

## Example context-rich problems: One-dimensional Motion at a Constant Velocity

- You are writing a short adventure story for your English class. In your story, two submarines on a secret mission need to arrive at a place in the middle of the Atlantic ocean at the same time. They start out at the same time from positions equally distant from the rendezvous point. They travel at different velocities but both go in a straight line. The first submarine travels at an average velocity of 20 km/hr for the first 500 km, 40 km/hr for the next 500 km, 30 km/hr for the next 500 km and 50 km/hr for the final 500 km. In the plot, the second submarine is required to travel at a constant velocity, so the captain needs to determine the magnitude of that velocity.
- It is a beautiful weekend day and, since winter will soon be here, you and four of your friends decide to spend it outdoors. Two of your friends just want to relax while the other two want some exercise. You need some quiet time to study. To satisfy everyone, the group decides to spend the day on the river. Two people will put a canoe in the river and just drift downstream with the 1.5 mile per hour current. The second pair will begin at the same time as the first from 10 miles downstream. They will paddle upstream until the two canoes meet. Since you have been canoeing with these people before, you know that they will have an average velocity of 2.5 miles per hour relative to the shore when they go against this river current. When the two canoes meet, they will come to shore and you should be there to meet them with your van. You decide to go to that spot ahead of time so you can study while you wait for your friends. Where will you wait?
- It's a sunny Sunday afternoon, about 65 °F, and you are walking around Lake Calhoun enjoying the last of the autumn color. The sidewalk is crowded with runners and walkers. You notice a runner approaching you wearing a tee-shirt with writing on it. You read the first two lines, but are unable to read the third and final line before he passes. You wonder, "Hmm, if he continues around the lake, I bet I'll see him again, but I should anticipate the time when we'll pass again." You look at your watch and it is 3:07 p.m. You recall the lake is 3.4 miles in circumference. You estimate your walking speed at 3 miles per hour and the runner's speed to be about 7 miles per hour.
- You have joined the University team racing a solar powered car. The optimal average speed for the car depends on the amount of sun hitting its solar panels. Your job is to determine strategy by programming a computer to calculate the car's average speed for a day consisting of different race conditions. To do this you need to determine the equation for the day's average speed based on the car's average speed for each part of the trip. As practice you imagine that the day's race consists of some distance under bright sun, the same distance with partly cloudy conditions, and twice that distance under cloudy conditions.
- Because of your technical background, you have been given a job as a student assistant in a University research laboratory that has been investigating possible accident avoidance systems for oil tankers. Your group is concerned about oil spills in the North Atlantic caused by a super tanker running into an iceberg. The group has been developing a new type of down-looking radar which can detect large icebergs. They are concerned about its rather short range of 2 miles. Your research director has told you that the radar signal travels at the speed of light which is 186,000 miles per second but once the signal arrives back at the ship it takes the computer 5 minutes to process the signal. Unfortunately, the super tankers are such huge ships that it takes a long time to turn them. Your job is to determine how much time would be available to turn the tanker to avoid a collision once the tanker detects an iceberg. A typical sailing speed for super tankers during the winter on the North Atlantic is about 15 miles per hour. Assume that the tanker is heading directly at an iceberg that is drifting at 5 miles per hour in the same direction that the tanker is going.

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