mistake, choose a different button. 1. Which of the following is a conditional statement? 2. Given: r : You give me twenty dollars. s : I will be your best friend. Problem: Which of the following statements represents, "If you give me twenty dollars, then I will be your best friend"? 3. What is the truth value of rs when the hypothesis is false and the conclusion is true in Example 2? 4. Given: a : x is prime. b : x is odd. Problem: What is the truth value of ab when $x = 2$? 5. What is the truth value of ab when $x = 9$ in Exercise 4?

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