

A nurse has two solutions that contain different concentrations of a certain medications. One is a 10% concentration and the other is a 5% concentration. How many cubic centimeters (cc) of each should be mixed to obtain 20 cc of an 8% solution?

To understand how concentrations work, let's think a bit about a simple situation. If a solution is a 10% concentration, that means that 10% of it is medication, the rest is an inert substance like saline or water. If we mix together 10% concentration with 5% concentration, we'll get a result that falls somewhere in between. If we put in more 10% concentration, we'll get a result that is closer to 10%. If we add more 5% concentration, we'll get a result that is closer to 5% concentration. If we add equal parts 10% and 5%, we'll get a result that is 7.5%. Since we are looking to get a 10% concentration, we'll need to add a bit more 10% concentration than 5% concentration.

Now that you have some intuition of what should happen, let's get started by determining what it is that we are looking for. Since the question asks, "How many cubic centimeters (cc) of each should be mixed to obtain 20 cc of an 8% solution?", let's define the two variables:

x: amount of 5% concentration solution

y: amount of 10% concentration solution

To complete setting up the problem, we need to find information that relates these amounts.

First off, we know that we need to end up with a total of 20 cc of solution. Since the variables describe the components we'll mix to get that result, we can deduce that

$$x + y = 20$$

We have to look closer to deduce the second equation. This equation describes the total amount of medicine in the final result. Since we need to end up with 20 cc of a 7.5% concentration, we require the result to have

$$7.5\% \text{ of } 20 \text{ cc of medicine} = (.075)(20) = 1.5 \text{ cc of medicine}$$

This medicine will come from either the 5% concentration or the 10% concentration:

5% of x is medicine or $.05x$

10% of y is medicine or $.10y$

This means that the total amount of medicine is related by

$$.05x + .10y = 1.5$$

This leaves us with our system of equations:

$$x + y = 20$$

$$.05x + .10y = 1.5$$