LESSON 7

- BOOK CHAPTER 8
- Potential Energy and Conservation of Energy

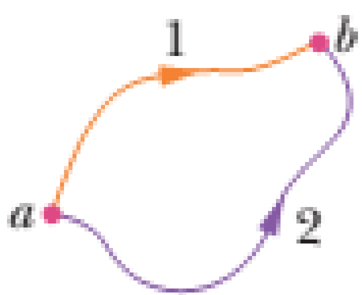
Conservative and non-conservative forces:

Conservative force:

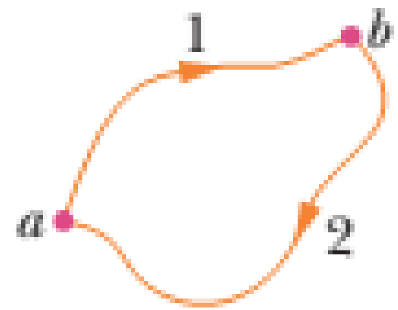
A force is a **conservative force** if the net work it does on a particle moving around any closed path, from an initial point and then back to that point, is zero.

Equivalently, **a force is conservative** if the net work it does on a particle moving between two points does not depend on the path taken by the particle. Examples: The gravitational force and the spring force are conservative forces.

The term conservative force comes from the fact that when a conservative force exists, it conserves mechanical energy.

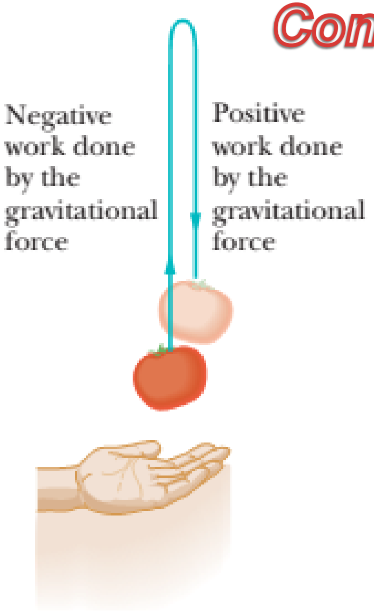


The force is conservative. Any choice of path between the points gives the same amount of work.

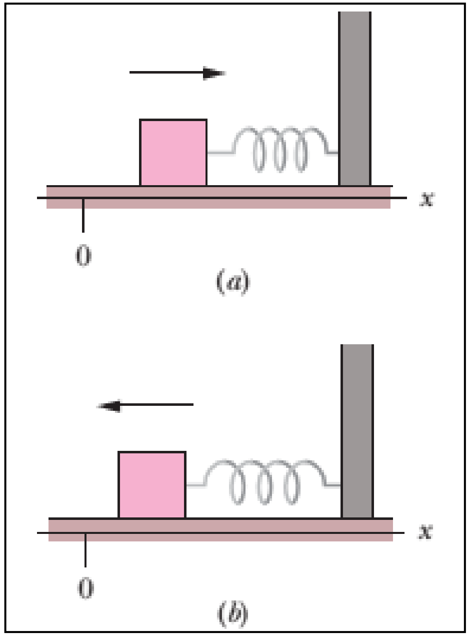


And a round trip gives a total work of zero.

Conservative force:



A tomato is thrown upward. As it rises, the gravitational force does negative work on it, decreasing its kinetic energy. As the tomato descends, the gravitational force does positive work on it, increasing its kinetic energy.



A block, attached to a spring and initially at rest at $x = 0$, is set in motion toward the right. (*a*) As the block moves rightward (as indicated by the arrow), the spring force does negative work on it.
(*b*) Then, as the block moves back toward $x = 0$, the spring force does positive work on it.

For either rise or fall, the change ΔU in gravitational potential energy is defined as being equal to the negative of the work done on the tomato by the gravitational force. Using the general symbol W for work, we write this as

$$\Delta U = -W$$

Non-conservative force:

A force that is not conservative is called a **non-conservative force.** The kinetic frictional force and drag force are non-conservative.

For an example, let us send a block sliding across a floor that is not frictionless. During the sliding, a kinetic frictional force from the floor slows the block by transferring energy from its kinetic energy to a type of energy called *thermal energy* (which has to do with the random motions of atoms and molecules).We know from experiment that this energy transfer cannot be reversed (thermal energy cannot be transferred back to kinetic energy of the block by the kinetic frictional force).

The principle of Conservation of Mechanical Energy:

The mechanical energy E_{mec} of a system is the sum of its kinetic energy K and potential energy U of the objects within it. That is,

$$\boldsymbol{E_{mec} = K + U}$$

This conservation principle can also be written as

$$\boldsymbol{\Delta E_{mec} = \Delta K + \Delta U = 0}$$

Here $\Delta K = +W$

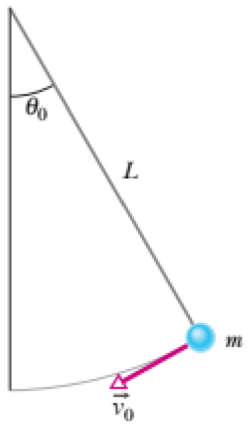
and $\Delta U = -W$

Let’s try……..

1. What is the spring constant of a spring that stores 25 J of elastic potential energy when compressed by 7.5 cm?

2. A 5.0 g marble is fired vertically upward using a spring gun. The spring must be compressed 8.0 cm if the marble is to just reach a target 20 m above the marble’s position on the compressed spring. (a) What is the change in the gravitational potential energy of the marble–Earth system during the 20 m ascent? (b) What is the change in the elastic potential energy of the spring during its launch of the marble? (c) What is the spring constant of the spring?

3. Figure shows a thin rod, of length L = 2.00 m and negli gible mass, that can pivot about one end to rotate in a vertical circle. A ball of mass m " 5.00 kg is attached to the other end. The rod is pulled aside to angle θ = 30.0° and released with initial velocity . As the ball descends to its lowest point, (a) how much work does the gravitational force do on it and (b) what is the change in the gravitational potential energy of the ball–Earth system?



Thank You