This mathematical distraction is taken from Book 6 of the Ilfinor fiction series. Enjoy.

Chapter Appendix: The Perimeter Problem

In attendance that morning for the geometry class were Ostap, Walter, Joe, Harrison, Nickolas, Alexander, Peter, Terry, Clarence, Steven, and Pasha.

Phaedrus entered the classroom and all the students sat down and sat up at attention for respect.

"Hello, class. It's that time of year again. Time to begin our review study for the quarter final."

"Yay!" yelled a few students.

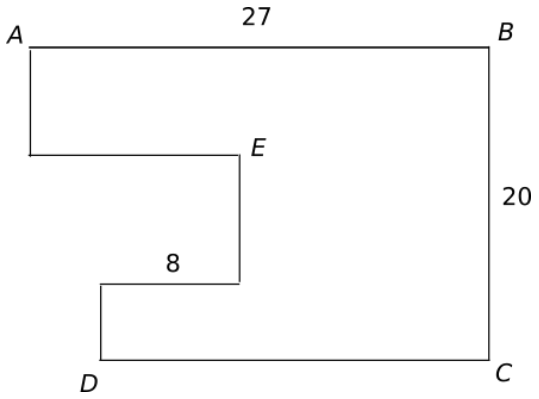
"Of course, we still have new material to go through as well. Today's review problem is the perimeter problem, to which you all know exactly how to solve, right?"

"Oh, I know that one," said Terry.

"Let's begin with the most basic rule of totals, which is, class?"

"Every total is equal to the sum of all its parts," they all replied.

"Correct. Now, I'll draw the figure."



"All right. This is the figure to work with. We are asked to find the perimeter of this figure with only the information given, which is barely enough to do it."

"What does that mean?" asked Pasha.

"That's right, Pasha. You haven't been here when we went over this kind of problem earlier in the quarter. When I say that there is barely enough to solve for the perimeter, I mean that there is **not** enough to solve for the individual lengths of the three segments, say, on the left-hand side of the figure. Okay?"

"Okay. I get it now."

“So, who can tell me what the next step is?”

Walter raised his hand.

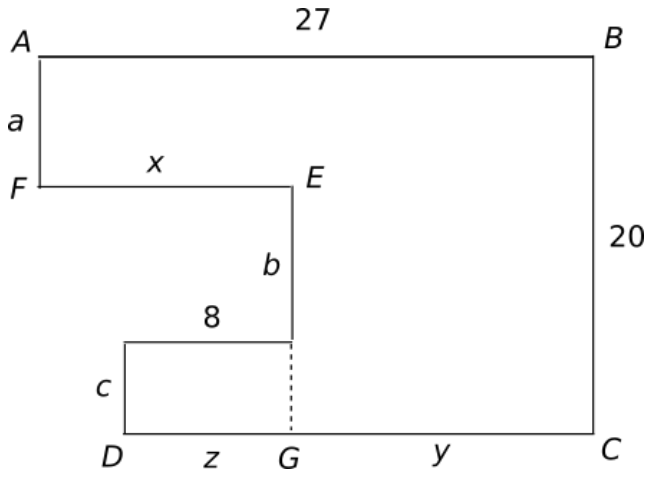
“Yes, Walter.”

“Label the missing parts.”

“Correct. But is there only one way to label the missing parts?”

“You usually tell us that there is not.”

“Correct again. So, let me add to the figure, like so.”



“Let’s not forget that all the angles formed by the meeting of any two line segments is either 90° or 270°. Does anyone take issue that I’m replacing the length of DC with the sum of lengths of DG and GC, which are *z* and *y*, respectively?”

No one complained.

“We have a named axiom for that, right, gentlemen?”

Terry raised his hand.

“Yes, Terry?”

“It’s the Axiom of Line Segment Subdivision, also known by some as the *Segment Addition Postulate*.”

“Correct. Hence, what is our next step in solving this type of problem?”

Harrison raised his hand.

“Yes, Harrison?”

“We should divide the parts into the sum of vertical parts and the sum of horizontal parts.”

“Do we have to look at this solution this way, Harrison?”

“No, sir, but you claim that it can be useful to do it that way. You refer to it as a *heuristic* for this kind of problem.”

“Correct. Are you sure that that particular break down will not leave out any line segment?”

“According to the figure, every segment part is either horizontal or vertical, so it will not leave out any part.”

“Correct! Very good. And, given that the perimeter of this figure is the sum of all the lengths of all the segment parts, I will write down the equation:

$$\text{Perimeter} = \Sigma\text{HP} + \Sigma\text{VP},$$

"where Σ means to take a sum. Now, can anyone of you bright students tell me the sum of all the vertical parts?"

Clarence raised his hand.

"Yes, Clarence?"

"It's 40."

"Correct," said Phaedrus.

Some of the students groaned.

"Okay, Clarence, the sum of all the vertical parts is 20 (for segment BC) plus the sum of $a + b + c$, right?"

"Right."

"I'll write it out for the benefit of the class:

$$\Sigma\text{VP} = 20 + a + b + c.$$

"Is that correct, Clarence?"

"Yes, sir."

"Then what is the value of, say, b?"

"I don't know, but I don't have to know."

"Why don't you have to know?"

"Because all I need to know is $a + b + c$, which is 20."

"Why is it 20, Clarence?"

"It's 20 because it has to be the same length as segment BC."

"Correct, but what is the reasoning on that?"

"Because horizontal segments AB and DC are parallel to each other and thus have a fixed distance between them, which is 20."

"Thank you, Clarence. Now, I'll call on some other student for the sum of the horizontal lengths. Anyone?"

No one raised his hand.

"Don't be bashful. How about you, Peter?"

"Okay. We already know that AB is 27."

"What are all the remaining lengths we have to add to that, Peter?"

"x, 8, z, and y."

"Fine. What was the trick I suggested the last time we did a problem like this? Do you remember?"

Peter whispered to his neighbor Ostap for help and then said,

"We're supposed to pick a path through the figure that's bounded by the longest line segment we know."

"That's roughly correct. What is the longest horizontal line segment we know?"

"Segment AB."

"And what is its length?"

"27."

"So, what is the pathway you chose?"

“I chose AFEGC, and I’ll only count the horizontal lengths as I go. Which is: *x* plus *y*, which is equal to 27.”

“Correct. But now we have to go back and collect all the pieces that we haven’t counted thus far. Which are those, Peter?”

“Ah, 8 and *z*.”

“And how much is *z*?”

Peter conferred with Ostap and then said, “Eight.”

“Why?”

“Because 8 and *z* are opposite sides of a rectangle.”

“Correct. So, that makes for 8 + 8 = 16, which we add to 27 + 27 to get what, someone who hasn’t yet spoken up today?”

Nickolas raised his hand.

“Nickolas.”

“That’s a total of 70.”

“So, Nickolas, add that number to the number we got for the vertical lengths and that gives us, what?”

After a quick calculation, he replied, “That gives us 110.”

“Good. So, class, you’re all going to get an A on the final, right?”