Worksheet 11: Conservative and non-conservative forces

Objective

- Classify forces as conservative or non-conservative.

Summary

A **conservative** force maintains mechanical energy. A conservative force is the negative gradient of some scalar potential function, $\vec{F} = -dU/dx$. Work done by a conservative force $\vec{F}$ is a change of its associated potential energy U.

This can be expressed in several ways:

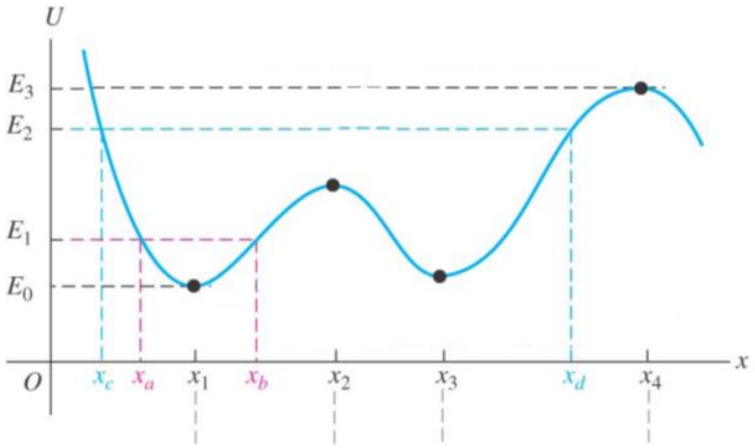
- The work done by a conservative force is the same along all paths between the same two places.
- The work done by a conservative force around any closed path is zero.
- The curl $\nabla \times \vec{F}$ of a conservative force is zero everywhere.

Problems

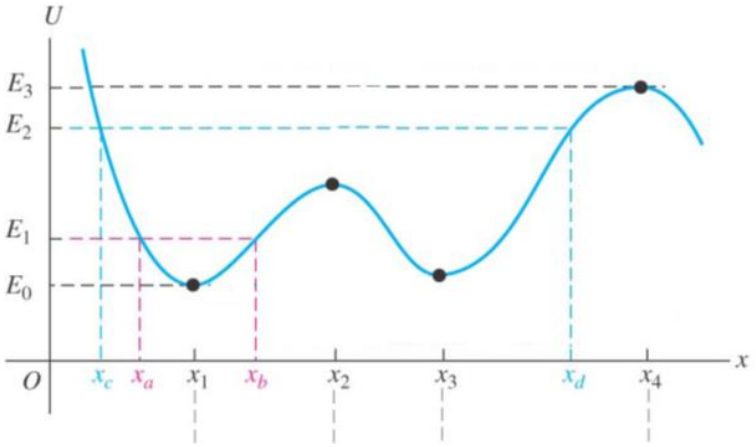
1. a. Sketch the potential energy function near a point of neutral equilibrium.

   b. Give an example of an object in neutral equilibrium.

2. Below is an arbitrary hypothetical potential function $U(x)$.
   a. Mark where the gradient of $U(x)$ is positive, negative, and zero



b. Mark where the force on the particle is to the right, and where it is to the left.



c. Mark where the particle is at equilibrium, and classify the equilibrium as stable or unstable.

4. Identify the places where the particle in the potential U above can be and describe its possible motion in the scenarios described below.
   a. Total energy $E = E_0$.

   b. Total energy $E = E_1$.

   c. Total energy $E = E_2$.

   d. Total energy $E > E_3$.

   e. Total energy $E < E_0$.