Dynamics

- Kinematics
  - Geometry of motion
  - Position, Velocity, Acceleration
    - 1-D, Chapter 2
    - 2-D, Chapter 3
  - Special applications
    - Constant acceleration
    - Projectile motion

- Kinetics
  - Relation between forces and motion
    - \( F = ma \)
      - Module 2
      - Chapters 4-6
  - Energy methods & impulse-momentum
    - Module 3
    - Chapters 7-9

Rectilinear Motion

- Motion along a line
- Need three things:
  1. 
  2. 
  3. 
- This is our coordinate system.
- Motion variables are vectors since they have magnitude and direction.

Module 4 – Kinematics and Kinetics of Rotational Motion

Chapters 10 & 11

Velocity

- Average velocity
- Instantaneous velocity
- Work backwards

  - Slope of position graph = velocity
  - Area under velocity graph = change in position

Acceleration

- Average acceleration
- Instantaneous acceleration
- Work backwards

  - Slope of velocity graph = acceleration
  - Area under acceleration graph = change in velocity
Example 1

\[ s(t) = 6t^2 - t^3 \]

where,
- \( t \) is in seconds
- \( s \) is in feet

Qualitatively plot \( v-t \) and \( a-t \) graphs.

Physically describe the motion.

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Example 2

\[ a(t) = 12t^2 \]

\[ v_0 = 200 \]

\[ s_0 = -500 \]

where,
- \( t \) is in seconds
- \( s \) is in m

Qualitatively plot \( v-t \) and \( s-t \) graphs.

Physically describe the motion.

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Example 3

\[ v(t) = 4t \]

\[ s_0 = -10 \]

where,
- \( t \) is in seconds
- \( s \) is in feet

Qualitatively plot \( a-t \) and \( s-t \) graphs.

Physically describe the motion.

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The Kinematics Ladder

Down the ladder:

\[ s(t) = s_0 + \int v(t)\,dt \]

\[ v(t) = \frac{ds}{dt} \]

\[ a(t) = \frac{dv}{dt} \]

Up the ladder:

\[ v(t) = v_0 + \int a(t)\,dt \]