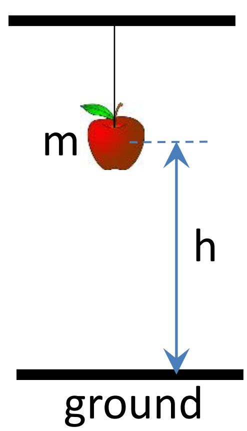
Homework 12

Potential energy

We can think about potential energy as of the energy “stored” in the system. Unlike kinetic energy which depends on the object’s *velocity*, potential energy depends on the *position* of the physical body with respect to other objects with which the body interacts. Expression for potential energy depends on the type of interaction between the objects. Here we discuss how to calculate the potential energy in case of gravity force.

Any object with mass is attracted by Earth. The higher is the position of the object over the ground level the stronger it will hit the ground when it falls. It is natural to assume that potential energy depends on the distance between the object and the ground. When a stone starts falling it accelerates toward the Earth. The kinetic energy of the stone increases. At a first glance it looks like the energy is created as the stone goes down. But this statement is not correct. The total energy of the stone remains constant as the stone is falling down, in full agreement with the energy conservation law. The total energy of the stone is the sum of potential and kinetic energies. In the highest point kinetic energy is zero and potential energy is maximal. At the lowest point, just before the stone hits the ground, potential energy is minimal and kinetic energy is maximal. Potential energy corresponding to the gravity force can be calculated as

$$E_{potential} = m \cdot g \cdot h$$



Here *m* is the mass of the object; *g* is acceleration due to gravity, *h* is the distance between the object and, say, the ground. There are two important points:

1. As with the kinetic energy absolute value of potential energy does not make much sense. We can count h from any level when solving a problem. What does make sense it is *change* in the potential energy in a certain process. This change will not depend on the “zero potential energy level” which you can choose arbitrary.

2. The formula above is valid only if the object is close enough to the Earth – the distance between the object and the Earth should be much less than the radius of Earth.

Problems

1. A 1 kg stone is falling down from a height of 10m. Calculate kinetic and potential energies of the stone in the upper, middle and lower points. Please calculate the kinetic energy through the calculation of the stone's velocity and show that the total energy of the stone remains constant as it goes down.
2. A 10g bullet is sent up at a speed of 300m/s. How high it will go? Solve this problem by two ways.
3. A 50g ball is falling down. As the ball passes a certain distance its potential energy changes for 2J. Calculate this distance. Does this distance depend on the initial velocity of the ball?