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The total mechanical energy, $E_{\text{sub mech}}$ is defined as the sum of the kinetic energy and the potential energy, so the sum of K plus U , where U is the potential energy function associated with the conservative force-- with an appropriate choice of zero point.

If there are multiple conservative forces acting on the system, then U will be the sum of individual potential energy functions for each conservative force with an appropriate choice of zero point for each individual function.

We've also seen that the change in the kinetic energy plus the change in the potential energy is equal to the change in the total mechanical energy.

And that's just basically the derivative of the equation that I wrote above.

And this change in the total mechanical energy will be 0 for conservative forces.

In addition, we've seen that the change in potential energy is related to the conservative work done in the system so that $W_{\text{sub C}}$, the conservative work done, is equal to the negative of the change in the potential energy.

But we also know that the total work done includes both conservative and non-conservative forces.

So the total work done is equal to the sum of $W_{\text{sub C}}$, the conservative work done, plus the non-conservative work done, and that that total work is equal to the change in kinetic energy.

Now, I can rewrite that equation by rewriting the conservative work in terms of the potential energy.

So I could write this, now, as the non-conservative work minus the change in the potential energy is equal to the change in the kinetic energy.

This is, again, just a restatement of the work kinetic energy theorem.

Now, by rearranging this equation, this means that the non-conservative work is equal to ΔK , the change in kinetic energy, plus ΔU , the change of potential energy.

But that's equal to the change in the total mechanical energy.

So the non-conservative work is equal to the change in the total mechanical energy.

This is a sufficiently important result that I'm going to write it by itself in a box.

So the non-conservative work is equal to the change in the total mechanical energy.

So what we've shown here is that the result of any non-conservative work on the system is to change the total mechanical energy of the system.

Now, if there is no non-conservative work, if the forces acting on the system are all conservative, then the total mechanical energy remains unchanged now that ΔE_{mech} is 0.

And we say the total mechanical energy is conserved.

Now if there is a non-conservative force, it turns out that in most cases the work done by non-conservative force is negative, resulting in a negative change in the total mechanical energy-- in other words, in the removal of total mechanical energy from the system.

It's lost from the system.

Now we've been talking here only about mechanical energy, which we've defined as the sum of kinetic energy and potential energy.

But one can also talk about non-mechanical energy.

The most common example of which is loosely referred to as heat.

As an example, in the case of friction, which is a non-conservative force, we know that the action of friction generates heat.

What's happening is that the non-conservative work done by friction is negative and, therefore, is reducing the mechanical energy, the total mechanical energy, according to this expression, but where does that energy go?

We said that it's removed from the system-- in terms of mechanical energy, that's true.

But we can think of it as, at the same time, causing an increase in the non-mechanical energy, or the heat energy, of the system.

So if one were to keep track of both mechanical and non-mechanical energy, then it turns out that the total energy, mechanical and non-mechanical, the total energy of a system is conserved, even if non-conservative forces are acting.

However, it's difficult to recover the non-mechanical energy and change it back into mechanical energy.

These non-conservative processes are not reversible.

This is a complicated topic, and it's the province of more advanced courses in thermodynamics or statistical mechanics, which you may encounter later.

In this course, we will confine our attention to mechanical energy, the sum of kinetic energy and potential energy, and will treat non-conservative force as removing, or adding, mechanical energy to the system.