Velocity Unit Problem Set # 7

1. The graphs of three position functions are shown below.

|  |  |  |  |
| --- | --- | --- | --- |
|  | velocity | acceleration | speed |
| a. |  |  |  |
| b. |  |  |  |
| c. |  |  |  |

 In each case determine the signs of the velocity and

 acceleration, then determine whether the particle is

 speeding up or slowing down.

1. b. c.

s

s

s





|  |  |  |
| --- | --- | --- |
|  | acceleration | speed |
| a. |  |  |
| b. |  |  |
| c. |  |  |

2. The graphs of three velocity functions are shown below.

 In each case determine the signs of the acceleration, then

 determine whether the particle is speeding up or slowing down.

v

v

1. b. c.



v



3. The position function of a particle moving on a coordinate line

 is shown on the right.

s

1. Is the particle moving left or right at time t0? \_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Is the acceleration pos. or neg. at time t0? \_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Is the particle speeding up or slowing down at t0? \_\_\_\_\_\_\_\_\_\_\_\_\_\_

t0 0

t1 0

1. Is the particle speeding up or slowing down at t1? \_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. The graph shows the velocity of a particle moving

V(m/sec)

 along a horizontal coordinate axis.

t(sec)

a. When does the particle reverse direction? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. When is the particle moving at a constant speed? \_\_\_\_\_\_\_\_\_\_

c. When is the particle moving at its greatest speed?\_\_\_\_\_\_\_\_\_\_

d. Graph the acceleration (where defined).

t(sec)

a(m/sec)

5. A particle moves along a vertical coordinate axis so that its position at any time  is given by the function where s is measured in centimeters and t is measured in seconds.

a. Find the displacement during the first 6 seconds. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. Find the average velocity during the first 6 seconds \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. Find the expressions for the velocity and acceleration at time t.

 *v(t)* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ *a(t)* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d. For what values of t is the particle moving downward? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. The position of a particle moving on the line y = 2 is given by where *t* is

 time in seconds.

a. When does the particle speed up? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Slow down? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. When does the particle change direction? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. When is the particle at rest? ­­­­­­­­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d. When is the particle at the point (5, 2)?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. A 45 – caliber bullet fired straight upward from the surface of the moon would reach a height of

 feet after t seconds. On Earth, in the absence of air, its height would be

  feet after t seconds. How long would it take the bullet to get back down in each

 case.

 Moon \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Earth \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

8. A rock thrown vertically upward from the surface of the moon at a velocity of 24m/sec reaches a height

 of meters in *t* seconds.

a. Find the expressions for the velocity and acceleration at time t. (acceleration here will be on the moon)

 *v(t)* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ *a(t)* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. How long did it take the rock to reach its highest point? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. How high did the rock go? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d. How long did it take the rock to reach half its maximum height? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. How long was the rock aloft? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

9. The figure shows the position versus time curve for a certain

 particle moving on a straight line.

s

a. Is the particle moving faster at time t0 or t2? Explain.

t1

t2

t0

t

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. At the origin, the tangent is horizontal, what does this tell us about the initial

 velocity of the particle? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. Is the particle speeding up or slowing down in the interval ? Explain.

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d. Is the particle speeding up or slowing down in the interval ? Explain.

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

10. Emergency food supplies are dropped from a helicopter and hit the ground 10 seconds later.

a. What is the height *h* of the helicopter? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. The box in which the supplies are packed is strong enough to withstand a speed of 180 mi/hr on impact.

 Will the supplies be intact? Explain. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. What is the maximum height at which the helicopter can be positioned to guarantee that the box will not

 break up when it hits the ground? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

A projectile is fired directly upward with an initial velocity of v0 ft/sec, and its height in feet above the ground after *t* seconds is given by *s(t)*. Find (a) the velocity and acceleration after t seconds, (b) the maximum height, and (c) the duration of the flight.

11. ; 

Velocity \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Acceleration \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Max\_\_\_\_\_\_\_\_\_ Duration\_\_\_\_\_\_\_\_\_\_

12. ; 

Velocity \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Acceleration \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Max\_\_\_\_\_\_\_\_\_ Duration\_\_\_\_\_\_\_\_\_\_

13. A cork bobs up and down in the lake. The distance from the bottom of the lake to the center of the cork

 at time is given by , where *s(t)* is in inches and *t* is in seconds.

a. Find the velocity of the cork at t = 0 \_\_\_\_\_\_\_\_\_\_, t = .5 \_\_\_\_\_\_\_\_\_\_, t = 1 \_\_\_\_\_\_\_\_\_\_,

 t = 1.5 \_\_\_\_\_\_\_\_\_\_, t = 2 \_\_\_\_\_\_\_\_\_\_

b. During what time intervals is the cork rising? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

14. Match the graphs of the position functions shown with their velocity functions shown.

s

s

s

vv

v

v

15. Let 

a. Find s and v when a = 0 s \_\_\_\_\_\_\_\_\_\_\_\_ v \_\_\_\_\_\_\_\_\_\_\_\_

b. Find s and a when v = 0 s \_\_\_\_\_\_\_\_\_\_\_\_ a \_\_\_\_\_\_\_\_\_\_\_\_

16. Let 

a. Find s and v when a = 0 s \_\_\_\_\_\_\_\_\_\_\_\_ v \_\_\_\_\_\_\_\_\_\_\_\_

b. Find s and a when v = 0 s \_\_\_\_\_\_\_\_\_\_\_\_ a \_\_\_\_\_\_\_\_\_\_\_\_

17. During the first 40 sec of a rocket flight, the rocket is propelled straight up so that in *t* sec

 it reaches a height of .

a. How high does the rocket travel in 40 sec? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. What is the average velocity of the rocket during the first 40 sec? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

c. What is the average velocity of the rocket during the first 135 ft of its flight? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

d. What is the instantaneous velocity of the rocket at the end of 40 sec? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

18. A car is travelling on a straight road that is 120 miles long. For the first 100 miles the car travels at an

 average velocity of 50mi/hr. Show that no matter how fast the car travels for the final 20 miles it cannot

 bring the average velocity up to 60 mi/hr for the entire trip.

19. If is the position function of a moving particle for , at what instant of time will the

 particle start to reverse its direction of motion, and where is it at that instant?

 Reverse \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Location \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

20. A particle moves on a line away from its initial position so that after *t* hr is  miles from its

 initial position.

a. Find the average velocity of the particle over the interval  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. Find the instantaneous velocity at *t* = 1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

21. A particle moves in one direction along a straight line so that after *t* min is ft from the origin.

a. Find the average velocity of the particle over the interval  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

b. Find the instantaneous velocity at *t* = 2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

22. Let . Make a table showing the position, velocity, speed, and acceleration at times t =1,

 t = 2, t= 3, t= 4, and t= 5. At each of these times, specify the direction of motion, if any, and

 whether the particle is speeding up, slowing down, or neither.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| t | s(t) | v(t) | a(t) | Speed | Direction | Up/Down |
| 1 |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |

23. Let for . Find the maximum speed of the particle and the direction of motion of the

 particle when it has speed. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

24. Let , find the maximum speed of the particle when . During that interval,

 when is the particle furthest from the origin? What is its position at that instant?

 Speed \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ When \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Position \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

25. If a particle moves at a constant velocity, what can you say about its position versus time curve?