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An Analytical Study of Thermal Energy

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Introduction

Thermal Energy, also known as random or internal Kinetic Energy, due to the random motion of molecules in a system. Kinetic Energy is seen in three forms: vibrational, rotational, and translational. Vibrational is the energy caused by an object or molecule moving in a vibrating motion, rotational is the energy caused by rotating motion, and translational is the energy caused by the movement of one molecule to another location.

Thermal radiation in visible light can be seen on this hot metalwork. Thermal energy would ideally be the amount of heat required to warm the metal to its temperature, but this quantity is not well-defined, as there are many ways to obtain a given body at a given temperature, and each of them may require a different amount of total heat input. Thermal energy, unlike internal energy, is therefore not a state function.

In thermodynamics, thermal energy refers to the ntemal energy present in a system due to its temperature The average translational kinetic energy possessed by free partides in a system of free partides in thermodynamic equilibrium may also be referred to as the thermal energy per particle. In thermodynamics it is often most convenient and precise to think of heat as the transfer of energy, just as work is also a transfer of energy. Heat and work therefore depend on the path of transfer and are not state functions, whereas internal energy is a state function.

Microscopically, the thermal energy may include both the kinetic energy and potential energy of a system's constituent particles, which may be atoms, molecules, electrons, or particles. It originates from the individually random, or disordered, motion of particles in a large ensemble. In ideal monatomic gases, thermal energy is entirely kinetic energy. In other substances, in cases where some of the thermal energy is stored in atomic vibration or by increased separation of particles having mutual forces of attraction, the thermal energy is equally partitioned between potential energy and kinetic energy. Thermal energy is thus equally partitioned between all available degrees of freedom of the particles. As noted, these degrees of freedom may include pure translational motion in gases, rotational motion, vibrational motion and associated potential energies. In general, due to quantum mechanical reasons, the availability of any such degrees of freedom is a function of the energy in the system, and therefore depends on the temperature.

Heat is the thermal energy transferred across a boundary of one region of matter to another. As a process variable, heat is a characteristic of a process, not a property of the system; it is not contained within the boundary of the system. On the other hand, thermal energy is a property of a system, and exists on both sides of a boundary. Classically .thermal energy is the statistical mean of the microscopic fluctuations of the kinetic energy of the systems' particles, and it is the source and the effect of the transfer of heat across a system boundary.

According to the zeroth law of thermodynamics, heat is exchanged between thermodynamic systems in thermal contact only if their temperatures are different. If heat traverses the boundary in direction into the system, the internal energy change is considered to be a positive quantity, while exiting the system, it is negative. Heat flows from the hotter to the colder system, decreasing the thermal energy of the hotter system, and increasing the thermal energy of the colder system. Then, when the two systems have reached thermodynamic equilibrium, they have the same temperature, and the net exchange of thermal energy vanishes and heat flow ceases. Even after they reach thermal equilibrium, thermal energy continues to be exchanged between systems, but the net exchange of thermal energy is zero, and therefore there is no heat.

Thermal energy may be increased in a system by other means than heat, for example

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when mechanical or electrical work is performed on the system. Heat flow may cause work to be performed on a system by compressing a system's volume, for example. A heat engine uses the movement of thermal energy to do mechanical work. No qualitative difference exists between the thermal energy added by other means. There is also no need in classical thermodynamics to characterize the thermal energy in terms of atomic or molecular behavior. A change in thermal energy induced in a system is the product of the change in entropy and the temperature of the system.

Thermal energy is the portion of the thermodynamic or internal energy of a system that is responsible for the temperature of the system. The thermal energy of a system scales with its size and is therefore an extensive property. It is not a state function of the system unless the system has been constructed so that all changes in internal energy are due to changes in thermal energy, as a result of heat transfer. Otherwise thermal energy is dependent on the way or method by which the system attained its temperature. Thermal energy can be transformed into and out of other types of energy, and is not generally a conserved quantity.

Earth's proximity to the Sun is the reason that almost everything near Earth's surface is warm with a temperature substantially above absolute zero. Solar radiation constantly replenishes heat energy that Earth loses into space and a relatively stable state of near equilibrium is achieved. Because of the wide variety of heat diffusion mechanisms, objects on Earth rarely vary too far from the global mean surface and air temperature of 287 to 288 K(14to 15 °C). The more an object's or system's temperature varies from this average, the more rapidly it tends to come back into equilibrium with the ambient environment.

Thermal energy is energy possessed by an object or system due to the movement of particles within the object or the system. Thermal energy is one of various types of energy, where 'energy' can be defined as 'the ability to do work.' Work is the movement of an object due to an applied force. A system is simply a collection of objects within some boundary. Therefore, thermal energy can be described as the ability of something to do work due to the movement of its particles.

Because thermal energy is due to the movement of particles, it is a type of kinetic energy, which is the energy due to motion. Thermal energy results in something having an internal temperature, and that temperature can be measured - for example, in degrees Celsius or Fahrenheit on a thermometer. The faster the particles move within an object or system, the higher the temperature that is recorded.

Thermal energy is directly proportional to the : temperature within a given system . As a result of this relationship between thermal energy and the temperature of the system, the following applies: The more molecules present, the greater the movement of molecules within a given system, the greater the temperature and the greater the thermal energy + molecules = +movement = + temperature = + thermal energy

As previously demonstrated, the thermal energy of a system is dependent on the temperature of a system which s dependent on the motion of the molecules of the system. As a result, the more molecules that are present, the greater T-a amount of movement within a given system which raises re temperature and thermal energy. Because of this, at a temperature of 0°C, the thermal energy within a given system s also zero. This means that a relatively small sample at a somewhat high temperature such as a cup of tea at its boiling temperature could have less thermal energy than a larger sample such as a pool that's at a lower temperature. If the cup of boiling tea is placed next to the freezing pool, the cup of :ea will freeze first because it has less thermal energy than the pool.

Matter exists in three states: solid, liquid, or gas. When = given piece of matter undergoes a state change, thermal energy is either added or removed but the temperature remains constant. When a solid is melted, for example, thermal energy is what causes the bonds within the solid to break apart.

Thermal energy is a concept applicable in everyday life. For example, engines, such as those in cars or trains, do work by converting thermal energy into mechanical energy.

Also, refrigerators remove thermal energy from a cool region into a warm region.

Coal and diesel are used for the generation of thermal power in India. In fact, coal is the major source of energy used for the production of electricity in rose areas that either have no nearby water power sites or are located near coal mines. In states like Uttar Pradesh, West Bengal, Bihar, Orissa and Madhya Pradesh, coal is the major source of power. Further, some industrial cities like Kanpur and Ahmadabad are served totally with the electricity generated by coal. Moreover, diesel engines for generating electrical power have been installed basically at small towns of the country. Installed capacity of such power plants is only a few hundred kilowatts.

The modern world is well aware of hydro-electricity. It is derived from a source, which is plentiful and above all renewable. Thermal power plants, on the other hand, use coal, petroleum and natural gas to produce thermal electricity. These sources are of mineral origin. They are also called fossil fuels. Their greatest demerit is that they are exhaustible resources and cannot be replenished by human. Moreover, they are not pollution free as hydro-electricity is. However, electricity, whether thermal, nuclear or hydro, is most convenient and versatile form of energy. It is in great demand by industry agriculture, transport and domestic sectors its use is closely related to productivity and standard of living of the people.

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