

## Conceptual Questions

### 4.1 Displacement and Velocity Vectors

- 1 . What form does the trajectory of a particle have if the distance from any point  $A$  to point  $B$  is equal to the magnitude of the displacement from  $A$  to  $B$ ?
- 2 . Give an example of a trajectory in two or three dimensions caused by independent perpendicular motions.
- 3 . If the instantaneous velocity is zero, what can be said about the slope of the position function?

### 4.2 Acceleration Vector

- 4 . If the position function of a particle is a linear function of time, what can be said about its acceleration?
- 5 . If an object has a constant  $x$ -component of the velocity and suddenly experiences an acceleration in the  $y$  direction, does the  $x$ -component of its velocity change?
- 6 . If an object has a constant  $x$ -component of velocity and suddenly experiences an acceleration at an angle of  $70^\circ$  in the  $x$  direction, does the  $x$ -component of velocity change?

### 4.3 Projectile Motion

- 7 . Answer the following questions for projectile motion on level ground assuming negligible air resistance, with the initial angle being neither  $0^\circ$  nor  $90^\circ$  : (a) Is the velocity ever zero? (b) When is the velocity a minimum? A maximum? (c) Can the velocity ever be the same as the initial velocity at a time other than at  $t = 0$ ? (d) Can the speed ever be the same as the initial speed at a time other than at  $t = 0$ ?
- 8 . Answer the following questions for projectile motion on level ground assuming negligible air resistance, with the initial angle being neither  $0^\circ$  nor  $90^\circ$  : (a) Is the acceleration ever zero? (b) Is the vector  $\vec{v}$  ever parallel or antiparallel to the vector  $\vec{a}$ ? (c) Is the vector  $v$  ever perpendicular to the vector  $a$ ? If so, where is this located?
- 9 . A dime is placed at the edge of a table so it hangs over slightly. A quarter is slid horizontally on the table surface perpendicular to the edge and hits the dime head on. Which coin hits the ground first?

### 4.4 Uniform Circular Motion

- 10 . Can centripetal acceleration change the speed of a particle undergoing circular motion?

**11** . Can tangential acceleration change the speed of a particle undergoing circular motion?

## **4.5 Relative Motion in One and Two Dimensions**

**12** . What frame or frames of reference do you use instinctively when driving a car? When flying in a commercial jet?

**13** . A basketball player dribbling down the court usually keeps his eyes fixed on the players around him. He is moving fast. Why doesn't he need to keep his eyes on the ball?

**14** . If someone is riding in the back of a pickup truck and throws a softball straight backward, is it possible for the ball to fall straight down as viewed by a person standing at the side of the road? Under what condition would this occur? How would the motion of the ball appear to the person who threw it?

**15** . The hat of a jogger running at constant velocity falls off the back of his head. Draw a sketch showing the path of the hat in the jogger's frame of reference. Draw its path as viewed by a stationary observer. Neglect air resistance.

**16** . A clod of dirt falls from the bed of a moving truck. It strikes the ground directly below the end of the truck. (a) What is the direction of its velocity relative to the truck just before it hits? (b) Is this the same as the direction of its velocity relative to ground just before it hits? Explain your answers.