

## Rational Equations Word Problems

1. Working together, it takes Sam, Jenna, and Francisco two hours to paint one room. When Sam works alone, he can paint one room in 6 hours. When Jenna works alone, she can paint one room in 4 hours. Determine how long it would take Francisco to paint one room on his own.

2. Melissa walks 3 miles to the house of a friend and returns home on a bike. She averages 4 miles per hour faster when cycling than when walking, and the total time for both trips is two hours. Find her walking speed.

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*Consider how much can be accomplished in one hour. Sam, Jenna, and Francisco together can paint half a room in one hour. If Sam can paint one room in 6 hours on his own, then in one hour he can paint  $\frac{1}{6}$  of the room. Similarly, Jenna can paint  $\frac{1}{4}$  of the room in one hour. We do not yet know how much Francisco can paint in one hour, so we will say he can paint  $\frac{1}{f}$  of the room. So, in one hour, Sam has painted  $\frac{1}{6}$  of the room, Jenna has painted  $\frac{1}{4}$  of the room, and all three together can paint  $\frac{1}{2}$  the room, leading to the following equation for how much can be painted in one hour:*

$$\frac{1}{6} + \frac{1}{4} + \frac{1}{f} = \frac{1}{2}.$$

*A common multiple of the denominators is  $12f$ . Multiplying both sides by  $12f$  gives us:*

$$\begin{aligned}\frac{12f}{6} + \frac{12f}{4} + \frac{12f}{f} &= \frac{12f}{2} \\ 2f + 3f + 12 &= 6f, \\ f &= 12.\end{aligned}$$

*So, Francisco can paint the room in 12 hours on his own.*

2. Melissa walks 3 miles to the house of a friend and returns home on a bike. She averages 4 miles per hour faster when cycling than when walking, and the total time for both trips is two hours. Find her walking speed.

*Using the relationship  $d = r \cdot t$ , we have  $t = \frac{d}{r}$ . The time it takes for Melissa to walk to her friend's house is  $\frac{3}{r}$  and the time to cycle back is  $\frac{3}{r+4}$ . Thus, we can write an equation that describes the combined time for both trips:*

$$\begin{aligned}\frac{3}{r} + \frac{3}{r+4} &= 2. \\ 3(r+4) + 3r &= 2r(r+4) \\ 3r + 12 + 3r &= 2r^2 + 8r \\ 2r^2 + 2r - 12 &= 0 \\ 2(r-2)(r+3) &= 0\end{aligned}$$

*Thus,  $r = -3$  or  $r = 2$ . Since  $r$  represents Melissa's speed, it does not make sense for  $r$  to be negative. So, the only solution is 2, which means that Melissa's walking speed is 2 miles per hour.*

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