3.4/4.3
Introduction to
Rectilinear “Particle” Motion

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AP Calculus AB

Introduction to Rectilinear Motion

- Definition: Movement of a particle along a line
  - A line must be thought of as a 1 dimension horizontal.

- Original Function $f(x) = s(t)$ position function

- 1st Derivative $f'(x) = v(t)$ velocity function

- 2nd Derivative $f''(x) = a(t)$ acceleration function

Introduction to Rectilinear Motion

- In graphing a function: we are concerned with critical “x” values.
- In a motion problem, we are concerned with important times.
  - Done in the same manner as a normal function: set each derivative equal to zero.
  - You will still be doing first and second derivative tests.
  - Zero is always an important time

Introduction to Rectilinear Motion

- Once you have completed velocity and acceleration tests, you can go to your important time chart.

- Use the “chart” to create a **one-dimensional** position graph. (Position must occupy the x-axis)

Introduction to Rectilinear Motion

- In conclusion:
  - Motion graphs are formed using the same procedure as a polynomial graph with two exceptions:
    - Motion Graphs use important times instead of critical x-values.
    - Motion graphs only use a one-dimensional representation of position.

Rectilinear Motion

Objective: Use the tools of Calculus to analyze rectilinear motion in more depth

Rectilinear Motion

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- *The change in the position of the particle is called the displacement of the particle. The displacement describes where it is compared to where it started.*

Velocity and Speed

- *The rate of change of your position is based on your velocity. The rate of change is the first derivative. This leads us to:*

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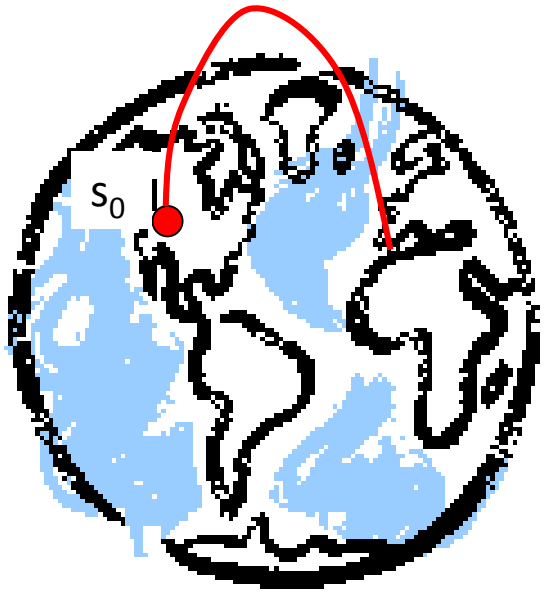
- *Remember, velocity has direction attached to it. If velocity is positive, the particle is moving to the right or up. If velocity is negative, the particle is moving to the left or down.*

Day 4: Applications; Gravity

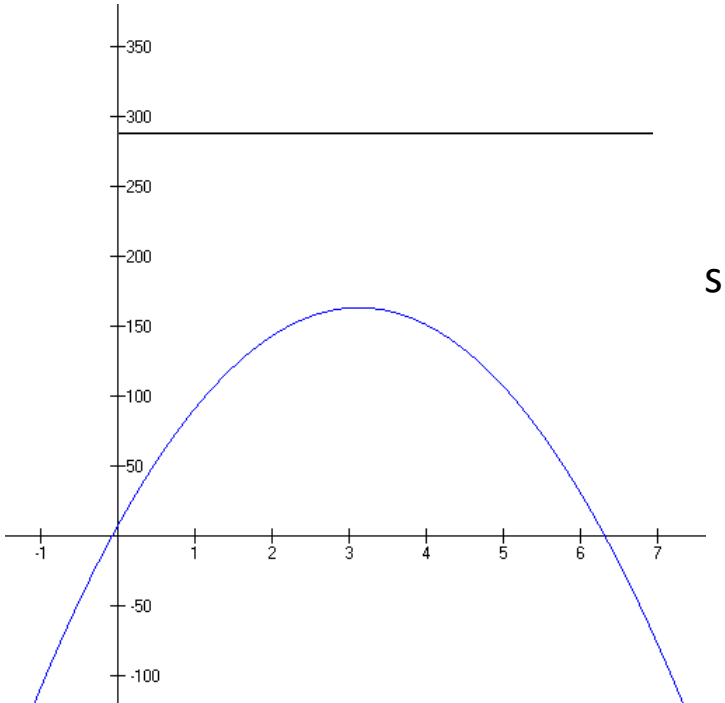
- $$s = s_0 + v_0 t - \frac{1}{2} g t^2$$
  - s = position (height)
  - s_0= initial height
  - v_0= initial velocity
  - t = time
  - g= acceleration due to gravity
    - g=9.8 m/s^2 (meters and seconds)
    - g=32 ft/s^2 (feet and seconds)

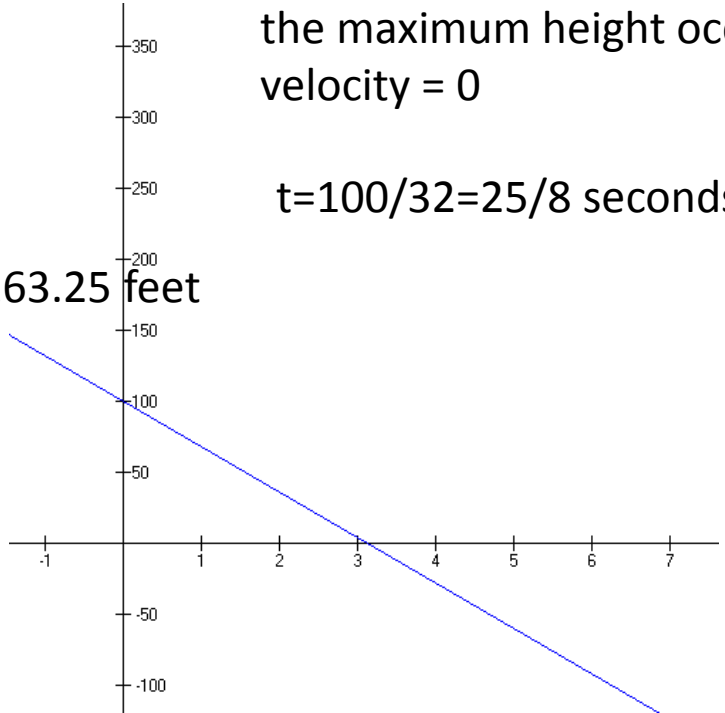


Example

- Nolan Ryan was capable of throwing a baseball at 150ft/s (more than 102 miles/hour). Could Nolan Ryan have hit the 208 ft ceiling of the Houston Astrodome if he were capable of giving the baseball an upward velocity of 100 ft/s from a height of 7 ft?

$$s = 7 + 100t - 16t^2 \qquad v = 100 - 32t$$





the maximum height occurs when velocity = 0

t=100/32=25/8 seconds

s(25/8)=163.25 feet