Algebra PoW Packet

Crossed Wires

Problem 4648 • https://www.nctm.org/pows/

Welcome!

This packet contains a copy of the problem, the "answer check," our solutions, teaching suggestions, and some samples of the student work we received in February 2008. The text of the problem is included below. A print-friendly version is available using the "Print" link on the problem page.

Standards

In **Crossed Wires** the **key concepts** are linear equations, similar triangles, systems of equations, slope, and ratio and proportions.

If your state has adopted the Common Core State Standards, this alignment may be helpful:

Algebra: Creating Equations

1. Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.
2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

Algebra: Reasoning with Equations and Inequalities

6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables..

Algebra: Mathematical Practices

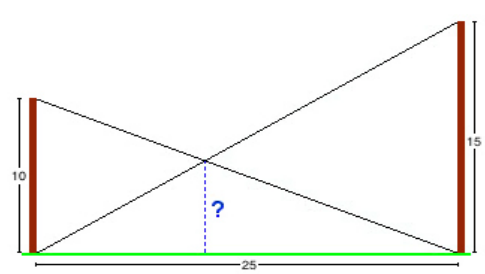
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for an express regularity in repeated reasoning.

The Problem

Crossed Wires

Two poles, 10 meters and 15 meters high, are 25 meters apart on level ground. A guy wire runs from the top of each pole to the foot of the other pole.

1. Find the height above ground of the point where the guy wires cross.
2. What happens to the height where the wires cross if the distance between the poles changes? Use algebra to support your conclusion.



Extra: Find a function that expresses the height of the intersection of the wires in terms of the heights of the two poles.

Answer Check

After students submit their solution, they can choose to "check" their work by looking at the answer that we provide. Along with the answer itself (which never explains how to actually **get** the answer) we provide hints and tips for those whose answer doesn't agree with ours, as well as for those whose answer does. You might use these as prompts in the classroom to help students who are stuck and also to encourage those who are correct to improve their explanation:

The guy wires intersect 6 meters above the ground. The intersection height does not change as the distance between the poles changes.

If your answer **doesn't match ours**:

- did you try modeling the problem by setting up a coordinate plane and using the given distances to create points in the plane?
- did you try finding the equations of the lines formed by the guy wires?
- did you try using two sets of similar triangles, one set created by each guy wire?
- did you use a variable or variables to represent the unknown quantity or quantities in the problem?
- did you check your arithmetic?

If any of those ideas help you, you might *revise* your answer, and then leave a *comment* that tells us what you did. If you're still stuck, leave a *comment* that tells us where you think you need help or where you're having trouble.

If your answer **does match ours**,

- did you use algebraic techniques to find your answer?
- did you show and explain the thinking and work you did?
- is your explanation clear and complete? Would another student understand your solution?
- did you make any mistakes along the way? If so, how did you find and fix them?
- are there any hints that you would give another student?
- have you tried the Extra question?

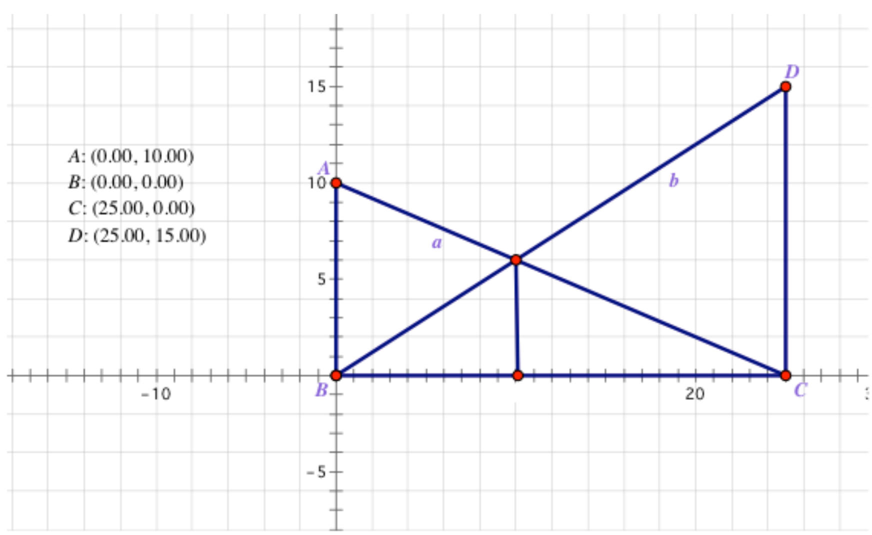
Revise your work if you have any ideas to add. Otherwise leave us a *comment* that tells us how you think you did—you might answer one or more of the questions above.

Our Solutions

Crossed Wires offers students an opportunity to use variable to express a relationship between weights and distances and then solve that equation for one of the variables.

Method 1: Make a Mathematical Model

I started by drawing the figure on a coordinate plane.



That allowed me to see that I could find the equations for lines a and b and see where they intersected.

I first found the slope of line a.

For line a, I can find the slope using A(0, 10) and C(25, 0)

$$slope = \frac{10-0}{0-25} = -\frac{10}{25} = -\frac{2}{5}$$

Using the slope and point A, I can find the equation of line a. Point A gives me the y-intercept, 10, so I'll use y = mx + b form:

$$y = mx + b$$

$$y = -\frac{2}{5}x + 10$$

I can do the same for line b. I first found the slope:

$$slope = \frac{15-0}{25-0} = \frac{15}{25} = -\frac{3}{5}$$

Using the slope and point B, I can find the equation of line a. Point B gives me the y-intercept, 0, so I'll use y = mx + b form:

$$y = mx + b$$

$$y = \frac{3}{5}x$$

Looking at both line, it seems like the substitution method may be easiest to find the intersection:

$$y = -\frac{2}{5}x + 10 \quad and \quad y = \frac{3}{5}x$$

$$so$$

$$\frac{3}{5}x = -\frac{2}{5}x + 10$$

$$\frac{5}{5}x = 10$$

$$x = 10$$

Then I can substitute x = 10 in one equation to solve for y:

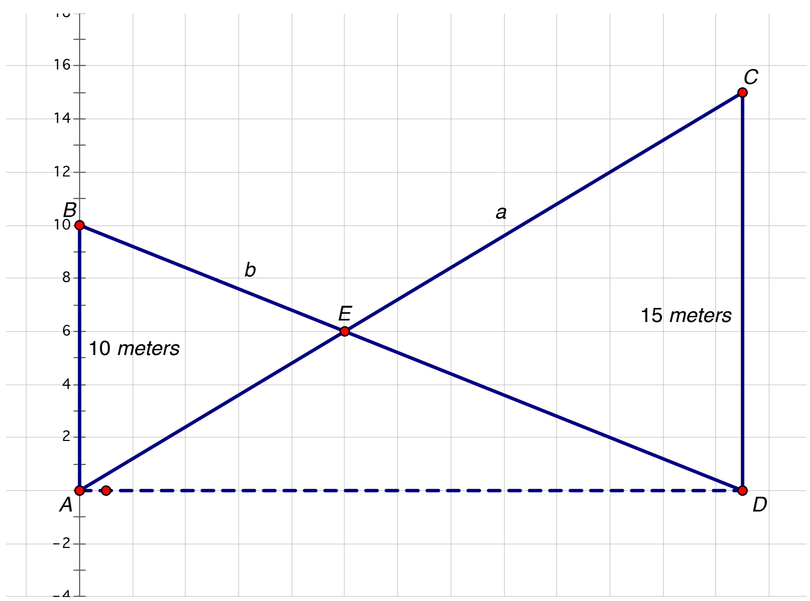
$$y = \frac{3}{5}x$$

$$y = \frac{3}{5}(10)$$

$$y = 6$$

So, the lines intersect at (10, 6). Which means the wires will cross 6 meters above ground.

Now I want to investigate how that height will change as the distance between the poles changes. I can use the same method, but instead of having the poles 25 meters apart, I'll assume that the distance between the poles is d.



A (0, 0)
B (0, 10)
C (d, 15)
D (d, 0)

Now I can set up equations for the lines and find where they intersect using the same process I did above, but everywhere I used 25, I'll know use d.

For line a, I can find the slope using A(0, 10) and C(d, 0)

$$slope = \frac{10-0}{0-d} = -\frac{10}{d}$$

Using the slope and point A, I can find the equation of line a. Point A gives me the y-intercept, 10, so I'll use y = mx + b form:

$$y = mx + b$$
$$y = \left(-\frac{10}{d}\right)x + 10$$

I can do the same for line b. I first found the slope:

$$slope = \frac{15-0}{d-0} = \frac{15}{d}$$

Using the slope and point B, I can find the equation of line a. Point B gives me the y-intercept, 0, so I'll use y = mx + b form:

$$y = mx + b$$
$$y = \frac{15}{d}x$$

Looking at both line, it seems like the substitution method may be easiest to find the intersection:

$$y = \left(-\frac{10}{d}\right)x + 10 \quad and \quad y = \frac{15}{d}x$$
$$so$$
$$\frac{15}{d}x = \left(-\frac{10}{d}\right)x + 10$$
$$15x = -10x + 10d$$
$$25x = 10d$$
$$x = \frac{10d}{25}$$
$$x = \frac{2d}{5}$$

I can now substitute this value of x into both of the equations to solve for y:

$$y = \frac{15}{d}x$$
$$y = \left(\frac{15}{d}\right)\frac{2d}{5}$$
$$y = \frac{30}{5}$$
$$y = 6$$

and

$$y = \left(-\frac{10}{d}\right)x + 10$$
$$y = \left(-\frac{10}{d}\right)\left(\frac{2d}{5}\right) + 10$$
$$y = \frac{-20}{5} + 10$$
$$y = -4 + 10$$
$$y = 6$$

Wow, it looks like the value of d does not matter and the height where the wires cross will always be 6 meters!

Extra:

I wanted to do the whole problem in a general sense, without any specific numbers, so I used the following variables:

Let f = the height of the first pole
s = the height of the second pole
d = the distance between the poles

I used a coordinate plane to set up the problem. The bottom of the first pole is at (0,0). The top of that pole is at (0,f). The bottom of the second pole is at (d,0). The top of that pole is at (d,s). The first wire connects (0,0) and (d,s). The second wire connects (d,0) and (0,f). I found the slopes and equations of the wires:

Slope of wire 1 = $\frac{s-0}{d-0} = \frac{s}{d}$

The y-intercept is 0, so the equation in slope-intercept form is

$$\begin{aligned} y &= \left(\frac{s}{d}\right)x + 0 \\ &= \left(\frac{s}{d}\right)x \\ &= \frac{sx}{d} \end{aligned}$$

Slope of wire 1 = $\frac{f-0}{d-0} = \frac{f}{d}$

The y-intercept is f, so the equation in slope-intercept form is y = (-f/d)x + f or y = -fx/d + f.

$$\begin{aligned} y &= \left(\frac{-f}{d}\right)x + f \\ &= \frac{-fx}{d} + f \end{aligned}$$

The point of intersection is on both wires, so I solved the system of equations for their common point. The left-hand side of each equation is y, so I set the two right-hand sides equal and solved for x:

$$\begin{aligned} \frac{sx}{d} &= \frac{-fx}{d} + f \\ sx &= -fx + fd \\ sx + fx &= fd \\ x(s+f) &= fd \\ x &= \frac{fd}{(s+f)} \end{aligned}$$

The height of the intersection is given by the y-coordinate of the point where they intersect, so I substituted $\frac{fd}{(s+f)}$ for x in one of my equations and solved for y:

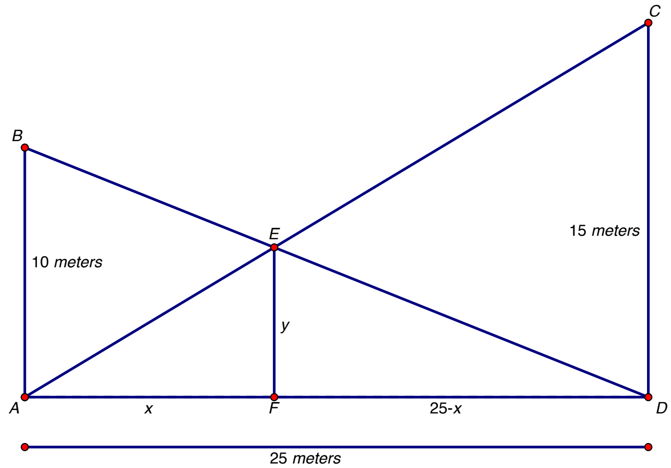
$$y = \frac{sx}{d}$$

$$y = \frac{\frac{s}{1} * \frac{fd}{(s+f)}}{d} = \frac{sfd}{(s+f)} * \frac{1}{d} = \frac{sf}{(s+f)}$$

The height of the point of intersection of the guy wires is determined by the product of the two pole heights divided by their sum. In function form, $h(f,s) = \frac{fs}{(f+s)}$.

Method 2: Similar Triangles

I started by drawing the picture and labeling the points and segments:



The problem asks us to find the height above ground of the point where the guy wires cross, I've labeled that height y. I also broke apart the 25 meters on the ground into two segments, AF and FD, I let AF = x and FD = (25 – x). Because I know that 25 = AD = AF + FD.

I can see that there are a number of triangles in this problem. I noticed that:

$$\Delta ABD \sim \Delta FED \text{ and } \Delta ACD \sim \Delta AEF$$

Using this I can set up some equivalent proportions that will hopefully help me find values for x and y.

$$\begin{aligned} \frac{FD}{AD} &= \frac{FE}{AB} \\ \frac{25-x}{25} &= \frac{y}{10} \\ 10(25-x) &= 25y \\ 250-10x &= 25y \end{aligned} \qquad \text{and} \qquad \begin{aligned} \frac{AF}{AD} &= \frac{EF}{AD} \\ \frac{x}{25} &= \frac{y}{15} \\ 15x &= 25y \end{aligned}$$

Looking at my two equations and two unknowns, I can see that I have two things that are equal to 25y, so I can substitute:

$$\begin{aligned} 250-10x &= 15x \\ 250 &= 25x \\ 10 &= x \end{aligned}$$

If x = 10, I can use that to solve for y.

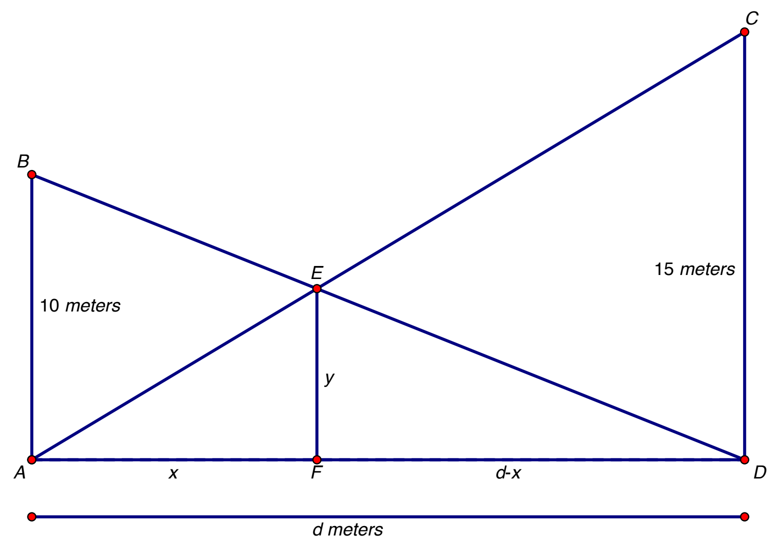
$$\begin{aligned} 15x &= 25y \\ 15(10) &= 25y \\ 150 &= 25y \\ 6 &= y \end{aligned} \qquad \text{or} \qquad \begin{aligned} 250-10x &= 25y \\ 250-10(10) &= 25y \\ 250-100 &= 25y \\ 150 &= 25y \\ 6 &= y \end{aligned}$$

Great, I checked both equations and I can see that the wires cross at 6 meters high!

Now I want to figure out what happens when I don't know how far apart the poles are. I can use the same picture, but instead of using 25, I'll

Let d = the distance between the two poles

I can use almost the same picture:



I still have the same similar triangles:

$$\Delta ABD \sim \Delta FED \text{ and } \Delta ACD \sim \Delta AEF$$

And I can again set up proportions that will hopefully help me figure out what's going on.

$$\frac{FD}{AD} = \frac{FE}{AB}$$
$$\frac{d-x}{d} = \frac{y}{10}$$
$$10(d-x) = dy$$
$$10d - 10x = dy$$

$$\frac{AF}{AD} = \frac{EF}{AD}$$
$$\frac{x}{d} = \frac{y}{15}$$
$$15x = dy$$

Looking at my two equations and two unknowns, I can see that I have two things that are equal to dy, so I can substitute:

$$10d - 10x = 15x$$
$$10d = 25x$$
$$\frac{10d}{25} = x$$
$$x = \frac{2d}{5}$$

Now I can substitute that value of x into the other two equations and solve for y:

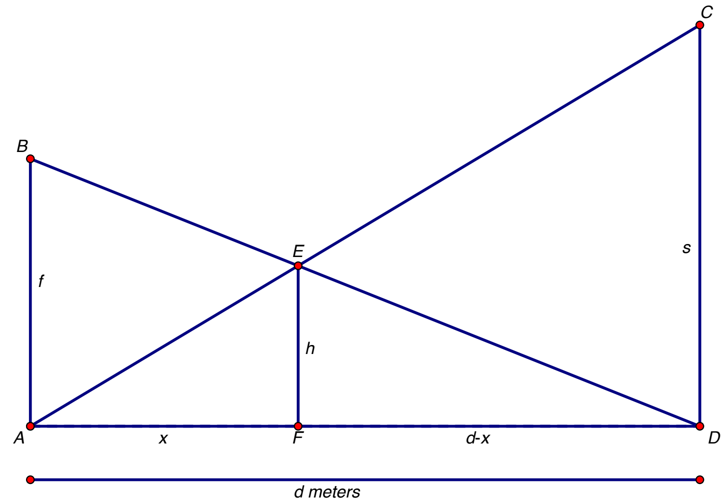
$$10d - 10x = dy$$
$$10d - 10\left(\frac{2d}{5}\right) = dy$$
$$10d - 4d = dy$$
$$6d = dy$$
$$6 = y$$

$$15x = dy$$
$$15\left(\frac{2d}{5}\right) = dy$$
$$6d = dy$$
$$6 = y$$

So, no matter how far apart the poles are, they will always cross at a height of 6 feet!

Extra:

As in the main problem, I drew the line segment from the intersection point of the wires to the ground and created two sets of similar triangles. But now I have no specific values, so I used f for the height of the first pole, s for the height of the second pole, and d for the distance between the poles. My diagram looked like this:



Since ABC is similar to FEC, $\frac{f}{d} = \frac{h}{x}$.

Since CDA is similar to FEA, $\frac{s}{d} = \frac{h}{(d-x)}$.

I used the proportions to get two equations and solved each one for x:

$$\frac{f}{d} = \frac{h}{x}$$
$$fx = dh$$
$$x = \frac{dh}{f}$$

$$\frac{s}{d} = \frac{h}{(d-x)}$$
$$s(d-x) = dh$$
$$sd - sx = dh$$
$$sd - dh = sx$$
$$\frac{(sd - dh)}{s} = x$$

I substituted $\frac{dh}{f}$ for x in the second equation and then solved for h since I wanted to express the height in terms of f and s:

$$\frac{(sd-dh)}{s} = \frac{dh}{f}$$
$$fsd - fdh = sdh$$
$$fsd = sdh + fdh$$
$$fs = sh + fh$$
$$fs = h)s + f)$$
$$\frac{fs}{(s+f)} = h$$

The height of the point of intersection of the guy wires is determined by the product of the two pole heights divided by their sum. In function form, h(f,s) = fs/(f + s).

Teaching Suggestions

Crossed Wires presents an opportunity for students to apply a mathematical model to a given situation. Whether students use the coordinate plane or similar triangles, or perhaps make sense of it in a different way, it is a nice opportunity to use concepts and ideas they may have already learned to make sense of a situation and explore whether or not the height varies as the pole moves.

In looking at the submissions from the last time we offered this problem, it seems clear that many students pretty immediately saw the triangles and quadrilaterals and wanted to use properties of a those shapes to solve the problem. Students saw right triangles and tried to use the Pythagorean formula, some tried to use equilateral triangles, trapezoids and rectangles. Students will need to familiarize themselves with the figure and choose and appropriate strategy. One good way to do this is by introducing the scenario first and having the students talk about the figure before they explore the actual problem.

We also saw that students took a number of non-algebraic approaches, for example, they saw that the wires could be written as lines and then plotted points on both lines until they found one that matched, or carefully and precisely graphed the situation on graph paper and then saw where the wires crossed.

Both of these are great strategies for making sense of the problem and then the question becomes how do you transition students from their model, which works, to an algebraic approach which would work more generally, the second questions in this problem sets you up nicely to make that transition since students can't set up and check every possible distance apart the poles could be.

For the second part of the problem, many students tested one case rather than proving the guy wires cross at 6 meters regardless of how far apart the poles are. Checking cases is a great way to start and to support students in thinking about the distance changing suggest they assign a variable to the distance and do the same calculations they've done for each of their cases.

Student Solutions

Focus on Communication

In the solutions below, I've provided the scores the students would have received in the **Communication** category of our scoring rubric. The table below is an excerpt from the rubric for this problem showing the guidelines for scoring in Communication:

Novice	Apprentice	Practitioner	Expert
Has written very little that tells or shows how they found their answer.	Submitted explanation without work or work without explanation. Leaves out enough details that another student couldn't follow or learn from the explanation.	Explains all of the important steps taken to solve the problem. Shows equations, formulas, and calculations used and explains the rationale behind them. Defines variable(s).	Adds in useful extensions and further explanation of some of the ideas involved The additions are helpful, not just "I'll say more to get more credit."

For each solution, I've included a comment about why I would score it as shown, as well as what I'd ask the student to work on when they revise their solution to help them move forward with solving the problem or improving their write-up of their work.

Cody
age 13

Communication
Novice

The height is 7 meters. If the poles were changed, then the height would decrease.

10/25= 2/5 15/25= 3/5 as the poles get more away from each other than the wire has to get longer, making the point of intersection drop.

Cody is using the numbers and trying to form relationships, but he has not given us a lot of information about why he's looking at 10/26 and 15/25. I'd ask him what those numbers represent and how they help us make sense of the problem. I'd then suggest he think about drawing the problem onto graph paper and using the x and y axis.

Erika
age 13

Communication
Novice

The point at which the guy wires cross is at 7 feet above the ground.

First, I found the perimeter of the entire figure, a quadrilateral, using degrees to find the last side's length. Then, since the two triangles on the side are similar and the two on the top and bottom are congruent, I could solve the problem.

Erika is clear that she's using shapes she sees in the problem, but her explanation makes it hard to see which parts of the diagram she's referring to. I'd suggest she draw a picture and label the sides and use those labels to tell me explain her thinking.

Cliff
age 14

Communication
Apprentice

Answer: 6 meters above ground is where they intersect. Answer: Adding 1 to the (y) from (x,y) coordinates will cause height of the intersection to increase, but (x) "distance between poles" will not affect the height in which poles intersect. Extra.

Answer: Using graph paper, I graphed the coordinates (0,0) and (0,10) for the 10 meter pole. For the other pole, I graphed (25,0) and (25,15). I drew a line from the top of the 15 meter pole to the bottom of the 10 meter pole, and vice versa from the 10 meter pole to the bottom of the 15 meter pole. The point of intersection, (x,y) would be the place where the men cross. The (x) would tell me how far from one pole to the other the men cross; but (y) would tell how high the men were, whre they intersected. I got the coordinate of (9,6). 6 meters is where the men intersected.

Answer II: I found out that if you added 1 to the (y) of the coordinates of the pole, it would cause the height in which they intersect to increase. For example, if the coordinates of the poles were (0,10) / (25,15), and changed to (0,11) / (25,16), the height would increase by 1 meter. But, the (x) will not affect the height.

Reflection: Reading the problem kind of confused me abit, but putting on graph paper made it easier for me to figure this out. I couldn't find an algebraic method to solve this problem, so I used graph paper. My friends told me that this would make it easier to solve.

Extra: I got the function of {[(a)+1] + [(b)+1} = h+1. Variables (a) and (b) represent the (y) coordinates of the poles. If 1 is added to (a) and (b), the height would be increased by one.

Cliff explains nicely how he used graph paper and the coordinate plane and how he labeled the point of intersection, but I wonder how he got from (x, y) to (9, 6). My guess is that he used his graph and looked at the coordinates, and if this is the case, I'd ask him if he could find equations for each of the guy wire lines and how that might help him find (x, y) precisely. I'd also ask if that level of precision might effect his answers for II and the Extra.

Thomas
age 16

Communication
Apprentice

The guy wires cross six meters above the ground. If the poles are spread apart, the wires still cross at six meters above the ground

I used rise over run to get two linear equations, y= 15/25 x and y= -10/25 x +10. Then, I solved the system of equations by multiplying the first equation by 2 and the second one by 3. The x's were cancelled out, so 5y = 30 and y = 6. For part two, I simply found the new slopes and equations when the distance between the poles was changed to 30. It was still 6 meters. I was glad.

Thomas is has clearly set up two linear functions and solved them simultaneously, but it would be hard for another student to follow his thinking. I'd ask Thomas to share more about how he came up with the linear equations and perhaps to add some equations to go along with his written explanations. It sounds like he checked 30 feet apart, but how could he be sure the wires would cross at 6ft if the poles were 5, 10, 26.3, or 100 feet apart?

Jashua
age 14

Communication
Practitioner

1. The solution to the system of linear equations is (10, 6). 2. The height doesn't change but the distance does. Extra: y = 3a/10 + 2b/10.

1. First, I used my knowledge of linear equations to create two that I could find the solution to answer the problem.

y = mx + b
y = -10x/25 + 10

The slope "-10/25" was found with the pole's height and the distance between the poles. Also it is negative because the line was going from left to right downwards. The y-intercept was "10" because of the length of the pole.

y = 15x/25

The slope of the line going from the base of the first pole (0, 0) to the top of the second pole (25, 15) was "15/25". The y-intercept is "0" because it intercepts the y-axis at "0".

Using the substitution method, we can solve this system of linear equations.

15x/25 = -10x/25 + 10
15x = -10x + 250
25x = 250 x = 10

Now, we can plug the value of "x" back into the equation to get "y".

y = 15x/25
y = 150/25
y = 6
We come to the solution of (10, 6).

2. Now we have to prove that the distance doesn't change the height, so we will change the distance from 25 to 20 but still using the same two linear equations.

15x/20 = -10x/20 + 10
15x = -10x + 200
25x = 200
x = 8

The distance of the line from the first pole has changed from "6" to "8". Now we have to find the height or "y" by substituting the value of "x" in.

y = -10x/20 + 10
y = -80/20 + 10
y = -4 + 10
y = 6

From the coordinates (8, 6), we can conclude that the height doesn't change if the distance does.

Extra: The variables "a" and "b" represent the height of the first pole and second pole. We can get two equations from the drawing using the relationships between "y", "a", and "b".

1. a/y = 25/15
2. b/y = 25/10

Using cross products we can find that adding these two proportions together will get us the function.

15a = 25y
+ 10b = 25y
= 15a + 10b = 50y
y = 15a/50 + 10b/50
y = 3a/10 + 2b/10

The function that we get is "3a/10 + 2b/10".

Joshua's done a nice showing each of the steps he took and explaining why he did them. For question 2 he's shown evidence from one case in which the poles are moved, but I'd push him to convince me that the guy wires would cross at 6 meters no matter where I move them. For the extra, I'd remind him that we no longer know the heights of the poles, what if the poles heights remained at a and b, how would that change his function?

Angela
age 12

Communication
Expert

Y = 200/X + 2

To solve this problem, I looked at the diagram as if it were in the first quadrant of a graph. So, I wrote an equation/function for each wire and used substitution to find the solution to the system. For the first wire, the one with a negative slope, I found that the points were (0,10) and (25,0). With that, I found the slope, which is -2/5. I did the same for the second wire, the one with a positive slope, which is 3/5.

With this, I then wrote two equations: y = -2/5x + 10 and y = 3/5x. The 10 in the first equation is the y-intercept (one point was (0,10)).

Next, I simply solved the system using substitution, not the linear combination method, because both equations are already in y-intercept form (y = ax + b).

3/5x = -2/5x + 10
x = 10

Knowing that the x coordinate equals 10, I then plugged that number back into one of the original equations. I chose y = 3/5x because it does not have a constant and is therefore easier to solve.

y = 3/5 (10)
y = 6

For the second part of this problem, I just changed the distance of the two poles by moving the second pole closer and farther. This trial and error method was quite simple.

First, I "moved" the second pole 15 meters closer to the first pole. Using the same method I used to solve the first part of the problem, I wrote two equations and solved for both x and y.

y = -2/5x + 10
y = 3/2x

3/2x = -2/5x + 10
6/10x = -4/10x + 10
x = 10

y = -2/5(10) + 10
y = -4 + 10
y = 6

The height is still 6 meters.

Extra: The function that expresses the height of the intersection of the wires in terms of the heights of the two poles is y = (AB)/(A+B).

To solve this, I substituted the 10 meter high pole with A, the 15 meter high pole with B, and the the 25 meters between the two as D. The height where the two wires cross I substituted with y and the distance from that point (when it is (10,0)) to the origin. So, using the equations I used in the problem, I substituted all the numbers with my new variables. (I also used y for the y in the y-intercept form, but it gets eliminated anyways)

y = (-A/D)x + A
y = (B/D) x

(the original equations were y = -2/5x + 10 and y = 3/5x)

Then, I solved for the solution to the system just like the what I did in the original problem.

(B/D)x = (-A/D)x + A
(A/D)x + (B/D)x = A
x = [D (A)]/A+B

Lastly, I substituted the new expression for x back into the original

Angela has done a great job of explaining each of her steps and her thinking that went along with those steps. It's easy to follow and makes a lot of sense. I like what she's done for part 2, but I'd ask her to go back and check her calculations. Like Joshua, I'd also ask her how she could be sure that the height would be 6 meters if the poles were any distance apart.

equation to find a function for y, the height from the point where the two wires cross to the floor.

y = (B/D)[D(A)]/A+B

The D's cancel out and leaves it with:

y = (AB)/(A+B)

Reflection: Everything in this problem, except the "extra" was pretty simple, since we have just gone over how to solve for the solution of a system in class. At first, when I first saw the triangles the wires formed on the problem, I thought of geometry. However, when I started reading the problem, I decided that using a graph would be a lot easier. As for the second part of the question, I thought that it was pretty easy as well. Many of my friends and I checked answers for that part since we were confused in the beginning. However, the "extra" was hard, and I had to ask my dad and check answers with my friends. Also, when I asked my dad, he showed me a different way of solving it - using ratios between similar triangles. If I used this method in the beginning, which was quite complicated, it would have made the "extra" easier to solve. However, my dad helped me find another way to solve it using my method.

Scoring Rubric

A **problem-specific rubric,** to help in assessing student solutions, is available in the Teacher Support Materials on the Problem page when you are logged in as a teacher. As shown above, we consider each category separately when evaluating the students' work, thereby providing more focused information regarding the strengths and weaknesses in the work. A **generic student-friendly rubric** can be downloaded from the *Teaching with PoWs* link in the left menu (when you are logged in). We encourage you to share it with your students to help them understand our criteria for good solutions. We hope these packets are useful in helping you make the most of the Algebra Problems of the Week. Please let us know if you have ideas for making them more useful.

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