Lab on the Ladder Problem

1. Base ladder length (1 point)

Refer to lab page 2. Two workmen want to carry a ladder around a corner where one corridor meets another. Whether or not the ladder fits depends on the length of the ladder and the widths of the two corridors. The interactive figure lets you experiment with different combinations of these distances. It gives a view looking down on the intersection, with the ladder represented by a red line segment.
You can drag points C and D to change the widths of the corridors. The picture is scaled so that the numbers reported are the widths of the corridors in feet. Drag point A to change the length of the ladder. After the distances are set, move point B to see if the ladder fits around the corner. When the ladder gouges the wall, it disappears. The goal is to make the ladder as long as possible and have it go around the corner without disappearing.

Press the refresh button to restore the initial picture. With these corridor widths, what is the longest that the ladder can be to fit around the corner?

2. 4x6 (0.5 point)

Refer to lab page 2. Drag D to reset the side corridor width to be 4, and leave the top corridor width 6. Now what is the longest that the ladder can be?

3. 2x3 (0.5 point)

Refer to lab page 2. How about making the side corridor 2 and the top corridor 3?

4. Geometry (0.5 point)

How can you use geometry to account for the relationship between the answer to question 2 and question 3?

a. The area of a triangle is one half the base of the triangle times the height of the triangle.
b. The top corridor and the side corridor are congruent in question 2 and in question 3
c. The corridor figure for question 3 is similar to the figure for question 2, but scaled down by a factor of 1/2.
d. The corridor figure for question 3 is similar to the figure for question 2, but scaled up by a factor of 2.

5. Ladder vs guide (0.5 point)

Refer to lab page 2. Click the button marked Show Angle and guide line to give some auxiliary information about how the ladder moves. The guide line is the thin blue line that tracks the ladder. It makes an angle with its vertex at point B. How do the ladder length and the guide line length compare when the ladder has disappeared?

a. The ladder length is exactly half the length of the guide line
b. The ladder length is shorter than the guide line
c. The ladder length is the same as the length of the guide line
d. The ladder length is longer than the length of the guide line

6. Angle (0.5 point)

Refer to lab page 2. What happens to the reported angle as point B moves further and further to the left?

a. The angle gets smaller, eventually approaching zero.
b. The angle gets smaller, but never gets smaller than 10^o.
c. The angle stays the same.
d. The angle gets larger, approaching 90^o as B approaches C
e. The angle gets larger, but never bigger than 85^o

7. Angle 2 (0.5 point)

Refer to lab page 2. What is the furthest to the right that B can move, and what happens to the reported angle there?

a. The angle gets smaller, eventually approaching zero.
b. The angle gets smaller, but never gets smaller than 10^o.
c. The angle stays the same.
d. The angle gets larger, approaching 90^o as B approaches C
e. The angle gets larger, but never bigger than 85^o

8. Isoceles (1 point)

Refer to lab page 2. Set the corridor widths to both be 6 feet. What angle makes the guide line length the shortest? (Answer in degrees.)

9. Ladder vs guide (1 point)

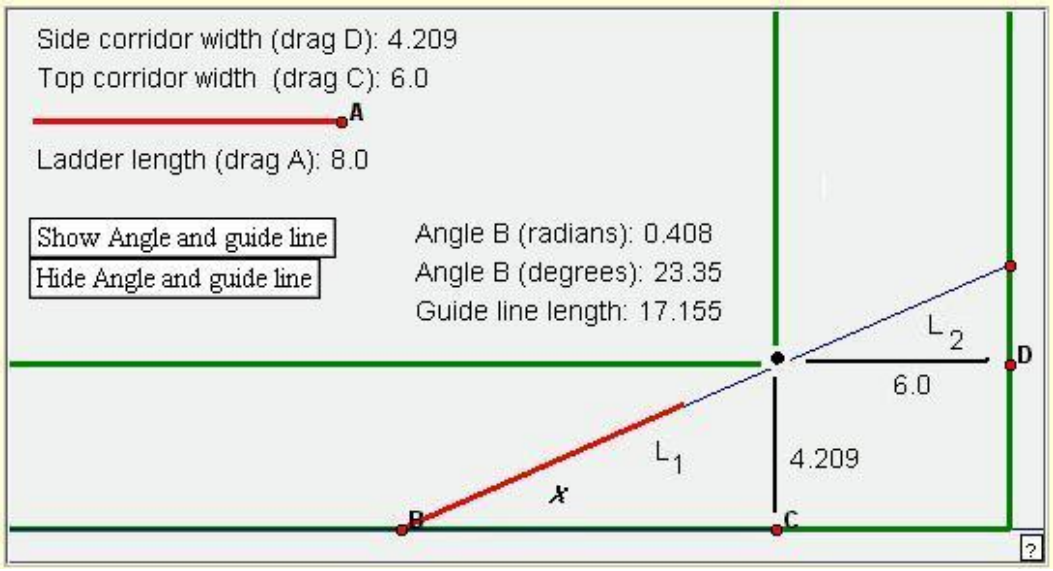
Refer to lab page 2. What is the relation between the ladder length and the guide line length?

a. The maximum ladder length is the maximum guide line length
b. The maximum ladder length is the minimum guide line length.
c. The minimum ladder length is the maximum guide line length.
d. The minimum ladder length is the minimum guide line length.

10. Picture of L (0.5 point)

Consider the picture as augmented below. The guide line has two parts,

labeled L1 and L2, for the part of the guide line in each corridor. The angle is labeled ***x***. Identify a right triangle and use it to write an equation giving L1 as a function of ***x***. (Note that L1 is not in general the same as the length of the ladder.)



a. L1=4.209 sin ***x***
b. L1 = 4.209 cos ***x***
c. L1 = 4.209/sin ***x***
d. L1=4.209/cos ***x***
e. L1= 6 sin ***x***
f. L1 = 6 cos ***x***
g. L1 = 6/sin ***x***
h. L1 = 6/cos ***x***

11. Picture of L 2 (0.5 point)

Write an equation giving L2 as a function of ***x***.

a. L2=4.209 sin ***x***
b. L2 = 4.209 cos ***x***
c. L2 = 4.209/sin ***x***
d. L2=4.209/cos ***x***
e. L2= 6 sin ***x***
f. L2 = 6 cos ***x***
g. L2 = 6/sin ***x***
h. L2 = 6/cos ***x***

12. Grapher (1 point)

The guide line length L is L1 + L2. Use the Grapher on lab page 3 to plot L as a function of x. Examine the graph to find the minimum value of L, and compare the answer to the experimental value for the longest ladder obtained in problem 1.

13. Appropriate domain (2 point)

The function that you graphed in the previous question is periodic, so the extreme value is achieved over and over. What is the appropriate restricted domain to use so that the function values make sense relative to the model? (Hint: look at questions 6 and 7.)