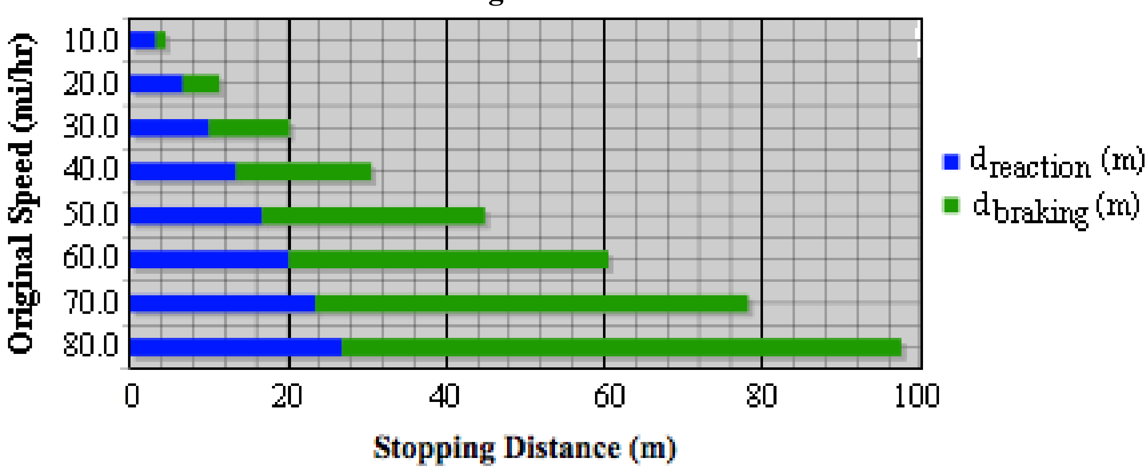
Stopping Distance

One aspect of safe driving involves the ability to stop a car readily. This ability depends upon the driver's alertness and readiness to stop, the conditions of the road, the speed of the car, and the braking characteristics of the car. The actual distance that it takes to stop the car can be thought of as consisting of two parts - the reaction distance and braking distance.

When a driver sees an event in his/her field of view that might warrant braking (for example, a dog running into the street), a collection of actions must be taken before the braking actually begins. First the driver must identify the event and decide if braking is necessary. Then the driver must lift his/her foot off the gas pedal and move it to the brake pedal. And finally, the driver must press the brake down its full distance in order to obtain maximum braking acceleration. The time to do all this is known as the **reaction time**. The distance traveled during this time is known as the **reaction distance**. Once the brakes are applied, the car begins to slow to a stop. The distance traveled by the car during this time is known as the **braking distance**. The braking distance is dependent upon the original speed of the car, the road conditions, and characteristics of the car such as its profile area, mass and tire conditions. **Figure 1** shows the stopping distance for a Toyota Prius on dry pavement resulting from a 0.75-second reaction time.

Figure 1



The reaction time of the driver is highly dependent upon the alertness of the driver. Small changes in reaction time can have a huge effect upon the total stopping distance. **Table 1** shows the reaction distance, braking distance and total stopping distance for a Toyota Prius with an original speed of 50.0 mi/hr and varying reaction times.

Table 1

t_{rxn} (s)	$d_{reaction}$ (m)	$d_{braking}$ (m)	d_{total} (m)
0.40	8.9	28.2	37.1
0.50	11.2	28.2	39.4
0.60	13.4	28.2	41.6
0.70	15.6	28.2	43.8
0.80	17.9	28.2	46.1
0.90	20.3	28.2	48.5
1.00	22.3	28.2	50.5

Questions:

1. Based on **Figure 1**, what effect does the doubling of the speed of a car have upon the braking distance?
   a. The braking distance is doubled.
   b. The braking distance is one-half the value.
   c. The braking distance is not affected by a doubling of speed.
   d. The braking distance is increased by more than a factor of two.

2. What is the reaction distance of a Toyota Prius moving at 60.0 mi/hr on dry pavement and driven by a driver with a 0.75-second reaction time?
   a. 16.8 meters   b. 20.0 meters
   c. 40.0 meters   d. 60.0 meters

3. Based on **Figure** 1, at what car speed does the reaction distance of a car equal the braking distance of a car?
   a. 20.0 mi/hr   b. 30.0 mi/hr
   c. 40.0 mi/hr   d. 60.0 mi/hr

4. A student is *texting* while driving a Toyota Prius at 50.0 mi/hr on dry pavement. As a result, the reaction time is 1.5 seconds. Use the data of **Table 1** to predict the total stopping distance of the student's car.
   a. Approximately 33.5 meters   b. Approximately 45.0 meters
   c. Approximately 50.5 meters   d. Approximately 61.7 meters

5. Which of the following combinations of reaction time and car speed would lead to the greatest stopping distance?
   a. Reaction time = 0.90 seconds;   car speed = 30 mi/hr.
   b. Reaction time = 0.75 seconds;   car speed = 40 mi/hr.
   c. Reaction time = 0.90 seconds;   car speed = 50 mi/hr.
   d. Reaction time = 0.70 seconds;   car speed = 80 mi/hr.