Velocity Unit Problem Set # 7

1. The graphs of three position functions are shown below. In each case determine the signs of the velocity and acceleration, then determine whether the particle is speeding up or slowing down.

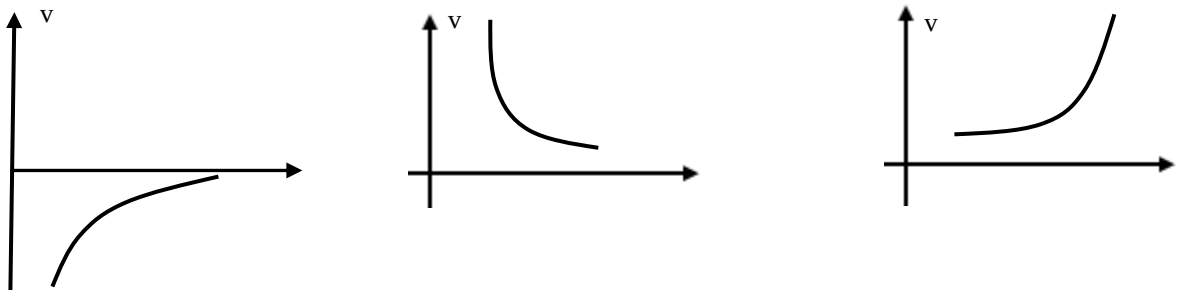
	velocity	acceleration	speed
a.			
b.			
c.			

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.

	acceleration	speed
a.		
b.		
c.		

a. b. c.



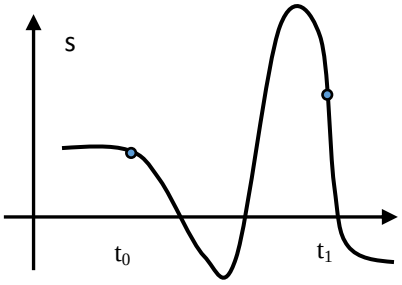
3. The position function of a particle moving on a coordinate line is shown on the right.

a. Is the particle moving left or right at time t_0? _____

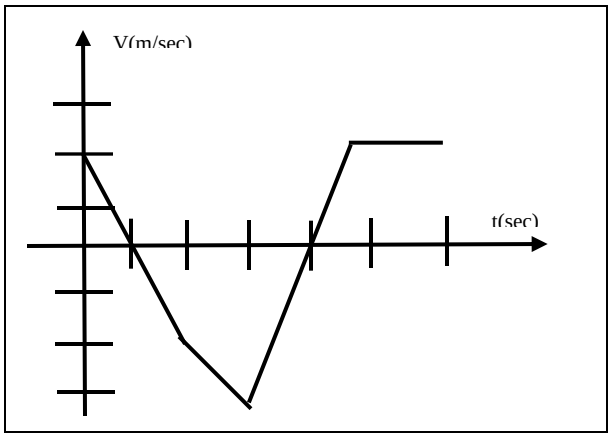
b. Is the acceleration pos. or neg. at time t_0? _____

c. Is the particle speeding up or slowing down at t_0? _____

d. Is the particle speeding up or slowing down at t_1? _____



4. The graph shows the velocity $v = f(t)$ of a particle moving along a horizontal coordinate axis.

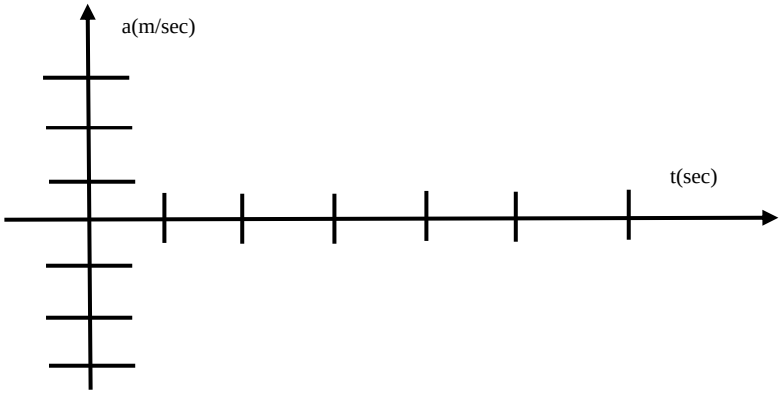


a. When does the particle reverse direction? _____

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).



5. A particle moves along a vertical coordinate axis so that its position at any time $t \geq 0$ is given by the function $s(t) = \frac{1}{3}t^3 - 3t^2 + 8t - 4$ 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 $s(t) = 2t^3 - 13t^2 + 22t - 5$ 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 $s(t) = -2.6t^2 + 832t$ feet after t seconds. On Earth, in the absence of air, its height would be $s(t) = -16t^2 + 832t$ 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 $s(t) = -.8t^2 + 24t$ 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)* = _____

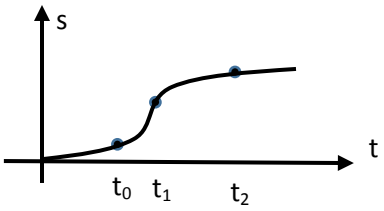
b. How long did it take the rock to reach its highest point? _____

c. How high did the rock go? _____

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

e. How long was the rock aloft? _____

9. The figure shows the position versus time curve for a certain particle moving on a straight line.



a. Is the particle moving faster at time t_0 or t_2? Explain.

_____

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 $[t_0, t_1]$? Explain.

_____

d. Is the particle speeding up or slowing down in the interval $[t_1, t_2]$? 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 v_0 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. $v_0 = 144;\ \ s(t) = 144t - 16t^2$

Velocity _____ Acceleration _____ Max_____ Duration_____

12. $v_0 = 192;\ \ s(t) = 100 + 192t - 16t^2$

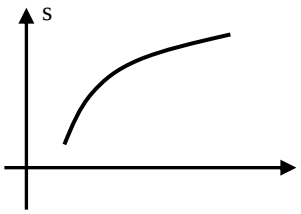
Velocity _____ Acceleration _____ Max_____ Duration_____

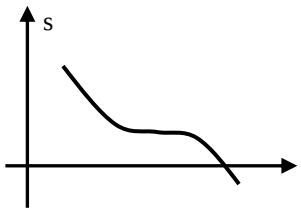
13. A cork bobs up and down in the lake. The distance from the bottom of the lake to the center of the cork at time $t \geq 0$ is given by $s(t) = \cos \pi t + 12$, where *s(t)* is in inches and *t* is in seconds.

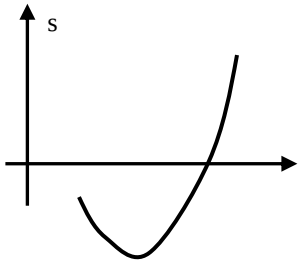
a. Find the velocity of the cork at t = 0 _____, t = .5 _____, t = 1 _____,
t = 1.5 _____, t = 2 _____

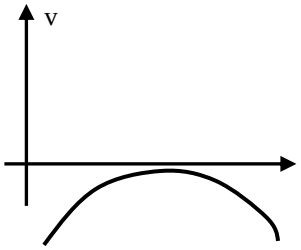
b. During what time intervals is the cork rising? _____

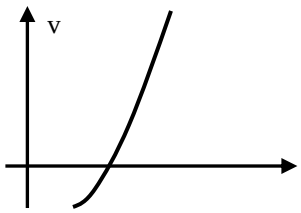
14. Match the graphs of the position functions shown with their velocity functions shown.

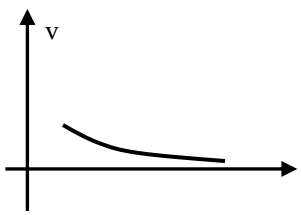












15. Let $s(t) = t^3 - 6t^2 + 1$

a. Find s and v when a = 0 s _____ v _____

b. Find s and a when v = 0 s _____ a _____

16. Let $s(t) = 4t^{\frac{3}{2}} - 3t^2$ *for* $t > 0$

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 $s(t) = 5t^3$.

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 $s(t) = \frac{t}{t^2 + 5}$ is the position function of a moving particle for $t \geq 0$, 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 $s(t) = 3t^2 + t$ miles from its initial position.

a. Find the average velocity of the particle over the interval $[1, 3]$ _____

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 $s(t) = 6t^4$ ft from the origin.

a. Find the average velocity of the particle over the interval $[2, 4]$ _____

b. Find the instantaneous velocity at $t = 2$. _____

22. Let $s(t) = t^3 - 6t^2$. 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 $s(t) = \dfrac{100}{t^2 + 12}$ for $t \geq 0$. Find the maximum speed of the particle and the direction of motion of the particle when it has speed. _____

24. Let $s(t) = 5t^2 - 22t$, find the maximum speed of the particle when $1 \leq t \leq 3$. 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?