Free Fall Equations … Set 2

Rectilinear and Projectile Motion

1. A particle is moving with its position defined by $s(t) = 2t^3 + 3t^2 - 36t + 40$ where t is in seconds and s is in feet.
   a) What are the particle's velocity and acceleration equations?
   b) What is the total distance traveled by the particle in the first three seconds?
   c) What is the displacement of the particle after the first eight seconds?

a) $v(t) = 6t^2 + 6t - 36$

$a(t) = 12t + 6$

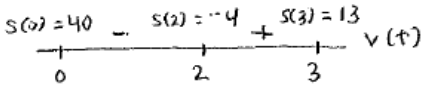
b) $0 = 6t^2 + 6t - 36$

$0 = 6(t^2 + t - 6)$

$0 = 6(t + 3)(t - 2)$

$t = \cancel{-3}$ $t = 2$ sec

↳ turns around



$|-4 - 40| + |13 - -4| = 61$ ft.

c) $s(8) - s(0)$

$968 - 40$

928 ft.

2. A silver dollar is dropped from a building that is 1,362 feet in height. Time is in seconds.
   a) What are the silver's dollar's height, velocity, and acceleration functions?
   b) When does the silver dollar hit the ground and what is its impact velocity?
   c) How far does the silver dollar travel between t = 1 second and t = 2 seconds?

a) $s(t) = -16t^2 + 1362$

$v(t) = -32t$

$a(t) = -32$

b) $0 = -16t^2 + 1362$

$t = 9.226$ sec

$v(9.226) = -295.232$ ft/sec

impact velocity: 295.232 ft/sec

c) $s(2) = 1298$ ft.

$s(1) = 1346$ ft

$1346 - 1298 = 48$ ft.

Free Fall Equations … Set 2

3. The displacement in feet of a body of water moving along a line at any time t in seconds is given by $s(t) = t^3 - 6t^2 + 9t + 5$.

a) What are the velocity and acceleration functions?
b) Find the total distance traveled from t = 0 seconds to t = 4 seconds.
c) What is the velocity of the body when the position is 8 feet?
d) Sketch a motion schematic. Be sure to label the time, [position, and velocity at each change and at the beginning.

a) $v(t) = 3t^2 - 12t + 9$

$a(t) = 6t - 12$

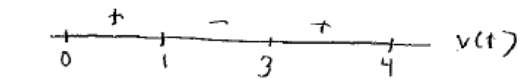
b) $0 = 3t^2 - 12t + 9$

$0 = 3(t^2 - 4t + 3)$

$0 = 3(t-3)(t-1)$

$t = 3$ sec, 1 sec

↳ turns around



$s(0) = 5$ $s(1) = 9$ $s(3) = 5$ $s(4) = 9$

$|9-5| + |5-9| + |9-5|$

16 ft.

c) $8 = t^3 - 6t^2 + 9t + 5$

$0 = t^3 - 6t^2 + 9t - 3$

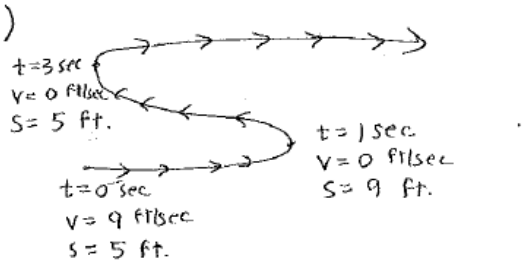
$t = .468, 1.653, 3.879$ sec

$v(.468) = 4.041$ ft/sec

$v(1.653) = -2.639$ ft/sec

$v(3.879) = 7.592$ ft/sec

d)



4. A marble is thrown straight down from the top of a 220-foot building. Its initial velocity was 22 feet per second.

a) What are the marble's height, velocity, and acceleration functions?
b) When does the marble hit the ground and what is its impact velocity?
c) What are the velocity and position at three seconds?
d) What is the velocity after falling 108 feet?

a) $s(t) = -16t^2 - 22t + 220$

$v(t) = -32t - 22$

$a(t) = -32$

b) $0 = -16t^2 - 22t + 220$

$t = 3.084$ sec

$v(3.084) = -241.376$ ft/sec

impact velocity: 241.376 ft/sec

c) $v(3) = -118$ ft/sec

$s(3) = 10$ ft.

d) $112 = -16t^2 - 22t + 220$

$0 = -16t^2 - 22t + 108$

$t = 2$ sec

$v(2) = -86$ ft/sec