Discrete Mathematics and Proof Unit 1 worksheet: Saying a conditional without if-then

Name _____ Date _____ Period _____

1. Rewrite each conditional as an or-statement, and each or-statement as a conditional. Keep every $\neg$ on a single letter, with no letter carrying two of them.

(a) $\neg P \to Q$

(b) $P \to \neg Q$

(c) $\neg R \vee S$

(d) $P \vee \neg Q$

(e) $(P \wedge Q) \to R$

2. Write the negation of each statement as an and-sentence. Do not use "if" or "it is not the case". In (a) to (c), also decide which is true, the statement or its negation.

(a) If 91 is odd, then 91 is prime.

(b) If $2^{10} > 1000$, then $2^{20} > 1{,}000{,}000$.

(c) If $\sqrt{50} < 7$, then $50 < 49$.

(d) If the pool is heated, then the swim meet goes ahead.

(e) If Naomi does not practice, then she does not pass her driving test.

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3. Each sentence below is an or-statement. Rewrite it as an if-then sentence. In (d) and (e), n is an integer: also decide whether the sentence is true for every integer n, and if it is not, name an integer that makes it false.

(a) The bakery sells out by noon, or Hannah buys bread there after school.

(b) The bridge is closed, or the ferry does not run.

(c) Elena does not get a ticket, or she goes to the concert.

(d) n is odd, or n^2 is a multiple of 4.

(e) n is a multiple of 3, or $n^2 + 1$ is even.

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4. Show each equivalence without a truth table. Begin by rewriting every conditional in its or-form. Besides that rewriting you may use the De Morgan laws, cancelling a double negation, reordering and regrouping the parts of an or, the fact that $A \vee A \equiv A$, and, in (c), the law $(A \vee C) \wedge (B \vee C) \equiv (A \wedge B) \vee C$.

(a) $P \to \neg P \equiv \neg P$. Then say in words what this tells you about a statement that implies its own negation.

(b) $(P \wedge Q) \to R \equiv P \to (Q \to R)$

(c) $(P \to R) \wedge (Q \to R) \equiv (P \vee Q) \to R$

5. Let n be an integer, and consider the statement: if n is odd, then $n^2 - 1$ is a multiple of 8.

(a) Rewrite the statement as an or-statement, without "if".

(b) Prove the statement by showing that one part of your or-statement holds for every integer n. (Hint: sort the integers by their remainder on division by 4.)

Statements	Reasons

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