Intro to the Kinematic Equations

From the Activity

- $V_y = mx + b$
- $V_y = -9.8t + b$

- $y = ax^2 + bx + c$
- $y = -4.9t^2 + bt + c$

Where We Are At…

- So far, we have described motion with pictures and with some simple calculations using the following equations:
  - Displacement: $\Delta x = x_f - x_i$
  - Velocity: $v = \Delta x/\Delta t$
  - Change in velocity: $\Delta v = v_f - v_i$
  - Acceleration: $a = \Delta v/\Delta t$

Kinematic Equations

- $v = \Delta y/\Delta t$ → for CONSTANT velocity only
- $a = \Delta v/\Delta t$
- $v_{(t)} = at + v_i$
- $y_{(t)} = ½at^2 + v_i t + y_i$
- $v_{(t)}^2 = v_i^2 + 2(a\ \Delta y)$
- $\Delta y = \frac{t}{2}(v_f + v_i)$
- When something is written with (t), such as $v_{(t)}$, the v and (t) are not being multiplied. It means the "velocity at time = t."

Kinematic Equations

Vertical Motion

- $v = \Delta y/\Delta t \rightarrow$ for CONSTANT velocity only
- $a = \Delta v/\Delta t$
- $v_{(t)} = at + v_i$
- $y_{(t)} = \frac{1}{2}at^2 + v_i t + y_i$
- $v_{(t)}{}^2 = v_i{}^2 + 2(a\,\Delta y)$
- $\Delta y = \frac{t}{2}(v_f + v_i)$

Horizontal Motion

- $v = \Delta x/\Delta t \rightarrow$ for CONSTANT velocity only
- $a = \Delta v/\Delta t$
- $v_{(t)} = at + v_i$
- $x_{(t)} = \frac{1}{2}at^2 + v_i t + x_i$
- $v_{(t)}{}^2 = v_i{}^2 + 2(a\,\Delta x)$
- $\Delta x = \frac{t}{2}(v_f + v_i)$

Kinematic Equations

Let’s take a look at these equations:

- $v = \Delta y/\Delta t$ → for CONSTANT velocity only
- $a = \Delta v/\Delta t$
- $v_{(t)} = at + v_i$
- $y_{(t)} = ½at^2 + v_i t + y_i$
- $v_{(t)}{}^2 = v_i{}^2 + 2(a\ \Delta y)$
- $\Delta y = \frac{t}{2}(v_f + v_i)$

Kinematic Equations

- How do we use these equations?
  - If an object with an initial position of y = 3 m and a velocity of 5 m/s accelerates at -10 m/s^2, how long will it take for the object to stop? Where will the object be when it stops?

1. Make a list of the information provided.
2. Make a list of what you need to calculate.
3. Find the equations that will allow you to solve for one of your unknowns based on the information provided.

How to Solve These Equations

- If an object with an initial position of y = 3 m and a velocity of 5 m/s accelerates at -10 m/s^2, how long will it take for the object to stop? Where will the object be when it stops?

What we have	What we need
y_i = 3 m	**t_f**
v_i = 5 m/s	**x_f**
v_o = 0 m/s	
a = -10 m/s^2	

  - $v_{(t)} = at + v_i$ to get t
  - $y_{(t)} = ½at^2 + v_it + y_i$ to get x at that same time.

Practice

- A person on top of the Grand Canyon leans over the edge and drops an orange. The person releases the orange 100 m above the canyon floor below. What is the final velocity of the orange when it hits the floor?