* **49.** (III) An airplane whose air speed is 620 km/h is supposed to fly in a straight path 35.0° north of east. But a steady 95 km/h wind is blowing from the north. In what direction should the plane head?

* **50.** (III) An unmarked police car, traveling a constant 95 km/h, is passed by a speeder traveling 145 km/h. Precisely 1.00 s after the speeder passes, the policeman steps on the accelerator. If the police car's acceleration is 2.00 m/s², how much time elapses after the police car is passed until it overtakes the speeder (assumed moving at constant speed)?

* **51.** (III) Assume in Problem 50 that the speeder's speed is not known. If the police car accelerates uniformly as given above, and overtakes the speeder after 7.00 s, what was the speeder's speed?

* **52.** (III) Two cars approach a street corner at right angles to each other (Fig. 3–41). Car 1 travels at a speed relative to Earth $v_{1E} = 35$ km/h, and car 2 at $v_{2E} = 55$ km/h. What is the relative velocity of car 1 as seen by car 2? What is the velocity of car 2 relative to car 1?

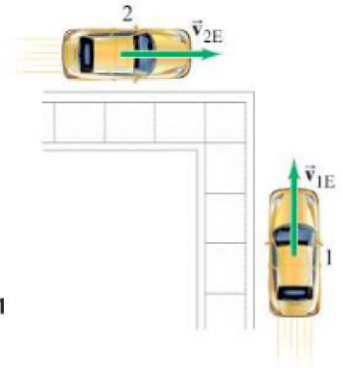**FIGURE 3–41**
Problem 52.

General Problems

53. William Tell must split the apple atop his son's head from a distance of 27 m. When William aims directly at the apple, the arrow is horizontal. At what angle must he aim it to hit the apple if the arrow travels at a speed of 35 m/s?

54. A plumber steps out of his truck, walks 50 m east and 25 m south, and then takes an elevator 10 m down into the subbasement of a building where a bad leak is occurring. What is the displacement of the plumber relative to his truck? Give your answer in components, and also give the magnitude and angles with the x axis in the vertical and horizontal planes. Assume x is east, y is north, and z is up.

55. On mountainous downhill roads, escape routes are sometimes placed to the side of the road for trucks whose brakes might fail. Assuming a constant upward slope of 32°, calculate the horizontal and vertical components of the acceleration of a truck that slowed from 120 km/h to rest in 6.0 s. See Fig. 3–42.

FIGURE 3–42 Problem 55.

56. What is the y component of a vector (in the xy plane) whose magnitude is 88.5 and whose x component is 75.4? What is the direction of this vector (angle it makes with the x axis)?

57. Raindrops make an angle θ with the vertical when viewed through a moving train window (Fig. 3–43). If the speed of the train is v_T, what is the speed of the raindrops in the reference frame of the Earth in which they are assumed to fall vertically?

FIGURE 3–43   Problem 57.

58. A light plane is headed due south with a speed of 155 km/h relative to still air. After 1.00 hour, the pilot notices that they have covered only 125 km and their direction is not south but southeast (45.0°). What is the wind velocity?

59. A car moving at 95 km/h passes a 1.00-km-long train traveling in the same direction on a track that is parallel to the road. If the speed of the train is 75 km/h, how long does it take the car to pass the train, and how far will the car have traveled in this time? What are the results if the car and train are instead traveling in opposite directions?