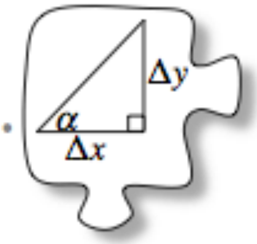
Name: ____ Date: ____________

4.1.4 What about other right triangles?

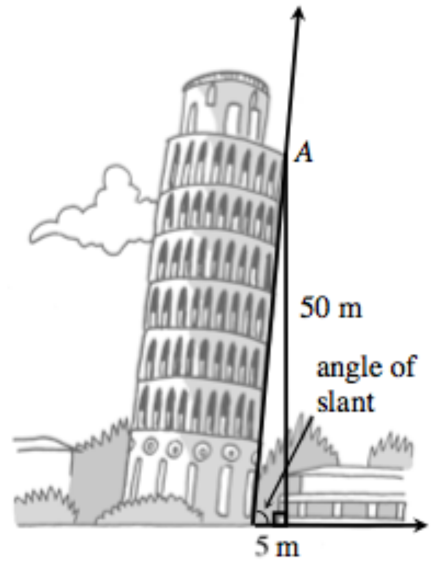
The Tangent Ratio



In Lesson 4.1.2 you started a Trig Table Toolkit of angles and their related slope ratios. Unfortunately, you only have information for a few angles. How can you quickly find the ratios for other angles when a computer is not available or when an angle is not on your Trig Table? Do you have to draw each angle to get its slope ratio? Or is there another way?

4-33. WILL IT TOPPLE?

In problem 4-1, you learned that the Leaning Tower of Pisa is expected to collapse once its angle of slant is less than 83°. Currently, the top of the seventh story (point *A* in the diagram at right) is 50 meters above the ground. In addition, when a weight is dropped from point *A*, it lands 5 meters from the base of the tower, as shown in the diagram.

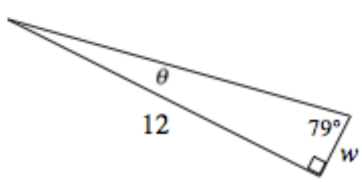


a. What is the slope ratio for the tower?

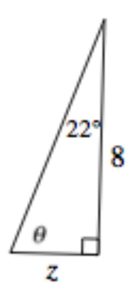
b. Use your Trig Table Toolkit to determine the angle at which the Leaning Tower of Pisa slants. Is it in immediate danger of collapse?

4-34. Solve for the variables in the triangles below. It may be helpful to first orient the triangle (by rotating your paper or by using tracing paper) so that the triangle resembles a slope triangle. Use your Trig Table for reference.

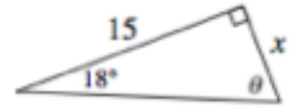
a)



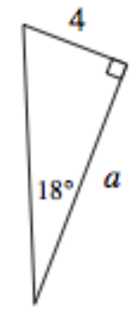
b)



c)



4-35. MULTIPLE METHODS



Tiana, Mae Lin, Eddie, and Amy are looking at the triangle at right and trying to find the missing side length.

a) Tiana declares, "*Hey! We can rotate the triangle so that 18° looks like a slope angle, and then* $\Delta y = 4$*.*" Will her method work? If so, use her method to solve for *a*. If not, explain why not.

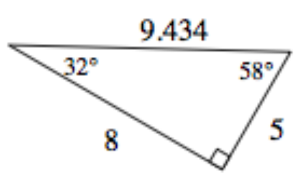
b) Mae Lin says, *"I see it differently. I can tell* $\Delta y = 4$ *without turning the triangle."* How can she tell? Explain one way she could know.

c) Eddie replies, *"What if we use 72° as our slope angle? Then* $\Delta x = 4$*."* What is he talking about? Discuss with your team and explain using pictures and words.

d) Use Eddie's observation in part (c) to confirm your answer to part (a).

4-36. USING A SCIENTIFIC CALCULATOR

Examine the triangle below.



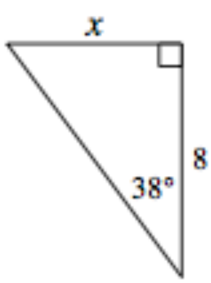
a) According to the triangle above, what is the slope ratio for 32°? Explain how you decided to set up the ratio. Write the ratio in both fraction and decimal form.

b) What is the slope ratio for the 58° angle? How do you know?

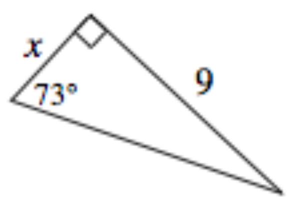
c) Scientific calculators have a button that will give the slope ratio when the slope angle is entered. In part (a), you calculated the slope ratio for 32° as 0.625. Use the "tan" button on your calculator to verify that you get approximately 0.625 when you enter 32°. Does that button give you approximately 1.600 when you enter 58°? Be ready to help your teammates find and use the button on their calculators.

d) The ratio in a right triangle that you have been studying is referred to as the **tangent ratio**. When you want to find the slope ratio of an angle, such as 32°, it is written "tan 32°." So, an equation for this triangle can be written as tan 32° = $\frac{5}{8}$. Read more about the tangent ratio in the Math Notes box for this lesson.

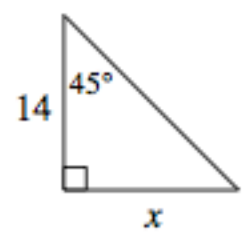
4-37. For each triangle below, trace the triangle on tracing paper. Label its legs Δy and Δx based on the given slope angle. Then write an equation (such as tan 14° = $\frac{x}{5}$), use your scientific calculator to find a slope ratio for the given angle, and solve for *x*.



a)



b)



c)

4-38. LEARNING LOG

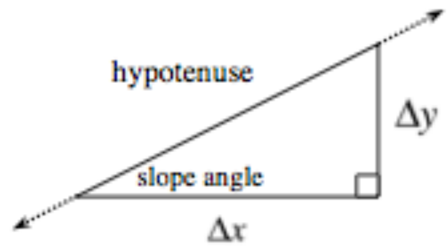
How do you set up a tangent ratio equation? How do you know which side of the triangle is Δy? How can you use your scientific calculator to find a slope ratio? Write a Learning Log entry about what you learned today. Be sure to include examples or refer to your work from today. Title this entry "The Tangent Ratio" and include today's date.

METHODS AND MEANINGS

MATH NOTES

The Tangent Ratio

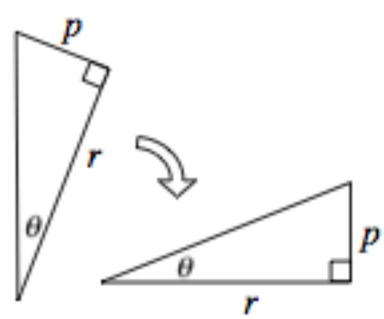
For any slope angle in a slope triangle, the ratio that compares the Δy to Δx is called the **tangent ratio**. The ratio for any angle is constant, regardless of the size of the triangle. It is written:



$$\tan(\text{slope angle}) = \frac{\Delta y}{\Delta x}$$

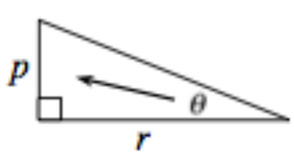
One way to identify which side is Δy and Δx is to first reorient the triangle so that it looks like a slope triangle, as shown at right.

For example, when the triangle at right is rotated, the resulting slope triangle helps to show that the tangent of θ is $\frac{p}{r}$, since θ is the slope angle, p is Δy and r is Δx. This is written:



$$\tan\ \theta = \frac{p}{r}$$

Whether the triangle is oriented as a slope triangle or not, you can identify Δy as the leg that is always opposite (across the triangle from) the angle, while Δx is the leg closest to the angle.



$$\tan\ \theta = \frac{\text{opposite leg}}{\text{adjacent leg}} = \frac{p}{r}$$