**5.Energy**

**5.1 Force and Potential Energy**

**Energy** is **conserved** in **any form** of energy!

**Potential Energy Principle:** All forces derive from a potential energy denoted as **V({x})**, where {x} denotes the entire set of 3N coordinates, or the configuration space of all particles in the system.

Generally, the relation between Force and Potential energy is

or

If we translate this, what it says is nothing more than, that every force, **is always directed so that it pushes the particle toward the minimum or stationary potential energy.**

It can be gravity, the force of a transformed spring, a pendulum, the effect is the same.

**Potential energy is not conserved by itself, but**

**The sum of Kinetic and Potential energy is.** (when talking in a simple system with no fraction or other forms of energy.)

We will denote the Potential energy as V and the Kinetic energy as T.

And will refer to V(xi)

So

To prove that all we need to do is to take the time derivative of T+V so

becomes

or

We can further denote as which translates to

So now we can go back and do

Now if we do some simple math we get

Now remember that

We can say from Newtons second law

That

That shows that