**Title (primary CCSS Math with Title)**

# Can You Help Me? -- HSG-SRT.C.8

**Alignment to Content Standards**

This standard states that students will be able to use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

**Tasks**

Billy’s cat is stuck 10 feet up in a tree. Billy’s friend Tommy remembers that his dad has three ladders at home that they can use to get the cat down: a 10.5 foot ladder, a 15 foot ladder, and a 25 foot ladder. Tommy knows that when using a ladder, the ladder must make an angle that is between 30 and 60 degrees with the ground. Use the picture below to decide which ladder Tommy should use to help get Billy’s cat down. Show two ways to find how far away is the base of the ladder from the base of the tree?

 **x 10 ft.**

 **θ**

a.) If 30**°**<θ<60**°**, should Billy use the 10.5 foot ladder, the 15 foot ladder, or the 25 foot ladder?

b.) Using the ladder that you chose, show two ways to find how far away is the base of the ladder from the base of the tree?

**Commentary**

This task requires students to use sever types of knowledge and problem solving skills to complete. Students must use basic trigonometric functions (HSG-SRT.C.8), and must understand algebraic expressions and inequalities. After answering the first part of this problem, students are then asked to use the Pythagorean Theorem to solve the second part (HSG-SRT.C.8). This problem also engages students by creating a model in which they can envision the problem that they are solving. This problem will not take too much time, and can be used to assess students after a basic trigonometry lesson.

If students still struggle with these types of problems, teacher may consider having students work in groups on this problem so that students can teach each other and increase their conceptual understanding.

**Solution**

1. In order to find which ladder Billy should use, students must use their knowledge of trigonometry and the diagram to solve the following two equations.

1. $\sin(30)=\frac{10}{x}$

2. $\sin(60)=\frac{10}{x}$

Solving each of these equations will give a lower and upper bound for the proper length of the ladder that Billy must use. In equation 1, solving for *x* gives *x* = 20 feet. In equation 2, solving for *x* gives *x* = 11.55 feet. Because 30**°**<θ<60**°**, we now know that 11.55<x<20.

Therefore the only ladder that works is the 15 foot ladder.

1. Because the problem asks for two ways to solve for the length between the base of the tree and the base of the ladder, we can use the cosine function and the Pythagorean Theorem.

In order to use the cosine function, we must first determine the exact angle the 15 foot ladder makes with the ground.

$$\sin(θ)=\frac{10}{15}$$

$$θ=41.81°$$

 Now we can use cosine to find the length between the two bases.

$$\cos(41.81=\frac{x}{15})$$

$x=11.18 $feet

 Or we can use the Pythagorean theorem to find the same length.

$$a^{2}+b^{2}=c^{2}$$

$$10^{2}+b^{2}=15^{2}$$

$$\sqrt{225-100}=b$$

$b=11.18$ feet