Physics I

Velocity Basics

Definition of velocity in one dimension: $v = \frac{x}{t}$

Equations when the acceleration is constant:

$$x = v_1 t + \frac{1}{2} a t^2 \qquad v_2{}^2 = v_1^2 + 2ax \qquad v_2 = v_1 + at \qquad \overline{v} = \frac{v_1 + v_2}{2}$$

1 mile = 1609 m

Problem 1.- Donovan Bailey of Canada broke the world record in the 100m dash at the 1996 Atlanta Olympics with a time of 9.84 seconds. With this gold medal, he became "the world's fastest man".

a. What was his average velocity over this distance in miles per hour?

b. A couple of days later, Michael Johnson set the world record in the 200m dash with a time of 19.32 seconds. What was his average speed in miles per hour?

c. Was Donovan Bailey the world's fastest man?

Problem 2.- In the Olympic Games in Seoul, Korea, Carl Lewis of the USA ran 100.0 meters in 9.92 seconds to win the gold medal. Find his average velocity in miles per hour. Use the correct number of significant figures.

Problem 3.- Usain Bolt of Jamaica broke the world record in the 100m dash in 2009 with a time of 9.58 seconds.

a. What was his average speed over this distance in miles per hour?

b. He also broke the world record in the 200m dash with a time of 19.19 seconds. What was his average speed in miles per hour?

c. In which race was his average speed higher?

Problem 4.- The cheetah is the fastest animal on land. Calculate how long (in seconds) it would take a cheetah to run 460 m at its maximum speed of 70 miles per hour.

Problem 5.- Find the equation for the time of flight of an airplane back and forth a distance L if the velocity of the plane in air is v and the wind velocity is v' in two cases:
i) Wind parallel to the direction of the plane.
ii) Wind perpendicular to the direction of the plane.

Problem 6.- In a new "crazy-triathlon" competition, you have to run sideways for 1km, then backwards for 1km and finally 1km any way you want (free-style).

Competitor A has speeds of 4m/s, 6m/s, and 8m/s for the three legs of the competition.

Competitor B has speeds of 5m/s, 6m/s, and 7m/s.

Which competitor wins the race?
Do you get any insight about average speeds from this problem?