Lecture 4, Sep 16, 2021

One Dimensional Motion, Continued

- $a(t) = \dfrac{\mathrm{d}v(t)}{\mathrm{d}t}$ is only defined for smooth and continuous functions; when collecting real world data there could be sharp changes in velocity that may not be differentiable (infinite change/discontinuity in acceleration)
  - In reality the actual motion between points is still continuous but the sampling is too rough to tell
  - Can't be described by a simple line

Definite Integrals

- $\int_a^b f(t)\,\mathrm{d}t$, the definite integral or area under the curve, can be calculated from the indefinite integral $\int f(t)\,\mathrm{d}t$, from the fundamental theorem of calculus
  - Definite integral is a value; indefinite integral is a function
  - $\int_a^b f(t)\,\mathrm{d}t = F(b) - F(a)$ where $F(t) = \int f(t)\,\mathrm{d}t$

Velocity and Acceleration

- $v = \dfrac{\mathrm{d}x}{\mathrm{d}t}$ and $x = \int v\,\mathrm{d}t$
- $a = \dfrac{\mathrm{d}v}{\mathrm{d}t}$ and $v = \int a\,\mathrm{d}t$
- Therefore if we have the velocity and need to know the change in position between two points in time, use $\int_{t_1}^{t_2} v(t)\,\mathrm{d}t = F(t_2) - F(t_1) = x_2 - x_1 = \Delta x$; similarly for velocity/acceleration

Constant Velocity Equations

- $v(t) = v_0$
- $\Delta x = \int_{t_0}^{t_f} v(t)\,\mathrm{d}t = v_0 \Delta t$

Constant Acceleration Equations

- $a(t) = a_0$
- $\Delta v = \int_{t_0}^{t_f} a(t)\,\mathrm{d}t = a_0 \Delta t$
- $v(x) = \Delta v + v_0 = a_0 \Delta t + v_0$