TH-GP General Physics Week 9 11/9

$$v_f = v_i + at$$

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

assumes constant acceleration

$$\bar{v} = \frac{v_f + v_i}{2}$$

$$(v_f)^2 = (v_i)^2 + 2a(x_f - x_i) \quad \Delta x$$

constant acceleration

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

Positim $x_f = x_i + v_i t + \frac{1}{2}at^2$ (1-1, 2-1)

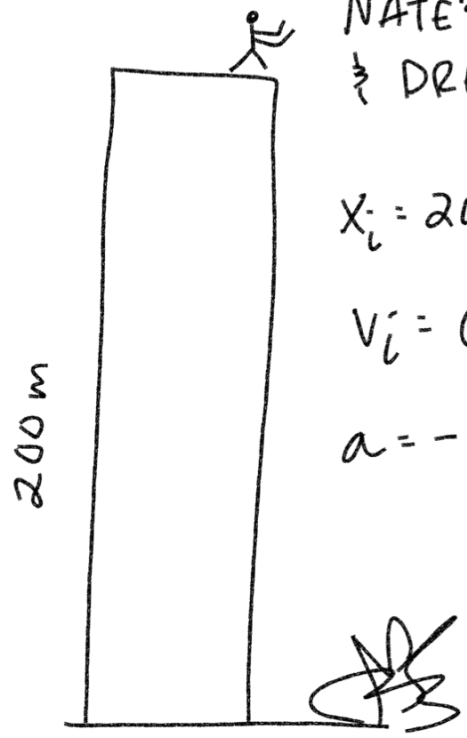
↓ 1st Derivative

Velocity $v_f = v_i + at$ (1-1)

↓ 2nd Derivative

Acceleration $a = a$

acceleration is constant



NATE'S HOPE & DREAMS

DROP

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

$[\![a_g = -9.80\ m/s^2]\!]$

acceleration is due to gravity

$x_i = 200\ m$

$v_i = 0\ m/s$

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

$x_f = 0$

Time to impact

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

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

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

$-200m \quad -200m$

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

$40.82\ s^2 = t^2$

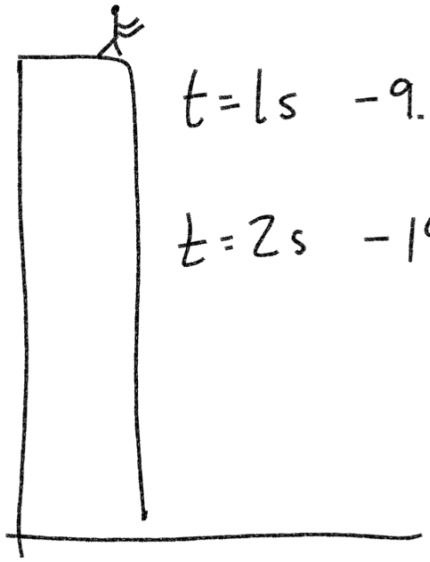
$\sqrt{40.82\ s^2} = \sqrt{t^2}$

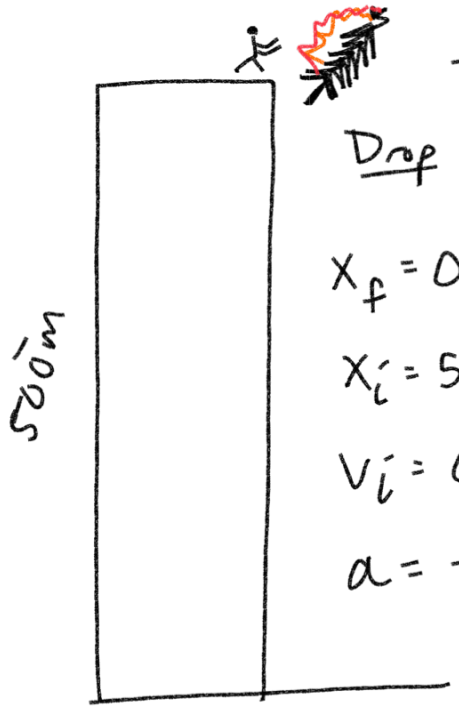
$t = 0s \quad 0\ m/s$

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

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

$\boxed{6.4s} = t$ or $\boxed{6\ s}$





flaming Christmas tree

Drop

$X_f = 0$

$X_i = 500m$

$V_i = 0$

$a = -9.80 m/s^2$

Time to impact

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

$0 = 500 + \frac{1}{2}(-9.80 m/s^2)t^2$

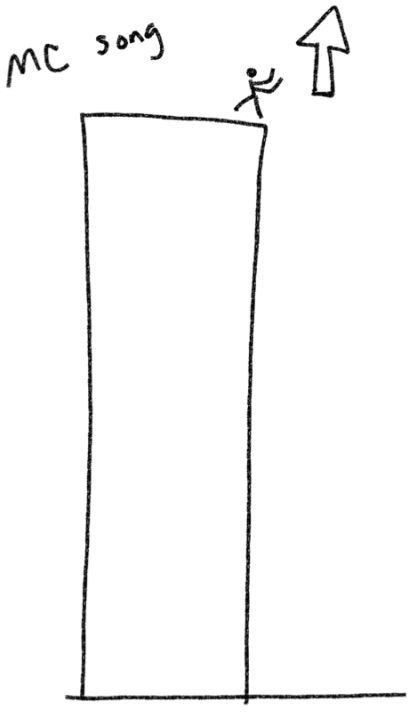
$0 = 500 - 4.9t^2$

$-500 \quad -500$

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

$\sqrt{102} = \sqrt{t^2}$

$t = 10.1 s$



$V_i = 20 m/s$

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

$t = 0 \quad 20 m/s$

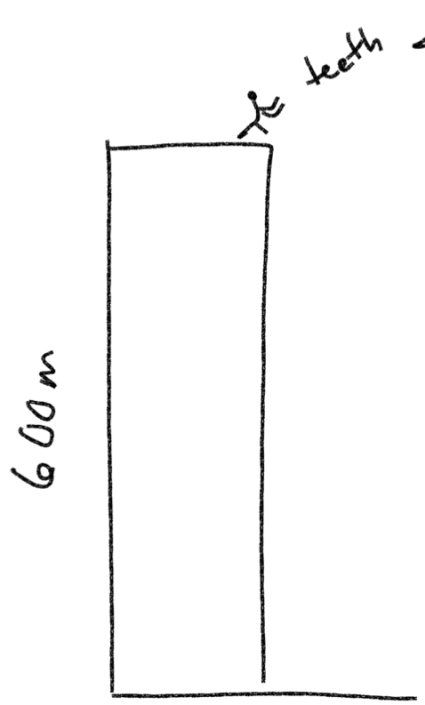
$t = 1 \quad 10 m/s$

$t = 2 \quad 0 m/s \rightarrow$ max height

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

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

velocity at max height = $0 m/s$



$[\![V_i = 30\ m/s]\!]$ ↑

time to max height

$V_f = 0\ m/s$

$[\![V_f = V_i + at]\!]$

$0 = 30 + (-9.8)t$

$0 = 30 - 9.8t$

$-30 \quad -30$

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

$t = 3.06s$

What is max height?

time to max height

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

max height

$600 + 30(3.06) + \frac{1}{2}(-9.8)(3.06)^2$

time to impact

$= 600 + 91.8 - 45.9$ (-4.9)

$t = 14.5s$

$= 645.9m$ → **646 m**

$\frac{1}{2}(-9.8) = -4.9$

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

$0 = 600 + 30t - 4.9t^2$

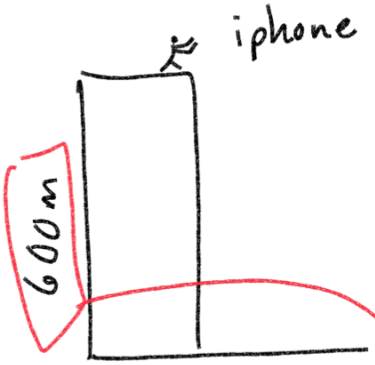
What was the velocity upm impact?

$$V_f = V_i + at$$

time to impact

$$30 + (-9.8)(14.5)$$

$$\boxed{-107 \text{ m/s}}$$



$V_i = 40$ m/s

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

1.) time to max height

$$V_f = V_i + at$$

$$0 = 40 - 9.8t$$

$$-40 \quad -40$$

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

$$\boxed{t = 4.1 \text{ s}}$$

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

$$0 = 600 + 40t - 4.9t^2$$

2.) Max height

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

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

$$\boxed{681 \text{ m}}$$

3.) Time to impact

$$0 = 600 + 40t - 4.9t^2$$

to Desmos...

$$\boxed{t = 15.9\text{ s}}$$

4.) Velocity upon impact

m/s

$$V_f = V_i + at$$

$$40 + (-9.8)(15.9) = \boxed{-115.8\ \text{m/s}}$$

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
a
t
$V_i = ?$

$V_f = V_i + at$

$16 = V_i + (1.5)(6)$

$16 = V_i + 9$

$-9 \qquad -9$

$V_i = 7.00\ m/s$

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

$\bar{V} = ?$

V_f

V_i

$\bar{V} = \frac{V_f + V_i}{2} = \frac{60 + 72}{2} = \frac{132}{2}$

$66.0\ m/s$

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

$x_f = ?$ $\quad x_i$

v_f $\quad t$

v_i

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

$$= 45 + \frac{1}{2}(26 + 14)(4)$$

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

$$45 + 80 = 125\ m$$

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_i t v_i a

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

$$52 + (8.5)(8) + \frac{1}{2}(2)(8)^2$$

$$52 + 68 + 64 = 184\ m$$

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.

position

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

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

$x_f = ?$

x_i

v_f

v_i

a

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

$(10)^2 = (15)^2 + 2(2)(x_f - 30)$

$100 = 225 + 4x_f - 120$

$100 = 105 + 4x_f$

$-105 \quad -105$

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

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

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