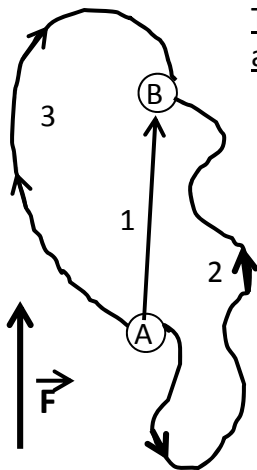## Conservative and Non-conservative Forces

In physics, we separate forces into conservative and non-conservative categories.

<u>The work done by a conservative force depends only on the beginning and ending positions of the object.</u>

Hence (as **s**hown in the figure), the work done by the force does not depend on the path that the object takes.

The work done by a <u>non-conservative</u> force <u>does</u> depend on the path of the object.

If $\vec{F}$ is a conservative force, then the work done in moving the object from A to B along paths 1, 2, and 3 is the same.

Examples of	Conservative Forces:	Non-Conservative Forces:
	Gravitational force	Friction
	Elastic spring restoring force	Air resistance
	Electrostatic force	Water drag on a moving boat
	Buoyancy force	Non-elastic material stress
		Viscosity
		Resistance to flow of electric current

Non-conservative forces are also called dissipative forces, as they dissipate[*] mechanical energy into other forms.

For example, friction can dissipate energy as heat and as sound.

Water drag and air resistance can dissipate energy as a wave, or as turbulence in a wake.

*
   In physics, dissipation (or degradation) of energy refers to the transfer of energy into some form in which it is less available for doing work.

Conservative Forces and Stored (or Potential) Energy:

With each conservative force, we can associate a stored energy. The energy stored depends on the relative position(s) of the object(s).

This stored energy is also called potential energy, because there is the potential to do work.

The difference in stored (potential) energies between two object positions is the amount of work required to move the object from one position to the other.

If a force does positive work on an object, then the stored energy of the object decreases, and vice versa.

In practice, we compare stored energies for different object positions.

This means that only differences in potential energy are important; the zero level can be set wherever is convenient.

Common forms of Stored (Potential) Energy	where	Zero level
Gravitational (near Earth's surface) P.E. = mgh	m = mass, h = vertical height	anywhere
Gravitational (Newton's) $P.E. = -\dfrac{Gm_1 m_2}{r}$	m_1 and m_2 are the masses, r is the distance between the objects	infinity
Elastic spring $P.E. = \dfrac{1}{2} kx^2$	k is the spring constant, x is the change in length (from equilibrium)	x = 0 (i.e., un-stretched)
Electrostatic $P.E. = \dfrac{Kq_1 q_2}{r}$	q_1 and q_2 are the charges, r is the distance between the objects	infinity

Exercises:

1. James lifts a box of mass 5 kg from the ground to the top of a 1 m high table. What is the change in stored gravitational energy?

2. Chris pushes the end of an un-stretched spring in by 10 com. The spring constant k = 3000 N/m. What is the change in stored elastic energy?

Answers: 1. 49 J 2. 15 J