Evaporating Pool Problem

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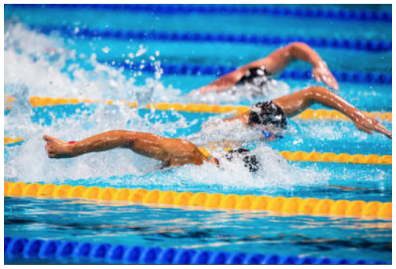

This is a fairly straight-forward problem[1] from A+ Click.

The water from an open swimming pool evaporates at a rate of 5 gallons per hour in the shade and 15 gallons per hour in the sun. If the pool loses 8,400 gallons in June and there were no clouds, what is the average duration of night during that month?

Answer Choices: 6 hours 8 hours 10 hours 12 hours

My Solution

Let N be the number of nighttime hours in June and D the number of daytime hours. Then

$$5\,N + 15\,D = 8400 = \text{gals evaporated}$$

and

$$N + D = 24{\cdot}30 \text{ hours in June}$$

Divide the first equation by 5 to get $N + 3D = 1680 = 24{\cdot}70$. Subtracting the second equation from this yields

$$2\,D = 24{\cdot}40 \text{ or } D = 24{\cdot}20$$

Therefore the average nighttime hours are

$$N/30 = (24{\cdot}30 - 24{\cdot}20)/30 = 8 \text{ hours}$$

A+ Click Solution

8400 / 30 days = 280 gallons per day

There are 24 hours in a day, so

$$5\,X + 15(24 - X) = 280$$

$$10\,X = 360 - 280$$

$$X = 8$$

Comment. There is something I have noticed in the A+Click algebra problems: the solutions usually involve only one unknown. This may be due to pedagogic reasons that stem from the order in which algebra is taught: single variable problems and then multi-variable problems, at least in my day. So I am reminded of the difficulty I had with this, since most of the problems confronted at first were really multi-variable. That is, a direct translation of the word problem into variables and equations usually involved more than one variable. So in order to *begin* having a single variable solution the student has to do some mental calculations to reduce the intrinsic number of variables to one.

I recall having trouble with this and welcoming the stage when we could use more variables. The calculations with more than one variable to reduce the case to a single variable were easier to do symbolically then mentally. The hardest part of an algebra word problem is translating it into symbols. Having to do mental calculations as part of the effort just makes it more difficult.

[1] https://aplusclick.org/t.htm?level=12;q=4564

Of course having more than two variables starts to get into the difficulties of solving a bunch of simultaneous equations. But most early elementary problems only involve two variables and their simultaneous equations are usually easy to solve on paper—a lot easier than having to do them in your head before translating the problem.

In the A+ Click solution, the student is required to think mentally first about the *average daily total evaporation*, and that this average is achieved by multiplying the shade evaporation rate times the *average* nighttime hours and adding that to the sunlight evaporation rate times the *average* daytime hours. Again, in symbols

$$5\ N/30 + 15\ D/30 = 8400/30 = 280.$$

And then the student has to consider X = N/30, so that implicitly D/30 = 24 – N/30 to arrive at

$$5\ X + 15(24 - X) = 280$$

That is a lot of mental calculation before writing down an algebraic translation. Of course, more advanced students can do more in their heads than beginners, but that is also where mistakes get made.

And one further quibble about the A+ "solution": it is good practice to state clearly at the *beginning* what the meaning of the unknown is. From the end result I realized X was the *average* nighttime hours in June. Just for clarity in readability it would have been good to make that clear initially, since the unknown is not always the direct answer to the problem.