Notation $y = f(x)$

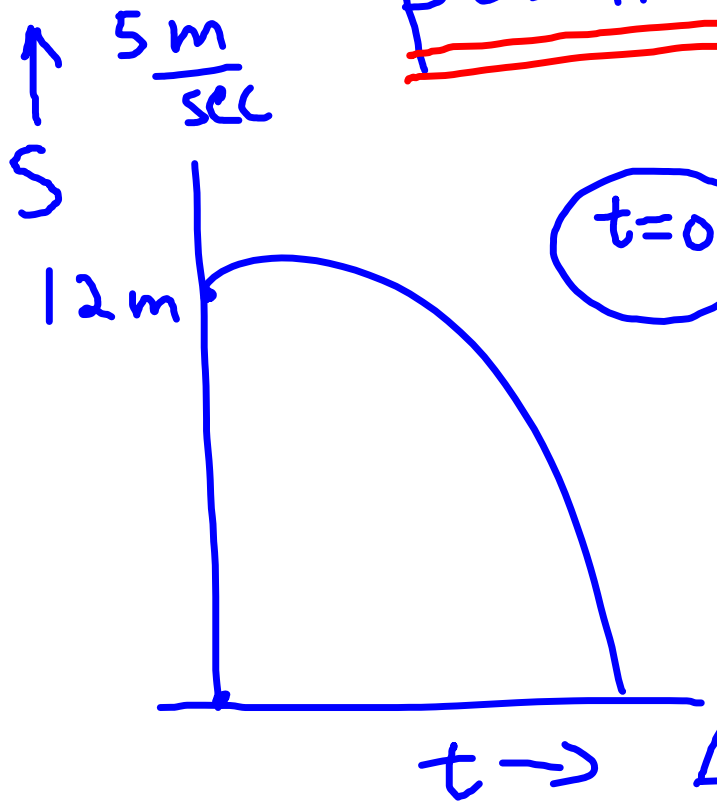
Tangent Slope Function or Derivative

$tsf(x)$, $f'(x)$, $D[f(x)]$, $\frac{dy}{dx}$

- position: $s(t)$
- velocity: $v(t) = s'(t)$
- acceleration: $a(t) = v'(t) = s''(t)$

→ Application to motion in 1 dim with constant acceleration.

Position: $s(t) = a_0\frac{t^2}{2} + v_0 t + s_0$



s_0 = initial position

v_0 = " velocity

a_0 = " acceleration

velocity:

$$v(t) = s'(t) = a_0 t + v_0$$

$$s(t) = -\frac{9.8}{2} t^2 + 5t + 12$$

$$v(t) = s'(t) = -\frac{9.8 \cdot 2}{2} t + 5 + 0$$

a. $s(t) = -9.8\frac{t^2}{2} + 5t + 12$ position

$v(t) = s'(t) = -9.8t + 5$ velocity

$a(t) = s''(t) = -9.8$ ✓ acceleration

SHW 5
Problem 1

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b. $v(t) = 0$

$-9.8t + 5 = 0$

$s'(t)$

$t = .510$ s

$s(.510) = -\frac{9.8}{2}(.51)^2 + 5(.51) + 12$

$= 13.28$ m

c. $s(t) = 3$

$$-\frac{9.8}{2}t^2 + 5t + 12 = 3$$

$$-\frac{9.8}{2}t^2 + 5t + 9 = 0$$

$$t = 1.958 \text{ sec}$$

$$v(1.958) = s'(1.958)$$

$$= -9.8(1.958) + 5$$

$$= -14.188 \frac{m}{sec}$$

d. $s(t) = 0$

$$-\frac{9.8}{2}t^2 + 5t + 12 = 0$$

$$\boxed{t = 2.1568 \text{ sec}}$$

$$v(2.1568) = s'(2.1568)$$

$$= -9.8(2.1568) + 5$$

$$= \boxed{-16.1288 \frac{m}{sec}}$$

9. $s(t) = a_0\frac{t^2}{2} + v_0 t + s_0$

JULIA

$s(t) = \frac{11}{2}t^2 + 0\cdot t + 0$

$= \frac{11}{2}t^2$

$v(t) = s'(t) = 2\cdot\frac{11}{2}t$

$= 11t$

$a(t) = \ddot{s}(t) = 11\ m/s^2$

b.

Harland

$$s(t) = \frac{11t^2}{2}$$

$$370 = \frac{11t^2}{2}$$

$$\frac{370}{5.5} = \frac{5.5t^2}{5.5}$$

$$\sqrt{67.27} = \sqrt{t^2}$$

$$t = 8.202\text{s}$$

$$s'(t) = 11t$$

$$s'(t) = 11 \cdot 8.202\text{s}$$

$$s'(t) = 90.222\text{m/s}$$

Shaterra

C. $S(t) = \frac{11}{2}t^2$

$185 = 5.5t^2$

$\frac{185}{5.5} = \frac{5.5t^2}{5.5}$

$\sqrt{t^2} = \sqrt{33.636...}$

$t = 5.799\,s$

$S'(t) = 11t$

$S'(t) = 11 \cdot 5.799$

$S'(t) = 63.796\,m/s$

SHW 5 Problem 3. 1D Motion with Constant Acceleration

A hot air balloon is ascending at a constant speed of 11 m/s. When it is 10 m above the ground, a care package is released from the balloon.

(a) Specify the position and velocity functions for the motion of the package.

Julia

$$s(t)=\frac{1}{2}a_0t^2+v_0t+s_0$$

$s(t)=\frac{-9.8}{2}t^2+11t+10$

$s'(t)=-9.8t+11$

$s''(t)=-9.8$

(b) What is the maximum height reached by the package?

$0=-9.8t+11$

$-11=-9.8t$

$t=1.122s$

$s(1.122)=\frac{-9.8}{2}(1.122)^2+11(1.122)+10$

(c) How long after being released does it take the package to reach a height of 14 m, and what is the velocity of the package when it reaches this height?

$s(t)=14$

$14=-\frac{9.8t^2}{2}+11t+10$

$=-\frac{9.8}{2}t^2+11t-4$

$t=.433659, 1.7s$

Sarah

$v(t)=-9.8(.433659)+11$

$v=6.746\ m/s$

(d) How long after being released does it take the package to hit the ground, and what is the velocity of the package just before it hits the ground?

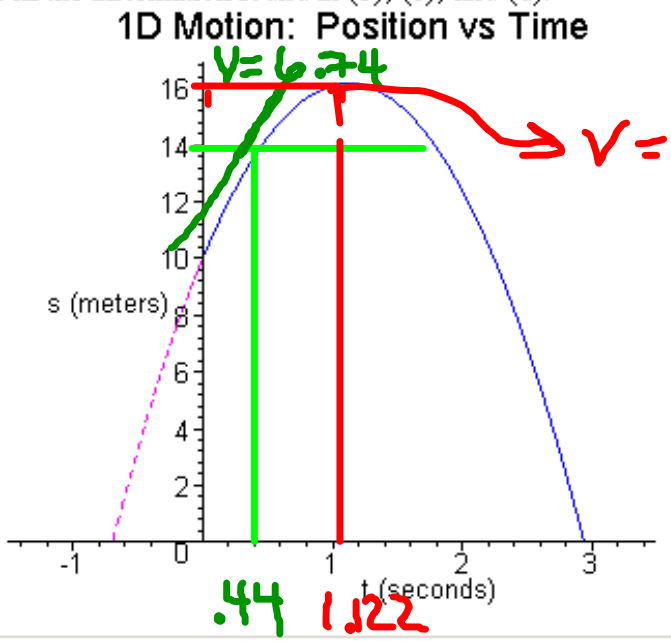
$s(t) = 0 = \frac{-9.8}{2}t^2 + 11t + 10$ Lonnie

$t = \frac{-11 \pm \sqrt{11^2 - 4(4.9)(10)}}{2(-4.9)}$ $t = -.694$, 2.94

$V(2.94) = -1.8(2.94) + 11$

$V = -17.812 \frac{m}{s}$

(e) Label the following Position vs Time graph with all the information found in (b), (c), and (d).



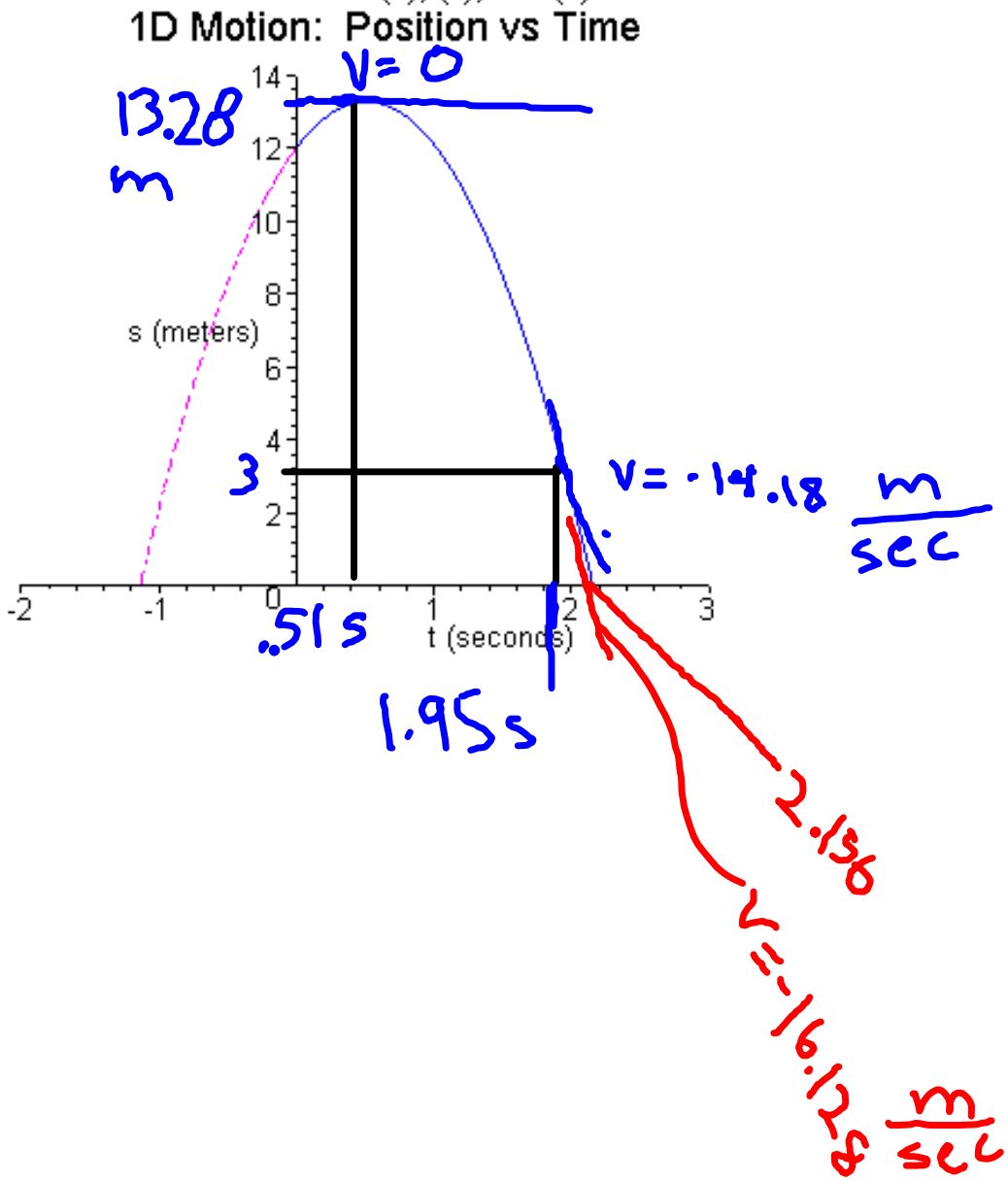
e.

Label the following Position vs Time graph with all the information found in (b), (c), and (d).

SAM

Meredith

Jeff



SHW 5 Problem 4. 1D Motion with Constant Acceleration

A hot air balloon is descending at a constant speed of 5 m/s. When it is 22 m above the ground, a care package is released from the balloon.
(a) Specify the position and velocity functions for the motion of the package.

$$s(t) = \frac{1}{2}a_0 t^2 + v_0 t + s_0$$

$\frac{-9.8t^2}{2} - 5t + 22 = s(t)$ $\quad -9.8t - 5 = s'(t)$ Harland

(b) What is the maximum height of the package after it is released? Explain your answer.

After being released, it only goes down, so 22 m is the Max Height Jeff

(c) How long after being released does it take the package to reach a height of 10 m, and what is the velocity of the package when it reaches this height?

$10 = \frac{-9.8t^2}{2} - 5t + 22$ $\quad -10 \quad -10$

$0 = -4.9t^2 - 5t + 12$

$t = \frac{-5 \pm \sqrt{(-5)^2 - 4(-4.9)(12)}}{2(-4.9)}$

$t = -51.77, \boxed{1.136 s}$

$s'(1.136) = -9.8(1.136) - 5$

$s'(1.136) = -16.133 m/s$

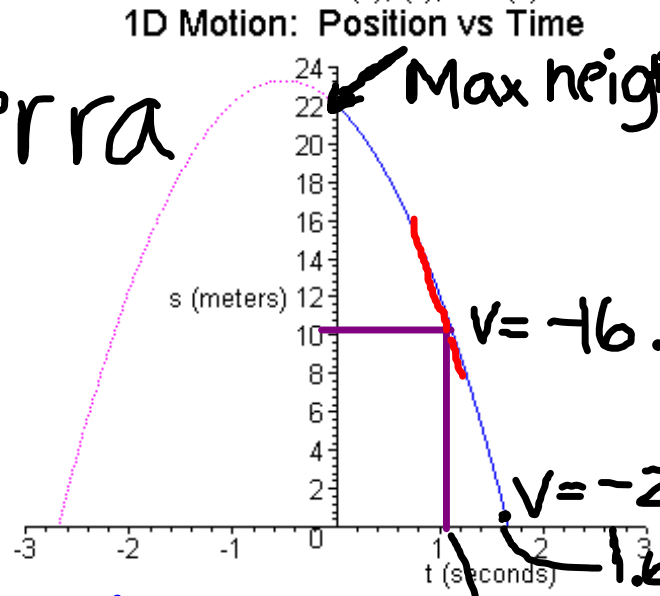
Jeff

(d) How long after being released does it take the package to hit the ground, and what is the velocity of the package just before it hits the ground?

Sarah

(e) Label the following Position vs Time graph with all the information found in (b), (c), and (d).

Shaterra



Max height 22m
V=0

V=-16.123m/s

V=-21.356m/s

1.669s

1.135s

d.) $0 = -4.905t^2 - 5t + 22$

$t = -2.6879$

$t = 1.6885$

$s'(t) = (-9.81)(1.66) - 5$

$V = -21.3630$ m/s

SHW 5 Problem 5. 1D Motion with Constant Acceleration

A hot air balloon is hovering motionlessly 35 m above the ground, when a care package is released from the balloon.
(a) Specify the position and velocity functions for the motion of the package.

$$s(t) = \frac{1}{2}a_0 t^2 + v_0 t + s_0$$

$s(t) = -4.9t^2 + 0t + 35$ $\quad s'(t) = -9.8t$

$= -4.9t^2 + 35$

(b) What is the maximum height of the package after it is released? Explain your answer.

$V = 0$ when it is released, so max height $= 35\text{m}$

(c) How long after being released does it take the package to reach a height of 25 m, and what is the velocity of the package when it reaches this height?

$s(t) = 25$

$-4.9t^2 + 35 = 25$

$4.9t^2 = 10$

$t = \pm\sqrt{\frac{10}{4.9}} = \boxed{1.42\text{ s}}$

(d) What is the maximum speed attained by the package?

$0 = -\frac{9.8}{2}t^2 + vt + 35$ $t = 2.67$ s

$t = -0 \pm \frac{\sqrt{-4(35)(4.9)}}{-9.8}$

$s'(2.67) = -9.8(2.67) + 0$

$s'(2.67) = -26.166$ m/s

max speed $= |s'(t)| =$ 26.166 m/s

(e) Label the following Position vs Time graph with all the information found in (b), (c), and (d). Lindsey + Ali