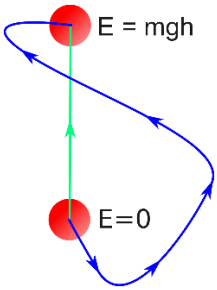
Internal and external forces

External forces are forces caused by external agent present outside of the system. External non-zero net force imparts an acceleration to the center of mass of the system regardless of point of application.
Internal forces are forces exchanged by the objects in the system. Internal forces may cause acceleration in different parts of the system but does not cause any acceleration in the center of mass of the entire system.
Example:
Friction is an external force if the body experiencing friction in the system.
If both the bodies involved in friction are considered as a system, then it acts as an internal force.

Properties of Conservative Forces



In this particular case in order to calculate work done by gravity in the closed path direct formula mghmgh can be applied owing to conservative nature of gravitational force.

Potential Energy

Potential energy is the energy stored in an object. For example, a body at height h has gravitational potential energy mgh. Its SI unit is Joules.

Forms of Potential Energy

The different forms of potential energy are:

Gravitational potential energy-The rock hanging above the ground has a form of stored energy called gravitational potential energy.

Elastic potential energy-Elastic potential energy is the energy stored when an object is squeezed or stretched. This stored energy then can cause the rubber band to fly across the room when you let it go.
Chemical potential energy-Chemical potential energy is the energy stored in bonds between the atoms that make up matter.

Potential energy with respect to a reference line

Potential energy is always defined with respect to a reference line in space. Usually infinity is taken as the reference line and potential energy defined is zero at infinity. In gravitation, for objects close to surface of earth, ground surface is taken as reference line and energy at ground surface is zero.
Note:
Choice of reference line is not fixed and can be redefined. This helps in solving of problems.

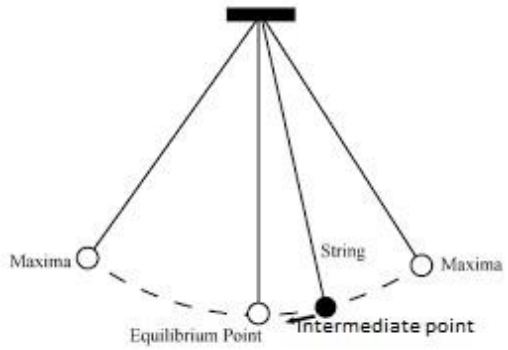
Conservation of Energy

Law of conservation of energy states that energy can neither be created nor be destroyed it can only be transformed from one form to another form.

Mechanical Energy

Mechanical energy is the energy of an object due to its position and motion. It is equal to the sum of kinetic energy and potential energy. Example: A freely falling body is comprised of mechanical energy.

Conservation of Mechanical Energy for simple pendulum



Total mechanical energy is conserved for motion of simple pendulum assuming no losses i.e. Total energy is same at maxima, intermediate point and equilibrium position. Note that total mechanical energy is given as sum of kinetic and potential energy.

Work is defined as the force in the direction of displacement times displacement. It is a scalar quantity having S.I unit Joule.
W=Fs
where F is the component of force in the direction of displacement.

No work done inspite of working hard

No work is done inspite of working hard when:

There is no displacement of object. Example: A boy pushing a wall.
Displacement is perpendicular to the object. Example: Uniform circular motion.

Work done scientifically

Following are the places where work is done scientifically:

Launching a rocket.
Internal combustion engine in a vehicle.
Drawing water by a pump.
Work output from the turbine.

Energy

Energy is defined as the capacity of a system to perform work. Suppose a body having mass mm kg moving with a linear velocity of vvmeter/sec so its energy is is in the form of kinetic energy which is equal to $K.E=12mv^2$

SI unit of energy is Joule.
CGS unit of energy is erg.

Forms of Energy

Some forms of energy are as follows:

Kinetic energy(due to motion).
Potential energy(due to position).
Mechanical Energy(sum of kinetic and potential energy).
Heat energy(due to temperature).
Electrical energy(due to electrical current).
Chemical energy(stored in a material).

Conversion of Energy

Energy can be converted from one form two another. Some examples are:

Potential energy stored in a ball at a height is converted to kinetic energy when it reaches the ground after free fall.
Chemical energy stored in a fire cracker is converted into kinetic, heat, light and sound energy on bursting.

Kinetic energy

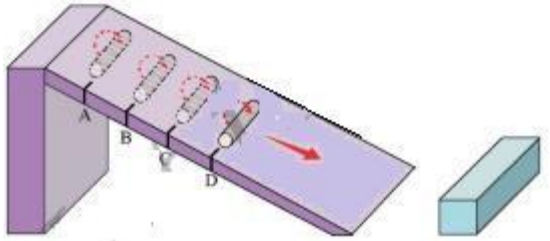
Kinetic Energy of an object is the energy of an object due to its motion. For an object of mass mm, it is given by $KE=12mv^2$.
Note:
The above definition is made for a body under translational motion. There are other forms of kinetic energy also which will be discussed in the later chapters.

Forms of Kinetic Energy

The various forms of kinetic energy are as follows:

Thermal-Motion of molecules in a material
Sound-Energy transfer by sound waves involve vibration of air molecules
Electrical-Drift of electrons
Mechanical-Motion of an object

Experiment to show relation between K.E, mass and velocity



1) Take a wooden plank of three feet and place it on the wooden block. This arrangement is called the inclined plane.
2) Mark A,B,C,D as shown in the figure.Take a cylindrical tin of medium size(200 g) with a tight fitting lid.
3) Fill it tightly with sand. Put an empty rectangular plastic cube container near the bottom of the inclined plane.
4) Now release the cylinder from the point A of the inclined plane. The cylinder strikes the plastic cube container which is at rest. The rolling cylinder moves the plastic cube container for some distance.
5) Mark the place where the plastic container rests. Measure the distance between the original position and the new position of the plastic cube container.
6) Repeat the experiment by releasing the cylinder from different heights (B.C.D) and measure the distance.

Conclusion: Every time the distance will be different ,hence we can say that K.E depend on the velocity of the cylinder when left from a different height because velocity will be different while falling from the inclined plane.And if repeat the same experiment with 500 g mass the plastic block will still move to different distance.From which we can conclude that The kinetic energy of a body also depends on its mass. Higher the mass of a body, higher is its kinetic energy.