

1. We traveled for nine hours. Then we increased our velocity by 10 miles per hour and traveled an additional five hours. What was our original velocity if all together we have traveled 750 miles?

Solution: Let us denote our velocity in the first nine hours by x . Then the second part of the trip our velocity was $x + 10$.

	$v \left(\frac{\text{mi}}{\text{hr}} \right)$	$t \text{ (hr)}$	$s \text{ (mi)}$
Part 1	x	9	$9x$
Part 2	$x + 10$	5	$5(x + 10)$

The distance traveled in the first part and the distance traveled in the second part add up to 750 miles.

$$9x + 5(x + 10) = 750$$

$$9x + 5x + 50 = 750$$

$$14x + 50 = 750$$

$$14x = 700$$

$$x = 50$$

Thus the original velocity was $50 \frac{\text{mi}}{\text{hr}}$.

2. A bicycle leaves Chicago, heading East at $10 \frac{\text{mi}}{\text{hr}}$. Three hours later, a second bicycle leaves Chicago, heading East at $12 \frac{\text{mi}}{\text{hr}}$. How long will it take for the second bicycle to overtake the first bicycle?

Solution: Let x denote the time that the second bicycle spent traveling. Then the first bicycle had $x + 3$ hours to travel.

	$v \left(\frac{\text{mi}}{\text{hr}} \right)$	$t \text{ (hr)}$	$s \text{ (mi)}$
bicycle 1	10	$x + 3$	$10(x + 3)$
bicycle 2	12	x	$12x$

The distances are equal. They both start at Chicago and meet at the meeting point.

$$10(x + 3) = 12x$$

$$10x + 30 = 12x$$

$$30 = 2x$$

$$15 = x$$

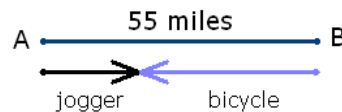
Thus it will take 15 hours after the second bicycle started.

3. Town A and town B are located 55 miles apart. A jogger starts in town A and jogs toward town B . At the same time, a bicycle starts in town B and travels toward town A . The difference between the speed of the jogger and that of the bicycle is 3 miles per hour. Find the speeds if the jogger and the bicycle meet exactly 5 hours after the start.

Solution: Let x denote the speed of the jogger. Then the speed of the bicycle is $x + 3$.

	$v \left(\frac{\text{mi}}{\text{hr}} \right)$	$t \text{ (hr)}$	$s \text{ (mi)}$
jogger	x	5	$5x$
bicycle	$x + 3$	5	$5(x + 3)$

The equation expresses that when they meet, the jogger and the bicycle has covered the 55 miles between A and B .



$$\begin{aligned}
 5x + 5(x + 3) &= 55 \\
 5x + 5x + 15 &= 55 \\
 10x + 15 &= 55 \\
 10x &= 40 \\
 x &= 4
 \end{aligned}$$

Thus the speed of the jogger is $4 \frac{\text{mi}}{\text{hr}}$ and that of the bicycle is $7 \frac{\text{mi}}{\text{hr}}$.

4. Ann headed south at 35 miles per hour. Two hours later Sue followed her, at 45 miles per hour. How long until Sue catches up with Ann?

Solution: Let x denote the time that Sue has traveled, measured in hours. Since she started two hours earlier, Ann traveled for $x + 2$ hours.

	$v \left(\frac{\text{mi}}{\text{hr}} \right)$	$t \text{ (hr)}$	$s \text{ (mi)}$
Ann	35	$x + 2$	$35(x + 2)$
Sue	45	x	$45x$

The distances are equal.

$$\begin{aligned}
 35(x + 2) &= 45x \\
 35x + 70 &= 45x \\
 70 &= 10x \\
 7 &= x
 \end{aligned}$$

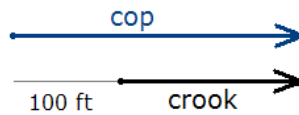
Thus it will take 7 hours.

5. The cop was chasing the crook who had a 100 ft head start. The velocity of the cop was 15 feet per second while that of the crook was 11 feet per second. How long until the cop catches up with him?

Solution: Let x denote the time they both had to travel.

	$v \left(\frac{\text{ft}}{\text{s}} \right)$	$t \text{ (s)}$	$s \text{ (ft)}$
crook	11	x	$11x$
cop	15	x	$15x$

The cop had to run as much as the crook ran, in addition to the headstart.



$$\begin{aligned} 11x + 100 &= 15x \\ 100 &= 4x \\ 25 &= x \end{aligned}$$

Thus it will take **25 seconds**.

6. A plane leaves an airport and flies south at 300 miles per hours. Later, a second plane leaves the same airport and flies south at 450 miles per hour. If the second plane overtakes the first one in 1 hour, how much earlier did the first plane leave?

Solution: Let x denote the time that the first plane traveled before the second plane started. Then the faster plane traveled for one hour, and the slower on has traveled $x + 1$ hour until they meet.

	$v \left(\frac{\text{mi}}{\text{hr}} \right)$	$t \text{ (hr)}$	$s \text{ (mi)}$
slower plane	300	$x + 1$	$300(x + 1)$
faster plane	450	1	450

The equation expresses that when they meet, the distances traveled by the planes are equal.

$$\begin{aligned} 300(x + 1) &= 450 \\ 300x + 300 &= 450 \\ 300x &= 150 \\ x &= \frac{150}{300} \\ x &= \frac{1}{2} \end{aligned}$$

Thus the first plane left **$\frac{1}{2}$ hr = 30 minutes earlier**.

7. Chicago, IL and Montpelier, VT are about 1000 miles apart. A car leaves Chicago to Montpelier at the same time as a train leaves Montpelier for Chicago. The train is $50 \frac{\text{mi}}{\text{hr}}$ faster than the car. Find the speed of the car if it takes 5 hours until the train and car meet.

Solution: Let x denote the speed of the car, measured in miles per hour. Then the speed of the train is $x + 50 \frac{\text{mi}}{\text{hr}}$.

	velocity $\left(\frac{\text{mi}}{\text{hr}}\right)$	time (hr)	distance (mi)
car	x	5	$5x$
train	$x + 50$	5	$5(x + 50)$

The equation expresses that the distances traveled are equal.

$$\begin{aligned}
 5x + 5(x + 50) &= 1000 \\
 5x + 5x + 250 &= 1000 && \text{subtract 250} \\
 10x &= 750 && \text{divide by 10} \\
 x &= 75
 \end{aligned}$$

Then the speed of the car is $75 \frac{\text{mi}}{\text{hr}}$.

8. A bicycle leaves Chicago, heading East at $14 \frac{\text{mi}}{\text{hr}}$. Three hours later, a second bicycle leaves Chicago, heading East at $17 \frac{\text{mi}}{\text{hr}}$. How long will it take for the second bicycle to overtake the first bicycle?

Solution: Let us denote by x the time it took for the second bicycle to overtake the first bicycle. Then the other bicycle had $x + 3$ hours, since it started three hours earlier.

	velocity $\left(\frac{\text{mi}}{\text{hr}}\right)$	time (hr)	distance (mi)
slower	14	$x + 3$	$14(x + 3)$
faster	17	x	$17x$

$$\begin{aligned}
 14(x + 3) &= 17x \\
 14x + 42 &= 17x && \text{subtract } 14x \\
 42 &= 3x && \text{divide by 3} \\
 14 &= x
 \end{aligned}$$

so it takes **14 hours**.

9. Milwaukee, WI and Albuquerque, NM are about 1500 miles apart. A plane leaves Milwaukee to Albuquerque at the same time as a train leaves Albuquerque for Milwaukee. The plane is $330 \frac{\text{mi}}{\text{hr}}$ faster than the train. Find the speed of the plane if it takes 3 hours until the plane and train meet.

Solution:

	velocity $\left(\frac{\text{mi}}{\text{hr}}\right)$	time (hr)	distance (mi)
train	x	3	$3x$
plane	$x + 330$	3	$3(x + 330)$

$$3x + 3(x + 330) = 1500$$

$$3x + 3x + 990 = 1500$$

$$6x + 990 = 1500$$

$$6x = 510$$

$$x = 85$$

Thus the speed of the train is $85 \frac{\text{mi}}{\text{hr}}$ and that of the plane is $415 \frac{\text{mi}}{\text{hr}}$.