Geometry Unit 1 worksheet: Conditionals, converse, inverse, contrapositive

Name _____ Date _____ Period _____

1. A climbing gym posts this rule: "A climber on the wall is under 12 only if an adult is with them."

(a) Write the rule as an if-then statement, and name its hypothesis and its conclusion.

(b) For each climber, say whether the rule is kept or broken, and why.

(i) A 9-year-old climbs with her father. (ii) A 10-year-old climbs alone. (iii) A 14-year-old climbs alone. (iv) A 40-year-old climbs with a friend his own age. (v) An 11-year-old climbs with his 16-year-old sister and no adult.

2. For an angle $\angle A$, let P be "$m\angle A = 90°$" and let Q be "$m\angle A > 80°$". Say whether each sentence means $P \to Q$ or $Q \to P$. Then say which sentences are true for every angle $\angle A$, and give one angle measure that is a counterexample to each false one.

(a) $m\angle A > 80°$ whenever $m\angle A = 90°$.

(b) $m\angle A = 90°$ only if $m\angle A > 80°$.

(c) $m\angle A > 80°$ only if $m\angle A = 90°$.

(d) $m\angle A = 90°$ if $m\angle A > 80°$.

(e) For $m\angle A > 80°$, it is sufficient that $m\angle A = 90°$.

(f) For $m\angle A > 80°$, it is necessary that $m\angle A = 90°$.

3. Each student was asked for the contrapositive of a statement. Find the mistake, write the correct contrapositive, and say whether the student's own sentence is true.

(a) Statement: "If M is the midpoint of $\overline{AB}$, then $AM = MB$." Diego wrote: "If $AM = MB$, then M is the midpoint of $\overline{AB}$."

(b) Statement: "If a point lies on the x-axis and on the y-axis, then it is $(0, 0)$." Maya wrote: "If a point is not $(0, 0)$, then it does not lie on the x-axis and it does not lie on the y-axis."

(c) Statement: "If an angle is acute, then its measure is less than 90°." Mateo wrote: "If an angle's measure is greater than 90°, then it is not acute."

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4. For each whole number k from 1 to 8, let P be "k is even" and let Q be "a square with sides of k cm has an area of more than 30 cm^2".

(a) For which values of k is Q true?

(b) For which values of k is $P \to Q$ false? For which is its converse false?

(c) For which values of k is the inverse false? For which is the contrapositive false?

(d) For how many of the eight values of k are all four statements true?

5. Let $A = (4, 0)$ and $B = (0, 2)$. For a point $P(x, y)$, consider the statement: "if P lies on the line $y = 2x - 3$, then $PA = PB$."

(a) Show that the statement is true for every point P.

(b) Write its converse, and decide whether the converse is true for every point P.

(c) Write the inverse and the contrapositive, and say whether each is true.

6. Claim: "If a rectangle has a perimeter of more than 20 cm, then at least one of its sides is longer than 5 cm."

(a) Write the contrapositive of the claim. Take care with the negation of "at least one of its sides is longer than 5 cm".

(b) Prove the contrapositive, and say why this proves the claim.

(c) Write the converse, and decide whether it is true.

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