Course: Geometry
Unit: Introduction to Proof
Section: Informal and Two Column Proofs

Example: Properties of Equality

The properties of equality from algebra apply in geometry as well.

The first property is the reflexive property. It states that an element is equivalent to itself. The definition is that a equals a.

An algebra example is that four equals four.

In geometry, the property may state that segment AB is congruent to segment AB.

The next property is the symmetric property. It states that you can interchange the elements on the left and right sides of an equivalence sign. If b equals a, then a equals b.

An algebra example would be that two plus three equals five, so five equals two plus three.

In geometry, segment AB is congruent to segment CD is the same as segment CD being congruent to segment AB.

Next is the transitive property. It states that if one element is equivalent to another, and that is equivalent to a third element, then the first is equivalent to the third. If a equals b and b equals c, then a equals c.

So if three plus four equals seven and seven equals two plus five, then three plus four equals two plus five.

In geometry, an example would be that if segment AB is congruent to segment CD and segment CD is congruent to segment EF, then segment AB is congruent to segment EF.

The addition and subtraction properties of equality are very similar. If you add or subtract the same element to two or more equivalent elements, the resulting elements are equivalent. If a equals b, then a plus c equals b plus c. The same would be true for subtraction. This property is used to solve equations.

Two x plus three equals five. So subtracting three from both sides is allowed by the property and would help to solve the equation

In geometry, if the measure of angle ABC is equal to the measure of DEF, we can add the measure of a third angle, such as GHI to both sides of the equation.

The multiplication and division properties of equality are also used to solve equations. If you multiply or divide two or more equivalent elements by the same element, then the resulting elements are equivalent. If a equals b, then ac equals bc.

In algebra, we can divide both sides of the equation four x equals twelve by four.

In geometry, we can multiply the measures of congruent segments AB and CD by three without changing the equivalence.

The final property is substitution. It states that you can substitute any value for any other equivalent value in an equation or inequality. So, if a equals b, then you can substitute a for b in any equation or inequality.

If x equals y and x plus two equals nine, then y plus two equals nine.

So if segment length AB is equal to segment length CD, then we can substitute CD for AB in any equation.
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