Topic S15

Thermodynamics

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Review

Conservative Forces and Potential Energy

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CP p. 252

Review

Potential Energy and Conservative Forces

Potential energy is the energy a system has due to position, shape, or configuration. It is stored energy that is completely recoverable.

A conservative force is one for which work done by or against it depends only on the starting and ending points of a motion and not on the path taken.

We can define a potential energy (PE) for any conservative force. The work done against a conservative force to reach a final configuration depends on the configuration, not the path followed, and is the potential energy added.

7.6 Conservation of Energy

Law of Conservation of Energy

Energy, as we have noted, is conserved, making it one of the most important physical quantities in nature. The **law of conservation of energy** can be stated as follows:

Total energy is constant in any process. It may change in form or be transferred from one system to another, but the total remains the same.

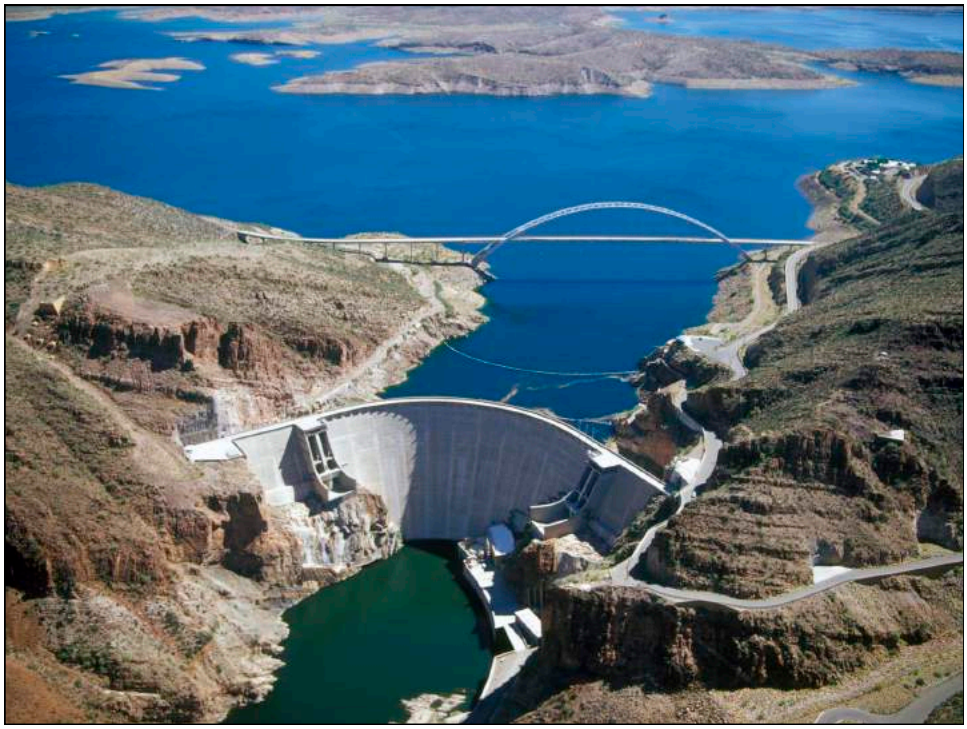
Thermodynamics

- The study of the relationship between heat and other forms of energy.
- Thermodynamics is a key additional layer of understanding that we have to put on top of what we've learned about the physics of energy.

Second Law of Thermodynamics

- The Second Law of Thermodynamics is an important caveat to the principle of the conservation of energy.
- While it is true that the amount of energy in the universe remains constant, it is not true that the amount of useful energy remains constant.
- It's not quite true to say that energy is the capacity to do work, because some energy can't do work …

- The capacity to do work is not just about the accumulation of mass, or electrons, or heat – it's about gradients, differences in these things that can be exploited to do work.
- Think of a dam: The ability of the dam to generate power to do work is not just a function of the water behind the dam, it's also the absence of water in front of the dam.



Second Law of Thermodynamics

Different statements:

- The total entropy of an isolated system can never decrease.
- "The natural tendency of the heat is to flow from high temperature reservoir to low temperature reservoir."
- "It is impossible to construct a device which, operating in a cycle, will produce no effect other than the transfer of heat from a colder to a hotter body."

Second Law of Thermodynamics

And the end of the universe:

- If entropy can never decrease, that means the universe is headed toward a state of maximum entropy, in which nothing can live, no information can be processed, and no work can be done.
- (Whether something else destroys the universe first is a different question …)