

Applications of Systems of Linear Equations

Mixture

Idea - mix two solutions together to obtain a third solution.

Unknowns - amt of each solution mixed

Knowns - total amount needed
strengths of each solution

How can we compare solutions of different strengths? We must compare only the amount of "pure" substance in the solution.

- Ex.
- ① 1.5 oz of 80 proof liquor (40%)
 - ② 12 oz of regular beer (5%)
 - ③ 5 oz of table wine (12%)

Pure Alcohol:

- ① $(1.5)(.40) = 0.6$ oz of pure alcohol
- ② $(12)(.05) = 0.6$ oz of pure alcohol
- ③ $(5)(.12) = 0.6$ oz of pure alcohol

To find amount of "pure" substance in a solution, multiply strength by amount.

Ex How many gallons each of 25% alcohol and 35% alcohol should be mixed to get 20 gal of 32% alcohol?

$$\boxed{\begin{array}{c} x \\ \hline 25\% \end{array}} + \boxed{\begin{array}{c} y \\ \hline 35\% \end{array}} = \boxed{\begin{array}{c} 20 \\ \hline 32\% \end{array}}$$

Solution $x =$ amt of 25% alcohol sol.

$y =$ amt of 35% alcohol sol.

$$\begin{cases} x + y = 20 & \text{---.25} \\ .25x + .35y = .32(20) & \rightarrow .25x + .35y = 6.4 \end{cases} \quad (x + y = 20)$$

$$-.25x - .25y = -5$$

$$\frac{.25x + .35y = 6.4}{.10y = 1.4}$$

$$y = 14$$

$$x + y = 20$$

$$x + 14 = 20$$

$$x = 6$$

6 gal of 25% sol.
14 gal of 35% sol.

Ex. Pure acid is to be added to a 10% acid solution to obtain 54L of a 20% acid solution. What amounts of each should be used?

$$\begin{array}{c} \boxed{X} \\ 100\% \end{array} + \begin{array}{c} \boxed{y} \\ 100\% \end{array} = \begin{array}{c} \boxed{54} \\ 20\% \end{array}$$

$X =$ amt of pure acid
 $y =$ amt of 10% acid

$$X + y = 54$$

$$X + y = 54$$

$$1X + .10y = .20(54) \Rightarrow -1(X + .10y = 10.8)$$

$$\begin{array}{r} \Rightarrow X + y = 54 \\ -X - .10y = -10.8 \\ \hline .9y = 43.2 \quad X + 48 = 54 \\ y = 48 \quad X = 6 \end{array}$$