Rate, Time Distance Problems With Solutions

The relationship between distance, rate (speed) and time

Distance = time * rate

is used to solve uniform motion problems. Detailed solutions to the problems are provided.

Problem 1: Two cars started from the same point, at 5 am, traveling in opposite directions at 40 and 50 mph respectively. At what time will they be 450 miles apart?

Solution to Problem 1:

- After $t$ hours the distances $D_1$ and $D_2$, in miles per hour, traveled by the two cars are given by
  
  $D_1 = 40t$ and $D_2 = 50t$

- After $t$ hours the distance $D$ separating the two cars is given by
  
  $D = D_1 + D_2 = 40t + 50t = 90t$

- Distance $D$ will be equal to 450 miles when
  
  $90t = 450$

  $t = 5$ hours.

  5 am + 5 hours = 10 am

Problem 2: At 9 am a car (A) began a journey from a point, traveling at 40 mph. At 10 am another car (B) started traveling from the same point at 60 mph in the same direction as car (A). At what time will car B pass car A?

Solution to Problem 2:

- After $t$ hours the distances $D_1$ traveled by car A is given by
  
  $D_1 = 40t$

- Car B starts at 10 am and will therefore have spent one hour less than car A when it passes it. After $(t - 1)$ hours, distance $D_2$ traveled by car B is given by
  
  $D_2 = 60(t - 1)$

- When car B passes car A, they are at the same distance from the starting point and therefore $D_1 = D_2$ which gives
  
  $40t = 60(t - 1)$

- Solve the above equation for $t$ to find
  
  $t = 3$ hours

- Car B passes car A at
  
  $9 + 3 = 12$ pm

We're Looking for Authors

www.childrens-book-publishing.com

Book Publishers Ready to Publish New Authors. Free Consultation!
D1 = 72 t and D2 = 78 t

- After t hours total distance D traveled by the two trains is given by
  \[ D = D1 + D2 = 72 t + 78 t = 150 t \]
- When distance D is equal to 900 miles, the two trains pass each other.
  \[ 150 t = 900 \]
- Solve the above equation for t
  \[ t = 6 \text{ hours}. \]

**Problem 4:** John left home and drove at the rate of 45 mph for 2 hours. He stopped for lunch then drove for another 3 hours at the rate of 55 mph to reach his destination. How many miles did John drive?

**Solution to Problem 4:**

- The total distance D traveled by John is given by
  \[ D = 45 \times 2 + 3 \times 55 = 255 \text{ miles}. \]

**Problem 5:** Linda left home and drove for 2 hours. She stopped for lunch then drove for another 3 hours at a rate that is 10 mph higher than the rate before she had lunch. If the total distance Linda traveled is 230 miles, what was the rate before lunch?

**Solution to Problem 5:**

- If \( x \) is the rate at which Linda drove before lunch the rate after lunch is equal \( x + 10 \). The total distance \( D \) traveled by Linda is given by
  \[ D = 2x + 3(x + 10) \]
- and is equal to 230 miles. Hence
  \[ 2x + 3(x + 10) = 230 \]
- Solve for \( x \) to obtain
  \[ x = 40 \text{ miles/hour}. \]

**Problem 6:** Two cars left, at 8 am, from the same point, one traveling east at 50 mph and the other traveling south at 60 mph. At what time will they be 300 miles apart?

**Solution to Problem 6:**

- A diagram is shown below to help you understand the problem.

![Diagram](http://www.analyzemath.com/math_problems/rate_time_dist_problems.html)

- The two cars are traveling in directions that are at right angle. Let \( x \) and \( y \) be the distances traveled by the two cars in \( t \) hours. Hence
  \[ x = 50 t \text{ and } y = 60 t \]
- Since the two directions are at right angle, Pythagora's theorem can used to find distance \( D \) between the two cars as follows:
  \[ D = \sqrt{x^2 + y^2} \]
- We now find the time at which \( D = 300 \text{ miles} \) by solving
  \[ \sqrt{x^2 + y^2} = 300 \]
- Square both sides and substitute \( x \) and \( y \) by 50 \( t \) and 60 \( t \) respectively to obtain the equation
\[(50 \, t)^2 + (60 \, t)^2 = 300^2\]

- Solve the above equations to obtain
  \[t = 3.84 \text{ hours (rounded to two decimal places)} \text{ or 3 hours and 51 minutes (to the nearest minute)}\]
- The two cars will 300 miles apart at
  \[8 + 3 \, h \, 51' = 11:51 \, \text{am.}\]

**Problem 7:** By Car, John traveled from city A to city B in 3 hours. At a rate that was 20 mph higher than John's, Peter traveled the same distance in 2 hours. Find the distance between the two cities.

**Solution to Problem 7:**

- Let \(x\) be John's rate in traveling between the two cities. The rate of Peter will be \(x + 10\). We use the rate-time-distance formula to write the distance \(D\) traveled by John and Peter (same distance \(D\))
  \[D = 3 \, x \text{ and } D = 2(x + 20)\]
- The first equation can be solved for \(x\) to give
  \[x = D / 3\]
- Substitute \(x\) by \(D / 3\) into the second equation
  \[D = 2(D / 3 + 20)\]
- Solve for \(D\) to obtain \(D = 120\) miles

**Problem 8:** Gary started driving at 9:00 am from city A towards city B at a rate of 50 mph. At a rate that is 15 mph higher than Gary's, Thomas started driving at the same time as John from city B towards city A. If Gary and Thomas crossed each other at 11 am, what is the distance between the two cities?

**Solution to Problem 8:**

- Let \(D\) be the distance between the two cities. When Gary and Thomas cross each other, they have covered all the distance between the two cities. Hence
  \[D_1 = 2 \times 50 = 100 \text{ miles, distance traveled by Gary}\]
  \[D_1 = 2 \times (50 + 15) = 130 \text{ miles, distance traveled by Gary}\]
- Distance \(D\) between the two cities is given by
  \[D = 100 \text{ miles} + 130 \text{ miles} = 230 \text{ miles}\]

**Problem 9:** Two cars started at the same time, from the same point, driving along the same road. The rate of the first car is 50 mph and the rate of the second car is 60 mph. How long will it take for the distance between the two cars to be 30 miles?

**Solution to Problem 9:**

- Let \(D_1\) and \(D_2\) be the distances traveled by the two cars in \(t\) hours
  \[D_1 = 50 \, t \text{ and } D_2 = 60 \, t\]
- The second has a higher speed and therefore the distance \(d\) between the two cars is given by
  \[d = 60 \, t - 50 \, t = 10 \, t\]
- For \(d\) to be 30 miles, we need to have
  \[30 \, \text{miles} = 10 \, t\]
- Solve the above equation for \(t\) to obtain
  \[t = 3 \, \text{hours.}\]

**Problem 10:** Two trains started at 10 pm, from the same point. The first train traveled North at the rate of 80 mph and the second train traveled South at the rate of 100 mph. At what time were they 450 miles apart?

**Solution to Problem 10:**

- Let \(D_1\) and \(D_2\) be the distances traveled by the two trains in \(t\) hours.
  \[D_1 = 80 \, t \text{ and } D_2 = 100 \, t\]
- Since the two trains are traveling in opposite directions, then total distance \(D\) between the two trains is given by
D = D₁ + D₂ = 180 t

- For this distance to be 450 miles, we need to have
  
  180 t = 450

- Solve for t to obtain
  
  t = 2 hours 30 minutes.

10 pm + 2:30 = 12:30 am

**Problem 11:** Two trains started from the same point. At 8:00 am the first train traveled East at the rate of 80 mph. At 9:00 am, the second train traveled West at the rate of 100 mph. At what time were they 530 miles apart?

**Solution to Problem 11:**

- When the first train has traveled for t hours the second train will have traveled (t - 1) hours since it started 1 hour late. Hence if D₁ and D₂ are the distances traveled by the two trains, then
  
  D₁ = 80 t and D₂ = 100 (t - 1)

- Since the trains are traveling in opposite directions, the total distance D between the two trains is given by
  
  D = D₁ + D₂ = 180 t - 100

- For D to be 530 miles, we need to have
  
  180 t - 100 = 530

- Solve for t
  
  t = 3 hours 30 minutes.

8 am + 3:30 = 11:30 am

**Math Game**

singapore.gumtree.sg/games

Great Range of Games for Kids. Amazing Deals. 100's of Local Ads!

More math problems with detailed solutions in this site.