EXERCISES

Conceptual Questions

1. The number of decimal places in a measurement along with the unit is an indicator of the precision of an instrument. Describe what kind of instruments can be used to produce measurements of 1 m, 1.0 m, 1.00 m, 1.000 m, and 1.000 000 m.

2. Having measured an object and found it to be 1.0 m, you then split it into three equal pieces and quote the value 0.333 333 333 m as the length of one of these pieces. This is what your calculator produces when you divide 1.0 by 3. Is this value reasonable? What is it implying?

3. Using dollars and cents as the units for any numbers you wish to use, explain why keeping your units consistent is important when adding and subtracting quantities.

4. Name three other scalar and vector quantities besides the ones mentioned in this chapter.

5. Design an odometer and a speedometer that can be used to measure vector quantities. Remember, we now have access to satellite mapping systems.

6. State three examples where the displacement is equal in magnitude to the distance travelled but not equal to the actual distance travelled.

7. Using examples, explain why two vectors of equal magnitude are not necessarily equal.

8. You have bought a Ferrari. On your trip, you had an average speed of 180 km/h, yet an average velocity of 2 km/h (magnitude only). How is this possible?

9. Do all the people on the rotor ride (Fig. 1.26) have the same velocities and speeds at any given time? Explain.

Fig.1.26

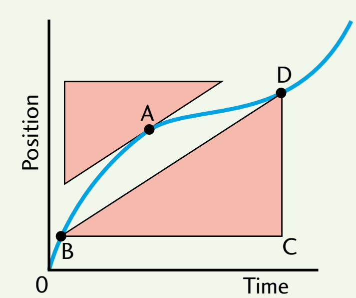
For image see student text.

10. Sketch a $\vec{d}$-t representation of a typical 100 m dash. Remember that sprinters do not increase their speed for the full 100 m. In many cases, they slow down near the end.

11. Sketch a $\vec{d}$-t graph for the 400 m run. Why is it different from the 100 m sketch? How can these graphs be used to help improve performance for an athlete?

12. Look at the $\vec{d}$-t graph in Fig. 1.27. Explain which parts of the graph you would use to find the average speed, the average velocity, and the instantaneous velocity.

Fig.1.27



13. a) Consider the west direction to be positive. A person is moving at –50 km/h, at a place +300 km from the starting point. Describe where she is and which way she is travelling.
    b) Using the standard reference frame, describe the Superman ride mentioned in the chapter in terms of displacement and velocity.

14. Can an object have
    a) a positive velocity and a negative displacement?
    b) a negative velocity and a displacement of zero?
    c) a value for distance and an average speed of zero?

    Explain each case.

Problems

1.2 Terms and Units

15. Convert the following times. All units must be shown as well as cancellations.
    a) 20 minutes to seconds
    b) 6.5 hours to minutes
    c) 0.6 days to hours
    d) 4.5 years to seconds
    e) 453 seconds to hours
    f) 0.35 minutes to years

16. For a time of 250 s, state the value using each prefix. Use both decimal and scientific notation.
    a) micro
    b) milli
    c) kilo
    d) mega

17. Convert the following speeds. Show all units as well as cancellations.
    a) 25 km/h to m/s
    b) 150 km/h to m/s
    c) 2.0 m/s to km/h
    d) 50 m/s to km/h

18. a) An average person is 175 cm tall. How many people could you stack one on top of another to reach the top of the CN Tower (553 m)?
    b) If 1 inch = 2.54 cm and 12 inches = 1 foot, how tall is the CN Tower in feet?

19. a) The maximum speed reached by a standing skate boarder is about 14.7 m/s. Would the skateboarder get a ticket in a 30 km/h speed zone?
    b) A snail crawls 100 times slower than a normal human walk (3 km/h). How many times slower than the skate boarder is the snail?

20. For the roller coaster in Fig. 1.28, estimate the displacement and distance travelled for the following sections:
    a) A to B   b) B to C   c) C to B
    d) B to D   e) A to D

Fig.1.28

C

B   For image see student text.   D

A

21. Four people set out to measure a field's perimeter. They find that Side A = 20.0 m, Side B = 12 m, Side C = 20.005 m, and Side D = 11.99998 m. Taking into account significant digits,
    a) what is the perimeter, in metres and in millimetres?
    b) what is the sum of A + B?

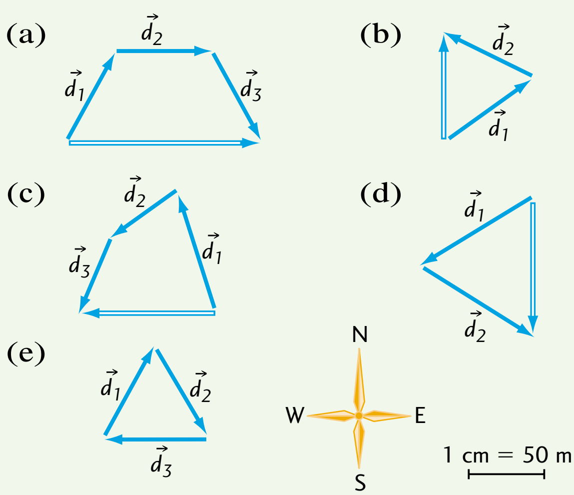
c) of C + D?
d) of B + D?
e) What would account for the different number of decimal places in the measurements?

22. What is the difference in heights for the following measurements?
a) 50.7 m and 30.2 m
b) 50.7 m and 2 m
c) 2356.9076 cm and 3567.2 m
d) 30.9 km and 30.9 mm

1.3 The Meaning of Negatives in Kinematics

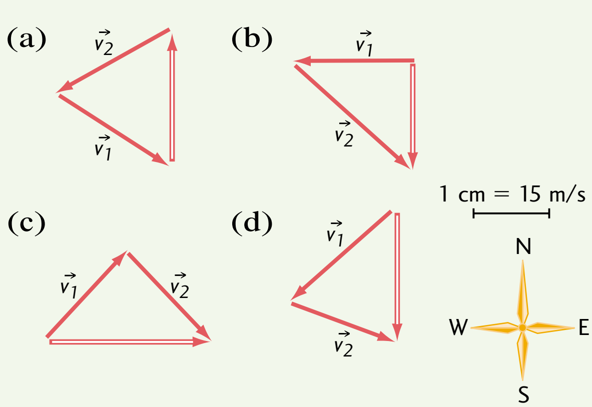
23. For the paths taken in Fig. 1.29, state the displacement using the standard reference system.

Fig.1.29



24. For the motions in Fig. 1.30, describe the velocity in terms of a reference system where north is negative and east is positive.

Fig.1.30

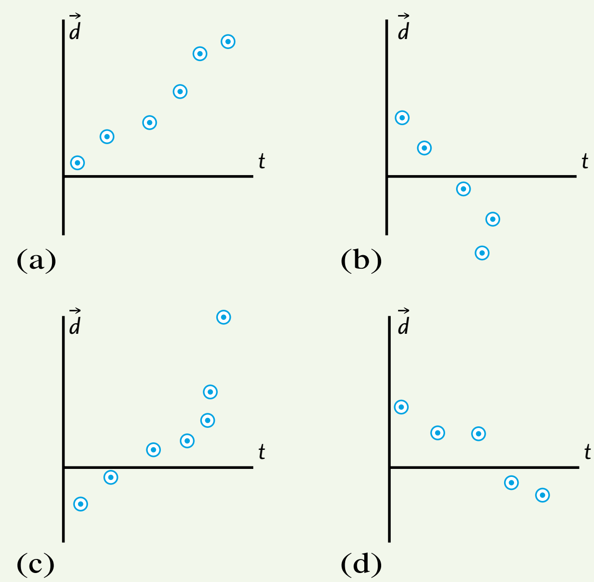


25. A person is walking 3 km/h in a train that is moving 70 km/h west. In the standard reference system, what are the person's two possible velocities as measured by a cop using a radar gun parked on the side of the road?

1.4 Three Steps to Graphical Analysis

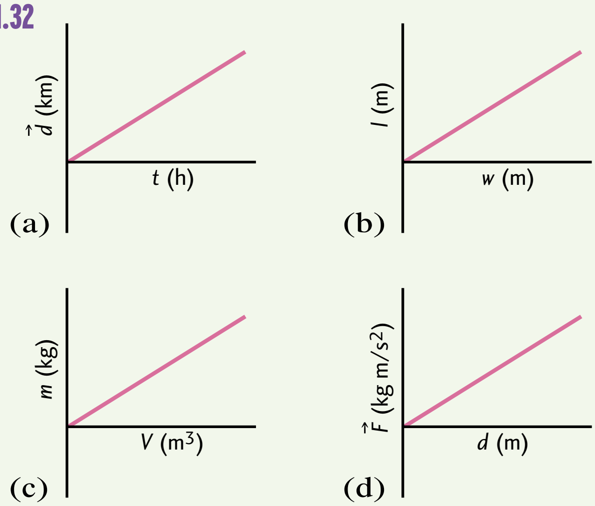
26. Copy the graphs in Fig. 1.31 into your notebook and draw a line of best fit for each. Indicate any points that are anomalies.

Fig.1.31



27. For the graphs in Fig. 1.32, state the units for
a) slopes taken from the graphs.
b) areas taken from the graphs.

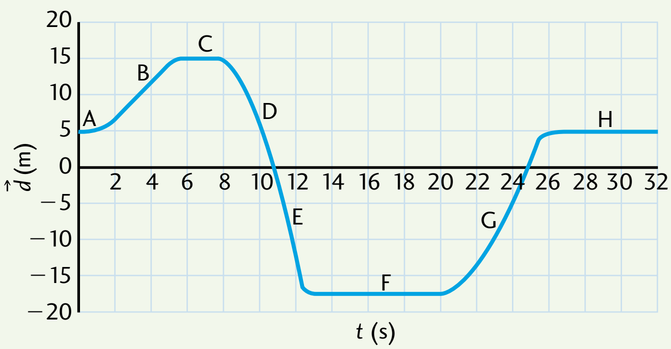
Fig.1.32



1.5 Analysis of Straight-Line $\vec{d}$-t Graphs

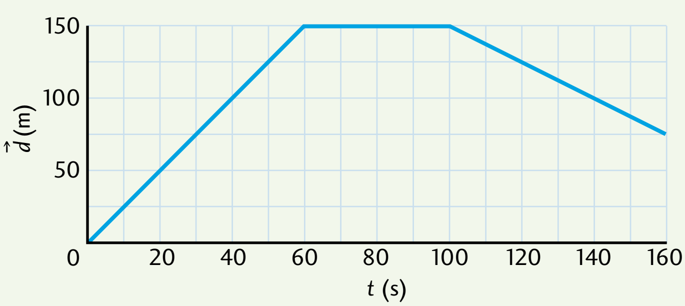
28. For the graph in Fig. 1.33, describe what the person is doing in each marked section.

Fig.1.33



29. For the graph in Fig. 1.34, calculate
    a) the slope for each section.
    b) the area for each section (this is practice for the next chapter).

Fig.1.34



30. Find the velocity for each section in Fig. 1.34.

31. Using the data in Fig. 1.35 for a Formula 1 car,
    a) plot a labelled $\vec{d}$-t graph and find the velocity of the car.
    b) Convert the velocity to km/h.

Fig.1.35

For image see student text.

Time (s)	Displacement (m)
0.0	0
1.0	72
2.0	144
3.0	216
4.0	288
5.0	360
6.0	432
7.0	504

32. The X-15A-2 travels at about six times the speed of sound (Mach 6). Use the data in Fig. 1.36 to create a $\vec{d}$-t graph. Find the velocity and convert it to km/h.

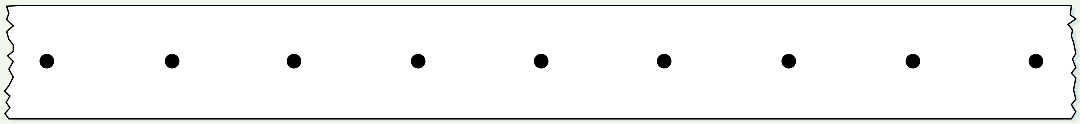
Fig.1.36

For image see student text.

Time (s)	Displacement (m)
0.0	0
1.0	332
2.0	664
3.0	996
4.0	1328
5.0	1660
6.0	1992
7.0	2324

33. Use the tickertape data in Fig. 1.37 to create a $\vec{d}$-t table and a $\vec{d}$-t graph, then find the object's velocity. The period of the ticker (time between dots) is 0.40 s.

Fig.1.37

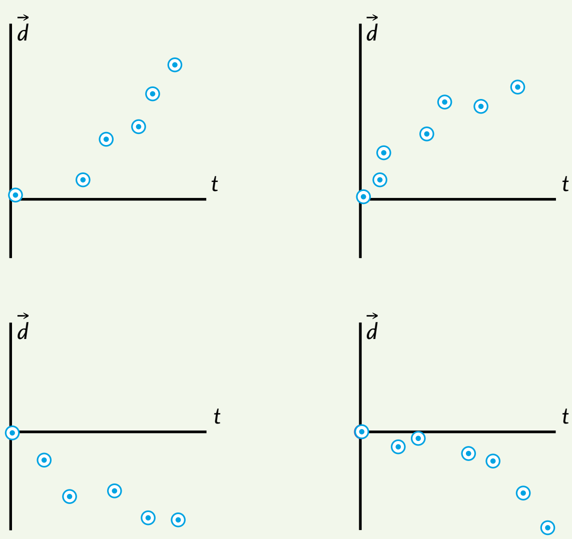


34. Graph the data from Fig. 1.37. Assume that all measurements of displacement are *negative*.

1.6 Analysis of Curved-Line $\vec{d}$-t Graphs

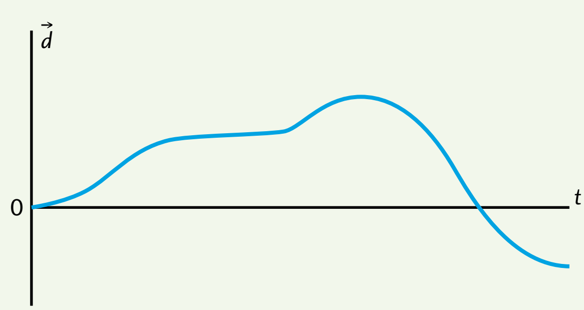
35. Copy the graphs in Fig. 1.38 into your notebook and draw curves of best fit. Then draw in three representative tangents for each curve.

Fig.1.38



36. Describe what is happening in the following graph by identifying motion sections. Assume positive is up.

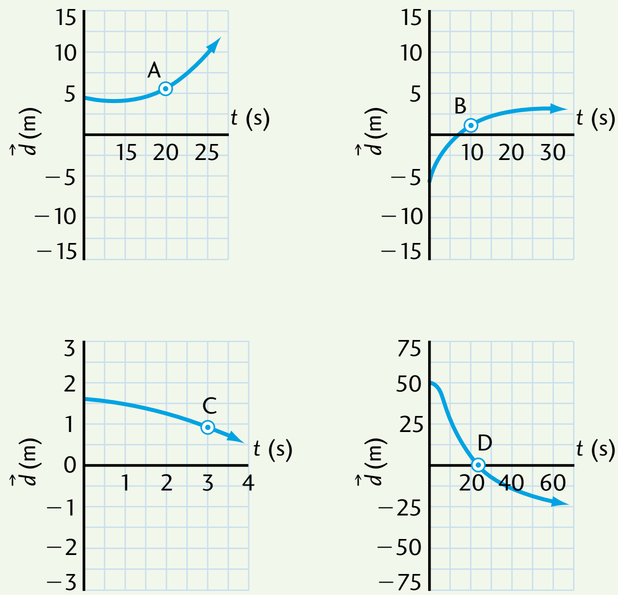
Fig.1.39



37. Copy the graph in Fig. 1.39 into your notebook and draw one tangent per section.

38. Copy the graphs in Fig. 1.40 into your notebook. Draw a tangent at the point indicated and find its slope.

Fig.1.40



39. For the following data of a car, draw a $\vec{d}$-t graph and describe the motion. Draw tangents at 2, 4, and 6 s, and find their slopes. Convert the values to km/h.

Time (s)	Displacement (m)
0.0	0.0
1.0	5.0
2.0	15
3.0	30
4.0	55
5.0	70
6.0	80
7.0	90

40. a) For the tickertape data in Fig. 1.41, measure the displacements, create a $\vec{d}$-t chart, then plot the values on a $\vec{d}$-t graph. Find the curve of best fit, draw four tangents, and find their slopes. Is this object speeding up or slowing down? (T = 0.05 s)

b) Change your displacement values to negative. Repeat the graphing procedure and find the slopes of the tangents. Is the object speeding up or slowing down?

Fig.1.41

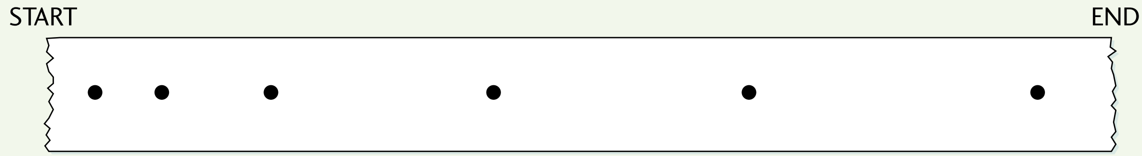


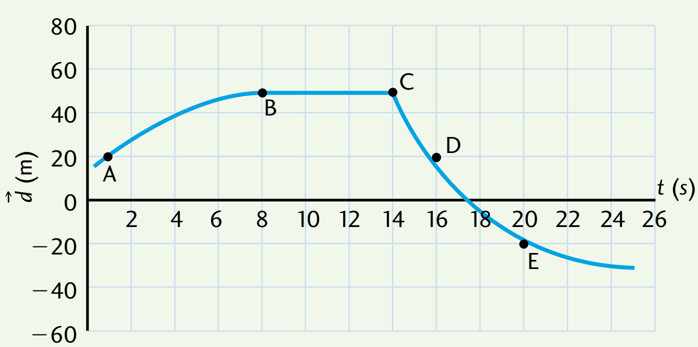
Fig.1.42

41. a) For the tickertape data in Fig. 1.42, measure the displacements, create a $\vec{d}$-t chart, then plot the values on a $\vec{d}$-t graph. Find the curve of best fit, draw four tangents, and find their slopes. Is this object speeding up or slowing down? ($T = 0.05$ s)
    b) Change your displacement values to negative. Repeat the graphing procedure and find the slopes of the tangents. Is the object speeding up or slowing down?

1.7 Average and Instantaneous Velocities

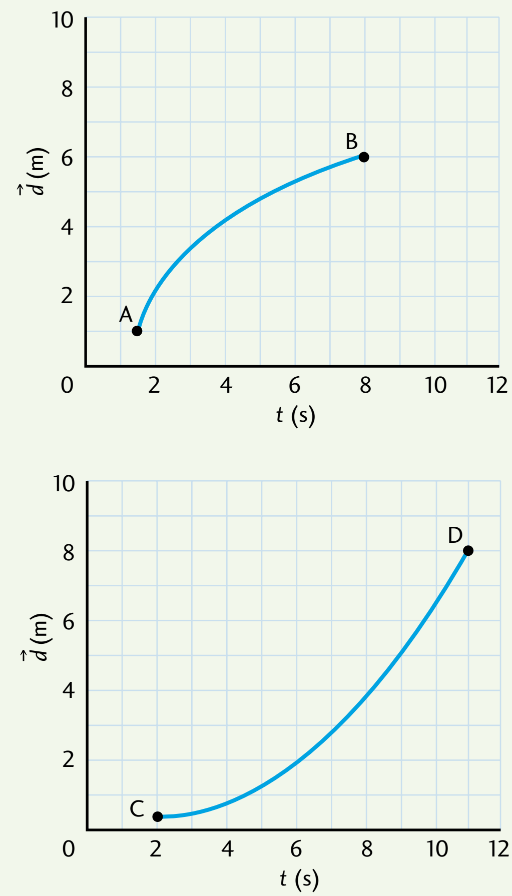
42. For the graph in Fig. 1.43, find the average velocity between the points indicated.

Fig.1.43



43. For the graphs in Fig. 1.44, find the average velocity, as well as the instantaneous velocities at the beginning and end of the time period indicated. Calculate the average of the instantaneous values and compare them to the average velocity obtained graphically.

Fig.1.44



44. A person walks 50 m [up] a flight of stairs in 1.0 min, then waits 125 s while being hooked up to a bungee cord. He jumps off, falls 55 m in 5.0 s, then stops and bounces back 10 m in 1.0 s before eventually coming to rest. Draw a representative $\vec{d}$-t graph. Remember to include a slowing-down section as the free fall was 50 m in height. You can add extra sections for the person bouncing to a complete stop if you wish.