

Civil Engineering problems –

Answer to Question #1:

The worker hours to do the job are $30 * 12 * 8 = 2,880$ worker hours. In the second situation we let x be the number of hours per day, and so

$$\begin{aligned}24 * 10 * x &= 2880 \\ x &= 2880 \div (24 * 10) = 12 \text{ hours a day}\end{aligned}$$

So the job could be done by 24 workers in 10 days working **12 hours a day**.

Answer to Question #2:

We could think of this problem as having three variables, but with a little trick we can write it with just one. Let's define the amounts of material like this.

$$\begin{aligned}\text{cement} &= 3x \\ \text{sand} &= 6x \\ \text{gravel} &= 8x\end{aligned}$$

We don't know x yet, but can you see that the ratios are correct?

The next step is to find x with this equation.

$$\begin{aligned}3x + 6x + 8x &= 850 \\ \text{or} \\ 17x &= 850\end{aligned}$$

We can now solve for x .

$$\begin{aligned}\frac{17x}{17} &= \frac{850}{17} \\ x &= 50\end{aligned}$$

But you're not finished yet. The final step is to compute $8x$ to get the amount of gravel needed to make 850 cubic meters of cement.

$$8x = 8 * 50 = \mathbf{400 \text{ cubic meters of gravel}}$$

Let's check our answer using the original ratio of materials (3:6:8) and adding:

$$\begin{aligned}\text{cement} &= 3 * 50 = 150 \text{ cubic meters of gravel} \\ \text{sand} &= 6 * 50 = 300 \text{ cubic meters of gravel} \\ \text{gravel} &= 8 * 50 = \underline{400 \text{ cubic meters of gravel}} \\ &850 \text{ cubic meters of gravel}\end{aligned}$$

Chemical Engineering problem –

Answer to Question #3:

The total must be 1.2 kg at 62%

Let W = the weight of 60% alloy

Let $1.2 - W$ = the weight of the 65% alloy

This ensures that the TOTAL weight is 1.2 since $W + (1.2 - W) = 1.2$

Therefore, the equation to satisfy is

$$0.60W + 0.65(1.2 - W) = 0.62 * 1.2$$

Then

$$0.60W + 0.65(1.2 - W) = 0.744$$

0.744 is the weight of pure silver in 1.2 kg of the final mixture.

Now we need to determine how much of the other two alloys are needed.

Simplifying the above equation we get:

$$0.60W + 0.78 - 0.65W = 0.744$$

$$0.60W - 0.65W = 0.744 - 0.78$$

$$-0.05W = -0.036$$

Divide both sides by -0.05 to find W

$$W = 0.72 \text{ kg}$$

Earlier we said

Let W = the weight of 60% alloy

Let $1.2 - W$ = the weight of the 65% alloy

Therefore, the answer is

$$\begin{aligned} W &= \mathbf{0.72 \text{ kg is required of the 60\% alloy, and}} \\ 1.2 - W &= 1.2 - 0.72 = \mathbf{0.48 \text{ kg is required of the 65\% alloy}} \end{aligned}$$