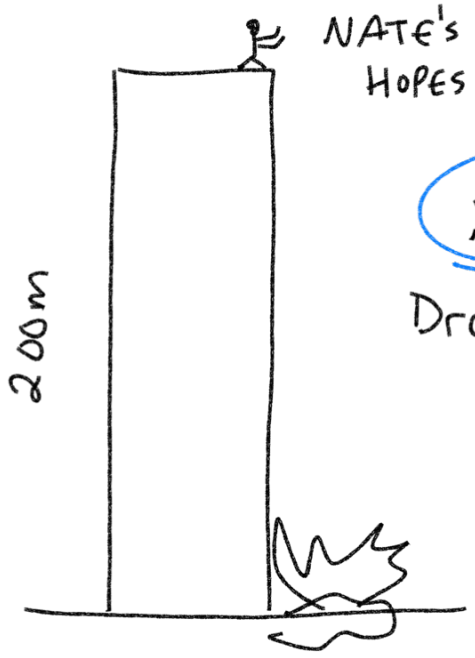
M-GP General Physics Week 9 11/6

$v_f = v_i + at$ $\quad x_f = x_i + \frac{1}{2}(v_i + v_f)t$

$\bar{v} = \frac{v_f + v_i}{2}$ $\quad (v_f)^2 = (v_i)^2 + 2a(x_f - x_i)$

$$x_f = x_i + v_i t + \frac{1}{2}at^2$$



DROP

$x_f = x_i + v_i t + \frac{1}{2}at^2$

$[[a_g = -9.80\ m/s^2]]$ acceleration due to gravity

$x_i = 200m$

Drop $v_i = 0\ m/s$

$a = -9.80\ m/s^2$

Time to impact

$x_f = x_i + \cancel{v_i t}^{0} + \frac{1}{2}at^2$

$0 = 200m + \frac{1}{2}(-9.80\ m/s^2)t^2$

$0 = 200m - 4.90\ m/s^2\ t^2$

$-200m \quad -200m$

$\frac{-200m}{-4.90\ m/s^2} = \frac{-4.90\ m/s^2\ t^2}{-4.90\ m/s^2}$

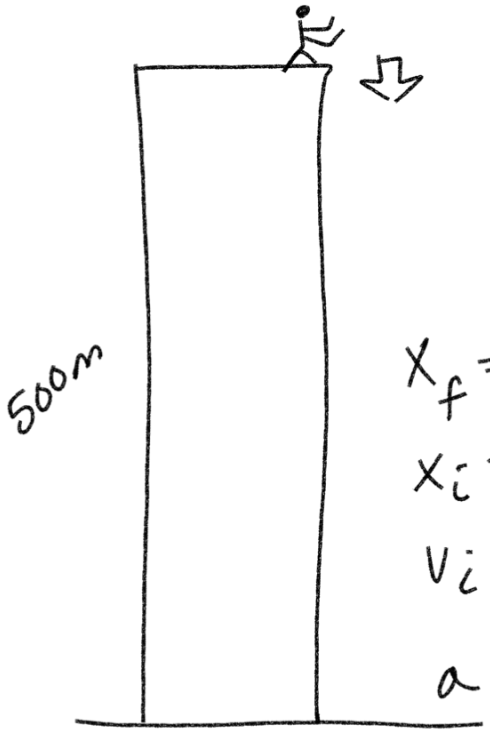
$\sqrt{40.82\ s^2} = \sqrt{t^2}$

$t = 6.4\ s$ → 6 s

Drop $v_i = 0\ m/s$

$$t = \sqrt{\frac{x_i}{-4.9}}$$

Bowling Ball Filled with banana pudding



time to impact?

Drop

$X_f = X_i + V_i t + \frac{1}{2}at^2$ ($V_i t = 0$)

$X_f = 0$

$X_i = 500m$

$V_i = 0 m/s$

$a = -9.8 m/s^2$

$0 = 500 + \frac{1}{2}(-9.8)t^2$

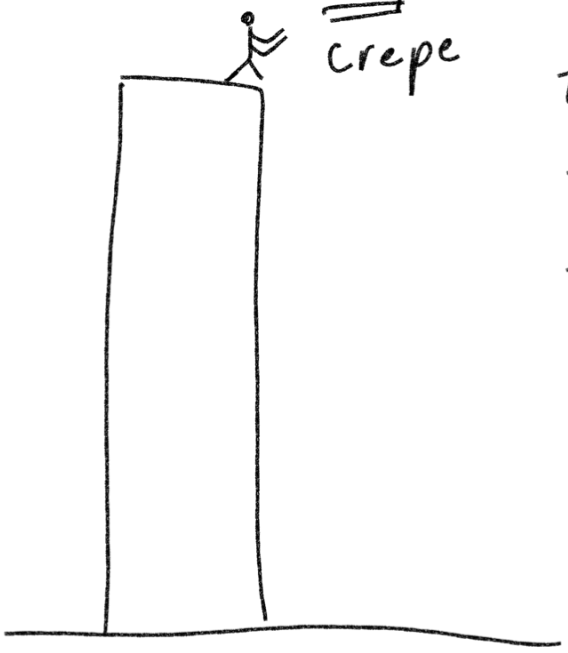
$0 = 500 - 4.9t^2$

$-500 \quad -500$

$\frac{-500}{-4.9} = \frac{-4.9t^2}{-4.9}$

$t = \sqrt{\frac{-500}{-4.9}} = \boxed{10\ s}$

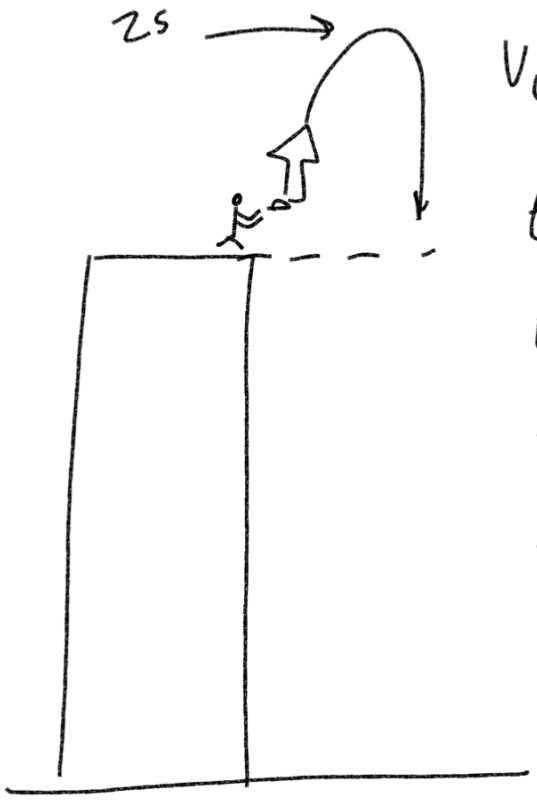
Drop crepe



$t=0 \quad 0 m/s$

$t=1 \quad -9.8 m/s$

$t=2 \quad -19.6 m/s$



$V_i = 20\ m/s$

Round Numbers

$g = -10\ m/s^2$

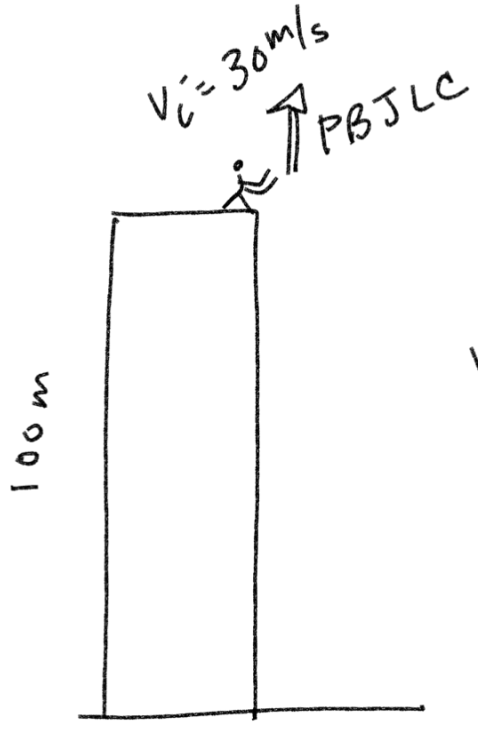
$t=0 \quad 20\ m/s$

$t=1 \quad 10\ m/s$

$t=2 \quad 0\ m/s$

$t=3 \quad -10\ m/s$

$t=4 \quad -20\ m/s$



time to max height:

$$\boxed{X_f = X_i + V_i t + \frac{1}{2}at^2}$$

velocity at max height

$V_f = 0\ m/s$

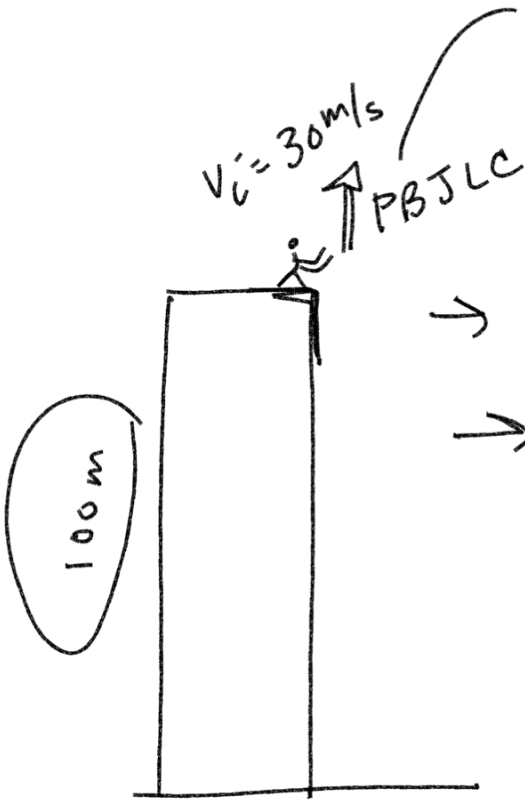
$$\boxed{V_f = V_i + at}$$

$$0 = 30 + (-9.8)t$$

$-30 \quad -30$

$$\frac{-30}{-9.8} = \frac{-9.8t}{-9.8}$$

$$3.1s = t$$



3.1s

What is max height?

$$\rightarrow X_f = X_i + V_i t + \frac{1}{2} a t^2$$

$$\rightarrow = 100 + (30 m/s)(3.1 s) + \frac{1}{2}(-9.8 m/s^2)(3.1 s)^2$$

$$100 m + 93 m + (-47.1 m)$$

$$145.9 m = \boxed{146 m}$$

$X_i = 100m \quad V_i = 30 m/s \quad a = -9.8 m/s^2$

Time to impact

$$X_f = X_i + V_i t + \frac{1}{2} a t^2$$

$$0 = 100 + 30t - 4.9t^2$$

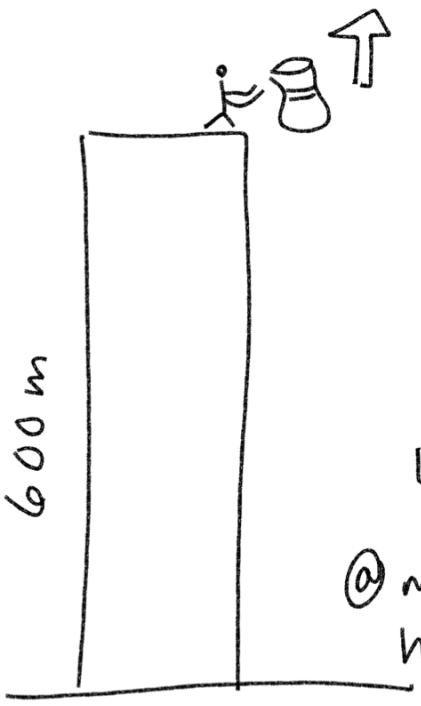
$$\boxed{t = 8.5 s}$$

What was terminal velocity?

$$V_f = V_i + at$$

$$30 m/s + (-9.8 m/s^2)(8.5 s)$$

$$\boxed{-53.3 m/s}$$



$V_i = 40\ m/s$

1.) Time to max height
2.) Max height
3.) Time to impact
4.) Velocity upon impact

1.) $V_f = V_i + at$

@ max height $V_f = 0$ $\quad 0 = 40 + (-9.8)t$

$-40 \quad -40$

$\frac{-40}{-9.8} = \frac{-9.8t}{-9.8}$

$\boxed{4.1s = t}$

Max height

2.) $X_f = X_i + V_i t + \frac{1}{2}at^2$

$X_f = 600 + 40(4.1) + \frac{1}{2}(-9.8)(4.1)^2$

$681\ m$

Time to impact 3.) $X_f = 600 + 40t - 4.9t^2$

$\boxed{15.9\ s}$

4.) Velocity upon impact.

$V_f = V_i + at$

$= 40 + (-9.8)(15.9s) = -115.8$

$\boxed{-116\ m/s}$

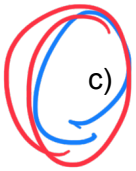
2.5 One-Dimensional Motion with Constant Acceleration

12.) Write the formula with the given terms: final velocity, initial velocity, acceleration, and time.

13.) Solve each.

a) Find the final velocity with the following parameters.
$v_i = 40.0\ m/s \quad a = 2.00\ m/s^2 \quad t = 12.0\ s$

b) Find the final velocity with the following parameters.
$v_i = 28.0\ m/s \quad a = 3.50\ m/s^2 \quad t = 4.50\ s$



c) Find the initial velocity with the following parameters.
$v_f = 16.0\ m/s \quad a = 1.50\ m/s^2 \quad t = 6.00\ s$

$v_f \quad a \quad t \quad v_i = ?$

$v_f = v_i + at$

$-at \qquad -at$

$v_i = v_f - at$

$16.0\ m/s - (1.50\ m/s^2)(6.00\ s)$

$16.0\ m/s - 9.00\ m/s = \boxed{7.0\ m/s}$

d) Find the acceleration with the following parameters.

$v_f = 24.0\ m/s \quad v_i = 18.0\ m/s \quad t = 3.00\ s$

14.) Write the formula for average velocity (with constant acceleration).

15.) If the acceleration is constant, find the average velocity under each of the following conditions:

a) $v_f = 33.0\ m/s \quad v_i = 15.0\ m/s$

b) $v_f = 60.0\ m/s \quad v_i = 72.0\ m/s$

$v_f \quad v_i \quad \bar{v}$

$$\bar{v} = \frac{v_f + v_i}{2} = \frac{60.0\ m/s + 72.0\ m/s}{2} = \frac{132.0\ m/s}{2} = 66.0\ m/s$$

16.) Write the formula with the given terms: final position, initial position, final velocity, initial velocity, and time.

17.) Find the final ~~velocity~~ position under each of the following conditions:

a) $v_f = 26.0\ m/s \quad v_i = 14.0\ m/s \quad x_i = 45.0\ m \quad t = 4.00\ s$

$$x_f = x_i + \frac{1}{2}(v_f + v_i)t$$

$$45.0m + \frac{1}{2}(26.0m/s + 14.0m/s)(4.00s)$$

$$45 + \frac{1}{2}(40)4$$

$$45 + 80 = 125\ m$$

b) $v_f = 16\ m/s \quad v_i = 28\ m/s \quad x_i = 80\ m \quad t = 6\ s$

18.) Write the formula with the given terms: final position, initial position, acceleration, initial velocity, and time.

19.) Find the final position under each of the following conditions:

a) $x_i = 52.0\ m \quad v_i = 8.50\ m/s \quad a = 2.00\ m/s^2 \quad t = 8.00\ s$

X_f

$X_f = X_i + v_i t + \frac{1}{2} a t^2$

$52.0m + (8.50m/s)(8.00s) + \frac{1}{2}(2.00m/s^2)(8.00s)^2$

$52 + 68 + 64$

$120 + 64 = 184\ m$

b) $x_i = 24.0\ m \quad v_i = 12.5\ m/s \quad a = 3.50\ m/s^2 \quad t = 6.00\ s$

c) $x_i = 35.0\ m \quad v_i = -2.50\ m/s \quad a = 4.00\ m/s^2 \quad t = 3.00\ s$

20.) Write the formula with the given terms: final position, initial position, acceleration, initial velocity, and final velocity.

21.) Find the final ~~velocity~~ position under each of the following conditions.

a) $x_i = 30.0\ m \quad v_f = 10.0\ m/s \quad v_i = 15.0\ m/s \quad a = 2.00\ m/s^2$ (find x_f)

$$(v_f)^2 = (v_i)^2 + 2a(x_f - x_i)$$

$$(10.0\ m/s)^2 = (15.0\ m/s)^2 + 2(2.00\ m/s^2)(x_f - 30.0\ m)$$

$$100 = 225 + 4(x_f - 30)$$

$$100 = 225 + 4x_f - 120$$

$$-105 \quad -105$$

$$-5 = 4x_f$$

$$\frac{-5}{4} = \frac{4x_f}{4}$$

$$x_f = \frac{-5}{4} = -1.25\ m$$

b) $x_i = 55.0\ m \quad v_f = 22.0\ m/s \quad v_i = 12.0\ m/s \quad a = 3.00\ m/s^2$