Resources used in this course:
- Syllabus
- Lesson plan
- Lecture slides

Overview of this course:
- Preview the lesson: learning modules (in Quest)
- Use of Clickers during the lecture
- Use of Quest homework system
- TA sessions
- 4 midterms and 1 final
Basic Principles of Mechanics

Momentum principle: \[ \Delta p = F \Delta t \]

Nonrelativistic: \[ \Delta mv = m \Delta v = F \Delta t \]
\[ \Delta v = \frac{F \Delta t}{m} \]
\[ \therefore m \frac{\Delta v}{\Delta t} = F \rightarrow F = ma \]

Energy Principle:
For 1 massive particle: \[ K = \frac{1}{2} mv^2 \]
\[ \Delta K = W = F \cdot \Delta l \]

Gravity
Path \( m \) by height \( h \)
Let go at the initial point \( i \)
Particle is accelerated with acceleration \( g \)
\[ \Delta K = K_f - K_i = mgh \]

You are ready to study M&I Vol. II: E&I so long as you have the basic knowledge of:
\[ \begin{aligned} \Delta p &= F \cdot \Delta t \\ \Delta E &= \vec{F} \cdot \Delta \vec{l} \end{aligned} \] (and their applications)
Review Vectors

Vector in 3D: \( \vec{r} = <x, y, z> \)

Vector in 2D: \( \vec{r} = <x, y, z = z_1> = <x, y> \)

Displacement Vectors

Intuitive Description:
Starting at A, add D, it ends at B

\[
\vec{D} = \vec{B} - \vec{A} \\
\vec{A} + \vec{D} = \vec{B}
\]
Magnitude

\[ |D| : |\vec{D}|^2 = D_x^2 + D_y^2 + D_z^2 \quad (3D) \]

\[ D = \sqrt{D_x^2 + D_y^2} \quad (2D) \]

Unit Vector: \[ \hat{D} = \frac{\vec{D}}{|D|} \]

Product of 2 Vectors:

Scalar Product = Dot Product
Vector Product = Cross Product
Scalar Product = Dot Product

\[ \mathbf{A} \cdot \mathbf{B} = A_x B_x + A_y B_y = AB \cos \alpha \]

\[ RHS = A_x B_x + A_y B_y \]
\[ = A \cos \theta_1 B \cos \theta_2 + A \sin \theta_1 B \sin \theta_2 \]
\[ = AB \cos (\theta_1 - \theta_2) \]
\[ = AB \cos \alpha \]
\[ = A \perp B = AB \perp \]
Vector Product = Cross Product

\[ \vec{A} \times \vec{B} = AB \sin \alpha \hat{n} \]

\[
\begin{vmatrix}
  i & j & k \\
  A_x & A_y & 0 \\
  B_x & B_y & 0 \\
\end{vmatrix}
= \hat{k} (A_x B_x - A_y B_y)
= \hat{k} AB (\cos \theta_1 \sin \theta_2 - \sin \theta_1 \cos \theta_2)
= \hat{k} AB \sin(\theta_2 - \theta_1)
= \hat{k} AB \sin \alpha