Geometry **5.5 *INDIRECT* Proofs** Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_per\_\_\_\_\_

**Objective: To use indirect reasoning to write proofs.** *(proofs by contradiction)*

Indirect Proofs basically prove a statement is TRUE, by eliminating the negation of that statement. In other words, we prove that the statement can’t be FALSE, which means it has to be true!

Just as a quick example…If I asked you to use the triangle below and **prove that it is NOT equilateral…**

You might start by saying …“If it **WAS** equilateral, then all of the angles would be 60o, and since neither of the given angles are 60o, then it can’t be equilateral.

**STEPS for INDIRECT PROOF:** \*\*Usually written as paragraph proofs

1. **Assume the negation of the “PROVE” is TRUE.** (like above when we said ‘if it WAS equilateral’)
2. **Use some of the “GIVENS” and other geometry truths to show your assumption from step 1 can’t be true, either because it *CONTRADICTS* one of these facts, or it leads to a statement that is *ABSURD*!**

(like above when we used the “GIVEN” angle measures to CONTRADICT the equilateral triangle theorem that states all angles of an equilateral triangle are congruent.)

1. **Write a ‘therefore’ statement as a conclusion that the PROVE must be TRUE. For example, “Therefore , since our assumption lead to a CONTRADICTION (or absurd statement) , then our assumption must be FALSE, and \_\_\_\_\_\_\_\_\_\_\_\_(the prove) must be true.**

The logic of these indirect proofs are based on the basic fact that…

 ***\*\*\*\*A statement and its negation CANNOT BOTH be TRUE! In other words if ‘p’ is true, then ‘not p’ must be false and vice versa!***

 Practice finding the ‘negation’ of a statement..

|  |  |
| --- | --- |
| **Statement** | **Negation** (the opposite of the statement) |
| 4 | Not 4 |
| Congruent | Not congruent |
| x > 7 | x 7 |
| <ABC is acute | (HINT: don’t say ‘not acute’) |
| y is negative |  |
| ab |  |
| <C is not obtuse or acute  |  |

 **In all of these examples, is it possible for the ‘STATEMENT’ and its ‘NEGATION’ to BOTH be TRUE??? NO**



Let’s write an indirect proof;

Example#1:

**Given: ∠***A* and ∠*B* are not complementary.

**Prove: ∠***C* is not a right angle.

**Step 1:** Assume that∠*C* is a right angle.

**Step 2:** If ∠*C* is a right angle, then by the Triangle Angle-Sum Theorem, *m*∠*A +* *m*∠*B +* 90 = 180. So *m*∠*A +* *m*∠*B =* 90. Therefore, ∠*A* and ∠*B* are complementary. But ∠*A* and ∠*B* are not complementary.

**Step 3:** Therefore, ∠*C* is not a right angle.

Let’s try another one on our own…

2.

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