Distance Problems

In order to solve distance problems, you will need to use one of the following formulas:

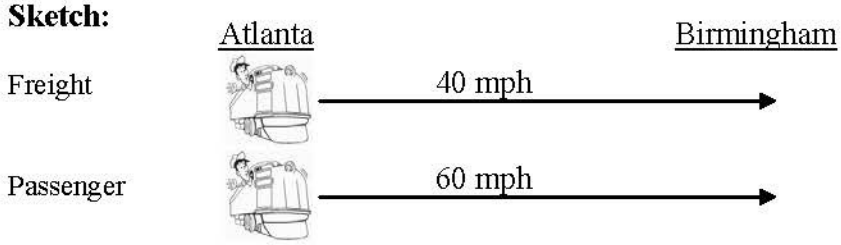
i) $\text{Distance} = \text{Rate} \bullet \text{Time}$ **ii)** $\text{time} = \frac{\text{distance}}{\text{rate}}$ **iii)** $\text{rate} = \frac{\text{distance}}{\text{time}}$

In addition, you should always do the following:

1. Make a sketch to illustrate the information given within the problem.
2. Construct a table showing the given information.
3. Write an equation based on the relationships found in the table.

Example: A freight train starts from Atlanta and heads for Birmingham at 40 mph. Two hours later, a passenger train leaves the same station for Birmingham traveling 60mph. How long before the passenger train overtakes the freight train?

Sketch:



Let **x** = time traveled by passenger train

	Rate	**Time**	**Distance** = rate * time
Freight	40	x + 2	40 (x + 2)
Passenger	60	x	60x

Explanation:
Since both trains are traveling from Atlanta to Birmingham, when the passenger train overtakes the freight train, they would have both traveled the same distance. The equation can therefore be obtained by setting the distance of the freight train **equal to** the distance of the passenger train.

Equation:

$$40(x+2) = 60x$$
$$40x+80 = 60x$$
$$-20x = -80$$
$$x = 4$$

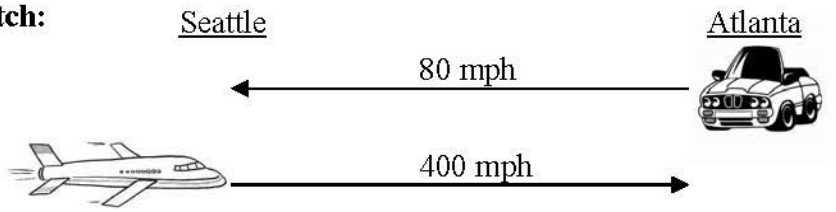
The Passenger train overtakes the freight train in 4 hours.

HINT: Either the **distance** or the **time** should be placed at the end of the table, depending on which quantity (distance or time) is equal for both parties. In the above example, the distances were the same for both trains, so distance was placed at the end of the table.

Sample Problems:

1. Laura leaves Atlanta for Seattle in her car, averaging 80 mph across open country. At the same time, a plane leaves Seattle for Atlanta using the same path and flying at 400 mph. If the distance from Atlanta to Seattle is 1200 miles, how long before the plane and the car pass each other?

Sketch:



Let **x** = distance traveled by Laura

	Rate	**Distance**	**Time** = $\frac{\text{distance}}{\text{rate}}$
Laura (car)	80	x	$\frac{x}{80}$
Plane	400	1200 - x	$\frac{1200-x}{400}$

Explanation:
Since both Laura and the plane will pass each other at the same instant, their times must be equal. The equation can therefore be obtained by setting the time for Laura **equal to** the time for the plane.

Equation:

$$\frac{x}{80} = \frac{1200-x}{400}$$

$$400x = 80(1200-x) \quad \text{cross - multiply}$$
$$400x = 96000 - 80x$$
$$480x = 96000$$
$$x = \frac{96000}{480}$$
$$x = 200$$

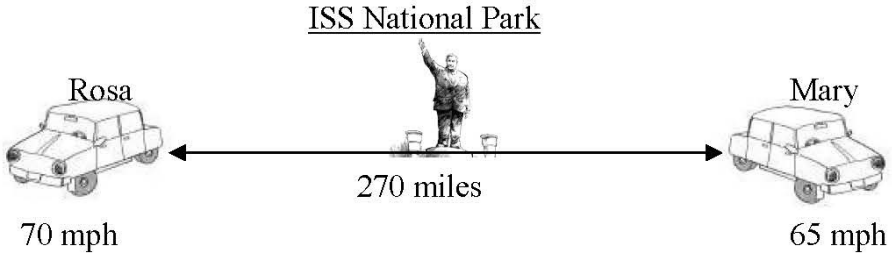
This represents the **distance** that Laura has traveled. To find the time, we can use either equation in the table above under the **time** column.

$$time = \frac{x}{80}$$
$$time = \frac{200}{80}$$
$$time = 2.5 \text{ hrs.}$$

It takes 2.5 hrs for the plane and the car to pass each other.

2. Mary leaves ISS National Park traveling east at 65 mph. At the same time, Rosa leaves the same park traveling at 70 mph due west. When will Mary and Rosa be 270 miles apart?

Sketch:



Let **x** = time traveled by either Mary or Rosa since they both have been traveling for the same amount of time.

	Rate	**Time**	**Distance** = rate * time
Mary	65	x	65x
Rosa	70	x	70x

Explanation:
Since Mary and Rosa are traveling in opposite directions, the total distance traveled is the sum of both their distances. Our equation can therefore be obtained by adding both Mary's and Rosa's distances, and setting this sum equal to 270.

$$65x + 70x = 270$$
$$135x = 270$$
$$x = \frac{270}{135}$$
$$x = 2$$

Mary and Rosa will be 270 miles apart in 2 hours.