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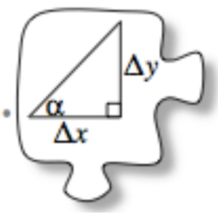
4.1.3 What if the angle changes?



Expanding the Trig Table

In the last few lessons, you found the slope ratios for several angles. However, so far you are limited to using the slope angles that are currently in your Trig Table. How can you find the ratios for other angles? And how are the angles related to the ratio?

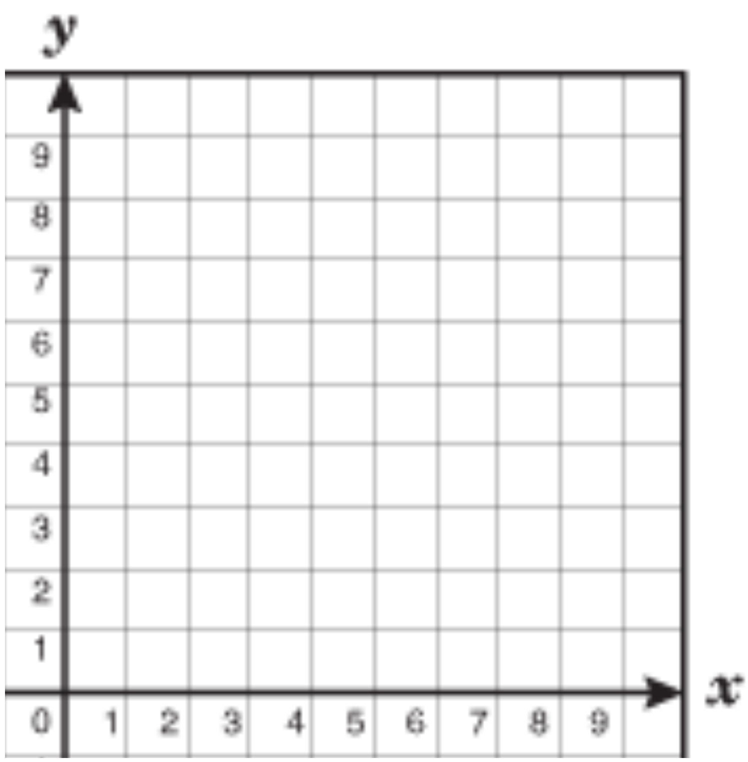
Today your goal is to determine ratios for more angles and to find patterns. As you work today, keep the following questions in mind:

What happens to the slope ratio when the angle increases? Decreases?

What happens to the slope ratio when the angle is 0°? 90°?

When is a slope ratio more than 1? When is it less than 1?

4-23. On your paper, draw a slope triangle with a slope angle of 45°.



Now visualize what would happen to the triangle if the slope angle increased to 55°. Which would be longer? Δy or Δx? Explain your reasoning.

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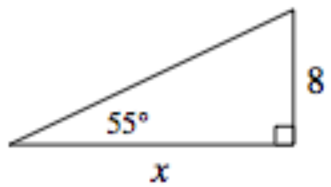
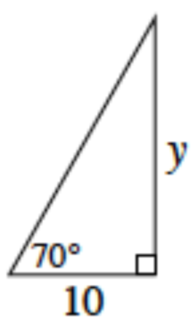
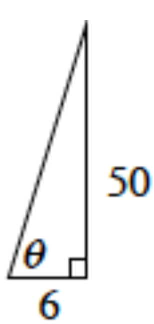
Using the Slope Ratios (Desmos) eTool (or the Lesson 4.1.3 Resource Page), create a triangle with a slope angle measuring 55°. Then use the resulting slope ratio to solve for x in the triangle at below. (Note: The triangle at right is not drawn to scale.)



4-24. Copy each of the following triangles onto your paper. Decide whether or not the given measurements are possible. If the triangle is possible, find the value of x, y, or θ. Your teacher will provide a Lesson 4.1.3 Resource Page with the needed ratios. Round angle measures to the nearest degree. If a triangle's indicated measurement is not possible, explain why.

a. 

b. 

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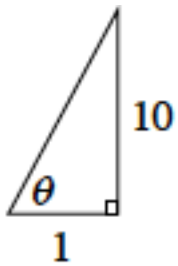
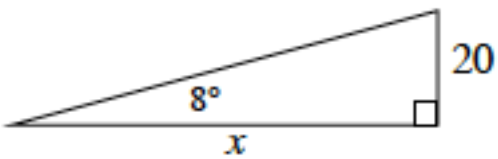
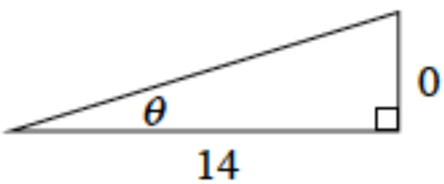
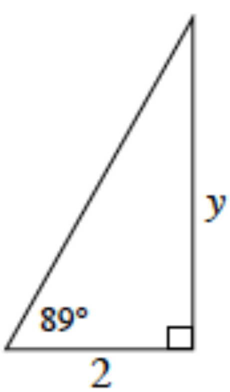
c. 

d. 

e. 

f. 

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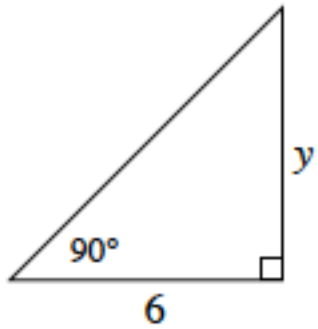
g. 

4-25. If you have not already, add these new slope ratios with their corresponding angles to your Trig Table Toolkit. Be sure to draw and label the triangle for each new angle. Summarize your findings—which slope triangles did not work? Do you see any patterns?

4-26. LEARNING LOG

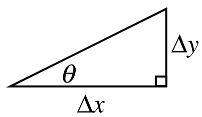
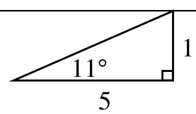
What statements can you make about the connections between slope angle and slope ratio? In your Learning Log, write down all of your observations from this lesson. Be sure to answer the questions given at the beginning of the lesson (reprinted below). Title this entry, "Slope Angles and Slope Ratios" and include today's date.

What happens to the slope ratio when the angle increases? Decreases?

What happens to the slope ratio when the angle is 0°? 90°?

When is a slope ratio more than 1? When is it less than 1?

Trig Table Toolkit

Angle	Slope triangle	Approximate slope ratio as a fraction and a decimal
$\theta°$		$\frac{\Delta y}{\Delta x}$
0°		0
8°		$\frac{52}{370} = \frac{26}{185} \approx 0.141$
11°		$\frac{1}{5} = 0.2$
18°		$\frac{1}{3} \approx 0.33$
22°		$\frac{2}{5} = 0.4$
45°		$\frac{1}{1} = 1$
55°		$\frac{10}{7} \approx 1.429$
68°		$\frac{5}{2} = 2.5$
70°		$\frac{13.737}{5} \approx 2.747$
72°		$\frac{3}{1} = 3$
79°		$\frac{5}{1} = 5$
83°		$\frac{50}{6} = \frac{25}{3} \approx 8.33$
84°		$\frac{10}{1} = 10$
89°		$\frac{5729}{100} = 57.29$

Note: Angle measures are rounded to the nearest degree.

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Sequences

A sequence is a function in which the independent variable is a positive integer (usually called the "term number") and the dependent value is the term value. A sequence is usually written as a list of numbers.

Arithmetic Sequences

In an arithmetic sequence, the **common differenc**e between terms is constant. For example, in the arithmetic sequence 4, 7, 10, 13, …, the common difference is 3.

The equation for an arithmetic sequence is: $t(n) = mn + b$ or $a_n = mn + a_0$ where n is the term number, m is the common difference, and b or a_0 is the zeroth term. Compare these equations to a continuous linear function $f(x) = mx + b$ where m is the growth (slope) and b is the starting value (y-intercept).

For example, the arithmetic sequence 4, 7, 10, 13, … could be represented by $t(n) = 3n + 1$ or by $a_n = 3n + 1$. (Note that "4" is the first term of this sequence, so "1" is the zeroth term.)

Another way to write the equation of an arithmetic sequence is by using the first term in the equation, as in $a_n = m(n - 1) + a_1$, where is the first term. The sequence in the example could be represented by $a_n = 3(n - 4) + 13$.

You could even write an equation using any other term in the sequence. The equation using the fourth term in the example would be $a_n = 3(n - 4) + 13$.

Geometric Sequences

In a geometric sequence, the **common ratio** or **multiplier** between terms is constant. For example, in the geometric sequence 6, 18, 54, …, the multiplier is 3. In the geometric sequence 32, 8, 2, $\frac{1}{2}$, …, the common multiplier is $\frac{1}{4}$.

The equation for a geometric sequence is: $t(n) = ab^n$ or $a_n = a_0 \cdot b^n$ where n is the term number, b is the sequence generator (the multiplier or common ratio), and a or a_0 is the zeroth term. Compare these equations to a continuous exponential function $f(x) = ab^x$ where b is the growth (multiplier) and a is the starting value (y-intercept).

For example, the geometric sequence 6, 18, 54, … could be represented by $t(n) = 2 \cdot 3^n$ or by $a_n = 2 \cdot 3^n$.

You can write a first term form of the equation for a geometric sequence as well: $a_n = a_1 \cdot b^{n-1}$. For the example, first term form would be $a_n = 6 \cdot 3^{n-1}$.