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IAG 2H9
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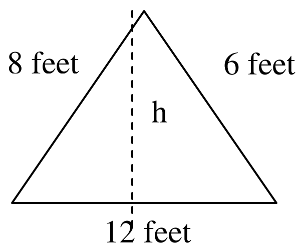
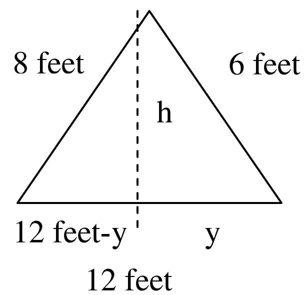
You Must be Wrong

Bees POW # 2

1. Problem Statement: In this simple POW you must find the area of two triangles. First, find the area of Dr. Rotoli's original triangle that has side lengths of 6, 8, and 12 feet. Then you must find the area of Mr. Brown's triangle with sides of 6, 8, and 10 feet. You must correctly determine which triangle has the largest area. This problem requires use of the "Crazy Triangle" process done twice.

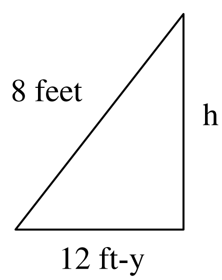
2. Process: I started to solve this easy POW by finding the area of Dr. Rotoli's original triangle. It had side lengths of 6, 8, and 12 feet. I used the "crazy triangle" process that we have learned in class.

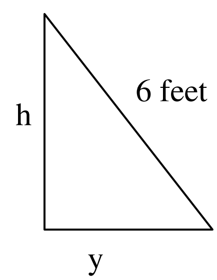




I first draw the triangle and insert an imaginary height line down the middle. In order to find the area of this triangle, I must find the height of it first.

I then divide the triangle up into two right triangles. I must split up the base among the two right triangles. To do this I write *y* on the **shorter** side and *12feet-y* on the other side. I will make them equal to each other as I use the Pythagoras theorem to express the triangle as an equation. I must now get *h* alone to be able to set it equal to the other equation's *h*; thereby making both right triangle's equations equal to each other. I do this and then see that there are parentheses in the problem. I must simply these before I can do any thing else to the problem.





$$8\,feet^2 = h^2(12\,feet - y)^2$$
$$64\,feet = h^2(12\,feet - y)^2$$
$$64\,feet - (12\,feet - y)^2 = h^2$$

$$6\,feet^2 = h^2 y^2$$
$$36\,feet = h^2 y^2$$
$$36\,feet - y^2 = h^2$$

$$64\,feet - (12\,feet - y)^2 = h^2 = 36\,feet - y^2$$

$$-(12\,feet - y)^2$$
$$-[(12\,feet - y) - (12\,feet - y)]$$
$$-[(12\,feet * 12\,feet) + (12\,feet * -y) + (-y * 12\,feet) + (-y * -y)]$$
$$-[(144\,feet) + (-12\,y) + (-12\,y) + (+y^2)]$$
$$-[144\,feet - 24\,y + y^2]$$
$$-144\,feet + 24\,y - y^2$$

FOIL Process

I simply them by using the FOIL method to get rid of the parentheses.

Now, after I have removed the parentheses from the problem, I can now simply my h^2 equations to find what y or the longer part of the base equals. I find this to be 4.833333 feet.

$$64\,feet - (12\,feet - y)^2 = h^2 = 36\,feet - y^2$$
$$64\,feet - 144\,feet + 24\,y - y^2 = 36\,feet - y^2$$
$$64\,feet - 144\,feet + 24\,y = 36\,feet$$
$$-80\,feet + 24\,y = 36\,feet$$
$$24\,y = 116\,feet$$
$$y = 4.833333\,feet$$

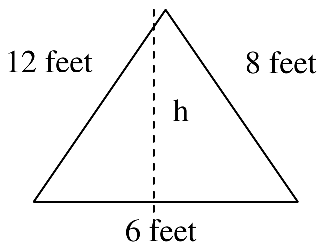
$$36\,feet = h^2\,y^2$$
$$36\,feet = h^2\,(4.8333333\,feet)^2$$
$$36\,feet = h^2\,23.3611111\,feet$$
$$12.638888\,feet = h^2$$
$$3.555121\,feet = h$$

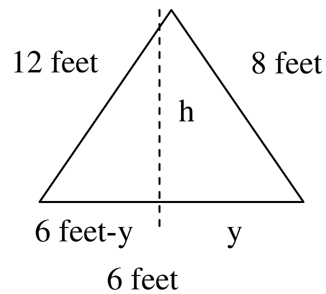
Now I can insert the value for y into one of the right triangle equations to find the height of the big triangle.

Once I have the height I can now simply find the area of Dr. Rotoli's triangle. It is 21.3307 $feet^2$.

$$a = \frac{1}{2}bh$$
$$a = \frac{1}{2}(12\,feet)(3.555121\,feet)$$
$$a = 21.3307\,feet^2$$

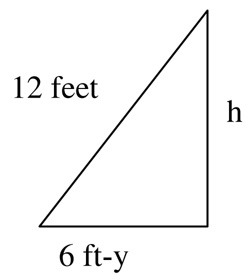
However, I wonder if my answer would be different if I used different numbers for each side. I will try this just to make sure my answer is always correct.

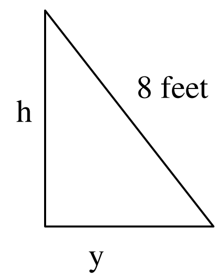




I start again by re-drawing the triangle and insert an imaginary height line down the middle. In order to find the area of this triangle, I must find the height of it first.

I then divide the triangle up into two right triangles. I must split up the base among the two right triangles. To do this I write *y* on the **shorter** side and *6feet-y* on the other side. I will make them equal to each other as I use the Pythagoras theorem to express the triangle as an equation. I must now get *h* alone to be able to set it equal to the other equation's *h*; thereby making both right triangle's equations equal to each other. I do this and then see that there are parentheses in the problem. I must simply these before I can do any thing else to the problem.





$$12 feet^2 = h^2 (6 feet - y)^2$$
$$144 feet = h^2 (6 feet - y)^2$$
$$144 feet - (6 feet - y)^2 = h^2$$

$$8 feet^2 = h^2 y^2$$
$$64 feet = h^2 y^2$$
$$64 feet - y^2 = h^2$$

$$144 feet - (6 feet - y)^2 = h^2 = 64 feet - y^2$$

$$-(6 feet - y)^2$$
$$-[(6 feet - y) - (6 feet - y)]$$
$$-[(6 feet * 6 feet) + (6 feet * -y) + (-y * 6 feet) + (-y * -y)]$$
$$-[(36 feet) + (-6y) + (-6y) + (+y^2)]$$
$$-[36 feet - 12y + y^2]$$
$$-36 feet + 12y - y^2$$

FOIL Process

I simply them by using the FOIL method to get rid of the parentheses.

Now, after I have removed the parentheses from the problem, I can now simply my h^2 equations to find what y or the longer part of the base equals. I find this to be 9.666666 feet.

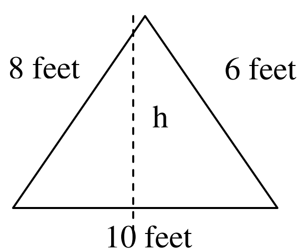
$$144\,feet - (6\,feet - y)^2 = h^2 = 64\,feet - y^2$$
$$144\,feet - 36\,feet + 12y - y^2 = 64\,feet - y^2$$
$$144\,feet - 36\,feet + 12y = 64\,feet$$
$$108\,feet + 12y = 64\,feet$$
$$12y = -44\,feet$$
$$y = -3.6666666\,feet$$

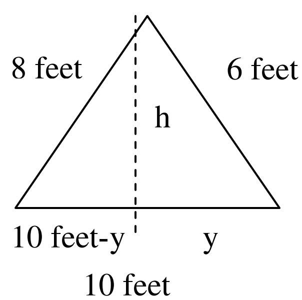
$$64\,feet = h^2 y^2$$
$$64\,feet = h^2(-3.66666666\,feet)^2$$
$$64\,feet = h^2 13.4444444\,feet$$
$$50.55555555\,feet = h^2$$
$$7.110243\,feet = h$$

Now I can insert the value for y into one of the right triangle equations to find the height of the big triangle.

Once I have the height I can now simply find the area of Dr. Rotoli's triangle. It is again 21.3307 feet^2. I can now say that no matter what side is the base or used for the height, the area of the triangle will not change. Knowing this, I can now try to find the area of Mr. Brown's triangle, where he shrinks on e of the sides.

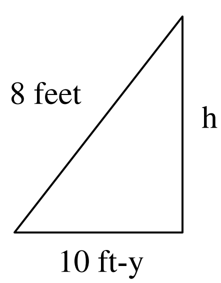
$$a = \frac{1}{2}bh$$
$$a = \frac{1}{2}(6\,feet)(7.110243\,feet)$$
$$a = 21.3307\,feet^2$$

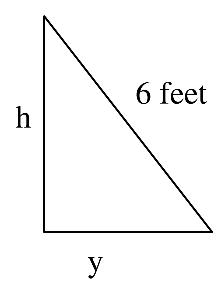




I start again by drawing the triangle and inserting an imaginary height line down the middle. In order to find the area of this triangle, I must find the height of it first.

I then divide the triangle up into two right triangles. I must split up the base among the two right triangles. To do this I write *y* on the **shorter** side and *10feet-y* on the other side. I will make them equal to each other as I use the Pythagoras theorem to express the triangle as an equation.





$$8\,feet^2 = h^2(10\,feet - y)^2$$
$$64\,feet = h^2(10\,feet - y)^2$$
$$64\,feet - (10\,feet - y)^2 = h^2$$

$$6\,feet^2 = h^2 y^2$$
$$36\,feet = h^2 y^2$$
$$36\,feet - y^2 = h^2$$

I must now get *h* alone to be able to set it equal to the other equation's *h*; thereby making both right triangle's equations equal to each other. I do this and then see that there are parentheses in the problem. I must simply these before I can do any thing else to the problem.
I simply them by using the FOIL method to get rid of the parentheses.

$$64\,feet - (10\,feet - y)^2 = h^2 = 36\,feet - y^2$$

$$-(10\,feet - y)^2$$
$$-[(10\,feet - y) - (10\,feet - y)]$$
$$-[(10\,feet * 10\,feet) + (10\,feet * -y) + (-y * 10\,feet) + (-y * -y)]$$
$$-[(100\,feet) + (-10y) + (-10y) + (+y^2)]$$
$$-[100\,feet - 20y + y^2]$$
$$-100\,feet + 20y - y^2$$

FOIL Process

Now, after I have removed the parentheses from the problem, I can now simply my h^2 equations to find what y or the longer part of the base equals. I find this to be 9.666666 feet.

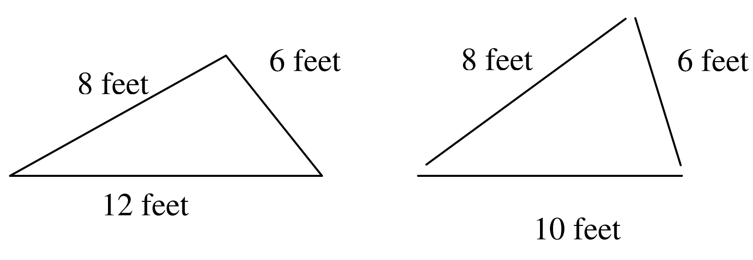
$$64\,feet - (10\,feet - y)^2 = h^2 = 36\,feet - y^2$$
$$64\,feet - 100\,feet + 20y - y^2 = 36\,feet - y^2$$
$$64\,feet - 100\,feet + 20y = 36\,feet$$
$$-36\,feet + 20y = 36\,feet$$
$$20y = 72\,feet$$
$$y = 3.6\,feet$$

$$36\,feet = h^2 y^2$$
$$36\,feet = h^2 (3.6\,feet)^2$$
$$36\,feet = h^2 12.96\,feet$$
$$23.04 = h^2$$
$$4.8\,feet = h$$

Now I can insert the value for y into one of the right triangle equations to find the height of the big triangle.

$$a = \frac{1}{2} bh$$
$$a = \frac{1}{2}(10\,feet)(4.8\,feet)$$
$$a = 24\,feet^2$$

I have now found the area of Mr. Brown's triangle. It is 24 feet^2. How can that be? A smaller side yields a bigger area? Let me try to understand it by construction exploded-scale models.



I did not change the lengths of the lines from one triangle to the next. I just rotated and re-positioned them.

3. Solution: I can see it now. The shorter base results in a much greater angle for the two sides in relation to the base. This also greatly increases the height of the triangle. This results in a bigger area. However, Mr. Brown's triangle is only about 3.6693 $feet^2$ bigger then Dr. Rotoli's triangle. So in conclusion, Mr. Brown's triangle has a bigger area even though he has a shorter perimeter. This happens because the shorter base forces a higher height, which increases the area of the triangle enough to overcome the negative effect of shorting the base.

4. Extension: Not necessary to do.

5. Evaluation: This was an easy problem in knowing exactly what to do in order to solve the problem. Part of the fun of POWs in previous years was that one did not know what steps to take in order to solve the problem. In this POW I knew exactly how to solve the problem. However, there was a lot of math and steps that had to be shown. This takes time to recreate on the computer. I also made a mistake over the weekend where I thought that *y* goes on the larger side, not the smaller side. However, once I took a look at my notes I could quickly fix my mistakes on the computer. The write up also takes time.

The answer was surprising to me, as I was expecting that Mr. Brown be wrong. I guess we are so involved in rectangles, where a decrease in the perimeter, will decrease the area also. I learned that this is not always the case with triangle. In general, triangles are funny. The Pythagoras theorem, trig and the property that the sum of any 2 sides is larger then the third rules all play a part in contributing to the weirdness of triangles. I think this POW is a good problem because of this surprise answer. However, I do miss having to figure out the method to solve the problem as featured in last year's POWs. I would not change the problem at all, but possibly throw it out and start over. However, that is not likely.