Motion (Speed, Velocity, and Acceleration)

1. Hans stands at the rim of the Grand Canyon and yodels down to the bottom. He hears his yodel echo back from the canyon floor 5.20 s later. Assume that the speed of sound in air is 340.0 m/s. How deep is the canyon at this location?

2. The horse racing record for a 1.50 mi track is shared by two horses: Fiddle Isle, who ran the race in 143 s on March 21, 1970, and John Henry, who ran the same distance in an equal time on March 16, 1980. What were the horses' average speed in a) mi/s? b) mi/h?

3. For a long time it was the dream of many runners to break the "4-minute mile." Now quite a few runners have achieved what once seemed an impossible goal. On July 2, 1988, Steve Cram of Great Britain ran a mile in 3.81 min. During this amazing run, what was Steve Cram's average in a) mi/min? b) mi/h?

4. It is now 10:29 a.m., but when the bell rings at 10:30 a.m. Suzette will be late for French class for the third time this week. She must get from one side of the school to the other by hurrying down three different hallways. She runs down the first hallway, a distance of 35.0 m, at a speed of 3.50 m/s. The second hallway is filled with students, and she covers its 48.0-m length at an average speed of 1.20 m/s. the final hallway is empty, and Suzette sprints its 60.0-m length at a speed of 5.00 m/s. A) Does Suzette make it to class on time or does she get detention for being late again? B) Draw a distance vs. time graph of the situation.

5. A jumbo jet taxiing down the runway receives word that it must return to the gate to pick up an important passenger who was late to his connecting flight. This jet is traveling at 45.0 m/s when the pilot receives the message. What is the acceleration of the plane if it takes the pilot 5.00 s to bring the plane to a halt?

6. While driving his sports car at 20.0 m/s down a four-lane highway, Eddie comes up behind a slow-moving dump truck and decides to pass it in the left-hand lane. If Eddie can accelerate at 5.00 m/s^2, how long will it take for him to reach a speed of 30.0 m/s?

7. Monica is walking to the hairdresser's at 1.3 m/s when she glances at her watch and realizes that she is going to be late for her appointment. Monica gradually quickens her pace at a rate of 0.090 m/s^2. What is Monica's speed after 10.0 s?

8. A torpedo fired from a submerged submarine is propelled through the water with a speed of 20.00 m/s and explodes upon impact with a target 2000.0 m away. If the sound of the impact is heard 101.4 s after the torpedo was fired, what is the speed of sound in water? (Because the torpedo is held at a constant speed by its propeller, the effect of water resistance can be neglected.)

Examples:

1. Benjamin watches a thunderstorm from his apartment window. He sees the flash of lightning bolt and begins counting the seconds until he hears the clap of thunder 10.0 s later. Assume that the speed of sound in air is 340.0 m/s. How far away was the lighting bolt a) in m? b) in km? (Note: The speed of light, 3.00×10^8 m/s, is considerably faster than the speed of sound. That is why you see the lightning flash so much earlier than you hear the clap of thunder. In actuality, the lightning and thunderclap occur simultaneously.)

2. On May 29, 1988, Rick Mears won the Indianapolis 500 in 3.45 h. What was his average speed during the 500-mi race? (Note: Generally the unit "miles" is not used in physics exercises. However, the Indianapolis 500 is a race that is measured in miles, so the mile is appropriate here. Don't forget, the SI unit for distance is the meter.)

3. The slowest animal ever discovered was a crab found in the Red Sea. It traveled with an average speed of 5.70 km/y. How long would it take this crab to travel 100. Km?

4. Tiffany, who is opening in a new Broadway show, has some limo trouble in the city. With only 8.0 minutes until curtain time, she hails a cab and they speed off to the theater down a 1000 m long one-way street at a speed of 25 m/s. At the end of the street the cab driver waits at a traffic light for 1.5 min and then turns north onto 1700 m long traffic-filled avenue on which he is able to travel at a speed of 10.0 m/s. Finally, this brings them to the theater. a) Does Tiffany arrive before the theater lights dim? b) Draw a distance vs. time graph of the situation.

5. Grace is driving her sports car at 30 m/s when a ball rolls out into the street in front of her. Grace slams on the brakes and comes to a stop in 3.0 s. What was the acceleration of Grace's car?