CHAPTER 3 REVIEW

Key Terms

3.1
- motion diagram
- operational definition
- particle model

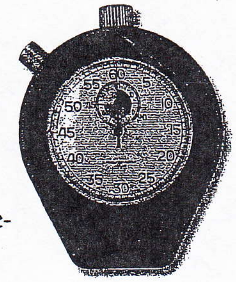
3.2
- coordinate system
- origin
- position vector
- scalar quantity
- vector quantity
- displacement
- time interval
- distance

3.3
- average velocity
- average speed
- instantaneous velocity
- average acceleration

Summary

3.1 Picturing Motion
- A motion diagram shows the position of an object at successive times.
- In the particle model, the object in the motion diagram is replaced by a series of single points.
- An operational definition defines a concept in terms of the process or operation used.

3.2 Where and When?
- You can define any coordinate system you wish in describing motion, but some are more useful than others.
- While a scalar quantity has only magnitude, or size, a vector quantity has both magnitude and a direction.
- A position vector is drawn from the origin of the coordinate system to the object. A displacement vector is drawn from the position of the moving object at an earlier time to its position at a later time.
- The distance is the length or magnitude of the displacement vector.



3.3 Velocity and Acceleration
- Velocity and acceleration are defined in terms of the processes used to find them. Both are vector quantities with magnitude and direction.
- Average speed is the ratio of the total distance traveled to the time interval.
- The most important part of solving a physics problem is translating words into pictures and symbols.
- To build a pictorial model, analyze the problem, draw a sketch, choose a coordinate system, assign symbols to the known and unknown quantities, and tabulate the symbols.
- Use a motion diagram as a physical model to find the direction of the acceleration in each part of the problem.

Reviewing Concepts

Section 3.1
1. What is the purpose of drawing a motion diagram?
2. Under what circumstances is it legitimate to treat an object as a point particle?

Section 3.2
3. How does a vector quantity differ from a scalar quantity?
4. The following quantities describe location or its change: position, distance, and displacement. Which are vectors?
5. How can you use a clock to find a time interval?

Section 3.3
6. What is the difference between average velocity and average speed?
7. How are velocity and acceleration related?
8. What are the three parts of the problem solving strategy used in this book?
9. In which part of the problem solving strategy do you sketch the situation?
10. In which part of the problem solving strategy do you draw a motion diagram?

Applying Concepts

11. Test the following combinations and explain why each does not have the properties needed to describe the concept of velocity: $\Delta \mathbf{d} + \Delta t$, $\Delta \mathbf{d} - \Delta t$, $\Delta \mathbf{d} \times \Delta t$, $\Delta t / \Delta \mathbf{d}$.
12. When can a football be considered a point particle?
13. When can a football player be treated as a point particle?
14. When you enter a toll road, your toll ticket is stamped 1:00 P.M. When you leave, after traveling 55 miles, your ticket is stamped 2:00 P.M. What was your average speed in miles per hour? Could you ever have gone faster than that average speed? Explain.
15. Does a car that's slowing down always have a negative acceleration? Explain.
16. A croquet ball, after being hit by a mallet, slows down and stops. Do the velocity and acceleration of the ball have the same signs?

Problems

Create pictorial and physical models for the following problems. Do not solve the problems.

Section 3.3

LEVEL 1

17. A bike travels at a constant speed of 4.0 m/s for 5 s. How far does it go?
18. A bike accelerates from 0.0 m/s to 4.0 m/s in 4 s. What distance does it travel?
19. A student drops a ball from a window 3.5 m above the sidewalk. The ball accelerates at 9.80 m/s^2. How fast is it moving when it hits the sidewalk?

LEVEL 2

20. A bike first accelerates from 0.0 m/s to 5.0 m/s in 4.5 s, then continues at this constant speed for another 4.5 s. What is the total distance traveled by the bike?
21. A car is traveling 20 m/s when the driver sees a child standing in the road. He takes 0.8 s to react, then steps on the brakes and slows at 7.0 m/s^2. How far does the car go before it stops?
22. You throw a ball downward from a window at a speed of 2.0 m/s. The ball accelerates at 9.8 m/s^2. How fast is it moving when it hits the sidewalk 2.5 m below?
23. If you throw the ball in problem 22 up instead of down, how fast is it moving when it hits the sidewalk? **Hint:** Its acceleration is the same whether it is moving up or down.

Critical Thinking Problems

Each of the following problems involves two objects. Draw the pictorial and physical models for each. Use different symbols to represent the position, velocity, and acceleration of each object. Do not solve the problem.

24. A car is traveling 25 m/s to the east, while a truck, initially 625 m away, is moving at 20 m/s to the west along the same road. Where do they meet?
25. A truck is stopped at a stoplight. When the light turns green, it accelerates at 2.5 m/s^2. At the same instant, a car passes the truck going 15 m/s. Where and when does the truck catch up with the car?
26. A truck is traveling at 18 m/s to the north. The driver of a car, 500 m to the north and traveling south at 24 m/s, puts on the brakes and slows at 3.5 m/s^2. Where do they meet?

Going Further

Using What You Know Write a problem and make a pictorial model for each of the following motion diagrams. Be creative!

a End Begin

b Begin Stop End

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