

# Applications of Rational Equations

**Goal:** To solve work and constant motion apps

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## Work App

15. **Filling a pool.** The San Paulo community swimming pool can be filled in 12 hr if water enters through a pipe alone or in 30 hr if water enters through a hose alone. If water is entering through both the pipe and the hose, how long will it take to fill the pool?

12 hrs for pipe  
30 hrs for hose

$x$  = hours to fill the pool if both valves open

pipe fills  $\frac{1}{12}$  of the pool in 1 hr.  
hose fills  $\frac{1}{30}$  " " " " " "

together they fill  $\frac{1}{x}$  of pool in 1 hr.

$$60x \left[ \frac{1}{12} + \frac{1}{30} \right] = \frac{1}{x} 60x$$

$$\cancel{60}x \frac{1}{12} + \cancel{60}x \cdot \frac{1}{30} = 60$$

$$5x + 2x = 60$$

$$7x = 60$$

$$x = \frac{60}{7} = 8\frac{4}{7} \text{ hrs.}$$

$$\begin{array}{r} 8 \\ 7 \overline{) 60} \\ \underline{-56} \\ 4 \end{array}$$

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## Work App

21. **Hotel management.** The Austin Healthmate 400 can purify the air in a conference hall in 15 fewer minutes than it takes the Airgle 750 Air Purifier to do the same job. Together the two machines can purify the air in the conference hall in 10 min. How long would it take each machine, working alone, to purify the air in the room?

Source: Based on information from manufacturers' and retailers' websites

$x$  = # min it takes Airgle to finish  
 $x - 15$  = # " " " Austin " "  
10 min for both to finish

together they finish  $\frac{1}{10}$  of the job in 1 min  
Airgle finishes  $\frac{1}{x}$  " " " " " "  
Austin "  $\frac{1}{x-15}$  " " " " " "

$$10x(x-15) \left[ \frac{1}{x} + \frac{1}{x-15} \right] = \frac{1}{10} 10x(x-15)$$

$$10(x-15) + 10x = x(x-15)$$

$$10x - 150 + 10x = x^2 - 15x$$

$$20x - 150 = x^2 - 15x$$

$$0 = x^2 - 35x + 150$$

$$0 = (x - 5)(x - 30)$$

$$x - 5 = 0 \text{ or } x - 30 = 0$$

~~$x = 5 \text{ min or } x = 30 \text{ min}$~~

$x = 5$  doesn't make sense

So, it takes the Airgle 30 min and the Austin 15 min to finish individually.

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## Constant Motion App

36. **Train speed.** The A train goes 12 mph slower than the E train. The A train travels 230 mi in the same time that the E train travels 290 mi. Find the speed of each train.

$$\frac{D}{R} = \frac{R \cdot T}{R}$$

$$T = \frac{D}{R}$$

	D	R	T
Train A	230	$(r-12)$	$t = \frac{230}{r-12}$
Train E	290	$r$	$t = \frac{290}{r}$

$$\frac{230}{r-12} = \frac{290}{r} \rightarrow 290(r-12) = 230r$$

$$290r - 3480 = 230r$$

$$\begin{array}{r} 290r - 3480 = 230r \\ -290r \qquad \qquad -290r \\ \hline -3480 = -60r \\ \underline{-60} \quad \quad \underline{-60} \end{array}$$

Train E goes 58 mph, and Train A goes 46 mph.  $58 = r$