January

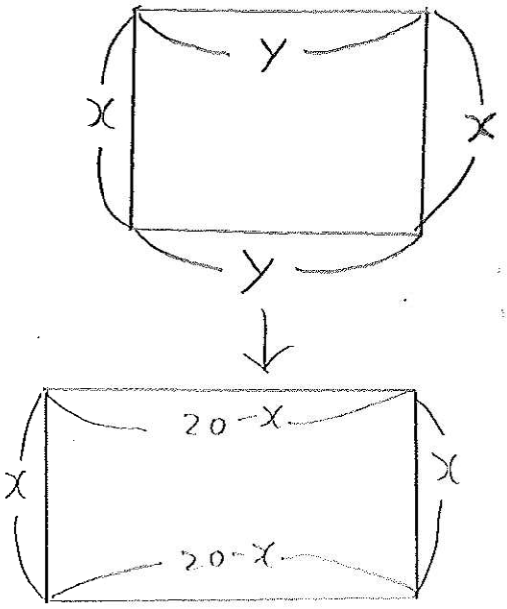
Jake Hyun

part 1

Question

Imagine you had 40 one-metre sections of fencing. What is the largest rectangular area you could fence off?

Answer + explanation



If we label the shape like the drawing on the left, xy is the Area. Since $(40m - 2x) \div 2$ is y, y is 20−x. This also means that xy (the area) is x(20−x) which is $-x^2+20x$. Because $-x^2+20x$ is the area, we must try make 20x bigger than x^2 as much as possible. If we look at the table, we can see that x needs to be 10 for the rectangle to be the largest. 2x equals 2y when x = 10. This shows that x equals y when you make the largest area in a rectangle.

$10 \times 10 = 100m^2$

x	x+y	Area	
1	20	19	
2	20	36	
3	20	51	
4	20	64	
5	20	75	
6	20	84	
7	20	91	
8	20	96	
9	20	99	
10	20	100	→ x=10, y=10
11	20	99	
12	20	96	
13	20	91	
14	20	84	
15	20	75	
16	20	64	
17	20	51	
18	20	36	
19	20	19	

Answer = $100 m^2$

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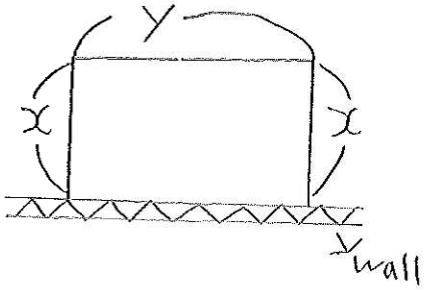
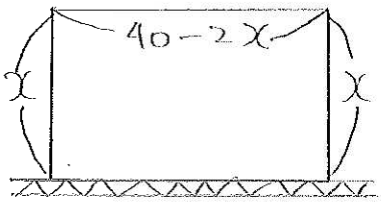
Part 2

Question

Now imagine you are building your rectangular fence along the side of a wall, so you are only using the fence for three sides of the inclosure. What's the largest area you could fence?

Answer + explanation





At the end of part 1, I said $x=10$ because it makes $2x$ equal $2y$.

When I said $2x = 2y$,

The 2 was because there were 2 sides that were x, and for the other 2, It was because there were 2 sides that were Y. However in this case, There is only one Y and 2 Xs. Therefore, $2x = y$ for the largest area. (The larger the x, the more fence you waste)

$$\begin{cases} 2x+y=40m \\ y=2x \end{cases}$$

$$\downarrow$$

$$4x = 40m$$

$$\downarrow$$

$$x=10$$

$$\downarrow$$

$$y=20$$

$$20 \times 10 = 200$$

Answer = $200\ m^2$

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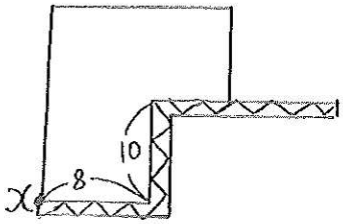
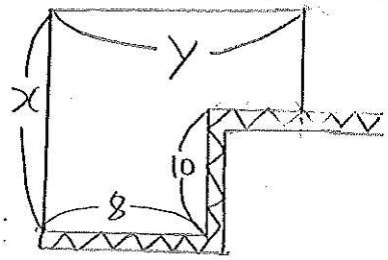
Part 3

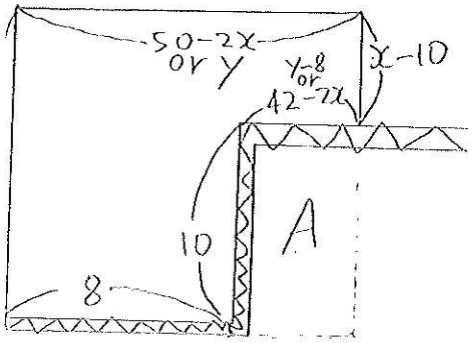
Question

Now imagine you could attach your fence to point x on the wall shown here. What is the largest area you could fence off now?



Answer + explanation





If you look at the second drawing, the area fenced off is $xy - A$

$$xy - A$$

$$\downarrow$$

$$-2x^2 + 50x - A$$

$$\downarrow$$

$$-2x^2 + 50x - 420 + 20x$$

$$\downarrow$$

$$\boxed{-2x^2 + 70x - 420}$$

x	Area	
13	152	
14	168	
15	180	
16	188	
17	192	→ largest
18	192	→ largest
19	188	
20	180	
21	168	

$x = 17$ $y = 16$ or $x = 18$ $y = 14$ is the answer with both $192\ m^2$

In this problem, more y meant more space subtracted from xy, and therefore caused it to be smaller than x.

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Answer = $192\ m^2$