Discrete Mathematics and Proof Unit 1 worksheet: Truth table for the conditional

Name _____ Date _____ Period _____

1. Let $n = 45$. For each statement, say whether its hypothesis and its conclusion are true or false, name the row of the table for $P \to Q$ the statement sits in, and give its truth value.

(a) If n is a multiple of 9, then n is a multiple of 3.

(b) If n is a multiple of 9, then n is even.

(c) If n is a perfect square, then n is a multiple of 5.

(d) If n is prime, then $n < 10$.

(e) Now let $n = 90$. Which of the statements (a) to (d) change truth value?

2. In each part, the facts listed are all true. Find the truth value of each of P, Q and R, or say that it cannot be determined.

(a) $P \to Q$ is false, and $Q \vee R$ is true.

(b) $P \to Q$ is true, $Q \to R$ is true, and R is false.

(c) $Q \to P$ is false, and $P \to R$ is true.

(d) $P \to \neg Q$ is true, and $P \wedge R$ is true.

3. Naomi claims: "Whatever statements P and Q are, at least one of $P \to Q$ and $Q \to P$ is true."

(a) Is she right? Explain with the rows of the two tables.

(b) In which rows of the table, letters P, Q in the fixed order, are $P \to Q$ and $Q \to P$ both true?

(c) Let P be "7 is even" and Q be "7 is prime". Which of the two conditionals is true, and which row is it in?

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4. Each card in a pack has a letter on one side and a whole number on the other. A claim about the pack says: "If a card has a vowel on one side, then it has an even number on the other side." Four cards lie on a table, showing A, M, 6 and 9.

(a) Which cards must you turn over to find out whether any of these four breaks the claim? Turn over no card you do not need to.

(b) Let P be "the card has a vowel" and Q be "the card has an even number". For each card you leave face down, use the rows of the table for $P \to Q$ to explain why it cannot break the claim.

5. A ski resort posts the notice: "If it snows or the wind is strong, the upper lift is closed." Let S be "it snows", W be "the wind is strong" and C be "the upper lift is closed".

(a) Write the notice as a statement in S, W and C.

(b) Build its truth table, rows in the order S, W, C, with a helper column for $S \vee W$.

(c) Sofia, who runs the lift, reads the notice as also promising that the lift is open on every calm day without snow. Use the table to explain why the notice makes no such promise.

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