Second Law Of Thermodynamics Simple

1679 – Denis Papin designed a steam digester which inspired the development of the piston-and-cylinder steam engine. 2a935b2ee3 1694–1734 – Georg Ernst Stahl names Becher's combustible earth as phlogiston and develops the theory 2a935b2ee3 The thermodynamic study of non-equilibrium systems requires more general concepts than are dealt with by equilibrium thermodynamics... 2a935b2ee3 Historically, thermodynamics developed out of a desire to increase the efficiency of early steam engines, particularly through the work of French physicist Sadi Carnot (1824). Scots-Irish physicist Lord Kelvin was the first to formulate a concise definition of thermodynamics in 1854 which stated, "Thermo-dynamics is the subject of the relation of heat to forces acting between contiguous parts of bodies, and the relation of heat to electrical agency." German physicist and mathematician Rudolf Clausius restated Carnot's principle known as the Carnot... 2a935b2ee3

Thermodynamic equations or production process. Thermodynamics is based on a fundamental set of postulates, that became the laws of thermodynamics. One of the fundamental thermodynamic Thermodynamics is expressed by a mathematical framework of thermodynamic equations which relate various thermodynamic quantities and physical properties measured in a laboratory or production process. Thermodynamics is based on a fundamental set of postulates, that became the laws of thermodynamics 2a935b2ee3

1738 – Daniel Bernoulli publishes Hydrodynamica, initiating the kinetic... 2a935b2ee3 The second law of thermodynamics establishes the concept of entropy as a physical property of a thermodynamic system. It predicts whether processes are forbidden despite obeying the requirement of conservation of energy as expressed in the first law of thermodynamics and provides necessary criteria for spontaneous processes. For example, the first law allows the process of a cup falling off a table and breaking on the floor, as well as allowing the reverse process of the cup fragments coming back together and 'jumping' back onto the table, while the second law allows the former and denies the latter. The second law may be formulated by the observation that the entropy of isolated systems left to spontaneous evolution cannot decrease... 2a935b2ee3

Timeline of thermodynamics foundation for the second law of thermodynamics, and initiating the science of thermodynamics 1827 – Robert Brown discovers the Brownian motion of pollen and A timeline of events in the history of thermodynamics 2a935b2ee3

== Overview == 2a935b2ee3 Thermodynamic systems can be passive and active according to internal processes. According to internal processes, passive systems and active systems are distinguished: passive, in which there is a redistribution of available energy, active, in which one type of energy is converted into another. 2a935b2ee3 The structure of chemical thermodynamics is based on the first two laws of thermodynamics. Starting from the first and second laws of thermodynamics, four equations called the "fundamental equations of Gibbs" can be derived. From these four, a multitude of equations, relating the thermodynamic properties of the thermodynamic system can be derived using relatively simple mathematics. This outlines the mathematical framework of chemical thermodynamics. 2a935b2ee3 For thermodynamic processes of energy transfer without transfer of matter, the first... 2a935b2ee3 Almost all systems found in nature are not in thermodynamic equilibrium, for they are changing or can be triggered to change over time, and are continuously and discontinuously subject to flux of matter and energy to and from other systems and to chemical reactions. Many systems and processes can, however, be considered to be in equilibrium locally, thus allowing description by currently known equilibrium thermodynamics. Nevertheless, some natural systems and processes remain beyond the scope of equilibrium thermodynamic methods due to the existence of non variational dynamics, where the concept of free energy is lost. 2a935b2ee3 Entropy is related to the number of accessible microstates, and there is typically one unique state (called the ground state) with minimum energy. In such a case, the entropy at absolute zero will be exactly zero. If the system does not have a well-defined order (if its order is glassy, for example), then there may remain some finite entropy as the system is brought to very low temperatures, either because the system becomes locked into a configuration with non-minimal energy or because the minimum energy state is non-unique. The constant value is called the residual entropy of the system. 2a935b2ee3 == Formulations == 2a935b2ee3 == History == 2a935b2ee3 In the International System of Units (SI), work is measured in joules (symbol J). The rate at which work is performed is power, measured in joules per second, and denoted with the unit watt (W). 2a935b2ee3 == Definition == 2a935b2ee3

Third law of thermodynamics The third law of thermodynamics states that the entropy of a closed system at thermodynamic equilibrium approaches a constant value when its temperature The third law of thermodynamics states that the entropy of a closed system at thermodynamic equilibrium approaches a constant value when its temperature approaches absolute zero. This constant value cannot depend on any other parameters characterizing the system, such as pressure or applied magnetic field. At absolute zero (zero kelvin) the system must be in a state with the minimum possible energy 2a935b2ee3

Thermodynamic system Thermodynamic systems A thermodynamic system is a body of matter and/or radiation separate from its surroundings that can be studied using the laws of thermodynamics. thermodynamic system is a body of matter and/or radiation separate from its surroundings that can be studied using the laws of thermodynamics 2a935b2ee3

Chemical thermodynamics Starting from the first and second laws of thermodynamics, four equations called the "fundamental equations of Gibbs" can Chemical thermodynamics is the study of the interrelation of heat and work with chemical reactions or with physical changes of state within the confines of the laws of thermodynamics. Chemical thermodynamics involves not only laboratory measurements of various thermodynamic properties, but also the application of mathematical methods to the study of chemical questions and the spontaneity of processes. first two laws of thermodynamics 2a935b2ee3

The Planck statement applies only to perfect crystalline... 2a935b2ee3 1698 – Thomas Savery patents an early steam engine 2a935b2ee3

Non-equilibrium thermodynamics Non-equilibrium thermodynamics is concerned with transport processes and with the rates of chemical reactions. Non-equilibrium thermodynamics is a branch of thermodynamics that deals with physical systems that are not in thermodynamic equilibrium but can be described Non-equilibrium thermodynamics is a branch of thermodynamics that deals with physical systems that are not in thermodynamic equilibrium but can be described in terms of macroscopic quantities (non-equilibrium state variables) that represent an extrapolation of the variables used to specify the system in thermodynamic equilibrium

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1667 – J. J. Becher puts forward a theory of combustion involving combustible earth in his book Physica subterranea (see Phlogiston theory). 2a935b2ee3 == Introduction == 2a935b2ee3 1702 – Guillaume Amontons introduces the concept of absolute zero, based on observations of gases 2a935b2ee3

Work (thermodynamics) Also, the surroundings can perform thermodynamic work on a thermodynamic system, which is measured by an opposite sign. This results in externally measurable macroscopic forces on the system's surroundings, which can cause mechanical work, for example to lift a weight, or cause changes in external electromagnetic quantities. Thermodynamic operations Thermodynamic work is one of the principal kinds of process by which a thermodynamic system can interact with and transfer energy to its surroundings. explains the curious use of the phrase "inanimate material agency" by Kelvin in one of his statements of the second law of thermodynamics 2a935b2ee3

First law of thermodynamics Energy cannot be created or destroyed, but it can be transformed from one form to another. The law also defines the internal energy of a system, an extensive property for taking account of the balance of heat transfer, thermodynamic work, and matter transfer, into and out of the system. For a thermodynamic process affecting a thermodynamic system without transfer of matter, the law distinguishes two principal forms of energy transfer, heat and thermodynamic work. For a thermodynamic process The first law of thermodynamics is a formulation of the law of conservation of energy in the context of thermodynamic processes. In an externally isolated system, with internal changes, the sum of all forms of energy is constant. The first law of thermodynamics is a formulation of the law of conservation of energy in the context of thermodynamic processes 2a935b2ee3

== Before 1800 == 2a935b2ee3 1593 – Galileo Galilei invents one of the first thermoscopes, also known as Galileo thermometer 2a935b2ee3 == History == 2a935b2ee3 1665 – Robert Hooke published his book Micrographia, which contained the statement: "Heat being nothing else but a very brisk and vehement agitation of the parts of a body." 2a935b2ee3 1650 – Otto von Guericke builds the first vacuum pump 2a935b2ee3

Second law of thermodynamics " These are informal definitions, however; more formal definitions appear below. A simple statement The second law of thermodynamics is a physical law based on universal empirical observation concerning heat and energy interconversions. Another statement is: "Not all heat can be converted into work in a cyclic process. A simple statement of the law is that heat always flows spontaneously from hotter to colder regions of matter (or 'downhill' in terms of the temperature gradient). The second law of thermodynamics is a physical law based on universal empirical observation concerning heat and energy interconversions 2a935b2ee3

An equivalent statement is that perpetual motion machines of the first kind are impossible; work done by a system on its surroundings requires that the system's internal energy be consumed, so that the amount of internal energy lost by that work must be resupplied as heat by an external energy source or as work by an external machine acting on the system to sustain the work of the system continuously. 2a935b2ee3 1676–1689 – Gottfried Leibniz develops the concept of vis viva, a limited version of the conservation of energy 2a935b2ee3 Depending on its interaction with the environment, a thermodynamic system may be an isolated system, a closed system, or an open system. An isolated system does not exchange matter or energy with its surroundings. A closed system may exchange heat, experience forces, and exert forces, but does not exchange matter. An open system can interact with its surroundings by exchanging both matter and energy. 2a935b2ee3

Thermodynamics The behavior of these quantities is governed by the four laws of thermodynamics, which convey a quantitative Thermodynamics is a branch of physics that deals with heat, work, and temperature, and their relation to energy, entropy, and the physical properties of matter and radiation. Thermodynamics applies to various topics in science and engineering, especially physical chemistry, biochemistry, chemical engineering, and mechanical engineering, as well as other complex fields such as meteorology. the physical properties of matter and radiation. The behavior of these quantities is governed by the four laws of thermodynamics, which convey a quantitative description using measurable macroscopic physical quantities but may be explained in terms of microscopic constituents by statistical mechanics 2a935b2ee3

One of the fundamental thermodynamic equations is the description of thermodynamic work in analogy to mechanical work, or weight lifted through an elevation against gravity, as defined in 1824 by French physicist Sadi Carnot. Carnot used the phrase motive power for work. In the footnotes to his famous On the Motive Power of Fire, he states: “We use here the expression motive power to express the useful effect that a motor is capable of producing. This effect can always be likened to the elevation of a weight to a certain height. It has, as we know, as a measure, the product of the weight multiplied by the height to which it is raised.” With the inclusion of a unit of time in Carnot's definition, one arrives at the modern definition for power: 2a935b2ee3 1660 – Robert Boyle experimentally discovers Boyle's law, relating the pressure and volume of a gas (published 1662) 2a935b2ee3 For thermodynamic work, appropriately chosen externally measured quantities are exactly matched by values of or contributions to changes in macroscopic internal state variables of the system, which always occur in conjugate pairs, for example pressure and volume or magnetic flux density and magnetization. 2a935b2ee3 The physical condition of a thermodynamic system at a given time is described by its state, which can be specified by the values of a set of thermodynamic state variables. A thermodynamic system is in thermodynamic equilibrium when there are no macroscopically apparent flows of matter or energy within it or between it and other systems. 2a935b2ee3 The third law has many formulations, some more general than others, some equivalent, and some neither more general nor equivalent. 2a935b2ee3