

**Systems Engineering
Teach Yourself Series**
Topic 5: Systems Energy Units 1, 2, 3 & 4

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Systems Energy

What is energy?

Energy is the capacity to do work. Unit of energy is Joule which is same as work.

Law of conservation of energy states that energy can neither be created nor destroyed. It can only be transferred from one form to another. Hence, it would be right to say that total energy of this universe is a constant value.

Mechanical, Kinetic, and potential energy

As it appears in Units 1 – 4

Mechanical energy is the energy acquired by the body when work is done on the body and is sum of kinetic energy and potential energy of the body. Kinetic energy is energy stored in the body due to its motion. Potential energy is the energy stored in the body by virtue of its position. Potential energy of an object at the ground surface is zero and when that object is lifted then the potential energy increases with rising distance. Consider a child sliding down the slide. On the top of the slide there is just potential energy. When the child starts sliding down, the potential energy starts getting converted into kinetic energy. At the bottom of the slide, when the child just touches the ground, there is only kinetic energy. In other words, all the potential energy has been converted to kinetic energy and losses due to friction.



https://en.wikipedia.org/wiki/Playground_slide

Review Questions

1. Friction is considered a necessary evil.
 - a. Why is it necessary?

- b. Why is it evil?

Energy types

As it appears in Units 1 – 4

1. Heat

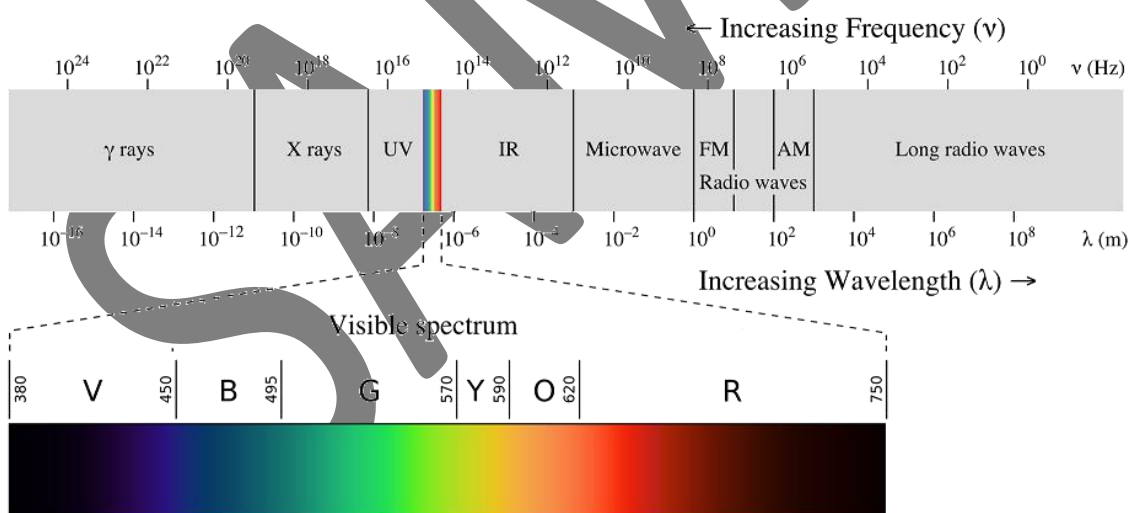
Heat (thermal) energy can be considered as kinetic energy of the molecules. At absolute zero temperature (-273 degree centigrade) there is no motion of the atoms constituting the object but as the temperature increases the kinetic energy of the atoms and molecules increases. There are diverse range of sources that can produce heat energy. Heat energy in heating devices is obtained by passing current through the heating element which are made using special alloys like nichrome (nickel and chromium). Sun produces heat and light through the process of fusion. The heat from the Earth's hot core come out in the form of volcanic eruptions and geothermal energy.

2. Sound

Sound energy are waves that fall in both audible (hearable) and nonaudible (not hearable) ranges. Human beings can hear frequencies that fall between 20 to 20000 Hz. Hearing can be affected by the unwanted sound generated by machines (e.g., vehicles). Desirable sound can be produced intentionally, for example, to generate music using instruments and speakers.

3. Light

Light energy is also generated by sources like Sun. We usually consider the light as the visible colours that we can see with naked eye, but light (electromagnetic) spectrum has both invisible and visible parts. The lower end frequencies (right side of the visible spectrum shown below) are used mainly for communications. The higher end frequencies (left side of visible spectrum) have various application in Systems Engineering industry. For example, UV is used in Systems Engineering to erase UV-EEPROM and X-rays can be used to detect defects in IC packages.



https://en.wikipedia.org/wiki/Electromagnetic_radiation