Conservative Forces * 藍色 highlight 的是句子的重新,然是是子句的重新。

Conservative forces have these two equivalent properties:

- 1. The work done by a conservative force on a particle moving between any two points is independent of the path taken by the particle.
- 2. The work done by a conservative force on a particle moving through any closed path is zero. (A closed path is one for which the beginning point and the endpoint are identical.)

The gravitational force is one example of a conservative force; the force that an ideal spring exerts on any object attached to the spring is another. The work done by the gravitational force on an object moving between any two points near the Earth's surface is $W_g = -mg\hat{\mathbf{j}} \cdot [(y_f - y_i)\hat{\mathbf{j}}] = mgy_i - mgy_f$. From this equation, notice that W_g depends only on the initial and final y coordinates of the object and hence is independent of the path. Furthermore, W_g is zero when the object moves over any closed path (where $y_i = y_f$).

For the case of the object-spring system, the work W_s done by the spring force is given by $W_s = \frac{1}{2}kx_i^2 - \frac{1}{2}kx_f^2$ (Eq. 7.12). We see that the spring force is conservative because W_s depends only on the initial and final x coordinates of the object and is zero for any closed path.

We can **associate** a potential energy for a system with a force acting between members of the system, but we can **do** so only if the force is conservative. In general, the work $W_{\rm int}$ done by a conservative force on an object that is a member of a system as the system changes from one configuration to another is equal to the initial value of the potential energy of the system minus the final value:

$$W_{\rm int} = U_i - U_f = -\Delta U \tag{7.23}$$

The subscript "int" in Equation 7.23 reminds us that the work we are discussing is done by one member of the system on another member and is therefore *internal* to the system. It is different from the work $W_{\rm ext}$ done on the system as a whole by an external agent. As an example, compare Equation 7.23 with the specific equation for the work done by the spring force (Eq. 7.12) as the extension of the spring changes.