Chapter 1 Motion Along A Straight-line Path

We are ready to embark on a study of motion - the single most important concept in our description of the physical world. This study begins by considering motion of objects along a straight-line path. [Straight-line path is to be interpreted to mean a path that can be traveled along in one direction or the other. It does not mean that the path has to be straight.] From here we proceed to the study of motion in three dimensions in chapter 3, as well as the forces which cause motions, the nature of gravity, and circular motion in chapters 2 and 4, - all of this culminating with a discussion of the planets in the solar system in chapter 5.

The first part of this chapter serves to introduce three concepts which are probably already familiar to you - POSITION (where the object is), VELOCITY (how fast and in what direction an object moves), and TIME. Most importantly, one is introduced to the interrelationship of these concepts in a very general manner. Emphasis is on graphical rather than algebraic approaches to solving problems, since the graphical approach emables you to 'see' what is going on and is applicable to problems where algebra just won't do the job. Also, experience with graphical analysis of problems is something that will serve you well throughout your study of physics and outside of school as well.

In the latter part of the chapter we will examine more closely the cases where the velocity of an object varies in time. The new concept that naturally arises is that of ACCELERATION - defined as the rate at which the velocity of an object is changing. Acceleration is probably a concept familiar to you already - at least in an intuitive manner. It is hoped that this chapter will enable you to make your intuitive ideas about acceleration, and motion in general, somewhat more concrete. Also we will see in succeding chapters that acceleration has a fundamental importance in nature since the concepts of forces and accelerations are strongly linked.

Performance Objectives

Upon the completion of this chapter, you should:

1. Be able to identify ones position and ones change in position.
2. Be able to understand the meaning of straight line position-time graphs.
3. Given a position-time graph of constant velocity, be able to deduce the velocity.
4. Be able to demonstrate an ability to calculate average speed using factor-label method of unit conversion.
5. Given a position-time graph, be able to deduce the velocity at any instant.
6. Given a velocity-time graph illustrating constant acceleration, be able to deduce the position of an object at any instant.
7. Be able to demonstrate the ability to calculate average acceleration.
8. Given a velocity-time graph illustrating constant acceleration, be able to:
    a. deduce the acceleration of the object.
    b. deduce the analytical relation for displacement and acceleration.
9. Be able to solve problems using the kinematic equations involving: acceleration, initial velocity, final velocity, distance, and time.

	x_1(m)	x_2(m)
(1)	5	8
(2)	7	−2
(3)	−5	−2
(4)	15	12
(5)	0	2
(6)	−5	−8
(7)	−5	0

1. Express the change in the following quantities, using the Δ notation:
   (a) The temperature T_1 of a room at 9 AM was 19°C, and an hour later the temperature T_2 was 25°C.
   (b) The reading d_1 of the odometer at the beginning of a trip was 2380 km, and the reading d_2 at the end of the trip was 4060 km.
   (c) Before dieting, a person's mass w_1 was 80 kg, and after dieting the person's mass w_2 was 70 kg.
2. In the table at the left, which displacements are equal?
3. Does the graph of a car trip in Fig. A represent a real situation? Explain.

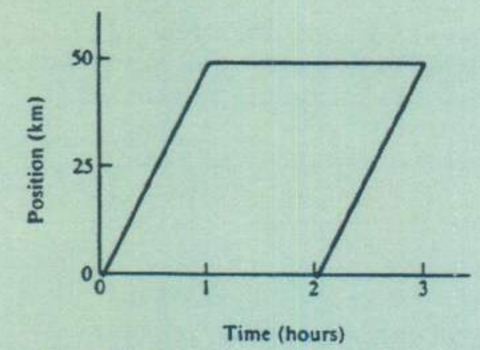
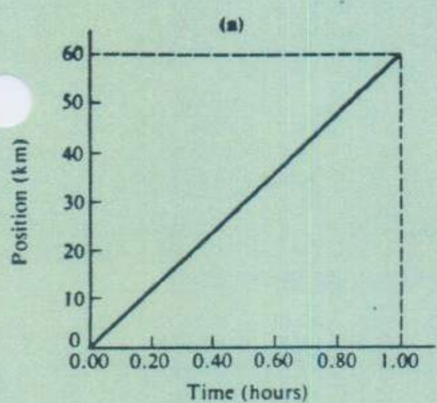
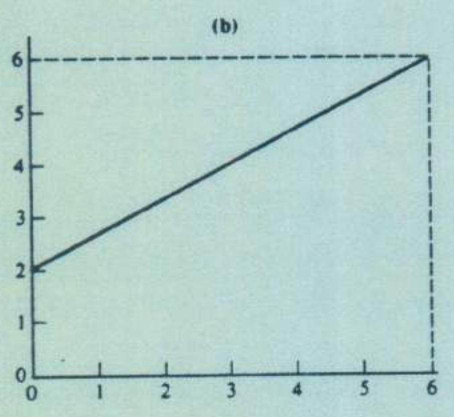
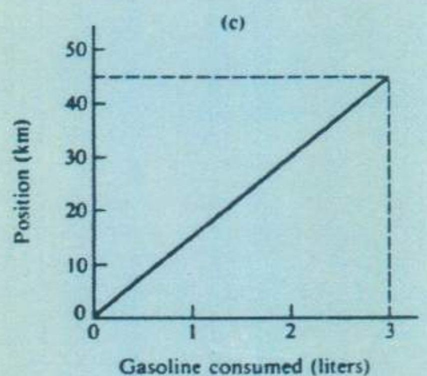


Figure A







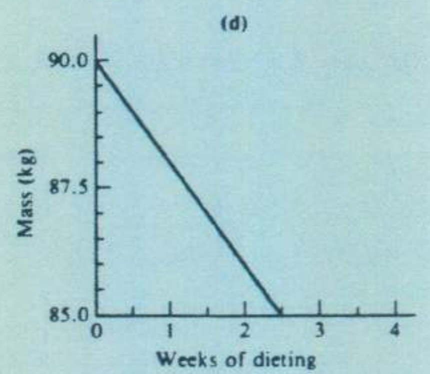


Figure B

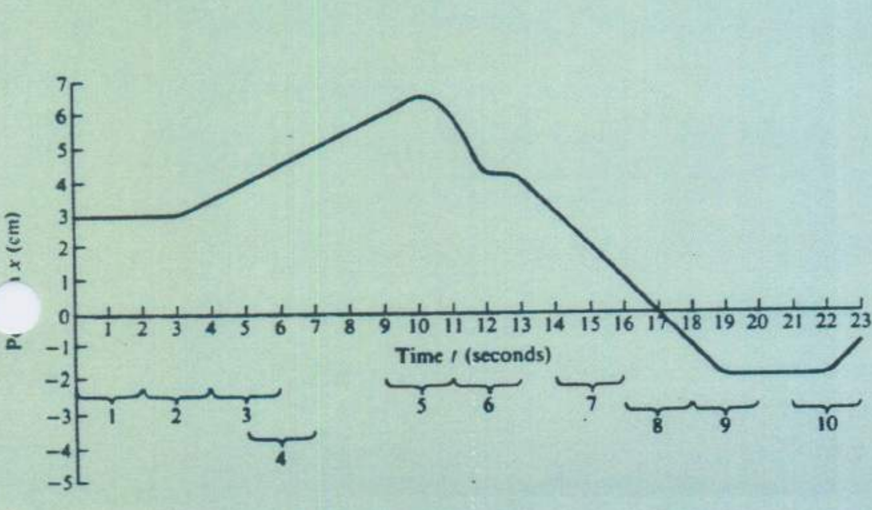


Figure 1–4 A position-time graph.

In this chapter you will rely heavily on graphical construction which will give a 'picture' of what actually is going on. At ALL times you are to draw accurate graphs, make precise measurements of the slopes of lines and of areas under curves. Near the end of the chapter you will use algebraic analysis to solve similar problems.

The title includes the words "straight line path". By this we mean that we are only able to go in one direction or the other along the path. Thus a road, path, etc. would fit the description of "straight line path" even though the path isn't straight.

1. Read the introductory paragraph on page 1.

   Do you feel that you know what is going on? If so, try to solve problem 30, on page 23. If you have difficulty, do not dismay. Just proceed with the next item of this study guide. You will be given a chance to solve it later.

2. Read Sec. 1-1: Position and Displacement Along a Straight Line page-1

3. a. How would you define your location on the Ohio Turnpike? Would it matter whether you were heading east or west?

   b. What would your change in DISTANCE be if you traveled from Exit-7 (119 mile post) to Exit-10 (163 mile post)?

   c. What DISTANCE would you travel in going from Exit-10 to Exit-7?

   d. What is your DISPLACEMENT going from Exit-7 to Exit-10?

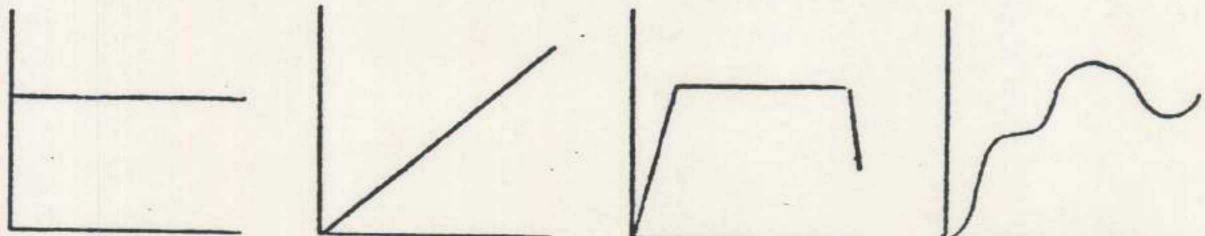
   e. What is your DISPLACEMENT going from Exit-10 to Exit-7?

   f. What DISTANCE would you travel when going from Exit-10 to Exit-7 and back to Exit-10? What would be your DISPLACEMENT?

   g. Contrast the difference between DISTANCE and DISPLACEMENT.

4. Problems: page 4: #1 #2 #3

5. The following four graphs represent position (plotted on the vertical) as a function of time (plotted on the horizontal). Describe the motion of the object in each case.



(a) (b) (c) (d)

6. Read: Section 1-2 Steady Motion: Constant Velocity page 4

7. Problems: page 6: #4 #5 #6

8. Using the graph at the right, answer the following questions.

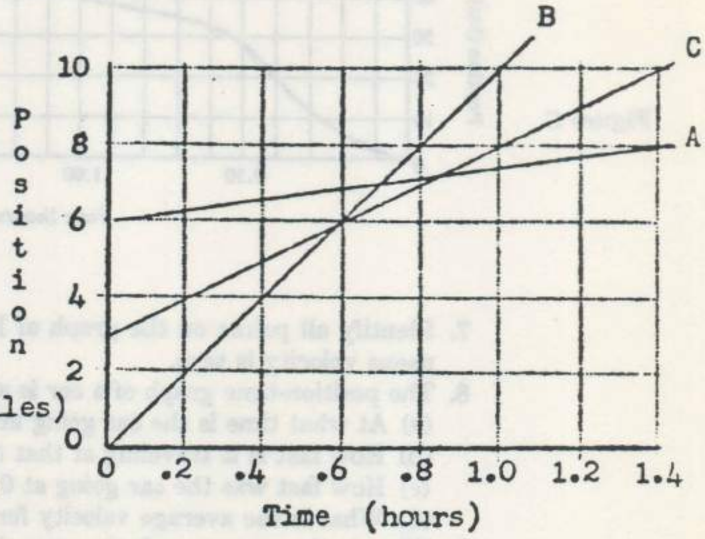
   a. Which graph represents the person traveling at the fastest speed?

   b. Are all three at the same point on the road at the same time?

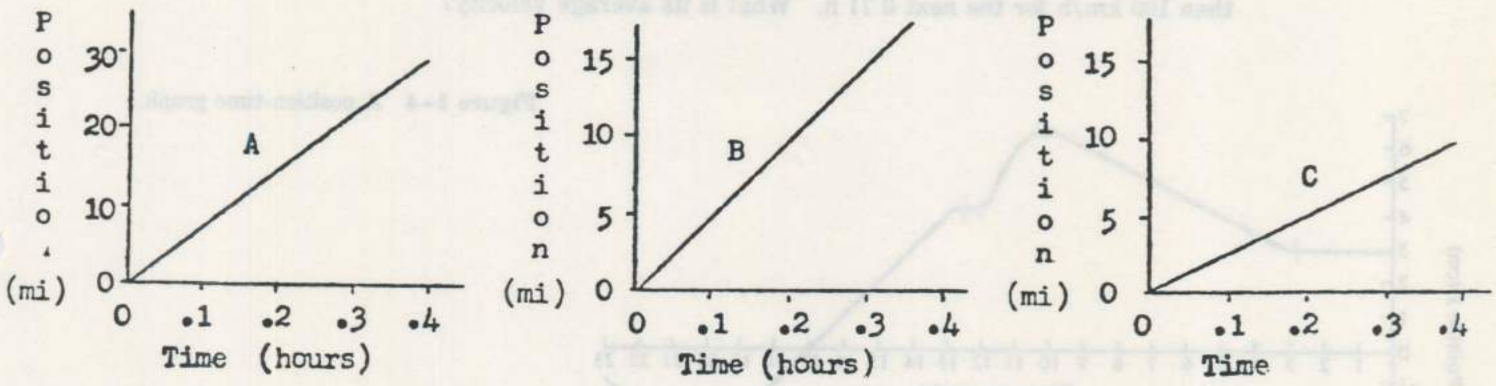
   c. When B passes A, where is C?

   d. How far did B travel between the time he passed C and A?

   e. Which men are on bicycles? Why?



9. Which car is going faster? A? or B? or C?



10. POSITIVE AND NEGATIVE VELOCITY: In trying to describe motion along a straight line, we have to be able to specify the DIRECTION in which the object is moving. This is due to the fact that the velocity of an object has both magnitude (speed), and direction of motion. For motion in a straight line, there are only two possible direction of motion: to the 'left' and to the 'right'. When an object is moving to the right, we conventionally say it is moving in the direction of increasing values of the positive coordinate; when the object is moving to the left, it is tending to decrease the value of the positive coordinate.

    Now also by convention, we call the direction of the initial velocity POSITIVE velocity while motion in the opposite direction is identified as NEGATIVE velocity. This sign convention comes in handy when left and right are not easily identifiable.

    When describing vertical motion near the surface of the earth, we conventionally choose motion 'upward' to be positive and motion 'downward' to be negative. There is nothing intrinsically positive about 'up', and the laws of physics will make the same predictions whether 'up' is chosen to be positive or negative. However, once the choice is made we must stick with it or else our calculations will be incorrect.

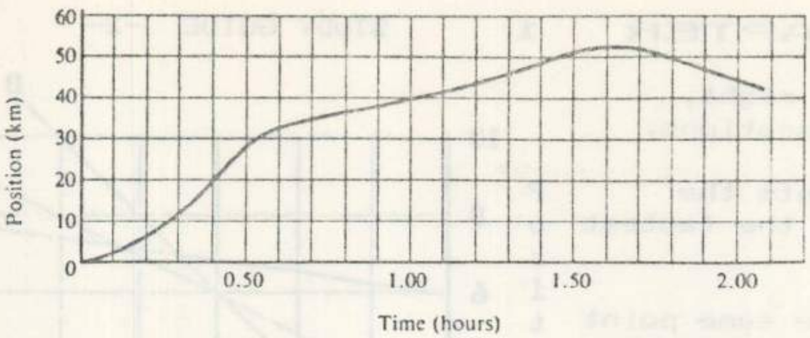


Figure C

7. Identify all points on the graph of Fig. 1–4 at which the instantaneous velocity is zero.
8. The position-time graph of a car is shown in Fig. C.
   (a) At what time is the car going at the greatest velocity?
   (b) How fast is it traveling at that time?
   (c) How fast was the car going at 0.70 h?
   (d) What is the average velocity for the first 0.70 h?
9. What is the average velocity over the first 90 s in the graph of Fig. 1–9?
10. A train travels 95 km/h for 0.52 h, 50 km/h for the next 0.24 h, and then 100 km/h for the next 0.71 h. What is its average velocity?

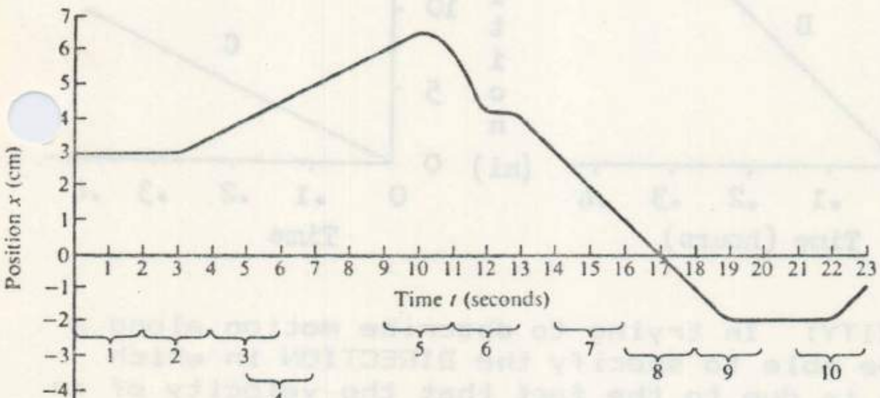


Figure 1–4 A position-time graph.

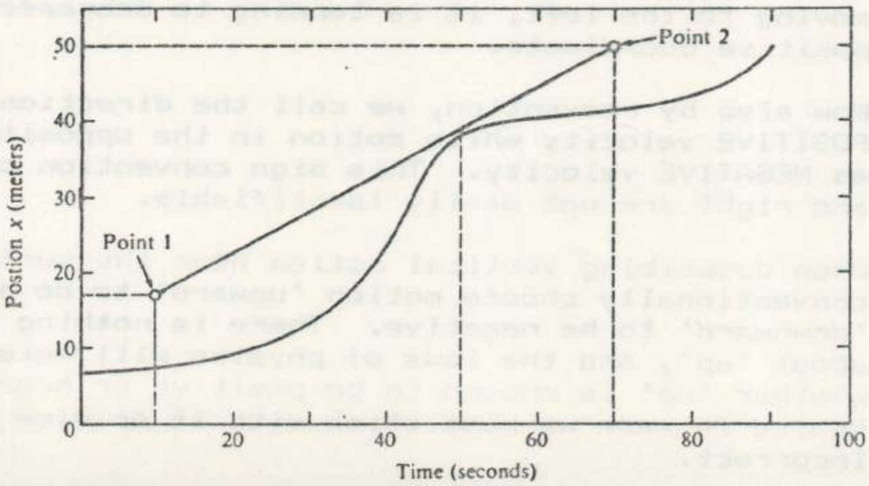


Figure 1–9 To find the velocity at any instant, draw a line tangent to the curve at the point being considered. Then, by taking any two points on the tangent line, find the slope. The value of the slope is the velocity.

THUS WHENEVER YOU WRITE DOWN A VELOCITY, BE SURE TO INCLUDE:

a. A NUMBER (which specifies the magnitude),
b. A SIGN (which specifies a direction), and
c. APPROPRIATE UNITS (meters/sec for example).

11. Read: Section 1-3: Instantaneous Velocity page 8

12. Problems: page 12: #7 #9

13. AVERAGE VELOCITY: There are two different ways to calculate the average velocity of a moving object. In this discussion we want to eliminate the confusion between them.

a. In all cases you can use the following relation:

$$v_{ave} = \frac{\Delta x}{\Delta t}$$

where Δx is the total displacement of the object in time Δt

b. In some cases, you can use:

$$v_{ave} = \frac{v_i + v_f}{2}$$

This is only valid, though, for a body undergoing a CONSTANT change in velocity.

14. In the text, a formal mathematical definition of instantaneous velocity is given. You may have been exposed to this type of formula and thus be able to answer the following questions. If not, ask your instructor for an explanation.

a. What is meant when the limiting process is used?

b. As Δt approaches zero, what happens to $\Delta x/\Delta t$?

c. How does v_{ave} differ from v_{inst}?

d. Note...One is not asked to analytically determine the instantaneous velocity using this formula. Instead, we will find the instantaneous velocity by determining the slopes of curves.

e. Problems: page 12: #8 #10

15. Read: Section 1-4 Velocity-Time from Position-Time Graphs p 14

Note...There are errors in Fig. 12, page 12. Change all 'cm' to 'm'.

16. Problems: page 13: #11 #12 #13

Figure D For Question 11.

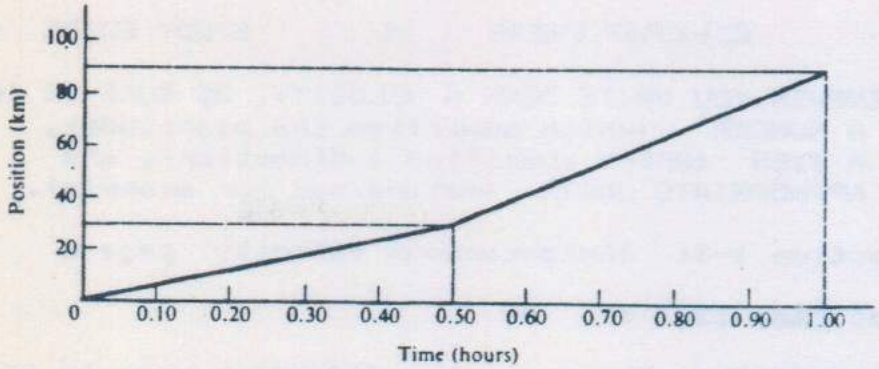
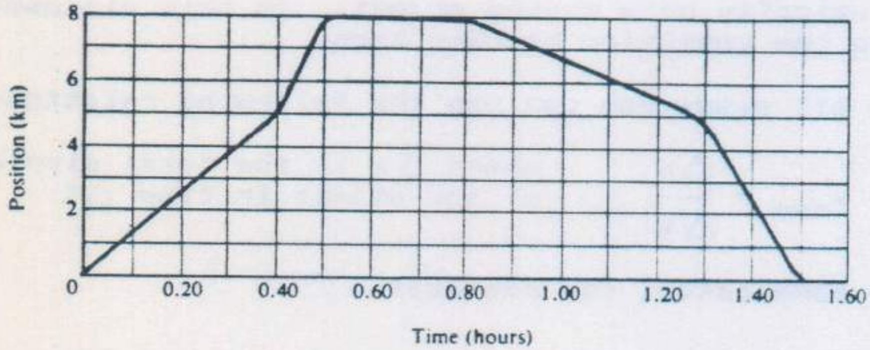


Figure E For Question 12.



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14. Sketch a velocity-time graph for a shuttle train which runs between cities A and C with an intermediate stop at city B. All cities are on a straight line.

15. What is the displacement of a car which travels at a steady velocity of 60 km/h (a) for 3 h, (b) for $\frac{1}{2}$ h?

16. A man walks to the corner to mail a letter and comes back. Sketch graphs showing his velocity and position plotted against time.

17. A train speeds up according to a velocity-time graph shown in Fig. F. How far does it travel in the first six minutes?

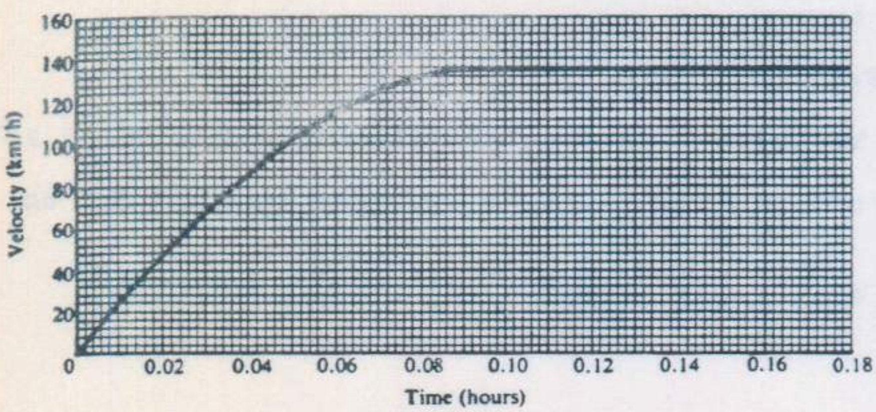
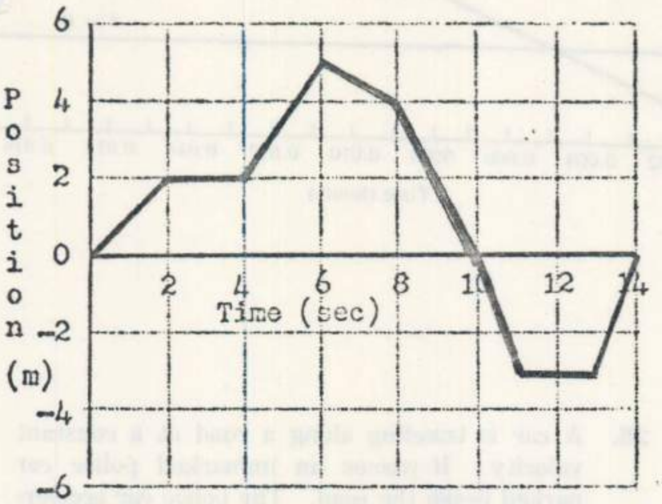
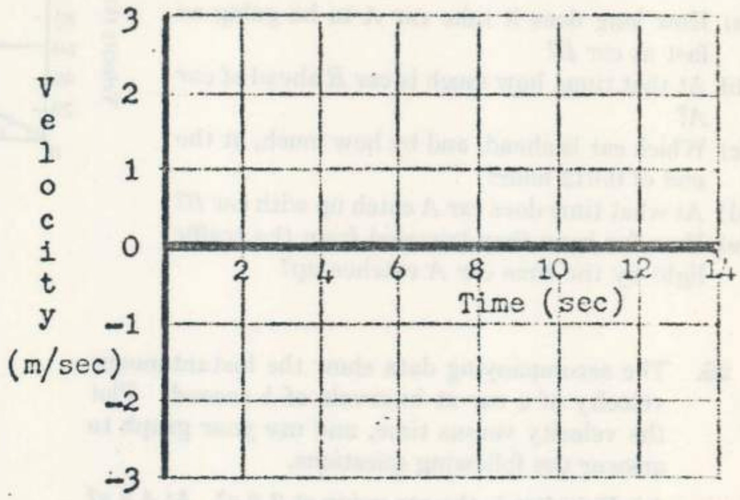


Figure F

17. Plot a velocity vs time graph on the axis at the right using the position vs time graph shown on the left.





Summary using graph at the left:

a. What quantity was plotted on the vertical axis?

b. What quantity was plotted on the horizontal axis?

c. What did you get when you found the slope? The units?

d. What formula do we use to find average velocity?

18. Read: Section 1-5 Displacement from Velocity-Time Graphs page 14

19. Problems: page 16: #14 #15 #16 (Did you meet a talking mail box?)

20. Use the velocity vs time graph shown on page 5 of this packet to answer the first 4 questions.

a. What is plotted on the vertical axis? the horizontal axis?

b. What does the graph tell you?

c. Find the area under the graph for the first two seconds. Check the answer sheet. Did you get the right units too? Trouble? If so, see instructor!

d. What DISTANCE did the car travel in 14 seconds?

e. What is the average SPEED of the car?

f. Plot a position vs time graph on the axis at the right.

g. Where is the car at the end of 14 seconds?

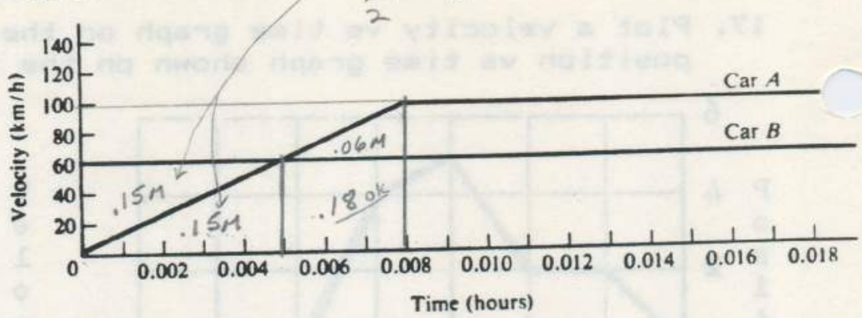
h. What is the DISPLACEMENT of the car?

i. What is the average VELOCITY of the car?

25. Car A is stopped at a traffic light. The light turns green and A starts up. Just as it does so, car B passes it, going at a steady velocity. Their velocity-time curves are shown in Fig. I.

(a) How long does it take car A to be going as fast as car B?
(b) At that time, how much is car B ahead of car A?
(c) Which car is ahead, and by how much, at the end of 0.012 hour?
(d) At what time does car A catch up with car B?
(e) How far have they traveled from the traffic light by the time car A catches up?

Figure I For Problem 25.



26. The accompanying data show the instantaneous velocity of a car at intervals of 1 second. Plot the velocity versus time, and use your graph to answer the following questions.

(a) How fast is the car going at 2.6 s? At 4.8 s?
(b) How far did the car travel between the two instants in part (a)?

TIME (s)	VELOCITY (m/s)
0.0	10.0
1.0	12.4
2.0	14.8
3.0	17.2
4.0	19.6
5.0	22.0
6.0	24.4

28. A car is traveling along a road at a constant velocity. It passes an unmarked police car parked beside the road. The police car accelerates, overtakes the speeding car, passes it, and signals it to a stop. Sketch a graph showing the velocities of the two cars plotted against time.

18. A car going at 30 km/h accelerates to 90 km/h in 6.0 seconds. What is the average acceleration?

19. Express an acceleration of $1.0 \frac{\text{km}}{\text{h-s}}$ in $\frac{\text{m}}{\text{s}^2}$.

20. Figure G is a multiple-flash photograph of a moving ball taken at $\frac{1}{30}$-s intervals. The ball is moving from left to right, and the zero point on the scale lines up with the right-hand edge of the ball's initial position.
(a) Plot a graph of position against time to describe this motion.
(b) From your graph in (a), construct a velocity-time graph.
(c) What does your velocity-time graph tell you about the acceleration of the moving ball?

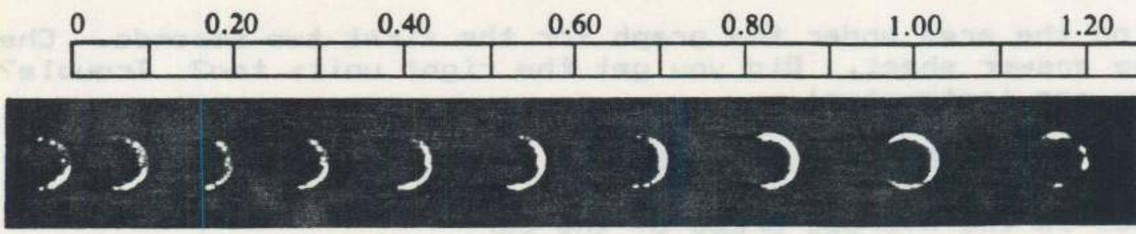


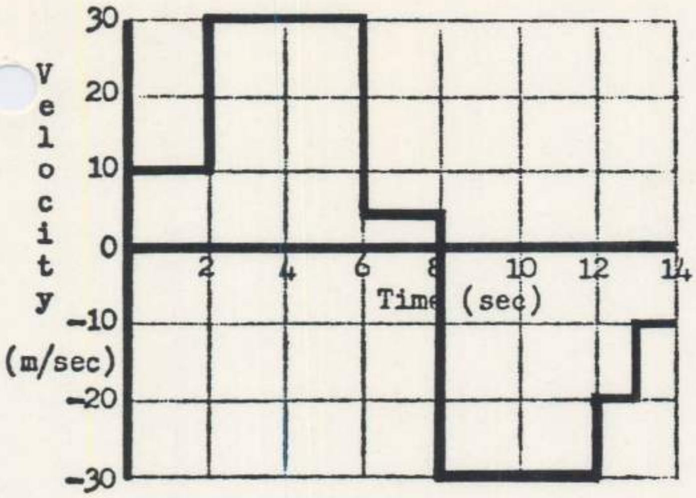
Figure G The scale is measured in meters.

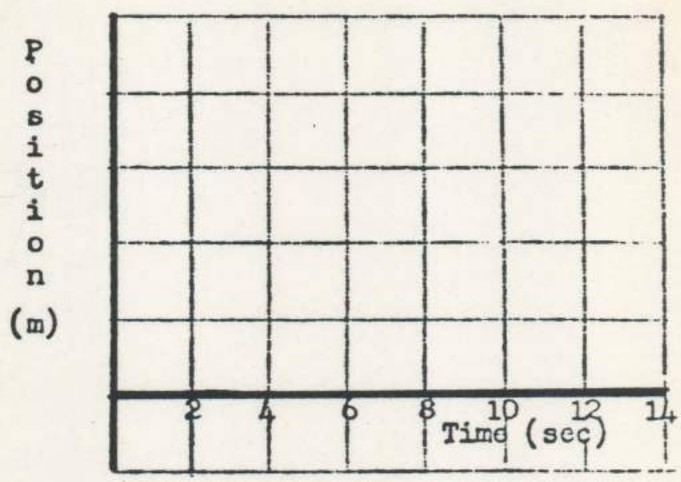
Figure 1–26 The relationships between position, velocity, and acceleration as a function of time.

x versus t —slope→ v versus t —slope→ a versus t

a versus t —area→ Δv versus t —area→ Δx versus t

a versus t —area and initial v→ v versus t —area and initial x→ x versus t



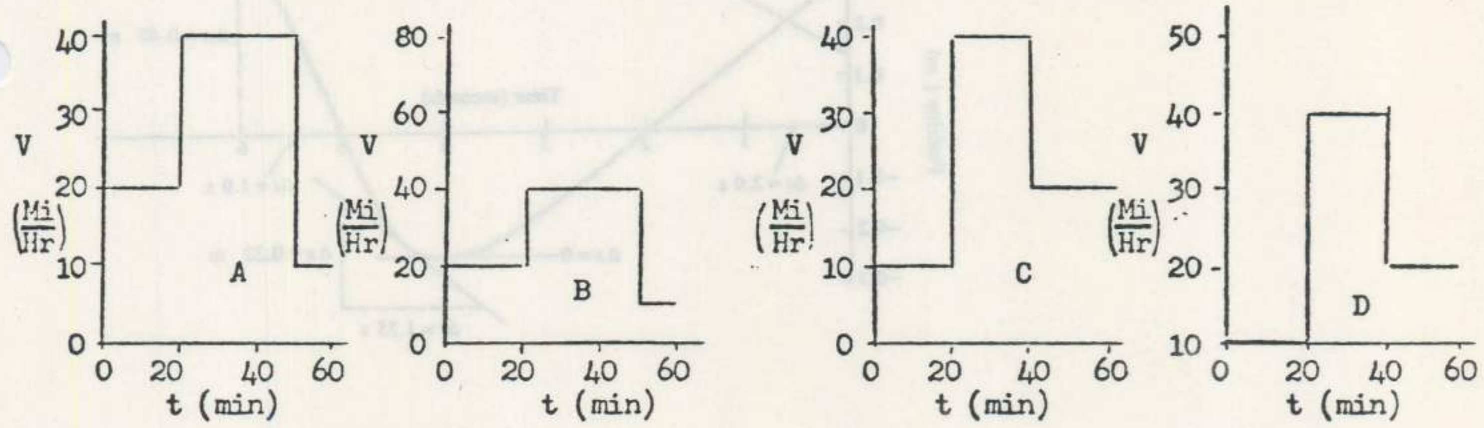


21. Problem: page 16: #17

22. The four graphs shown below are different plots of velocity vs time for the same car.

    a. Did the car go further in A or in B? How far did the car go in A? B?

    b. Did the car go further in C or in D? How far did the car go in C? D?



23. Problems: page 23: #25 #26

24. Complete enclosed work sheet titled: Chapter 1 Work Sheet. When finished, have it evaluatded by your instructor.

25. Read: Section 1-6 Acceleration page 17

    Note...There is an error in the text on page 19. At the end of the first line following the first equation, change $\Delta v/\Delta t$ to $\Delta x/\Delta t$.

26. POSITIVE AND NEGATIVE ACCELERATION: Because the direction or 'sign' of some physical quantities is very important, it is necessary to examine the important quantity, acceleration which has direction. To keep track of this direction, we use the following sign convention:

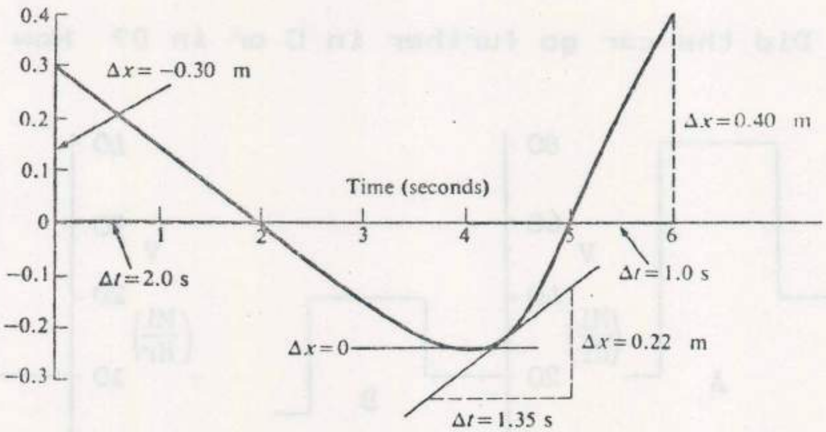


Figure 1–12 Finding the slope at various points on a position-time graph.

Positive acceleration tends to make the velocity of the object more positive. Thus, an object traveling at one instant with a velocity of +30 m/sec and accelerating positively will at some later time have a velocity of +40 m/sec. An object with a velocity at one instant of −30 m/sec and accelerating positively might at some later time have a velocity of −20 m/sec.

Negative acceleration tends to make the velocity of an object more negative. An object traveling momentarily at +30 m/sec and accelerating negatively might at some later time have a velocity of +20 m/sec while an object traveling momentarily at −30 m/sec and accelerating negatively might at some later time have a velocity of −40 m/sec.

Note that negative acceleration is not necessarily equivalent to deceleration. Deceleration means a loss in SPEED, and it should be clear from the discussion above that an object moving in the negative direction and accelerating negatively actually gains speed. Thus do not use the term DECELERATION!!!

27. Problems: page 20: #18 #19 #20
    page 23: #28

28. What does Figure 1-26 really say? Write a summary of what it says to you and have it evaluated by your instructor.

29. Optional...Need to review slope and area under a graph concept?

    a. Obtain Transparency T-2: 'Graphs of Various Motions'.

    b. Read and follow directions that are with the transparency.

    c. Cardboard masks are provided.

    d. Do not write on the transparency Shine the transparency on the chalkboard and then draw on the board.

30. A ball is thrown up and caught. What is the acceleration when the ball reaches its maximum height? To verify your answer do the following:

    a. Sketch a graph of the displacement as a function of time.

    b. From the 'd vs t' graph, plot a 'v vs t' graph.

    c. From the 'v vs t' graph, plot an 'a vs t' graph.

31. View the film: STRAIGHT LINE KINEMATICS (34 min) (Film notes provided.)

The first part of the film may seem to move rather slow. However don't fall asleep. When Mr. Hafner returns to the classroom to analyze the graphs, take out the graphs from the film notes and follow along. This should be an excellent review.

22. A bobsled has a constant acceleration of 2.0 m/s^2 starting from rest.
(a) How fast is it going after 5.0 seconds?
(b) How far has it traveled in 5.0 seconds?
(c) What is its average velocity in the first 5.0 seconds?
(d) How far has it traveled by the time its velocity has reached 40 m/s?

23. A car, initially traveling at uniform velocity, accelerates at the rate of 1.0 m/s^2 for a period of 12 seconds. If the car traveled 190 meters during this 12-second period, what was the velocity of the car when it started to accelerate?

24. A pedestrian is running at his maximum speed of 6.0 m/s to catch a bus stopped by a traffic light. When he is 25 meters from the bus the light changes and the bus accelerates uniformly at 1.0 m/s^2. Find either (a) how far he has to run to catch the bus or (b) his frustration distance (closest approach). Do the problem either by use of a graph or by solving the appropriate equations.

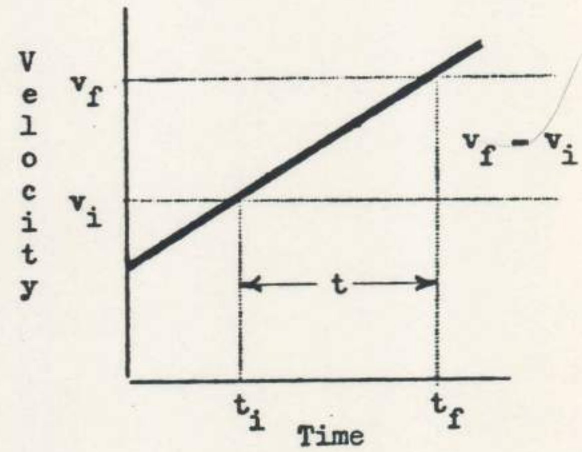
32. Read: Section 1-7 Constant Acceleration: Some Useful Equations p 21

a. Ask your instructor to discuss the following graph with you.

33. Can you develop the following two equations using the graph?

(1) $a = (v_f) - v_i) / t$

(2) $d = 1/2\ t\ (v_f + v_i)$



Using algebraic manipulation, satisfy that the following three equations can be derived from (1) and (2).

(3) $v_f^2 = v_i^2 + 2ad$

(4) $d = v_i t + 1/2\ at^2$

(5) $d = v_f t - 1/2\ at^2$

34. a. In equation (4) above, what does $v_i t$ and $1/2\ at^2$ represent?

b. In equation (5) above, what does $v_f t$ and $1/2\ at^2$ represent?

35. Problems: page 22: #22 #23 #24

36. Optional...Need more practice in solving problems? If so, see enclosed problem practice sheet. Note...Whenever an object is falling free, the acceleration of the object is constant and the value is given at the bottom of the sheet.

37. Complete enclosed two-page written exercise. When finished, have it evaluated.

Thought for the chapter:

It's all wool and 0.9144 of a meter wide.

Answers Chapter 1

3. (a) Since position is relative, one needs a reference point which happens to be at the west end of the turnpike for both sides of the road.
(b) 44 miles (c) 44 miles (d) +44 miles (e) −44 miles

4. (1)(a) 6 deg. C (b) 1680 km (c) −10 kg (2) [1 & 3] [4 & 6]
(3) No Between t=2 and t=3 is impossible

7. (4)(a) 3.6 km/hr (b) 36 km/hr (c) 90 km/hr (d) 900 km/hr (e) 28,800 km/hr
(5) $3<t<10$ = 0.5 cm/s $13<t<19$ = −1.1 cm/s $22<t<23$ = 1.0 cm/s, also where $v = 0$
(6)(a) 60 km/hr (b) 2/3 (c) 15 km/liter (d) −2.0 kg/week

8. (a) B (b) no (c) 1/2 mile behind (d) 1 mile (e) see instructor

9. A is greater than B. However, neither can be compared to C. Why?

12. (7) 0 to 3 sec, 12.0 to 12.7 sec, 19 to 22 sec, 10 sec

14. (b) It will approach some specific value.
(c) v_{ave} is the average velocity over a period of time
(e) (8)(a) 0.40 hr (b) 80 km/hr (c) 20 km/hr (d) 50 km/hr
(f) (10) 90 km/hr (First find total distance and then total time.)

16. (11) (12) (13) S.A.B. (See Answer Book)

17. (a) position (b) time (c) a velocity, m/s (d) $v_{ave} = \Delta d / \Delta t$

19. (14) S.A.B. (15)(a) 180 km (b) 30 km (16) S.A.B.

20. (a) velocity, time (b) ones speed at any time (c) 20 m (d) 300 m
(e) 21.4 m/s (g) where one began (h) zero (i) zero

21. (17) 9.1 km

22. (a) same (b) same (c) A = B = 28.3 miles, C = D = 23.5 miles

23. (25) 0.0048 hr (b) 0.15 km (c) 0.08 km (d) 0.01 hr (e) 0.60 km
(26)(a) 16.2 m/s, 21.5 m/s 41.4 m

27. (18) 10 km/hr/sec
(19) 0.28 m/sec^2
(20) (a)(b) S.A.B. (c) 9.4 m/sec^2
(28) S.A.B.

30. The acceleration is not zero. Draw graphs, then see instructor.

35. A hint. Apples plus peaches do not equal pears. Right? Then...

36. (22)(a) 10 m/sec (b) 25 m (c) 5 m/s (d) 400 m
(23) 9.8 m/sec
(24) never catches − 7 m is frustration distance (Can you use calculus?)

37. (1) 15 m/hr
(2) 1.6 m/s^2
(3) 43 m/s, 86 sec
(4) 144 ft/s^2, 960 ft/s
(5) 7.07 sec, 69.3 ft/sec
(6) 144 ft/s, 3.0 sec, 146 ft/sec
(7) 4.5 sec, 99.2 m, 39.2m
(8) 142 m
(9) 80 ft, 2.5 sec
(10) 94 ft/sec, 690 ft
(11) (a) 15 m/sec^2, (b) 50 m
(12) (a) 0, (b) 2 m/sec

TEACHER'S GUIDE TO THE PSSC FILM

STRAIGHT-LINE KINEMATICS (34 min.)

E. M. Hafner, University of Rochester

This film develops the relationships between distance, speed, and acceleration and is recommended for use as a review of Chapter 1 of the PSSC text.

Summary:

The kinematics of straight line motion is developed by experiments using an automobile with instruments attached that record simultaneously the distance traversed, the speed and the acceleration as a function of time.

The three graphs for a certain run are analyzed and Dr. Hafner shows that the speed and acceleration curves produced during the experiment can also be derived by taking the appropriate slopes of the distance and speed curves respectively. A simple graphical technique is used throughout, employing only a divider and a straight-edge.

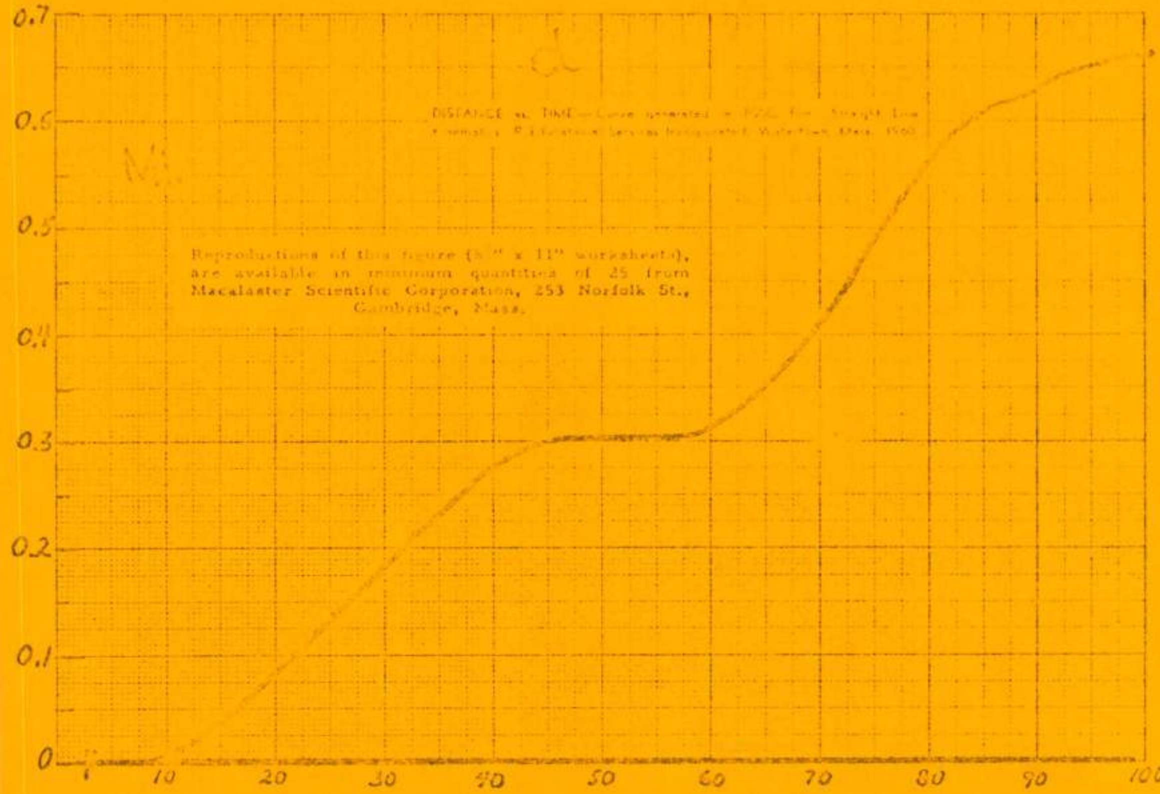
Finally, he shows how the procedure can be reversed. The distance traveled and the change in speed for a given time interval are represented by areas under the speed and acceleration curves respectively. From the acceleration curve, the speed and distance curves are derived by approximating the relevant areas.

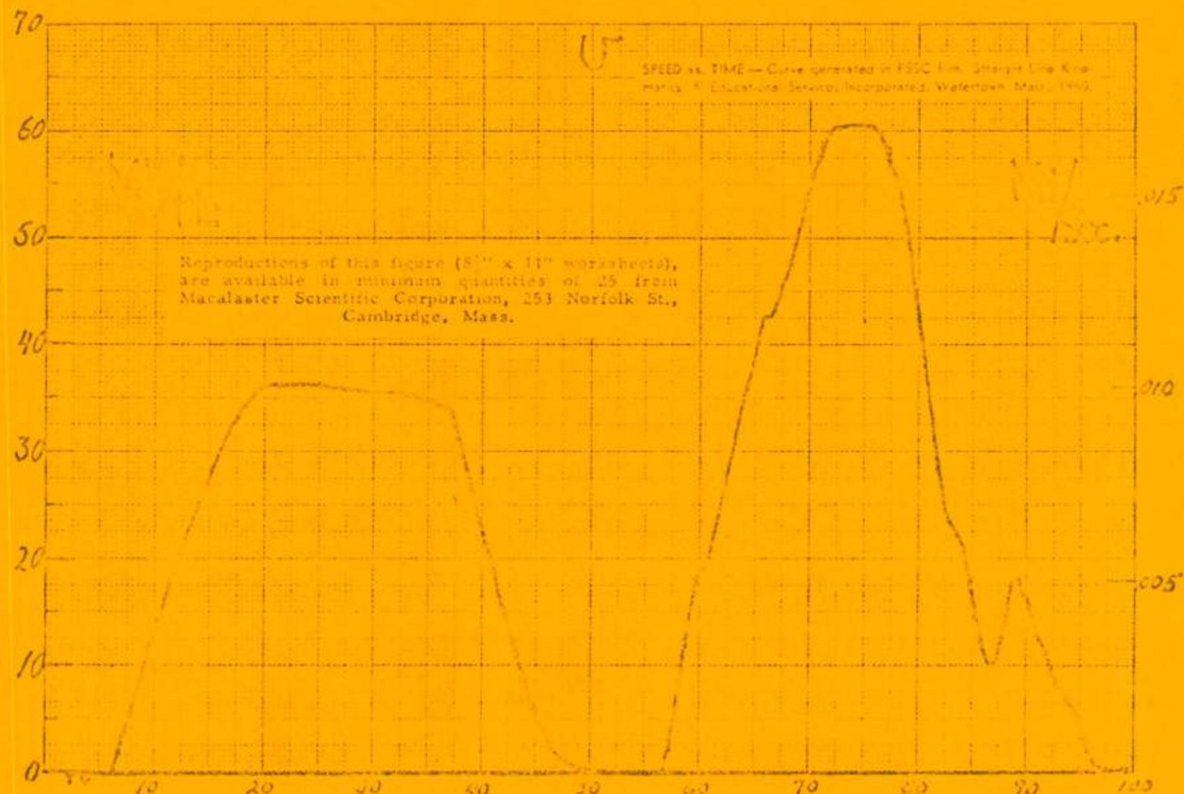
Throughout the film it is emphasized that the graphs of the three quantities are not independent.

Points for Discussion and Amplification:

(a) In Newtonian mechanics the relationships among distance, speed, and acceleration depend only on their mathematical definitions. No law of physics is involved in these relationships, such as conservation of momentum or energy. In this experiment, the instruments attached to the automobile have been engineered to record the distance, speed, and acceleration. As pointed out in the film, one could just as well have drawn any arbitrary curve for one of these, and the other two could be derived from the definitions. The laws of nature govern the motion of a body but not the relation among these curves.

(b) The three curves from the film have been reproduced on the two following pages.


DISTANCE vs. TIME
Reproductions of this figure (8½" x 11" worksheets), are available in minimum quantities of 25 from Macalaster Scientific Corporation, 253 Norfolk St., Cambridge, Mass.
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
10 20 30 40 50 60 70 80 90 100


SPEED vs. TIME — Curve generated in PSSC
Reproductions of this figure (8½" x 11" worksheets), are available in minimum quantities of 25 from Macalaster Scientific Corporation, 253 Norfolk St., Cambridge, Mass.
70
60
50
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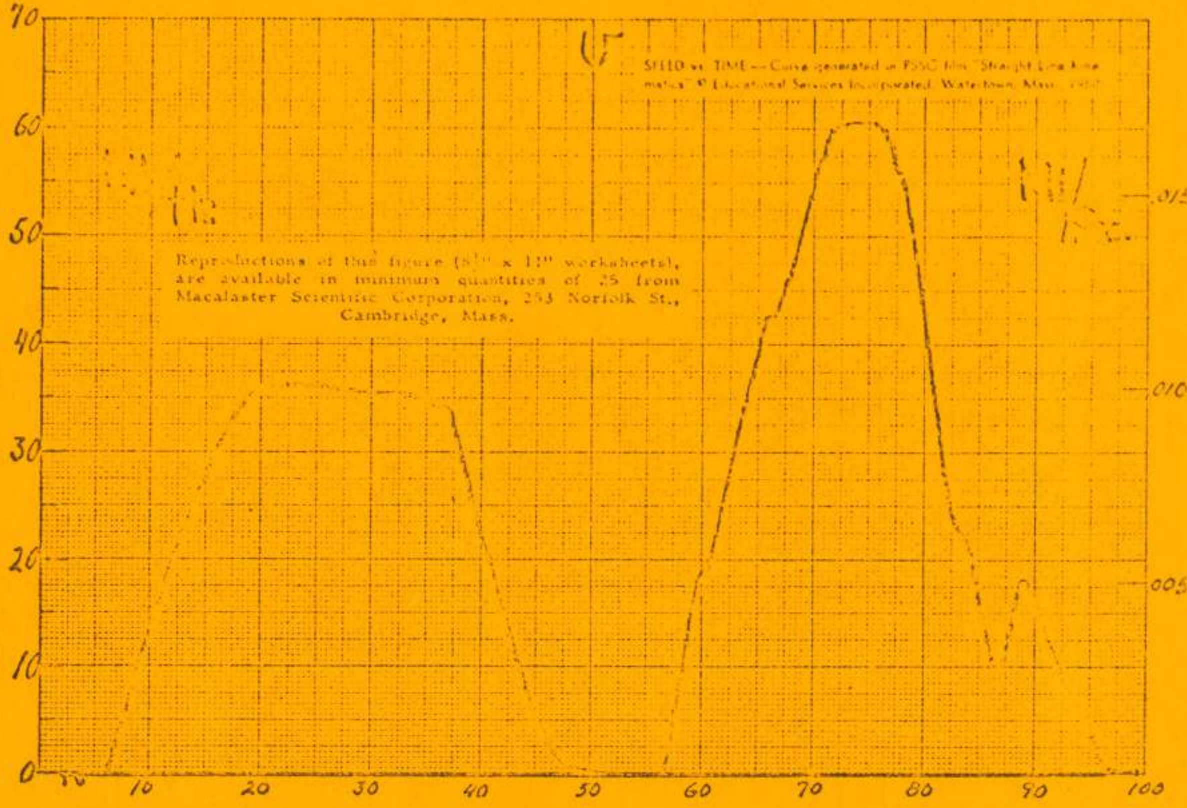
10 20 30 40 50 60 70 80 90 100
.015
.010
.005



v
SPEED vs. TIME — Curve generated in PSSC film "Straight Line Kinematics" © Educational Services Incorporated, Watertown, Mass., 1960
Reproductions of this figure (8½" x 11" worksheets), are available in minimum quantities of 25 from Macalaster Scientific Corporation, 253 Norfolk St., Cambridge, Mass.
70
60
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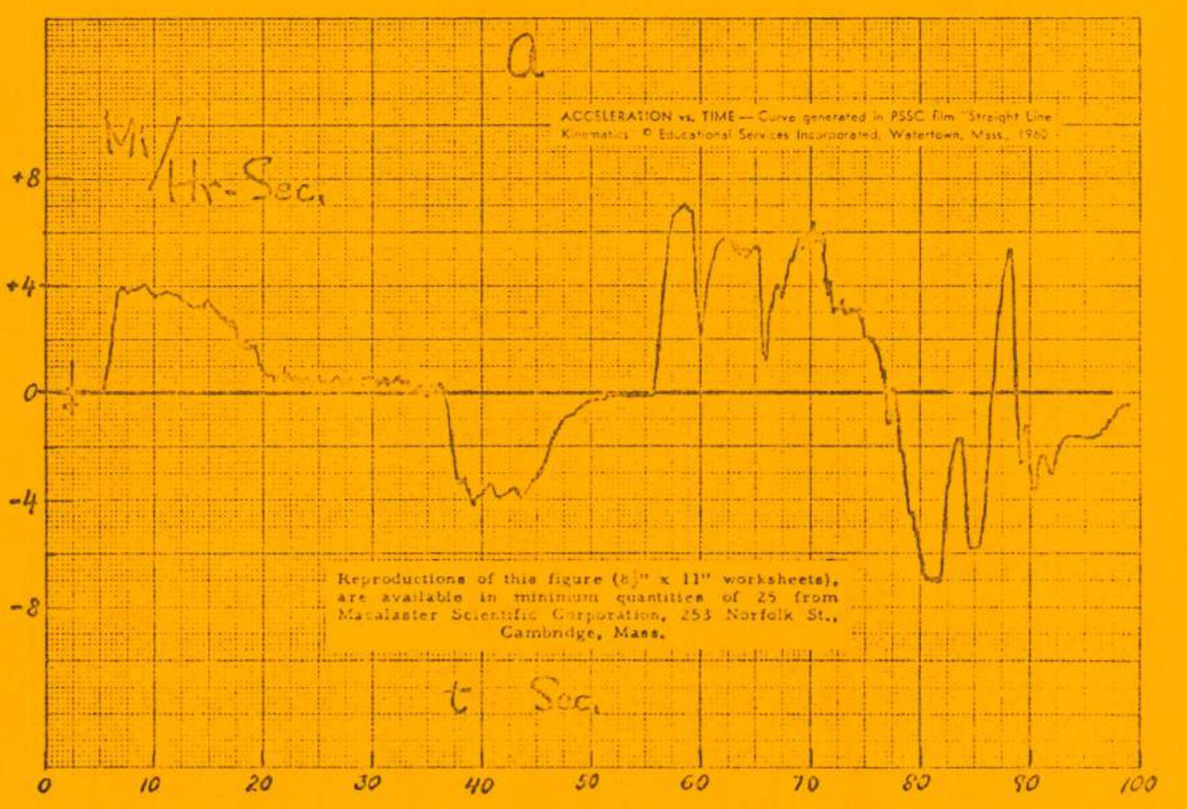
80
90
100



a
ACCELERATION vs. TIME — Curve generated in PSSC film "Straight Line Kinematics" © Educational Services Incorporated, Watertown, Mass., 1960
Mi/Hr-Sec.
+8
+4
0
-4
-8
Reproductions of this figure (8½" x 11" worksheets), are available in minimum quantities of 25 from Macalaster Scientific Corporation, 253 Norfolk St., Cambridge, Mass.
t Sec.
0
10
20
30
40
50
60
70
80
90
100

Chapter 1 Worksheet

1. A cyclist rides along a straight road for 2 minutes at a speed of 1000 meters per minute, then continues for three more minutes at 1500 meters per minute. How far did he go?

____

2. A cyclist starting from rest, speeds up uniformly to a speed of 20 meters per second in 20 seconds, continues at this speed for 20 seconds, and then slows down to a stop in 30 seconds. Plot his speed vs. time and determine how far he went.

____

3. A car speeds up uniformly from rest so that it is going 80 meters per second after 20 seconds. How far does it travel during the first 10 seconds? How long does it take to travel 600 meters?

____

____

4. If a car goes 40 kilometers at 30 km/hr and 15 kilometers at 45 km/hr, what is its average speed for the whole trip?

____

5. In the following pairs of columns d represents the positions of an object moving along a straight line, and t the time corresponding to these positions, beginning at t = 0. Which of the motions is/are uniform?

______ ______

a.

d (m)	t (sec)
0	0
2	6
6	18
8	24

b.

d (m)	t (sec)
0	0
4	2
12	8
16	10

c.

d (m)	t(sec)
0	0
4	2
6	7
8	12

Chapter 1 PRACTICE PROBLEMS

1. A runner runs the mile in 3 minutes, 58 seconds. Calculate his average speed in miles per hour.

2. An object which is undergoing uniform acceleration travels 7.2 meters in 3 seconds. Calculate (a) its acceleration, and (b) the distance the object moved during the third second.

3. An object which is accelerated at the rate of 0.5 m/sec^2 has covered a distance of 1849 meters. Calculate (a) the velocity it has attained, and (b) the time required to cover this distance.

4. An airplane has an initial velocity of 240 ft/sec. It covers 3000 feet in the next 5 seconds. Calculate (a) its acceleration during this time interval, and (b) its final velocity.

5. A ball is dropped from the top of a building 245 meters high. Calculate (a) the time it takes for the ball to reach the earth, and (b) the velocity with which the ball strikes the earth. The acceleration of the ball is 9.8 m/sec^2 down.

6. A stone is thrown downward with a velocity of 50 ft/sec from the top of a building which is 294 feet high. Calculate (a) its velocity at the end of two seconds, (b) the time it takes to strike the ground, and (c) the velocity with which it strikes the ground. The ball accelerates down at 32 ft/sec^2.

7. A freely falling body starting from rest attains a velocity of 44.1 m/sec. Calculate (a) the time during which it has been falling, (b) the distance it has fallen, and (c) the distance it has fallen during the last second of fall.

8. Calculate the distance fallen in meters by a freely falling body during its 15th second if it started from rest, under a downward acceleration of 9.8 m/sec^2.

9. (a) What is the final velocity of an object which is dropped from a height of 100 feet? (b) How long did it take to fall? Acceleration = 32 ft/sec^2.

10. If a motorist traveling at 30 mi/hr starts accelerating at 5 ft/sec^2, (a) how fast will he be traveling in 10 seconds, and (b) how far will he have traveled during the 10 seconds?

11. In a (v vs t) graph, the curve rises in a straight line from v = 10 m/sec at t = 3 sec to v = 40 m/sec at t = 5 sec. (a) What is the acceleration at t = 4 sec, and (b) how far did the object go in the two seconds?

12. In a (d vs t) graph, the curve rises in a straight line from d = 2 meters, t = 2 sec to d = 10 meters, t = 5 sec. Then it falls in a straight line to d = 2 meters, t = 14 sec. (a) what is the average velocity? (b) What is the greatest speed? and (c) Describe exactly the v vs t graph of this situation. (You may wish to sketch the graph rather than describing it in words. If so, label your graph properly.)

Note...Whenever an object is moving in space near the earth's surface, the object has a force acting on it causing it to accelerate towards the earth at either 9.8 m/sec^2 or 32 ft/sec^2. More about this in chapter 11 and 12.

$$v_{FREIGHT} = 40 \frac{mi}{HR} \qquad V_{express\ INITIAL} = 70 \frac{mi}{HR}$$

$$V_{express\ final} = 0$$

$$d_{express} = 2\ mi$$

$$a_{express} = ?$$

(a) FIND ACCELERATION OF EXPRESS.

$$v_f^2 = v_i^2 + 2ad$$

$$a = -\frac{v_i^2}{2d}$$

$$= -\frac{70\ mi}{HR} \times \frac{70\ mi}{HR} \times \frac{1}{2} \times \frac{1}{2\ mi}$$

$$a_e = -1225 \frac{mi}{HR^2}$$

(b) FIND EXPRESSION FOR Δd WHICH $= \Delta d_f - \Delta d_e$ STARTING when $t = 0$

AT $t = 0$, $\Delta d = 1\ mi$

$$\Delta d_f = v_f t$$

$$\Delta d_e = v_e t + \tfrac{1}{2} a_e t^2$$

$$\Delta d = v_f t + 1\ mi - \left[v_e t + \tfrac{1}{2} a_e t^2 \right]$$

(c) FIND $\frac{\Delta d}{\Delta t}$

$$\frac{\Delta d}{\Delta t} = v_f - v_e - a_e t$$

$t = .024\ hrs = 1.47\ min$

(d) SET $\frac{\Delta d}{\Delta t} = 0$, SOLVE FOR t

$$t = \frac{v_f - v_e}{a}$$

(RESULT IS time when Δd is MINIMUM)

(e) Substitute t INTO Δd : (RESULT IS MINIMUM SEPARATION)

$$\Delta d = v_f \left(\frac{v_f - v_e}{a} \right) + 1\ mile - v_e \left(\frac{V_f - v_e}{a} \right) - \frac{1}{2} a_e \left(\frac{v_f - v_e}{a} \right)^2$$

$$= \frac{v_f^2 - v_f v_e}{a} + 1\ mi - \frac{v_e v_f + v_e^2}{a} - \frac{1}{2} \frac{v_f^2 - 2 v_f v_e + v_e^2}{a}$$

$$= \frac{40 \frac{mi}{HR} \times 40 \frac{mi}{HR} - 40 \frac{mi}{HR} \times 70 \frac{mi}{HR}}{-1225 \frac{mi}{HR^2}} + 1\ mi - \frac{70 \frac{mi}{HR} \times 40 \frac{mi}{HR} + 4900 \frac{mi^2}{HR^2}}{-1225 \frac{mi}{HR^2}} - \frac{1}{2} \times \frac{1600 - 2 \times 2800 + 4900}{-1225}$$

$$= \frac{1600 - 2800}{-1225} - \frac{-2800 + 4900}{-1225} - \frac{1}{2} \left[\frac{1600 - 5600 + 4900}{-1225} \right]$$

$$= \frac{1200}{1225}\ mi + 1\ mi - \frac{2100}{1225}\ mi + \frac{450}{1225}$$

$$= \frac{775}{1225}\ mi = .63\ mi = 3340.41\ ft$$

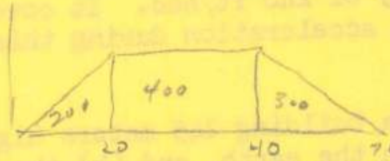
Chapter 1 Worksheet

1. A cyclist rides along a straight road for 2 minutes at a speed of 1000 meters per minute, then continues for three more minutes at 1500 meters per minute. How far did he go?

6500 m

2. A cyclist starting from rest, speeds up uniformly to a speed of 20 meters per second in 20 seconds, continues at this speed for 20 seconds, and then slows down to a stop in 30 seconds. Plot his speed vs. time and determine how far he went.

900 m



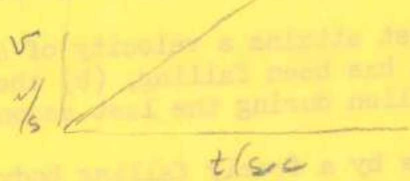
3. A car speeds up uniformly from rest so that it is going 80 meters per second after 20 seconds. How far does it travel during the first 10 seconds? How long does it take to travel 600 meters?

200 m

17.3 sec

$A = \frac{1}{2} b h$ $d = \frac{1}{2} K t^2$

$d = \frac{1}{2} t v$ $d = \frac{1}{2} \times 4 \frac{m}{s^2} \times t^2$



$v = Kt$

$K = 4 \frac{m}{s^2}$

$t = \sqrt{\frac{2d}{K}}$

$= \sqrt{300}\ s$

4. If a car goes 40 kilometers at 30 km/hr and 15 kilometers at 45 km/hr, what is its average speed for the whole trip?

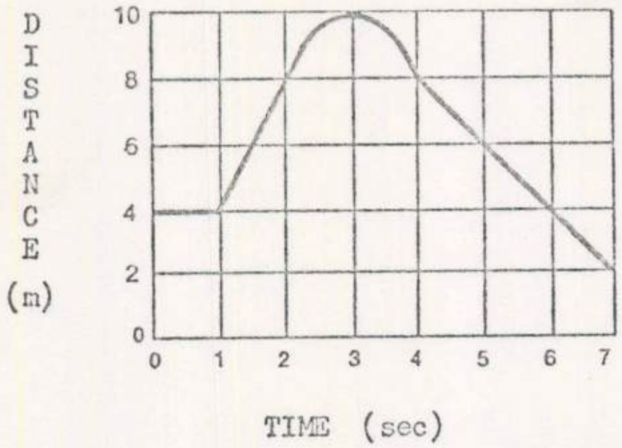
33 Km/hr

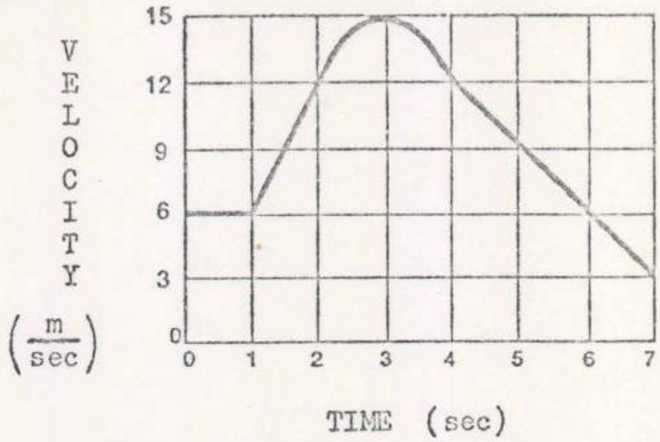
$v_{ave} = \frac{\Delta d}{\Delta t}$ $\frac{40 \text{ Km} + 15 \text{ Km}}{\frac{40 \text{ Km}}{30 \text{ Km}} hr + \frac{15 \text{ Km}}{45 \text{ Km}} h} = \frac{55 \text{ Km}}{5 \text{ hr}} \times 3$

5. In the following pairs of columns d represents the positions of an object moving along a straight line, and t the time corresponding to these positions, beginning at t = 0. Which of the motions is/are uniform?

a

a. d (m)	t (sec)	b. d (m)	t (sec)	c. d (m)	t(sec)
0	0	0	0	0	0
2	6	4	2	4	2
6	18	12	8	6	7
8	24	16	10	8	12





I. The position of an object as a function of time is shown in the diagram at the left.

________ 1. What is the velocity during the first second?

________ 2. What is the average velocity during the first 7 seconds?

________ 3. What is the velocity during the second second?

________ 4. What is the velocity at $t = 3$ seconds?

________ 5. What is the velocity at $t = 5$ seconds?

________ 6. What is the displacement during the first 6 seconds?

________ 7. What distance was traveled during the first 7 seconds?

II. The velocity of an object as a function of time is shown in the diagram at the right.

________ 8. How far does the object go during the first second?

________ 9. How far does the object go during the second second?

________ 10. What is the acceleration at $t = 1.5$ second?

________ 11. What is the acceleration at $t = 3.0$ seconds?

________ 12. What is the acceleration at $t = 5.0$ seconds?

________ 13. How far did the object go from $t = 4$ sec to $t = 7$ sec?

III. Plot the following graphs:

1. A velocity vs time graph of the displacement vs time graph shown at the left.
2. A position vs time graph of the velocity vs time graph shown at the right.

1. A ball started rolling on a level surface at a speed of 12 m/sec. Three seconds later it came to rest. Calculate (a) the average velocity of the ball during the three seconds and (b) the acceleration.

   a. ______________

   b. ______________

2. A ball rolls down a long inclined plane and has a velocity of 300 cm/sec at the end of two seconds. Calculate (a) its acceleration, (b) the distance it has covered in 2 seconds, and (c) the distance it would cover in 4 seconds.

   a. ______________

   b. ______________

   c. ______________

3. An automobile is traveling 60 km/hr. The brake is applied and the car comes to stop after it has traveled 60 meters. Calculate (a) the acceleration, and (b) how long it takes to stop the car.

   a. ______________

   b. ______________

4. A ball starting from rest rolls down an inclined plane and has a uniform acceleration of 4 cm/sec^2. Calculate (a) how many seconds are required for the ball to acquire a velocity of 40 cm/sec, (b) the average velocity during the time needed to reach a velocity of 40 cm/sec, (c) the distance traveled during the same time interval as in part b, (d) the distance the ball rolled during the last second of travel, and (e) the average velocity of the ball during the last 3 seconds of travel.

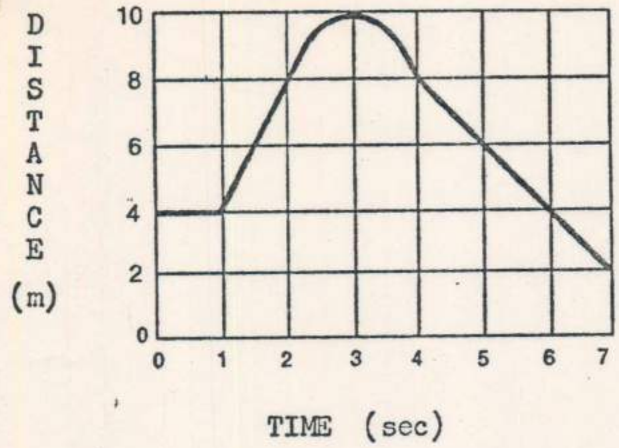
   a. ______________

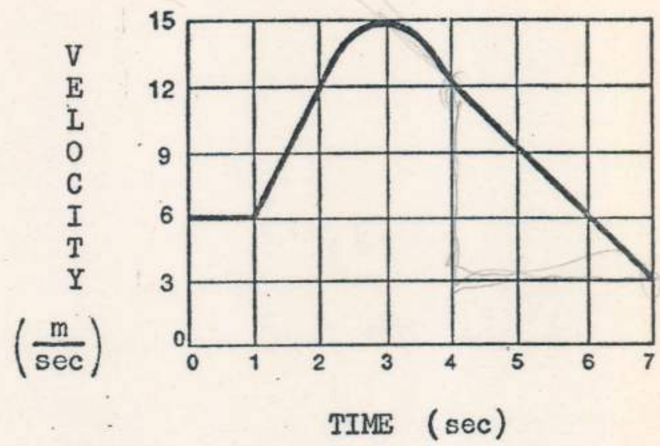
   b. ______________

   c. ______________

   d. ______________

   e. ______________





I. The position of an object as a function of time is shown in the diagram at the left.

0 1. What is the velocity during the first second?

-2/7 M/sec 2. What is the average velocity during the first 7 seconds? (-.29)

4 M/sec 3. What is the velocity during the second second?

0 4. What is the velocity at t = 3 seconds?

-2 M/sec 5. What is the velocity at t = 5 seconds?

0 6. What is the displacement during the first 6 seconds?

14 M 7. What distance was traveled during the first 7 seconds?

II. The velocity of an object as a function of time is shown in the diagram at the right.

6 M 8. How far does the object go during the first second?

9 M 9. How far does the object go during the second second?

6 M/sec² 10. What is the acceleration at t = 1.5 second?

0 11. What is the acceleration at t = 3.0 seconds?

-3 M/sec² 12. What is the acceleration at t = 5.0 seconds?

22.5 M 13. How far did the object go from t = 4 sec to t = 7 sec? $\int_4^7 v\,dt$

III. Plot the following graphs:

1. A velocity vs time graph of the displacement vs time graph shown at the left.
2. A position vs time graph of the velocity vs time graph shown at the right.

1. A ball started rolling on a level surface at a speed of 12 m/sec. Three seconds later it came to rest. Calculate (a) the average velocity of the ball during the three seconds and (b) the acceleration.

a. 6 M/sec

b. -4 M/sec²

$v_i = 12$ M/s, $t = 3$ sec, $v_f = 0$, $a = ?$

(a) $V_{ave} = \frac{V_i + V_f}{2} = \frac{\frac{12M}{s} + 0}{2} = 6$ M/s

(b) $a = \frac{V_f - V_i}{t} = \frac{0 - 12 M}{3 \text{ sec sec}} = -4 \frac{M}{sec^2}$

2. A ball rolls down a long inclined plane and has a velocity of 300 cm/sec at the end of two seconds. Calculate (a) its acceleration, (b) the distance it has covered in 2 seconds, and (c) the distance it would cover in 4 seconds.

a. 150 cM/s²

b. 300 cm

c. 1200 cM

$V_i = 0$, $V_f = 300 \frac{cm}{sec}$, $t = 2$ sec, $a = ?$, $d =$

(a) $a = \frac{V_f - V_i}{t} = \frac{300 \frac{cm}{sec} - 0}{2 sec} = 150 \frac{cm}{sec^2}$

(b) $d = \frac{1}{2} t (V_f + V_i) = \frac{1}{2} \times 2 sec \times 300 \frac{cm}{sec} = 300$ cm

(c) $d = ?$, $t = 4$ sec, $V_i = 0$, $a = 150$ cm/s²

$d = v_i t + \frac{1}{2} a t^2 = \frac{1}{2} \times 150 \frac{cm}{sec^2} \times 4 sec \times 4 sec = 150 \times \frac{16}{2} = 1200$ cm

3. An automobile is traveling 60 km/hr. The brake is applied and the car comes to stop after it has traveled 60 meters. Calculate (a) the acceleration, and (b) how long it takes to stop the car.

a. -3×10^4 Km/hr²

b. .002 hr

a. 2.3 m/sec²

b. 7.2 sec

$V_i = 60 \frac{Km}{hr}$, $d = 60$ M, $V_f = 0$, $a = ?$, $t =$

(a) $V_f^2 = V_i^2 + 2ad$

$\frac{-V_i^2}{2d} = a$

$- \frac{60 Km}{2 hr} \times \frac{60 Km}{60 M hr} \times \frac{10^3 M}{1 Km} = \frac{Km}{hr^2}$

-3×10^4

$a = \frac{V_f - V_i}{t}$, $t = \frac{V_f - V_i}{a} = \frac{-60 Km}{-3 \times 10^4 hr} \frac{hr^2}{Km}$

20×10^{-4}

.002 hr

4. A ball starting from rest rolls down an inclined plane and has a uniform acceleration of 4 cm/sec². Calculate (a) how many seconds are required for the ball to acquire a velocity of 40 cm/sec, (b) the average velocity during the time needed to reach a velocity of 40 cm/sec, (c) the distance traveled during the same time interval as in part b, (d) the distance the ball rolled during the last second of travel, and (e) the average velocity of the ball during the last 3 seconds of travel.

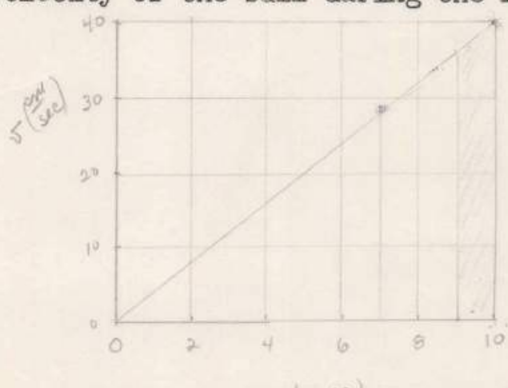
a. 10 sec

b. 20 cm/sec

c. 200 cm

d. 38 cm

e. 34 cm/sec



$V_i = 0$, $V_f = ?$, $a = 4 \frac{cm}{s^2}$, $d =$, $t = 7$ sec

(a) $V_i = 0$, $a = 4$ cm/s², $t = ?$, $V_f = 40$ cm/sec

$a = \frac{V_f - V_i}{t}$

$t = \frac{V_f}{a} = \frac{40 cm}{4 sec} \frac{sec^2}{cm} = 10$ sec

(b) $V_{ave} = \frac{V_i + V_f}{2} = \frac{40 cm}{2 sec} = 20$ cm

(c) $d = \frac{1}{2} v t = \frac{1}{2} \times \frac{40 cm}{sec} \times 10 sec = 200$ cm

(d) $d = \frac{1}{2} t (V_f + V_i) = \frac{1}{2} \times 1 sec \times (36 \frac{cm}{s} + 40 \frac{cm}{s})$

$= 38$ cm

Practice Problems Chapter 5

1. A runner runs the mile in 3 minutes, 58 seconds. Calculate his average speed in miles per hour.

2. An object which is undergoing uniform acceleration travels 7.2 meters in 3 seconds. Calculate (a) its acceleration, and (b) the distance the object moved during the third second.

3. An object which is accelerated at the rate of 0.5 m/sec^2 has covered a distance of 1849 meters. Calculate (a) the velocity it has attained, and (b) the time required to cover this distance.

4. An airplane has an initial velocity of 240 ft/sec. It covers 3,000 feet in the next 5 seconds. Calculate (a) its acceleration during this time interval, and (b) its final velocity.

5. A ball is dropped from the top of a building 245 meters high. Calculate (a) the time it takes for the ball to reach the earth, and (b) the velocity with which the ball strikes the earth.

6. A stone is thrown downward with a velocity of 50 ft/sec from the top of a building which is 294 feet high. Calculate (a) its velocity at the end of two seconds, (b) the time it takes to strike the ground, and (c) the velocity with which it strikes the ground.

7. A freely falling body starting from rest attains a velocity of 44.1 m/sec. Calculate (a) the time during which it has been falling, (b) the distance it has fallen, and (c) the distance it has fallen during the last second of fall.

8. Calculate the distance fallen in meters by a freely falling body during its 15th second if it started from rest.

9. What is the final velocity of an object which is dropped from a height of 100 feet? How long did it take to fall?

10. If a motorist travelling at 30 mi/hr starts accelerating at 5 ft/sec^2, (a) how fast will he be travelling in 10 seconds, and (b) how far will he have travelled during the 10 seconds?

11. In a (v vs t) graph, the curve rises in a straight line from v = 10 m/sec at t=3 sec to v = 40 m/sec at t=5 sec. (a) What is the acceleration at t=4 sec, and (b) how far did the object go in the two seconds?

12. In a (d vs t) graph, the curve rises in a straight line from d = 2 meters, t=2 sec to d = 10 meters, t=10 sec. Then it falls in a straight line to d = 2 meters, t=14 sec. (a) What is the average velocity? (b) What is the greatest speed? and (c) Describe exactly the v vs t graph of this situation. (You may wish to sketch the graph rather than describing it in words. If so, label your graph properly.)

ACCELERATION DUE TO GRAVITY IS 9.8 M/sec^2 or 32ft/sec^2.

PSSC PHYSICS: PROBLEMS - USING KINEMATICS GRAPHS - Chapter #9

1. Using the distance (i.e. position) vs. time graph, find the average speed from 20 to 35 seconds.
   Note: Time axis is calibrated in seconds.

2. Using the distance vs. time graph find the instantaneous speed when time equals 70 seconds.

3. Using the distance vs. time graph, find the average speed from 10 to 100 seconds.

4. Using the distance vs. time graph, find the instantaneous speed when time equals 80 seconds.

5. Using the speed vs. time graph, find the displacement and final position of a car from 5 to 50 seconds.

6. Using speed vs. time graph, find the displacement and final position of a car from 55 to 70 seconds.

7. Using the speed vs. time graph, find the displacement and final position of a car from 70 to 80 seconds.

   Note: There is an error in the acceleration vs. time graph. Can you find it?

8. Using the speed vs. time graph, find the instantaneous acceleration when time equals 40 seconds.

9. Using the speed vs. time graph, find the average acceleration from 6 to 12 seconds.

10. Using the speed vs. time graph, find the average acceleration from 61 to 66 seconds.

11. Using the acceleration vs. time graph, find the change in speed, and the final speed, from 5 to 25 seconds.

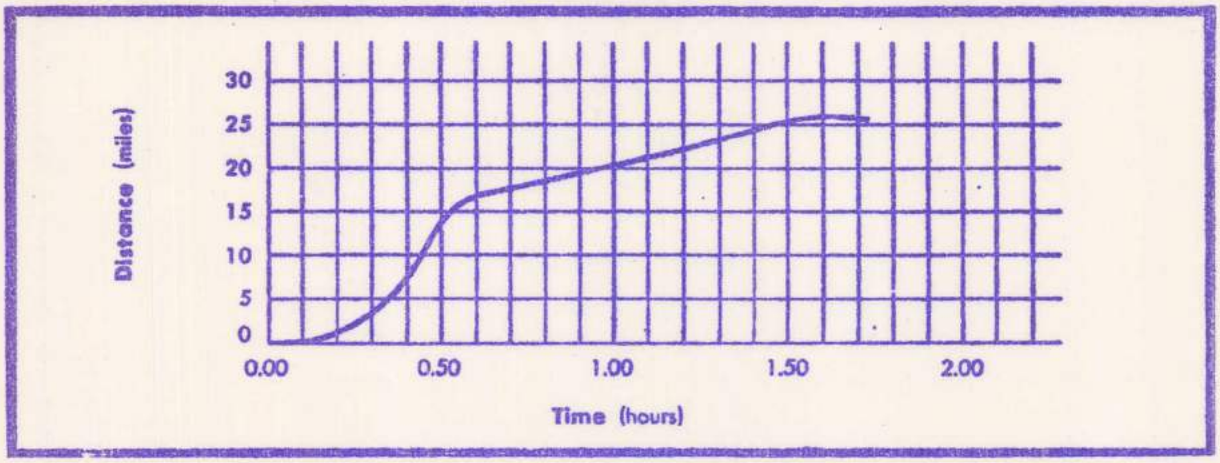
12. Using the acceleration vs. time graph, find the change in speed, and the final speed, from 35 to 50 seconds.

13. For more practice ask for a speed vs. time graph that can be used to make distance and an acceleration vs. time graphs.

PSSC PHYSICS QUIZ #________ Name Dick H

CHAPTER 9 - GRAPHS (SECTION 1-6) Date________

The distance-time graph for a car is shown below:



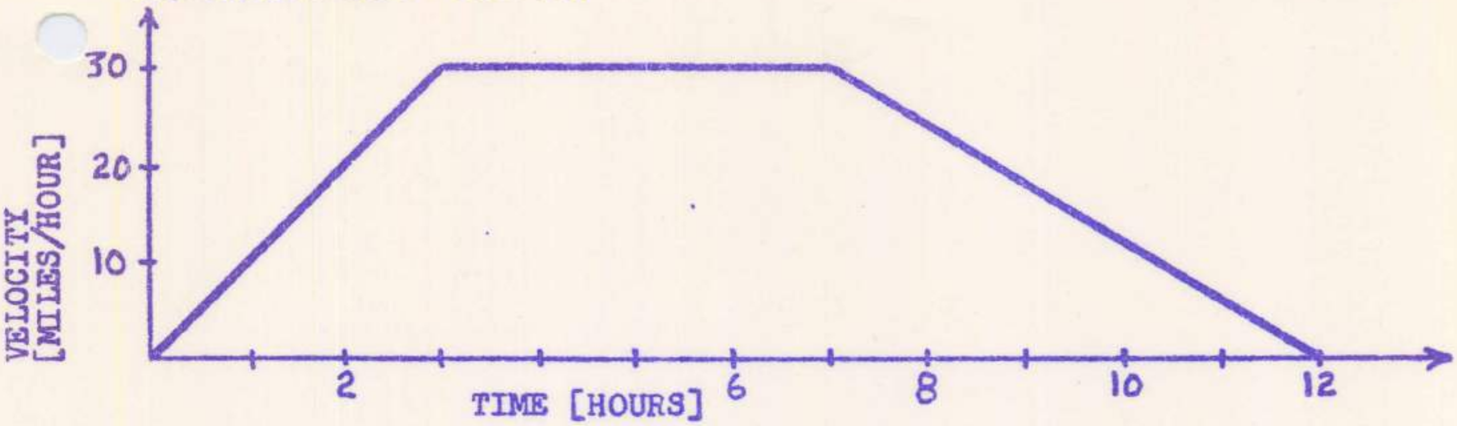
1. During what time interval was the car traveling at a constant speed? (1 pt.)

2. What was the value of this constant speed? (1 pt.)

3. At what instant was the car going at the greatest speed?

4. Calculate the speed of the car at that instant. (2 points)

5. What was the AVERAGE speed for the first half hour? (2 points)



6. Given the graph above showing the speed of a car vs. time:
   (A) Calculate as accurately as you can the total displacement of the car. (2 pts.)

   (B) What additional information would you need to know in order to find the final position of the car? (1 pt.)

EXTRA POINT:

Two physics students, and their trained fly, "Squatter", became involved in the following experiment. One student and "Squatter" sat on one motor-cycle, and 20 miles away the other student sat on his motorcycle. By and by they began racing toward each other. The instant they started, "Squatter", who was on the handlebar of the first student's cycle started flying straight toward the second student. As soon as it reached the handlebar of the second student the fly turned and started back. The fly flew back and forth this way, from handlebar to handlebar, until the two cycles met.

If each cycle had a constant speed of 10 miles per hour, and the fly flew a constant speed of 15 mph, what distance did the fly "Squatter" fly?

LAB S-2 Name ______________ Mod ________

UNIFORM MOTION ON THE LINEAR AIR TRACK

I. PURPOSE: To determine if there is a relationship between the position of a moving object and the time it takes to travel to that position, and if there is a relationship, what type of relationship is it.

II. PROCEDURE: Using the linear air track, make observations and collect data to determine the time it takes for the glider to move through a measured distance (get 6 or more data points). Then make a graph of the distance as a function (controlled by) of time. Determine the slope of the graph (rise/run) and using all of this information, try to write a simple formula that you could use to predict the position of the glider at any given time.

III. DATA TABLE:

TRIAL	DISTANCE TRAVELED	TIME

Unit 2 Worksheet Name ______________________________ mod ________

4. An object which is undergoing uniform acceleration travels 720 cm in 3 seconds.
   a) Calculate its acceleration.

   b) Calculate the distance it moved during the 3rd second.

5. An object which is accelerated at the rate of 0.5 m/sec^2 has traveled a distance of 1849 meters.
   a) Calcualte the velocity it attained.

   b) Claculate the time required to travel the above distance.

6. If the brakes of an automobile accelerate (deceleration) it at the rate of -5.2 m/sec^2
   a) How long will it take to stop the car when traveling at a velocity of 26 m/sec?

   b) How far will the car travel before it is stopped?

   c) How would this stopping distance be mathematically related to a car which was traveling at 13 m/sec and subjected to the same rate of acceleration?

7. Two cars are separated by some distance when they start from rest at the same time. The front car has an acceleration of 2 m/sec^2 while the rate of the rear car is 3 m/sec^2. The rear car overtakes the front car after the front car has moved 50 meters.
   a) How long does it take the rear car to overtake the front one?

   b) How far was the rear car behind the front one initially?

   c) What is the velocity of each car when they are right beside each other?

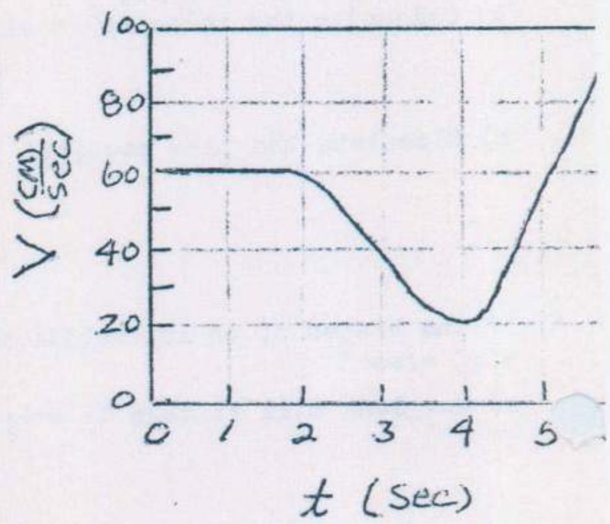
Unit 2 Worksheet Name ____________________ mod___

1. A bowling ball is released with a velocity of 5 m/sec. It takes it 4 sec to reach the pins which are 18 m away.

(a) What was the deceleration of the ball?

(b) What was its velocity when it struck the pins?

2. (a) How is acceleration determined from this V-T graph?



(b) How the distance traveled determined from the V-T graph?

(c) What is the acceleration at:

5 sec?

1 sec?

3 sec?

(d) What is the distance traveled in:

the first two seconds?

the last second?

3. A truck's speed increases uniformly from 22 ft/sec to 88 ft/sec in 20 sec.

(a) what is its average velocity?

(b) what is its rate of acceleration?

(c) how far will it travel during this period?

24+10+

12 sec

Chapter 1 Test

Name: Key

Mods______________

1. Over which section(s) of the graph was the velocity constanat?

   BC & FG

2. What was the maximum speed of the object?

   12 M/s   NOT 9

3. What was the change in position of the object in the first 5 seconds?

   27 M $\frac{1}{2} \times 4s \times 9\frac{M}{s} + 1sec \times 9\frac{M}{s}$ 18 M

4. What was the acceleration over the section 'AB'?

   2.25 M/sec^2 $\frac{9M/s}{4s} = 2.25$

5. What was the average velocity over the first 5 seconds?

   5.4 M/sec $v_{ave} = \frac{\Delta d}{\Delta t} = \frac{27M}{5sec}$

6. What was the average acceleration from t = 8 to t = 12 seconds?

   3 M/s^2 $a = \frac{\Delta v}{\Delta t}$ $\frac{0-(-12M/s)}{4sec} = 3 M/s^2$

7. What was the total distance travelled during the full 12 seconds?

   64.8 M   39.6 + 25.2

8. What was the position of the object at t = 12 seconds, given that it occupied the zero position initially?

   14.4 M

9. What was the average speed over the full 12 seconds?

   5.4 M/s $\frac{64.8 M}{12 s}$

10. What was the instantaneous velocity at D? (Where the graph crosses the zero axis)

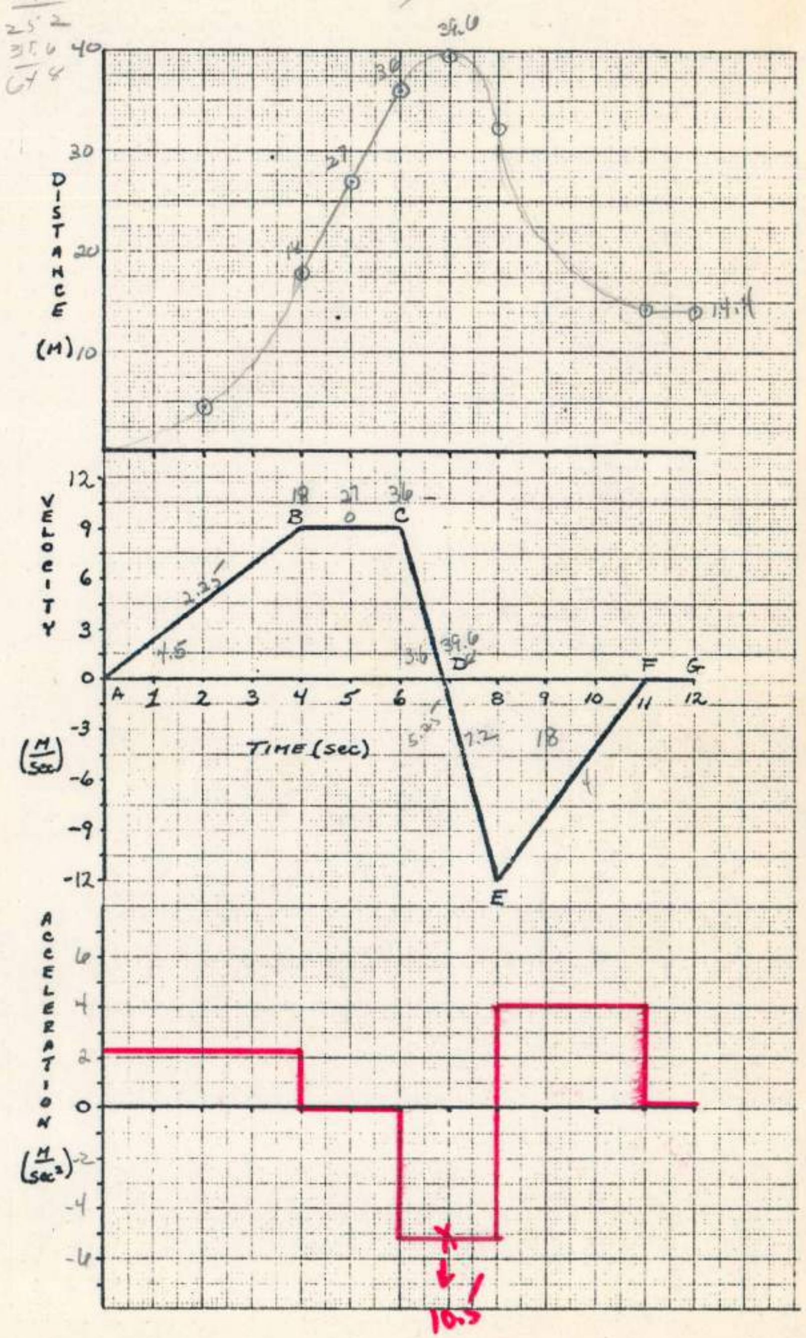
    0

11. Over which section was the magnitude acceleration greatest?

    C-E

12. Using the grids provided, draw the graphs of acceleration vs time and displacement vs time for the full 12 seconds.

10



50

A car traveling at 50 km/hr begins accelerating at a constant rate. At the end of 10 seconds its velocity is 80 km/hr. Find the value of:

a. Average Velocity

b. Acceleration

c. Time at which its velocity was 60 km/hr

d. Displacement after 10 seconds.

10 sec = .0028 hr

$v_i = 50 \frac{Km}{hr}$ 50 Km/hr

$v_f = 80 \frac{Km}{hr}$ 60 Km/hr

$t = 10$ sec ?

$a =$ 3.0 Km/hr·sec

.018 Km/sec

a. $v_{ave} = \frac{v_i + v_f}{2} = \frac{50 \frac{Km}{hr} + 80 \frac{Km}{hr}}{2} = \frac{130 \frac{Km}{hr}}{2} = 65 \frac{Km}{hr}$ 18.1 M/sec

b. $a = \frac{v_f - v_i}{t}$ $\frac{80 \frac{Km}{hr} - 50 \frac{Km}{hr}}{10 sec} = \frac{30 \frac{Km}{hr}}{10 sec} = 3.0 \frac{Km}{hr \cdot sec}$ 10,800 Km/hr²

c. $t = \frac{v_f - v_i}{a} = \frac{60 \frac{Km}{hr} - 50 \frac{Km}{hr}}{3.0 Km/hr/sec} = \frac{10 Km}{3.0} \frac{hr \cdot sec}{hr \cdot Km} = 3.3$ sec 9x10⁻⁴ sec

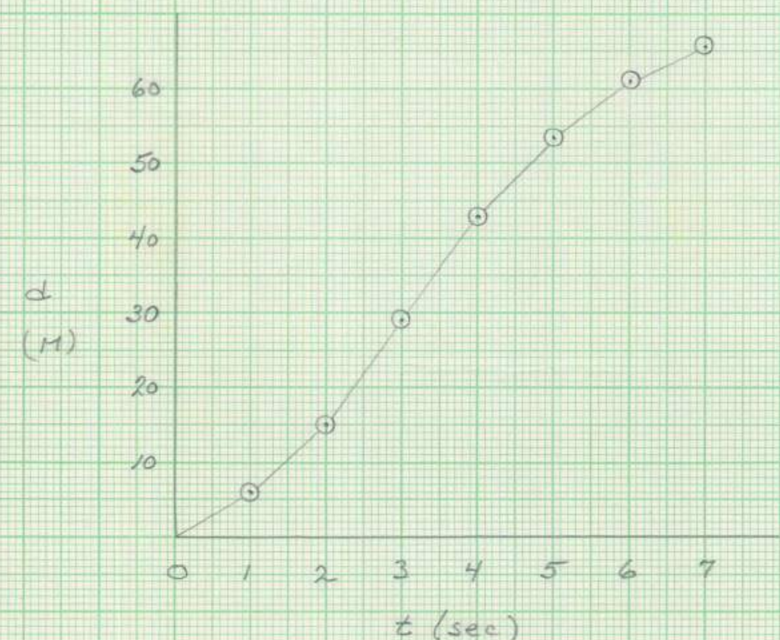
d. $d = \frac{1}{2} t (v_f + v_i) = \frac{1}{2} \times 10 sec \times (80 \frac{Km}{hr} + 50 \frac{Km}{hr})$

$\frac{1}{2} \times 10 sec \times 130 \frac{Km}{hr} \times \frac{1 hr}{3600 sec}$ $\frac{13}{72} = 0.18$ Km

$65 \frac{Km}{hr} \times \frac{1000 M}{1 Km} \frac{1 hr}{3600 sec}$ $3.3 sec \times \frac{1 hr}{3600 sec}$ .0009 hr

Was it worth your time seeing the film STRAIGHT LINE KINEMATICS? Yes___ No___ If yes should it be shown as a summary experience as this year? Or should it be shown as an introduction? Or should part of it be shown as an introduction and the rest later? Please indicate your feelings.


4
3
2
1
0
-1
-2
v
(M/S)
1
2
3
4
5
6
7
t (sec)
?
?


60
50
40
30
20
10
d
(M)
0
1
2
3
4
5
6
7
t (sec)

Chapter 1 Test

Name Key
Mods

1. Over which section(s) of the graph was the velocity constanat?

2 BC - FG 4-6 11-12

2. What was the maximum speed of the object?

1 4 M/sec

3. What was the change in position of the object in the first 5 seconds?

2 9M

4. What was the acceleration over the section 'AB'?

2 0.75 M/s²

5. What was the average velocity over the first 5 seconds?

3 1.8 M/sec 9M/5s

6. What was the average acceleration from t = 8 to t = 12 seconds?

3 1.00 M/sec²

7. What was the total distance travelled during the full 12 seconds?

4 21.6M

8. What was the position of the object at t = 12 seconds, given that it occupied the zero position initially?

3 4.8M

9. What was the average speed over the full 12 seconds?

2 1.8 M/s $v_{ave} = \frac{21.6M}{12 sec}$

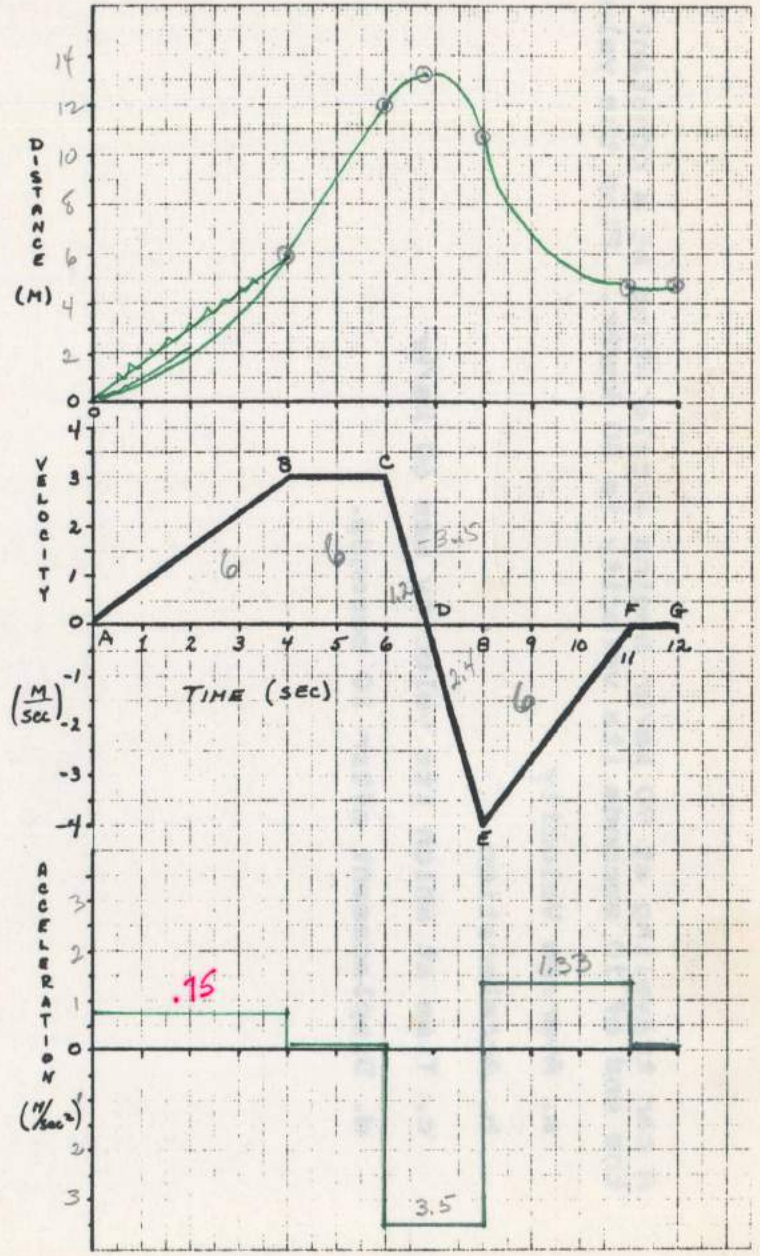
10. What was the instantaneous velocity at D? (Where the graph crosses the zero axis)

1 0

11. Over which section was the acceleration greatest?

1 CE

12. Using the grids provided, draw the graphs of acceleration vs time and displacement vs time for the full 12 seconds.



A car traveling at 90 km/hr begins accelerating at a constant rate. At the end of 10 seconds its velocity is 40 km/hr. Find the value of:

a. Average Velocity

b. Acceleration

c. Time at which its velocity was 60 km/hr

d. Displacement after 10 seconds.

Was it worth your time seeing the film STRAIGHT LINE KINEMATICS? Yes___ No___ If yes should it be shown as a summary experience as this year? Or should it be shown as an introduction? Or should part of it be shown as an introduction and the rest later? Please indicate your feelings.