

Races

May 2, 2011

[Adapted from “Math Circle for grades 6 and 7” by A. Spivak (in Russian).]

1. Jinny’s mom is chasing Jinny. At first, the distance between them is 10 meters. Jinny’s mom runs at a speed of 8 meters per second. Jinny runs at 7 meters per second. After how long will Jinny’s mom catch up with Jinny?
2. Clint’s car is traveling at a speed of 60 miles per hour. Clint wants to save 1 minute per mile. How should he increase the speed of his car?
3. Two hikers are hiking from Los Angeles to San Francisco. The first one covers 40 miles each day. The second starts a day later than the first one and covers 45 miles each day. When will the second hiker catch up with the first one?

4. It takes James 30 minutes to walk from home to school. It takes his younger sister Ann 40 minutes to walk the same route. In the morning, Ann starts walking to school 5 minutes earlier than James. How soon will James catch up with Ann? (Assume that each of them walks at a constant speed.)
5. Jack drove from his house to his sister's house in 10 hours. If the speed of his truck had been 10 miles per hour faster, the same distance would have taken only 8 hours.
- (a) Draw a line representing the distance from Jack's house to his sister's house. Make a mark showing how far Jack traveled in 8 hours, and another mark showing how far he *would* travel in 8 hours if he went 10 miles per hour faster.
- (b) How much extra distance would Jack travel over a period of 8 hours, if his speed increased by 10 miles per hour?
- (c) How far did Jack have left to drive after he had been driving for 8 hours?
- (d) What was the speed of Jack's truck?

6. Achilles and Tortoise have a 100-meter footrace, and Achilles wins by 20 meters.
- (a) What is the relationship between Achilles's speed and Tortoise's speed?

 - (b) How far back from the starting line should Achilles start in the next race so that they reach the finish line at the same time?
7. It takes the train 1 minute to cross a 450 meter long bridge. (Note: the clock starts as soon as any part of the train is on the bridge, and stops when the entire train is off the bridge.) It takes the train 30 seconds to pass a traffic light.
- (a) Suppose two traffic lights are spaced out so that it takes the train exactly 1 minute to completely pass them both. Draw a picture of what it looks like 30 seconds after the train started passing the first stoplight. (Be sure to label the stoplights "1st" and "2nd" and draw an arrow representing the direction of the train's motion.)

 - (b) If it takes the train exactly 1 minute to completely pass the two stoplights, how far apart are the stoplights, in meters? What is the length of the train?

 - (c) How fast is the train going (be sure to say what units of measurement you're using for speed!)

8. On a mountain road, the bus travels at a speed of 15 mph when going uphill and 30 mph going downhill. (No part of the road is flat.)
- (a) The bus makes a round trip between two villages on the mountain road. (Round trip means it starts at Village A, drives to Village B, then drives back to Village A.) What fraction of the total *distance* the bus travels is it going uphill?
- (b) How much longer does it take the bus to travel a certain distance uphill than the same distance downhill? What fraction of the total *time* the bus travels on its round trip, is it going uphill?
- (c) During the round trip, how much time does the bus spend going uphill? How much time does it spend going downhill?
- (d) What is the distance between the two villages, if the round trip between them takes 6 hours?