Potential Energy Functions
Potential Energy

• Conservative forces have potential energy functions associated with them.

• Force is the negative derivative of the potential energy function with respect to position.

\[ F = -\frac{dU}{dx} \]

• Gravitational PE = mgh
\[ F = -\frac{dU}{dh} = -mg \]

• Elastic PE = \( \frac{1}{2}kx^2 \)
\[ F = -\frac{dU}{dx} = -kx \]
Potential Energy Curves

• We can analyze the behavior of a system if we are given a graph of potential energy as a function of $x$.

**Ex:** Draw the PE of a pendulum as a function of $x$.

![Potential Energy Curve Graph](image)

- When is the object in equilibrium?
  - At turning point, when slope = 0, so force = 0

- What type of equilibrium is it?
  - If object is displaced slightly, it returns to its equilibrium position. This is called **stable equilibrium**.
Types of Equilibrium

• Stable equilibrium –

• Unstable equilibrium –

• Neutral –

**Ex:** For the potential energy curve shown, (a) determine where the force is +, -, or 0 at the five points indicated, and (b) indicate points of stable, unstable, and neutral equilibrium.