Unpacking the Magic of the "tan" Button:

Developing a Conceptual Understanding of Tangent

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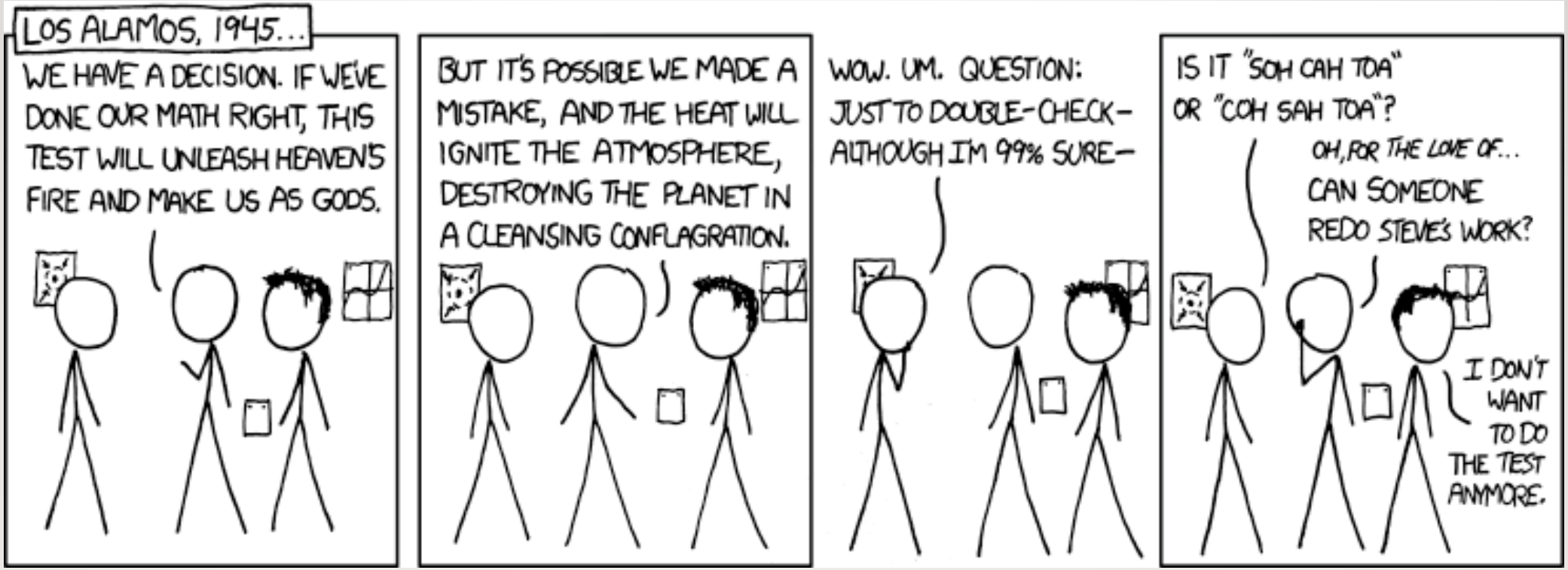
NCTM Annual Meeting 2017 :: San Antonio, TX

Tangent

Talk with a partner:

- How do you typically introduce tangent?
- What issues or dilemmas do you encounter?

Tangent



https://xkcd.com/809/

Effective Teaching and Learning in PtA

Learners should have experiences that enable them to—

- connect new learning with prior knowledge and informal reasoning and, in the process, address preconceptions and misconceptions;
- acquire conceptual knowledge as well as procedural knowledge, so that they can meaningfully organize their knowledge, acquire new knowledge, and transfer and apply knowledge to new situations

How much higher is Andy from the top of the box?

- What information do you need to solve the problem?
- With your partner/group, make a list of information that you would like to have in order to solve this problem.

What is Andy's height from his feet to the top of the box? Is this a safe jump?

- Andy is jumping onto a refrigerator box that is 8 ft away from the truck. The box is 6 ft tall.
- The angle of depression is 50 degrees.

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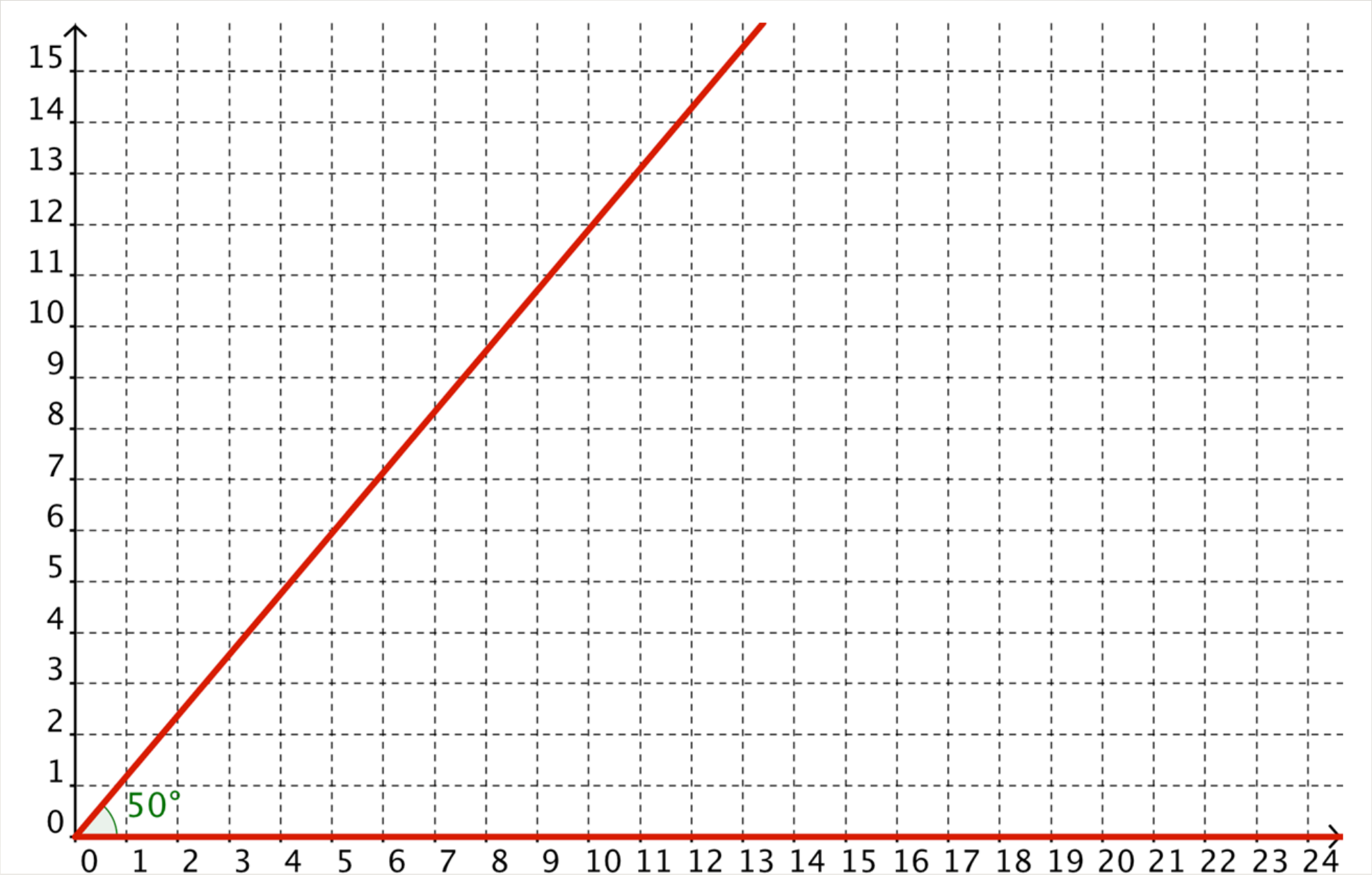
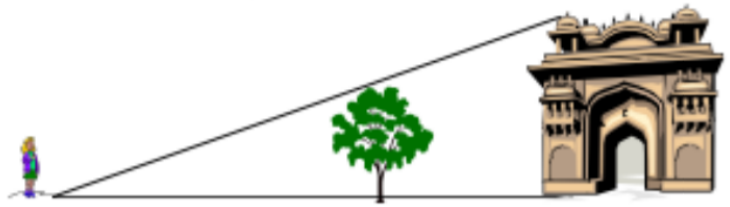

15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
50°
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

Warm-up

Name:_____

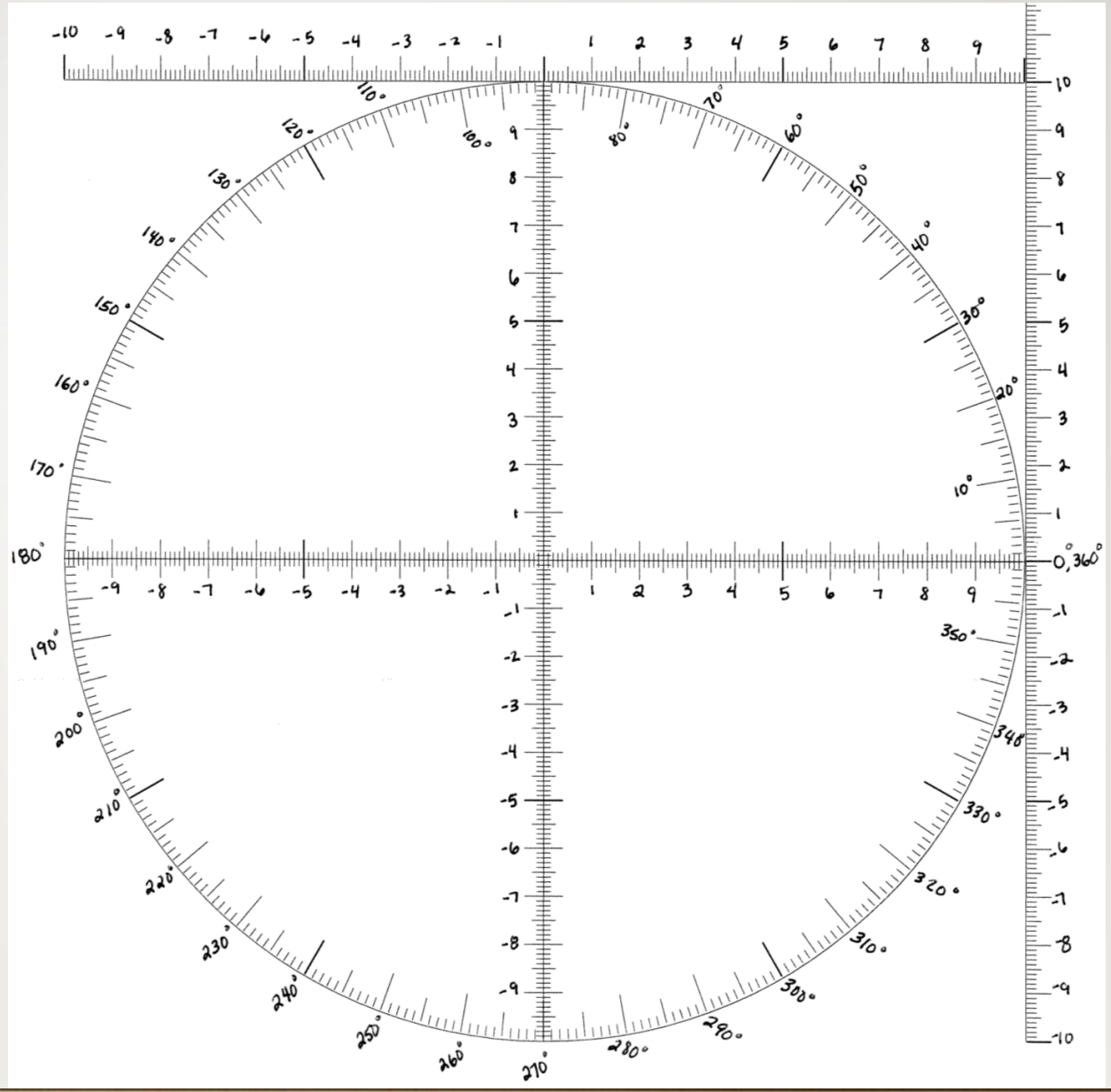
Geometry Warm-Up

Josie wants to find the height of the tallest building in her city. She stands 465 feet away from the building. There is a tree 38 feet in front of her, which she knows is 18 feet tall. How tall is the building? (Round to the nearest foot.)

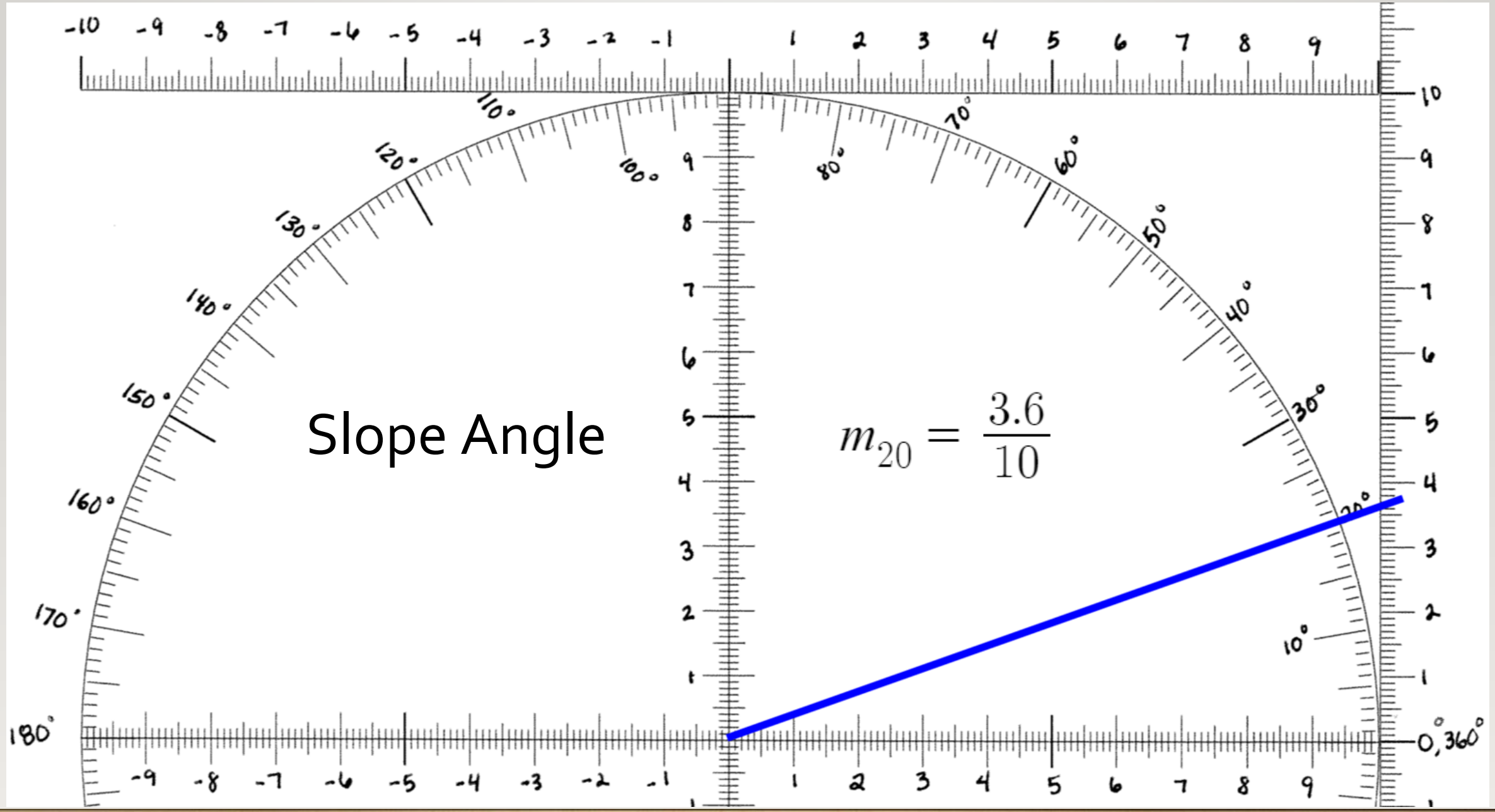


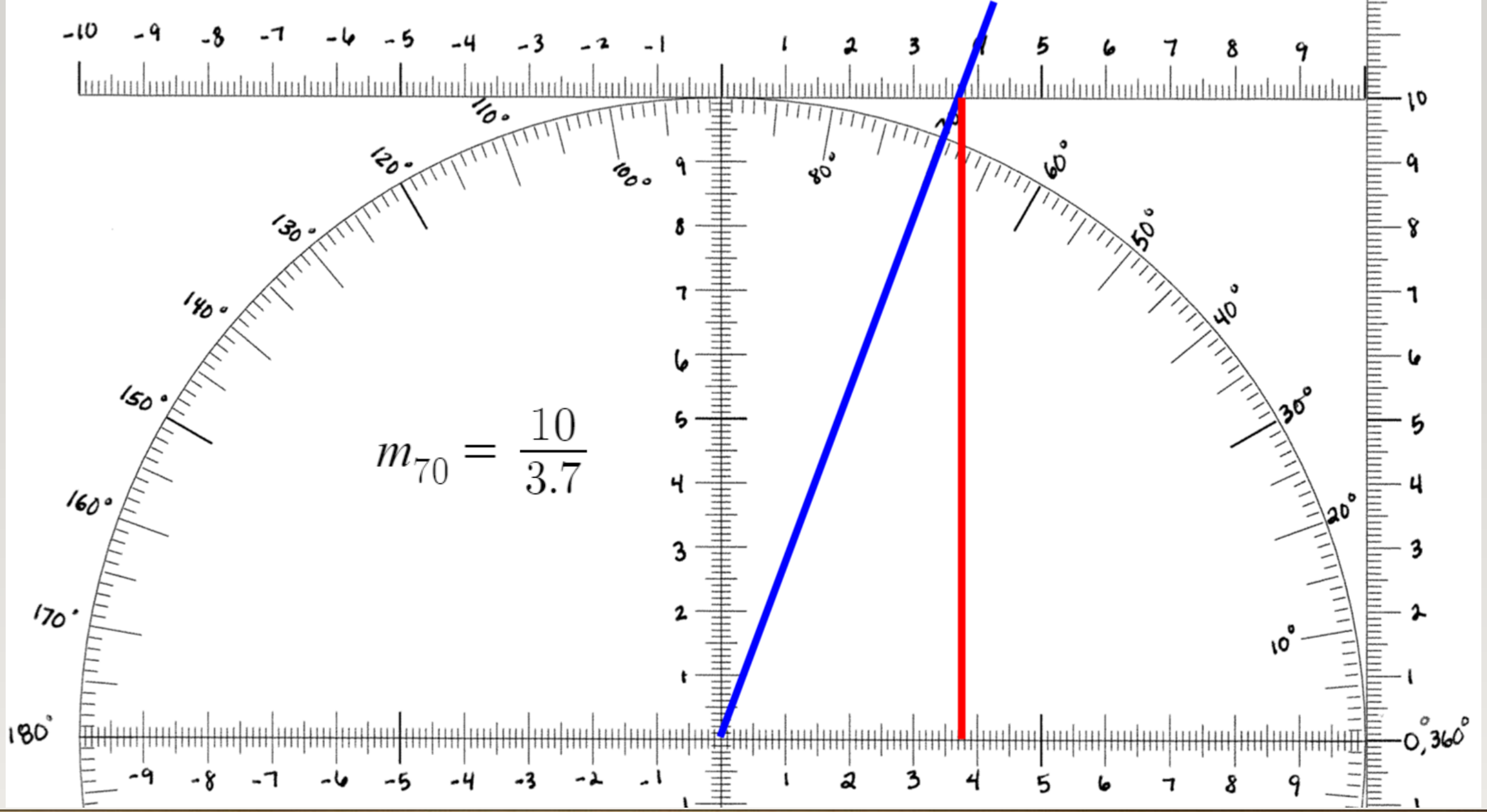
A New Tool

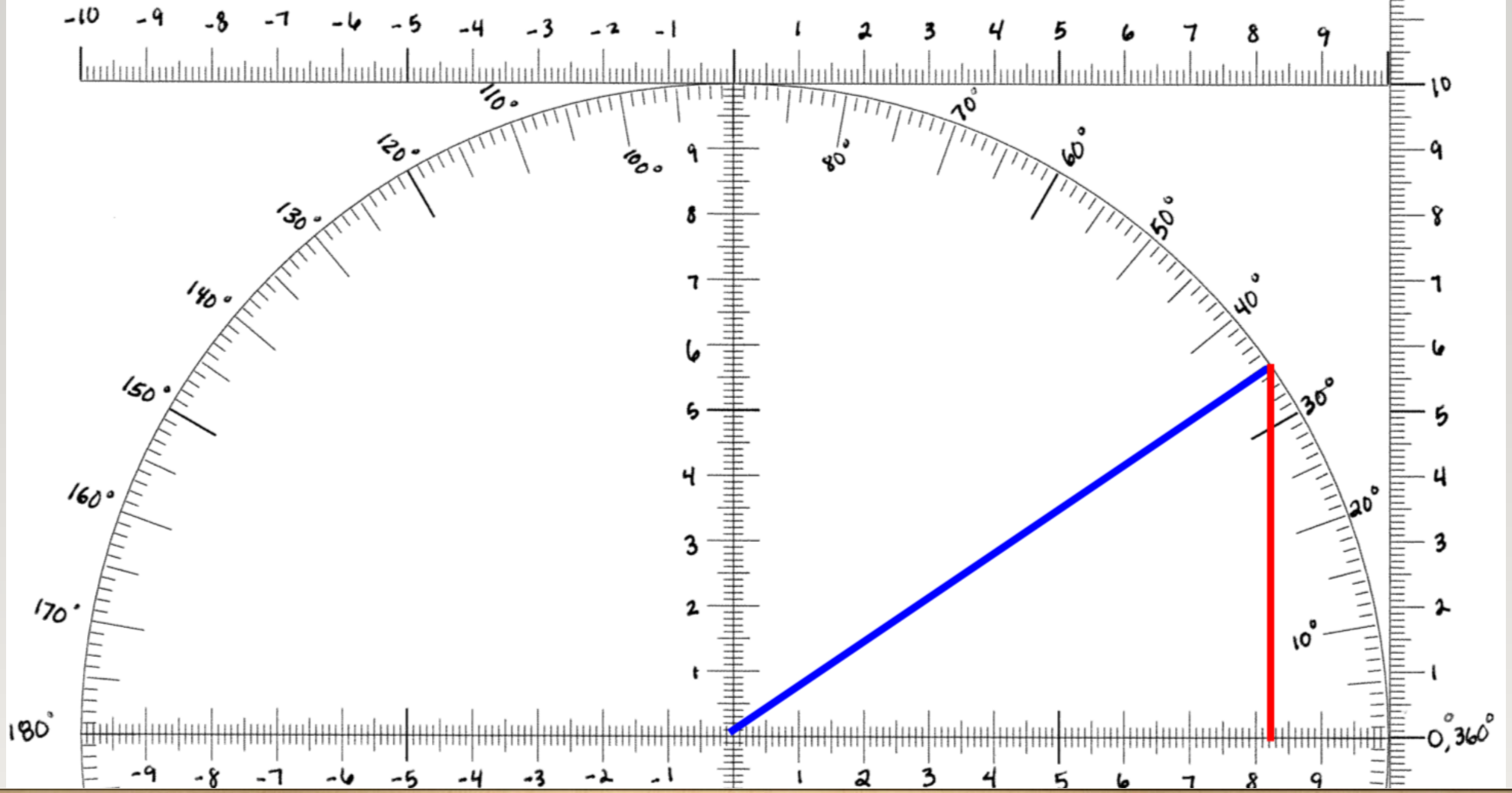
The 10 cm Circle



http://www.mathedpage.org/circle/

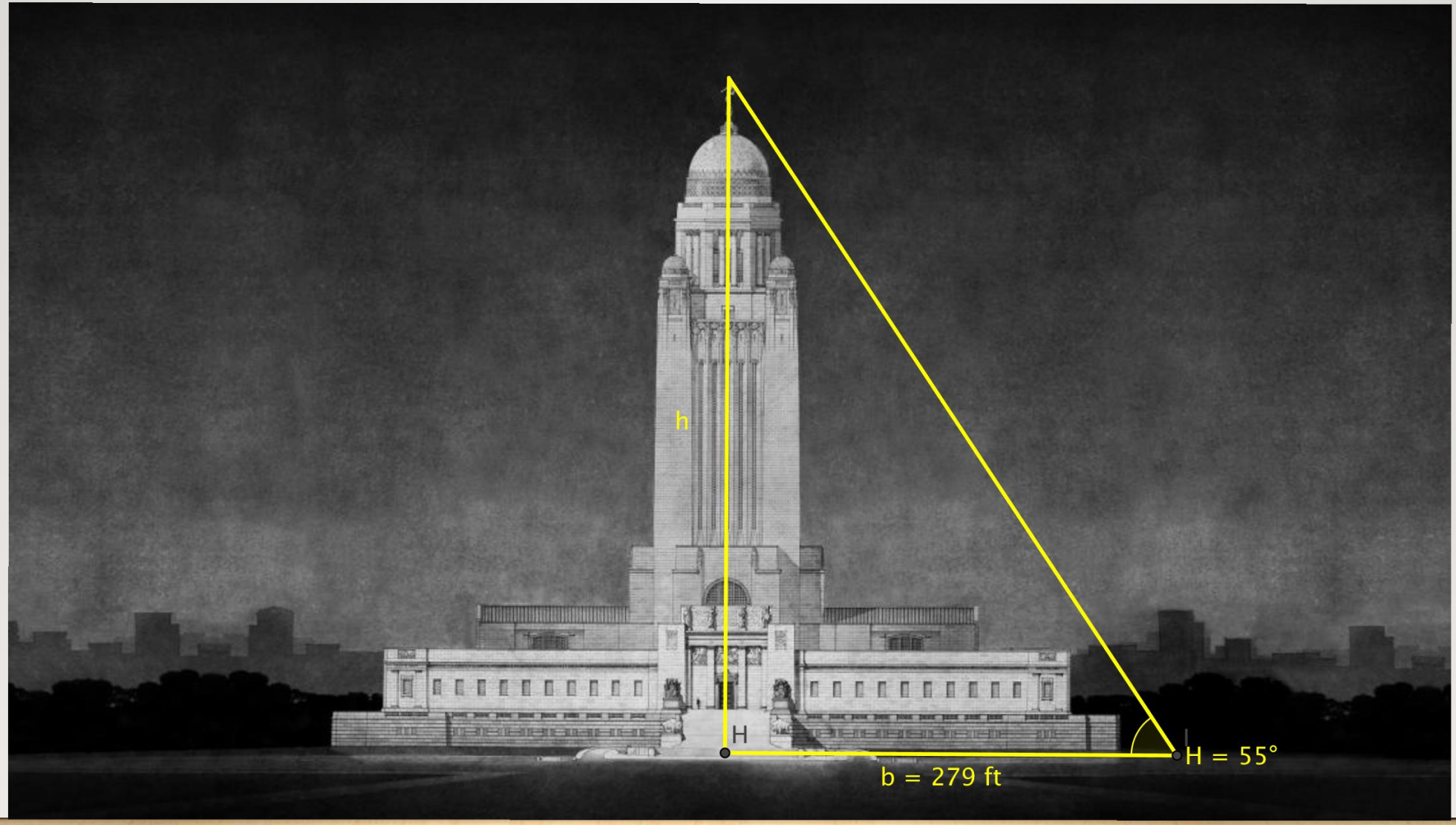

Slope Angle
$m_{20} = \frac{3.6}{10}$


$m_{70} = \frac{10}{3.7}$


-10 -9 -8 -7 -6 -5 -4 -3 -2 -1
1 2 3 4 5 6 7 8 9
110° 120° 130° 140° 150° 160° 170° 180°
100° 80° 70° 60° 50° 40° 30° 20° 10° 0°, 360°
9 8 7 6 5 4 3 2 1
10 9 8 7 6 5 4 3 2 1

How tall is the Nebraska State Capitol?

How tall is the Nebraska state capitol?



Nebraska State Capitol / Height

398′

Feedback

People also ask

When was Omaha the capital of Nebraska?

Why is Lincoln the capital of Nebraska?

What is the tallest building in Lincoln Nebraska?

When was the Nebraska State Capitol built?

Feedback

Nebraska State Capitol - Wikipedia
https://en.wikipedia.org/wiki/Nebraska_State_Capitol
The finial—The Sower and its pedestal—add an additional 32 feet (9.8 m) to the building's height. Common measurements list the capitol at **400 feet** (120 m), making it the second-tallest U.S. statehouse, surpassed only by the 450-foot (140 m) Louisiana State Capitol.
Dimensions and features · Capital cities, capitol buildings · History · Exterior

The Building – Nebraska's Third State Capitol – Lincoln, Nebraska
capitol.nebraska.gov/building/
The architect was Bertram G. Goodhue. There are 15 floors above ground. The building is 400 feet **tall**. It is the third **Nebraska State Capitol**. It cost $9.8 million in ...

Nebraska State Capitol

Website | Directions

4.5 ★★★★½ 63 Google reviews
Government office in Lincoln, Nebraska

The Nebraska State Capitol is the seat of government for the U.S. State of Nebraska and is located in downtown Lincoln. Wikipedia

Address: 1445 K St, Lincoln, NE 68508
Height: 398′
Floors: 22
Hours: Open today · 8AM–5PM
Architect: Bertram Goodhue

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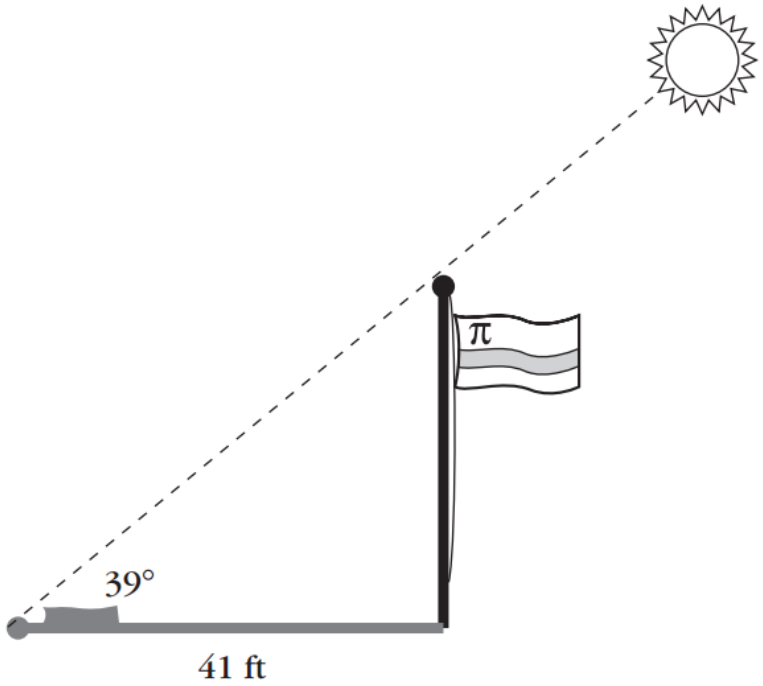
"A great **place** for **Family** Photos"

LAB 11.2
Using Slope Angles

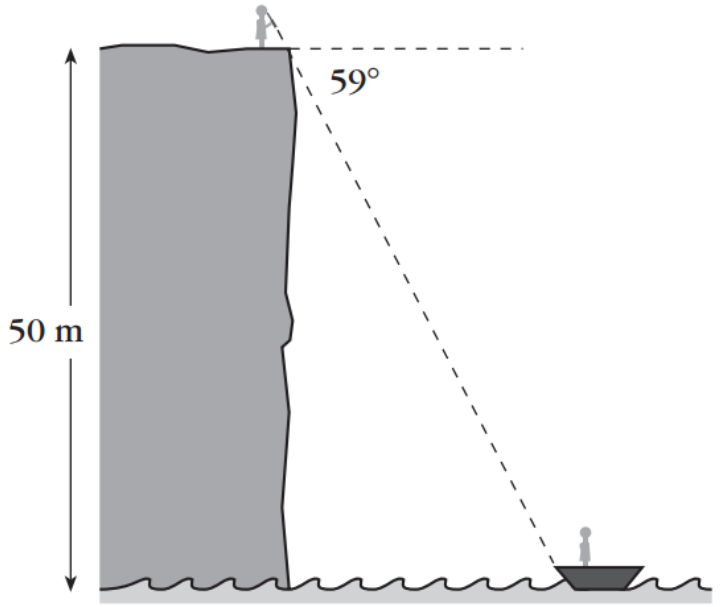
Name(s) _____

■ **Equipment:** The tables from Lab 11.1, CircleTrig geoboard, CircleTrig geoboard paper

1. How tall is the flagpole?



2. How far is the boat from the edge of the cliff?



For the remaining problems, make your own sketches on a separate sheet of paper.

3. Looking down at a boat from a 30-m-high lighthouse, an observer measures an angle of 15° below the horizontal.

a. Sketch this.

b. How far is the boat from the base of the lighthouse?

4. A ski lift rises 200 meters for a run of 250 meters. What angle does it make with the horizontal?

5. At a certain time of day, a 33-ft flagpole casts a 55-ft shadow. What is the angle made by the sun's rays with the horizontal?

6. The banister of a straight staircase makes an angle of 39° with the horizontal. The stairs connect two floors that are 10 feet apart.

a. How much horizontal space does the staircase take?

b. If steps are 8 inches high, how wide are they?

7. You stand on a cliff, looking down at a town in the distance. Using a map, you find that the town is 1.2 km away. The angle your line of vision makes with the horizontal is 11°. How high is the cliff?

8. A right triangle has a 15° angle and a short leg of 18 units. How long is the long leg?

9. A right triangle has a 75° angle and a short leg of 18 units. How long is the long leg?

Discussion

Talk with a partner:

- What would you do to connect slope angles to the tangent ratio?

Discussion

Talk with a partner:

- When do we connect slope angles to tangent?
- What about sine and cosine?

The Original Version from Henri Picciotto's Website

http://www.mathedpage.org/circle/

LAB 11.1 Name(s) _____

Angles and Slopes (continued)

4. Fill out the table below. Continue a pattern of going around the outer pegs of the geoboard to supply slopes where the table is blank. For angles, give answers between –90° and 90°. (That is, make your slope triangles in the first and fourth quadrants.)

m	0	0.2	0.4	0.6	0.8	1	1.25	1.67				–5		
θ											90°			

5. Fill out the table below.

θ	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°
m													

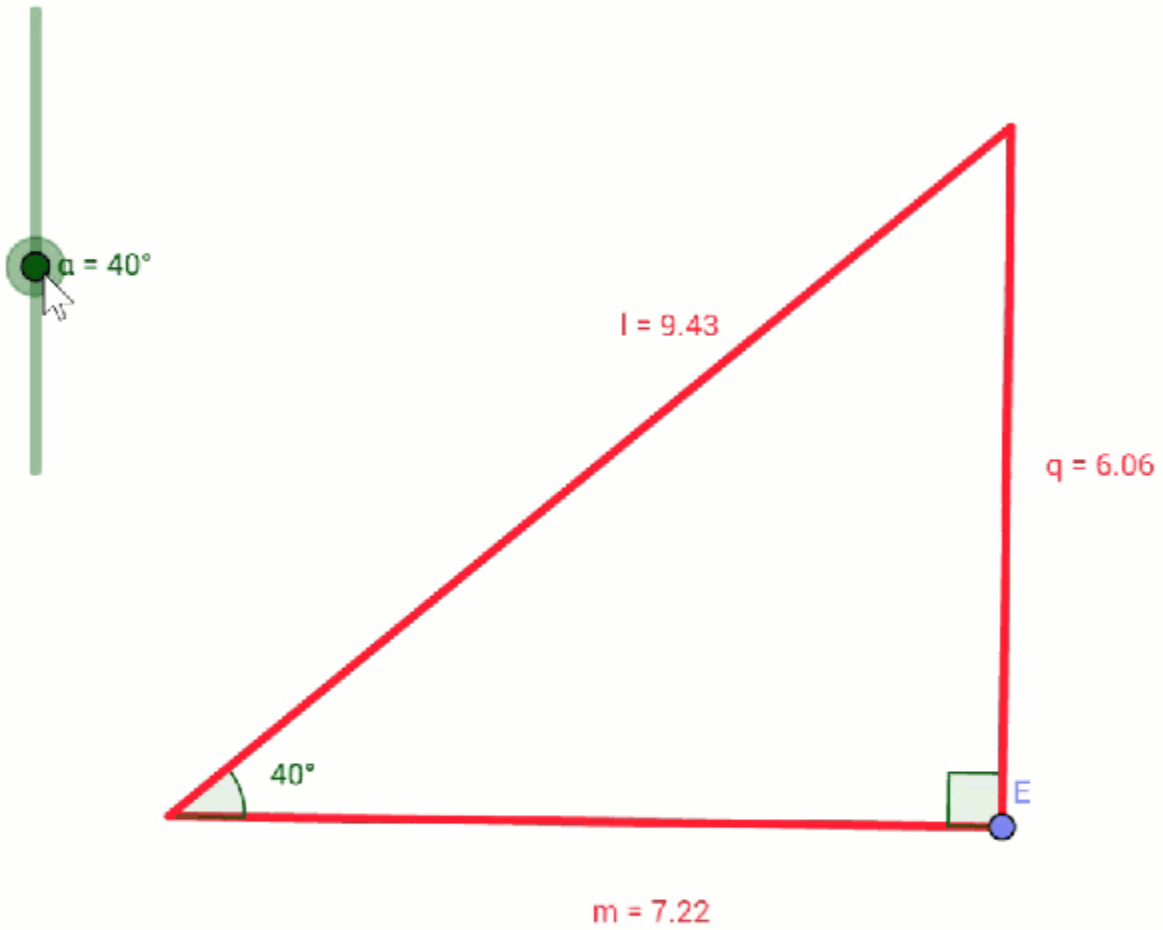
Discussion

A. What patterns do you notice when filling out the tables? What is the relationship between the slopes of complementary angles? For what angles is the slope positive? Negative? 0? For what angles is the slope between 0 and 1? Greater than 1?

B. Why is there no slope for the angle of 90°?

C. Explain how you chose one or another of the four types of slope triangles to help you fill out the tables.

D. Some of the slope triangles you used to fill out the tables are "famous right triangles." Check that the angles and slopes you found are correct by comparing your answers with those you got in Lab 10.7.



	A	B	C	D
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				

Discussion

Talk with a partner:

- Why would we want to introduce the tangent ratio in this way? What are the benefits?
- What are some challenges with introducing tangent in this way?

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