

4–8 Rate-Time-Distance Problems

Objective: To solve some word problems involving uniform motion.

Vocabulary **Uniform motion** Motion at a constant speed, or rate.

CAUTION Some problems give the time in *minutes* and the speed in *miles per hour*.
Be sure to write the time in terms of hours when you use the given facts.

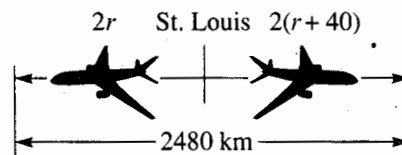
Example 1 **(Motion in opposite directions)** Two jets leave St. Louis at 8:00 A.M., one flying east at a speed 40 km/h greater than the other, which is traveling west. At 10:00 A.M. the planes are 2480 km apart. Find their speeds.

Solution

Step 1 The problem asks for the speeds, or rates, of the planes.

Step 2 Let r = the rate of the plane flying west. Then $r + 40$ = rate of the plane flying east. Make a chart organizing the given facts and use it to label a sketch. Remember that east and west are *opposite directions*.

	Rate	\times Time	= Distance
East bound	$r + 40$	2	$2(r + 40)$
West bound	r	2	$2r$



Step 3 The distance between two objects moving in *opposite directions* is the *sum* of the separate distances traveled. The sum of the distances is 2480 km.

$$2r + 2(r + 40) = 2480$$

Step 4 $2r + 2r + 80 = 2480$

$$4r + 80 = 2480$$

$$4r = 2400$$

$$r = 600$$

$$r + 40 = 640$$

Step 5 Check: In 2 h the eastbound plane flies $2(640) = 1280$ (km).
In 2 h the westbound plane flies $2(600) = 1200$ (km).
 $1280 + 1200 = 2480$ ✓

The speed of the plane flying west is 600 km/h.

The speed of the plane flying east is 640 km/h.

Solve.

- Two jets leave Ontario at the same time, one flying east at a speed 20 km/h greater than the other, which is flying west. After 4 h, the planes are 6000 km apart. Find their speeds.
- Two camper vans leave Arrowhead Lake at the same time, one traveling north at a speed of 10 km/h faster than the other, which is traveling south. After 3 h, the camper vans are 420 km apart. Find their speeds.
- Two cars traveled in opposite directions from the same starting point. The rate of one car was 10 km less than the rate of the other. After 4 h the cars were 600 km apart. Find the rate of each car.

4-8 Rate-Time-Distance Problems (continued)

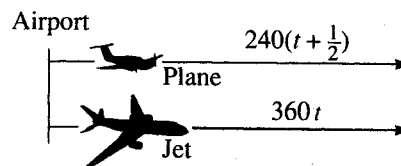
Example 2 (Motion in the same direction) A small plane leaves an airport and flies north at 240 mi/h. A jet leaves the airport 30 min later and follows the small plane at 360 mi/h. How long does it take the jet to overtake the small plane?

Solution

Step 1 The problem asks for the jet's flying time before it overtakes the small plane.

Step 2 Let t = the jet's flying time. Then $t + \frac{1}{2}$ = the small plane's flying time. Make a chart organizing the given facts and use it to label a sketch. Notice that 30 min must be written as $\frac{1}{2}$ h.

	Rate \times Time = Distance		
Plane	240	$t + \frac{1}{2}$	$240(t + \frac{1}{2})$
Jet	360	t	$360t$



Step 3 When the jet overtakes the plane, the distances will be equal.
 $360t = 240(t + \frac{1}{2})$

Step 4 $360t = 240t + 120$
 $120t = 120$
 $t = 1$

Step 5 Check in the words of the problem. The jet overtakes the plane in 1 h.

Solve.

- A car started out from Memphis toward Little Rock at the rate of 60 km/h. A second car left from the same point 2 h later and drove along the same route at 75 km/h. How long did it take the second car to overtake the first car?
- A tourist bus leaves Richmond at 1:00 P.M. for New York City. Exactly 24 min later, a truck sets out in the same direction. The tourist bus moves at a steady 60 km/h. The truck travels at 80 km/h. How long does it take the truck to overtake the tourist bus?
- Exactly 20 min after Alex left home, his sister Alison set out to overtake him. Alex drove at 48 mph and Alison drove at 54 mph. How long did it take Alison to overtake Alex?
- The McLeans drove from their house to Dayton at 75 km/h. When they returned, the traffic was heavier and they drove at 50 km/h. If it took them 1 h longer to return than to go, how long did it take them to drive home?
- It takes a plane 1 h less to fly from San Diego to New Orleans at 600 km/h than it does to return at 450 km/h. How far apart are the cities?

Mixed Review Exercises**Solve.**

1. $32 = -8x$

2. $3(x + 4) = 27$

3. $(x - 4)(x + 7) = (x + 4)(x - 3)$