Motion in One Dimension

- Kinematics
  - Speed
  - Velocity
  - Acceleration

- Forces
- Falling Objects
- Projectile Motion
- Galileo Vs Aristotle
Velocity

- Rate of Change of displacement

- Can an object having constant speed can have changing velocity?

- Yes, if its direction of motion changes
Acceleration

- Rate of Change of Velocity

Suppose

- $v_i$ is the initial velocity
- $v_f$ is the final Velocity

\[ \vec{a} = \frac{\vec{v}_f - \vec{v}_i}{t} \]

- UNITS of ‘$a$’ (m/s)/s = m/s²
Equations of motion

- Relation between $a$, $d$, $v$

\[ v = v_i + at \]
\[ d = v_i t + \frac{1}{2} at^2 \]
\[ v^2 = v_i^2 + 2ad \]
Acceleration due to Gravity

- Freely falling object has constant acceleration ignoring air resistance
- Constant
- “g” = 9.8 m/s\(^2\) or 32 ft/s\(^2\)
Height of a building

- Drop a penny from top of Empire State building.

86th floor to ground $\rightarrow$ 8.08 s

$v_i = 0$

- Free fall; $a = g = 9.8 \text{ m/s}^2$
- Use second eq of motion

\[ d = v_i t + \frac{1}{2} at^2 \]

\[ d = \frac{1}{2} (9.8 \frac{m}{s^2}) \times (8.08 s)^2 \]

\[ d = 320 m \]
Motion in Two Dimensions

Projectile Motion

- Has horizontal component and vertical component

Gravity acts on the vertical component of motion

- Ignoring air friction
- Velocity up = velocity down

![Diagram of motion in two dimensions]

\[ v_x \quad v_y \quad \theta \quad v \]
Projectile Motion – Bull’s Eye

- Initial velocity components: $v_{ix}$ (horizontal), $v_{iy}$ (vertical)
- Angle of projection: $\theta$
- Horizontal distance: $x_T$
- Vertical displacement: $h$
- Gravity vector
Galileo Vs Aristotle

- Reading Assignment
- In-class Discussion on Monday Sept 2, 2002