Math Diversion 1040

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Keep an open mind. That's the secret.
— Doctor Who

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Source: https://gmatclub.com/forum/the-ratio-by-weight-of-the
-four-ingredients-a-b-c-and-d-of-a-196635.html
Title: A Ratios Problem
 Presenter: Patrick
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1 Problem

The ratios, by weight, of four ingredients A, B, C, and D of a certain mixture is $4 : 7 : 8 : 12$. The mixture will be changed so that the ratio of A to C is quadrupled and the ratio of A to D is decreased. The ratio of A to B is held constant. If B constitutes 20% of the weight of the new mixture, by approximately by what percent will the ratio of A to D be decreased?

A. 15%
B. 25%
C. 35%
D. 45%
E. 55%

2 Solution 26.2.1: Conceptualizing the Problem

Mastering the previous problem is probably useful for understanding how to do this one. Just the same, this problem has quite a few moving parts of its own.

We start with an initial state of

$$A : B : C : D \quad \longleftrightarrow \quad 4 : 7 : 8 : 12\,. \tag{1}$$

On our way to the goal, we need to find the final serial ratios

$$A' : B' : C' : D' \quad \longleftrightarrow \quad ? : ? : ? : ?\,, \tag{2}$$

using the given information. Let's go one change at a time. 1) A to C is quadrupled:

$$A' : B' : C' : D' \quad \longleftrightarrow \quad 16 :? : 8 :? \,, \tag{3}$$

2) The ratio of A to D is decreased. We'll hold off on this gem. 3) The ratio of A to B is held constant. Now, we're getting somewhere. $A' : B' :: A : B$. So, $16 : B' :: 4 : 7$. Solving this simple proportion gives us $B' = 28$.

$$A' : B' : C' : D' \quad \longleftrightarrow \quad 16 : 28 : 8 : x \,, \tag{4}$$

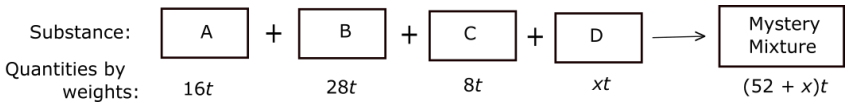

Figure 1. The new mixture, nearly specified. We don't know t and we don't need to solve for it either, but including it means we keep the ratios right. What we really need to know is x.

Once we know x, we can calculate how the ratio of A/D has decreased. This x is constrained by the fact that B constitutes 20% of the weight of the new mixture, or, put another way: B is .20 of the total weight of the new mixture.

Figure 1 show us the ingredients to make the new mixture. The parameter t is unknown, except that it must be a positive real number. It will cancel in the relation given below:

$$28t = 0.20(52 + x)t \,. \tag{5}$$

After canceling the t's, we get $x = 88$. This bring our serial ratio up to date:

$$A' : B' : C' : D' \quad \longleftrightarrow \quad 16 : 28 : 8 : 88 \,, \tag{6}$$

Now for the percent change of the ratio of $A : D$.

$$\text{Percent Change} = \frac{\text{new ratio} - \text{old ratio}}{\text{old ratio}} \times 100\% \,. \tag{7}$$

Substituting in the values

$$\begin{aligned} \text{Percent Change} &= \frac{A'/D' - A/D}{A/D} \times 100\% \\ &= \frac{16/88 - 4/12}{4/12} \times 100\% \\ &= -.4545 \,. \end{aligned} \tag{8}$$

This gives us a decrease in the ratio A/D of about 45% (Ans. D).