Velocity and Acceleration

Goal: • Can use derivative rules to apply the rate of change of distance over time as velocity. • Can use derivative rules to apply the rate of change of velocity over time as acceleration. • Can analyze 1-dimensional movement of a particle on a line.
Terminology: • Velocity • Acceleration

We know that average velocity is $\frac{\Delta x}{\Delta t}$ where x is the distance and t is the time. We talked about average and instantaneous rate change as the slope of a distance vs time graph. In Physics 11 you get the following kinematic equations. Derive them and give them a calculus definition.

Physics 11 Definition	Calculus Definition and Explanation
$\Delta x = \left(\frac{v_1 - v_0}{2}\right) \cdot \Delta t$	
$v_1 = v_0 + a\Delta t$	
$\Delta x = v_0 \Delta t + \frac{1}{2} a \cdot (\Delta t)^2$	
$v_1^2 = v_0^2 + 2a\Delta x$	

I want to briefly talk about motion along a line as it is a classic problem

Example: Consider a particle moving along the x-axis given by the equation

$$x(t) = t^3 - 25t^2 + 171t - 315$$

Where $x(t)$ is the distance in meters after t minutes. Determine:

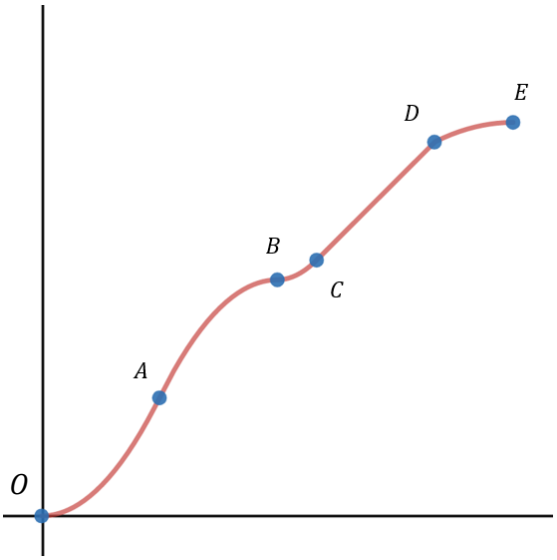
a. The velocity of the particle
b. The acceleration of the particle
c. Identify when the particle is moving to the left and right.
d. The total distance travelled from $t = 0$ to $t = 10$

Practice Problems: 3.1: # 1, 2-6 (do what you need), 7-9
3.2: # 1-2, 3-4 (do what you need), 5-9

Give calculus meaning to the kinematic equations

In Class Evidence

3.2.2. The graph of a position function is shown below.



a) For the part of the graph from O to A, use slopes of tangent lines to decide whether the velocity is increasing or decreasing. Is the acceleration positive or negative?

b) State whether the acceleration is positive, zero, or negative

i. From A to B

ii. From B to C

iii. From C to D

iv. From D to E

3.2.7 The particle moves according to the equation of motion: $s = t^3 - 9t^2 + 18t$. Where s is measured in meters and t in seconds. Determine when the acceleration is 0 and find the displacement and velocity at that time.

8. The motion of a particle is described by the position function

$$s = t^3 - 15t^2 + 63t, \qquad t \geq 0$$

Where t is measured in seconds and s in meters.

a. When is the particle at rest?
b. When is the particle moving in the positive direction?
c. Draw a diagram to illustrate the motion of the particle.
d. Find the total distance travelled in the first 10 seconds.