MINISTRY OF HIGHER AND SECONDARY SPECIALIZED
EDUCATION OF THE REPUBLIC OF UZBEISTAN

ANDIJAN MACHINE-BULDING INSTITUTE

Presentation of student 1-st course direction of technology and equipment machine building from subject English

ESSAY

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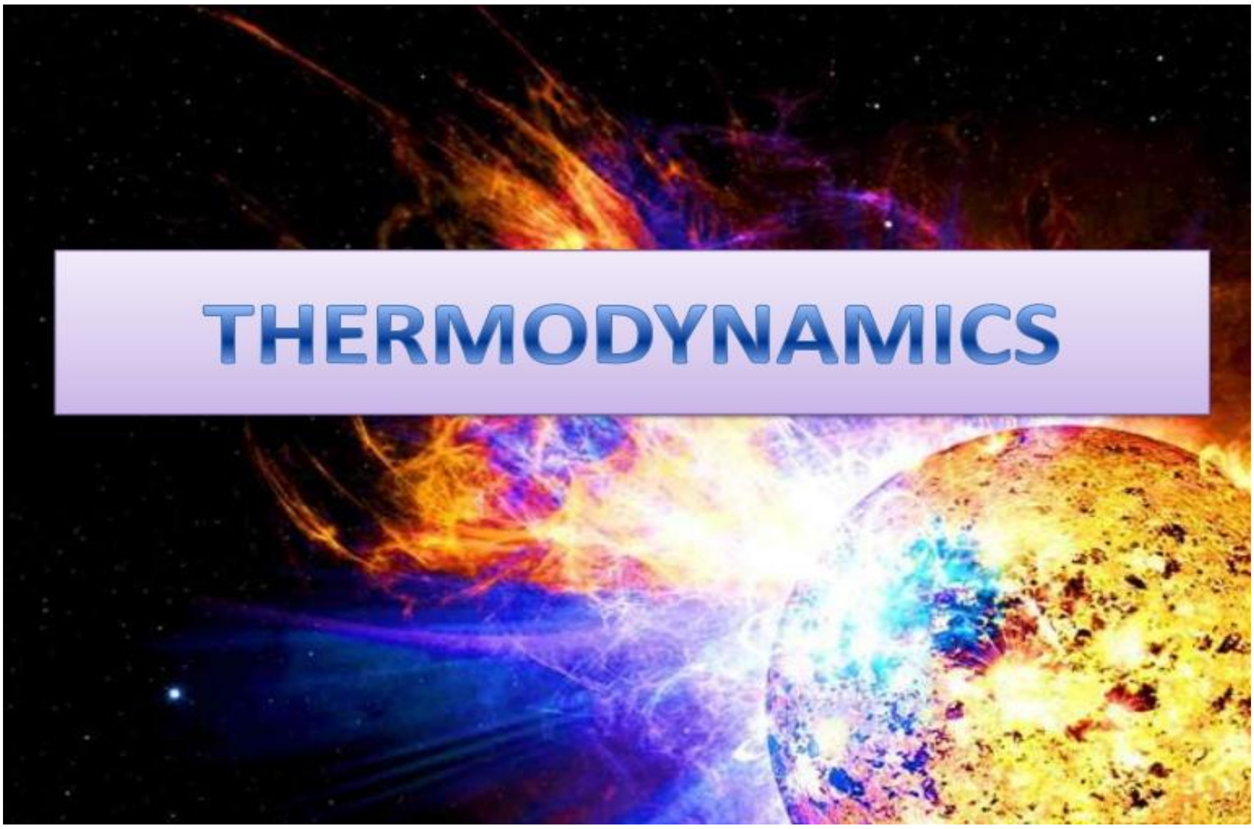


Introduction

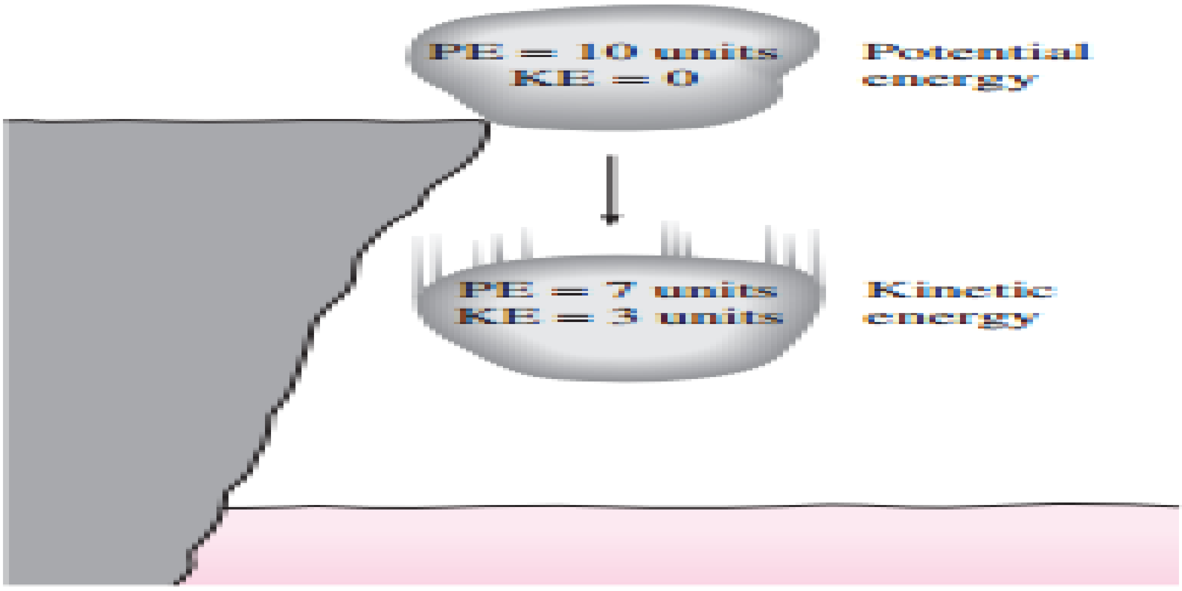
- Every *science* has a unique vocabulary associated with it, and thermodynamics is no exception.
- Precise definition of basic concepts forms a sound foundation for the development of a science and prevents possible misunderstandings.
- We start this presentation with an overview of thermodynamics and the *unit systems*, and continue with a discussion of some basic concepts such as *system*, *state*, *state postulate*, *equilibrium*, and *process*.

The objectives of Presentation

- Identify the unique vocabulary associated with thermodynamics through the precise definition of basic concepts to form a sound foundation for the development of the principles of thermodynamics.
- Review the metric SI and the English unit systems that will be used throughout the text.
- Explain the basic concepts of thermodynamics such as system, state, state postulate, equilibrium, process, and cycle.

Thermodynamics

- Thermodynamics can be defined as the science of energy.
- Energy can be viewed as the ability to cause changes.
- The name thermodynamics stems from the Greek words therme(heat) and dynamis(power).

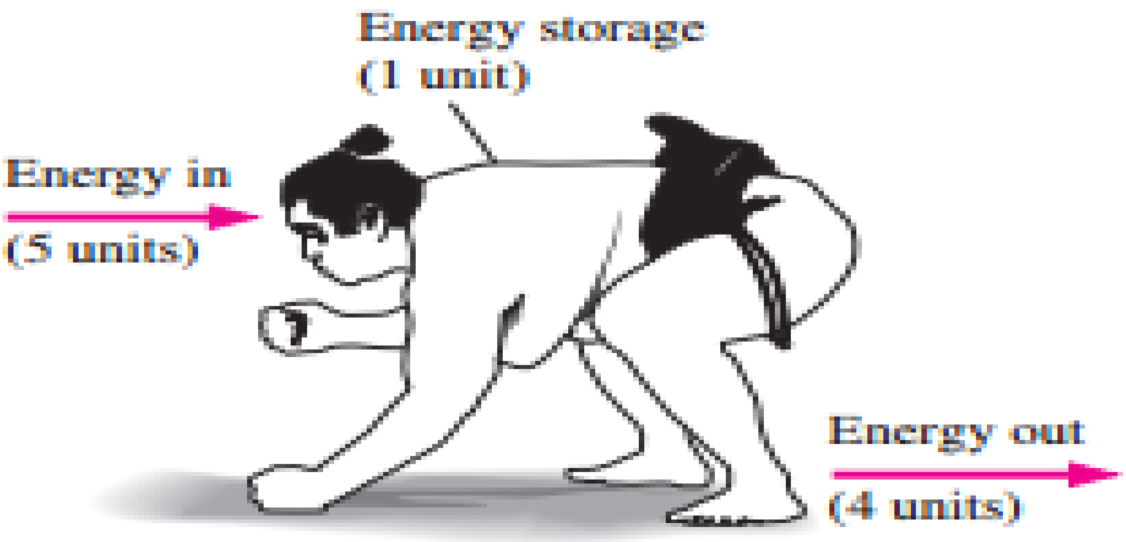


The conservation of energy principle

- One of the most fundamental laws of nature is the conservation of energy principle.
- Energy can change from one form to another but the total amount of energy remains constant.
- Energy cannot be created or destroyed.

A rock falling off a cliff picks up speed as a result of its potential energy being converted to kinetic energy

Conservation of energy principle for the human body



◦ The change in the energy content of a body or any other system is equal to the difference between the energy input and the energy output, and the energy balance is expressed as $E_{in} - E_{out} = \Delta(E)$

A person who has a greater energy input (food) than energy output (exercise) will gain weight (store energy in the form of fat), and a person who has a smaller energy input than output will lose weight

First and Second Laws of Thermodynamics

- **The first law of thermodynamics** is simply an expression of the conservation of energy principle, and it asserts that energy is a thermodynamic *property*.
- The second law of thermodynamics asserts that energy has quality as well as quantity, and actual processes occur in the direction of decreasing quality of energy.

First and Second Laws of Thermodynamics

FIGURE 1–3
Heat flows in the direction of decreasing temperature.

The high-temperature energy of the coffee is degraded

(transformed into a less useful form at a lower temperature) once it is transferred to the surrounding air

a cup of hot coffee left on a table

eventually cools, but a cup of cool coffee in the same room never gets hot by itself.

First and Second Laws of Thermodynamics

- Although the principles of thermodynamics have been in existence since the creation of the universe, thermodynamics did not emerge as a science until the construction of the first successful atmospheric steam engines inEngland by Thomas Savery in 1697 and Thomas Newcomen in 1712.
- These engines were very slow and inefficient, but they opened the way for the development of a new science

First and Second Laws of Thermodynamics

- The first and second laws of thermodynamics emerged simultaneously in the 1850s, primarily out of the works of William Rankine, Rudolph Clausius, and Lord Kelvin (formerly William Thomson). The term thermodynamicswas first used in a publication by Lord Kelvin in 1849.
- The first thermodynamic textbook was written in 1859 by William Rankine, a professor at the University of Glasgow.

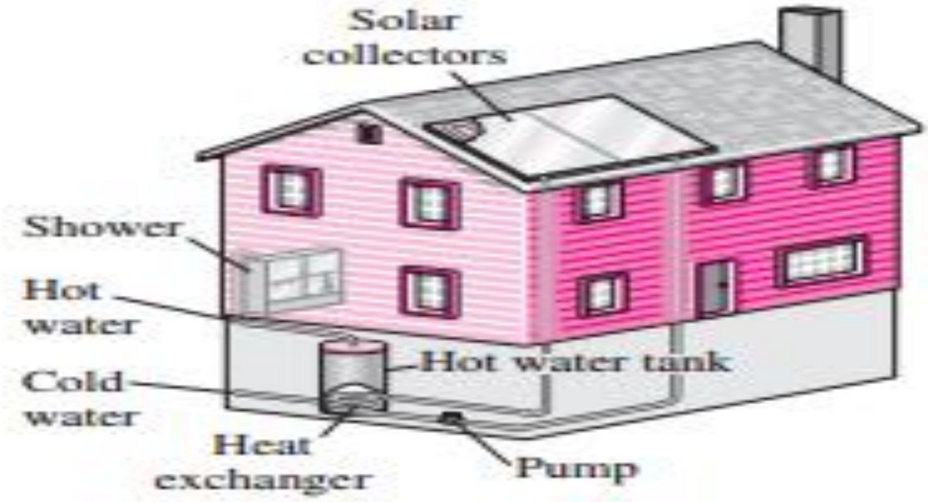
Classical and Statistical

- It is well-known that a substance consists of a large number of particles called molecules.
- The properties of the substance naturally depend on the behavior of these particles.
- For example, the pressure of a gas in a container is the result of momentum transfer between the molecules and the walls of the container.
- However, one does not need to know the behavior of the gas particles to determine the pressure in the container.

Classical and Statistical

- It would be sufficient to attach a pressure gage to the container.
- This macroscopic approach to the study of thermodynamics that does not require a knowledge of the behavior of individual particles is called **classical thermodynamics**.
- A more elaborate approach, based on the average behavior of large groups of individual particles ,is called **statistical thermodynamics.**

Application Areas of Thermodynamics



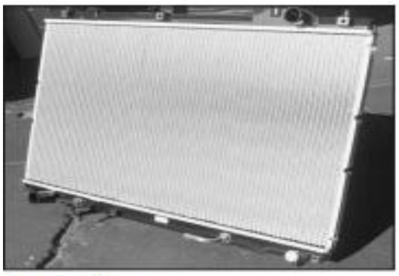
- The design of many engineering systems, such as this solar hot water system, involves thermodynamics.

Application Ar eas of Thermodynamics


The human body


Air conditioning systems


Airplanes


Car radiators


Power plants


Refrigeration systems

DIMENSIONS AND UNITS

- Any physical quantity can be characterized by dimensions.
- The magnitudes assigned to the dimensions are called units.
- Some basic dimensions such as mass m, length L, time t, and temperature T are selected as primary or fundamental dimensions, while others such as velocity V, energy E, and volume V are expressed in terms of the primary dimensions and are called secondary dimensions, or derived dimensions.

English system and SI systems

- A number of unit systems have been developed over the years. Despite strong efforts in the scientific and engineering community to unify the world with a single unit system, two sets of units are still in common use today: the English system,which is also known as the United States Customary System (USCS), and the metric SI(from Le Système International d'Unités), which is also known as the International System.
- The SI is a simple and logical system based on a decimal relationship between the various units, and it is being used for scientific and engineering work in most of the industrialized nations, including England. The English system, however, has no apparent systematic numerical base, and various units in this system are related to each other rather arbitrarily (12 in=1 ft, 1mile=5280 ft, 4 qt=gal, etc.), which makes it confusing and difficult to learn.
- The systematic efforts to develop a universally acceptable system of units dates back to 1790 when the French National Assembly charged the French Academy of Sciences to come up with such a unit system. An early version of the metric system was soon developed in France, but it did not find universal acceptance until 1875 when The Metric Convention Treaty was prepared and signed by 17 nations, including the United States. In this international treaty, meter and gram were established as the metric units for length and mass, respectively, and a General Conference of Weights and Measures(CGPM) was established that was to meet every six years.
- In 1960, the CGPM produced the SI, which was based on six fundamental quantities, and their units were adopted in 1954 at the Tenth General Conference of Weights and Measures:meter(m) for length, kilogram(kg) for

mass, second(s) for time, ampere(A) for electric current, degree Kelvin(°K) for temperature, and candela(cd) for luminous intensity (amount of light). In 1971, the CGPM added a seventh fundamental quantity and unit:mole(mol) for the amount of matter.

Fundamental dimensions and Units

TABLE 1–1

The seven fundamental (or primary) dimensions and their units in SI

Dimension	Unit
Length	meter (m)
Mass	kilogram (kg)
Time	second (s)
Temperature	kelvin (K)
Electric current	ampere (A)
Amount of light	candela (cd)
Amount of matter	mole (mol)

Some SI and English Units

- In SI, the units of mass, length, and time are the kilogram (kg), meter (m), and second (s), respectively.
- The respective units in the English system are the pound-mass (lbm), foot (ft), and second (s). The pound symbol lb is actually the abbreviation of libra, which was the ancient Roman unit of weight.
- The English retained this symbol even after the end of the Roman occupation of Britain in 410. The mass and length units in the two systems are related to each other by
- 1 ft=0.3048 m
- 1 lbm=0.45359 kg

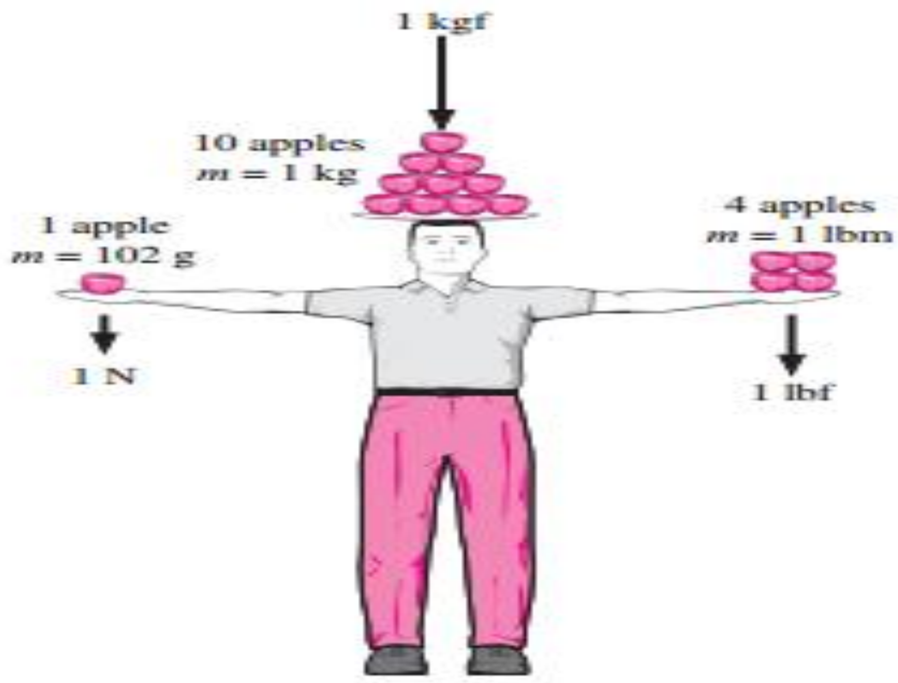
- In the English system, force is usually considered to be one of the primary dimensions and is assigned a nonderived unit.

- This is a source of confusion and error that necessitates the use of a dimensional constant (gc) in many formulas.
- To avoid this nuisance, we consider force to be a secondary dimension whose unit is derived from Newton's second law, that is,
- Force=Mass x Acceleration or F=ma (1–1)
- In SI, the force unit is the newton (N), and it is defined as the force required
- to accelerate a mass of 1 kg at a rate of 1 m/s^2.
- In the English system, the force unit is the pound-force(lbf) and is defined as the force required to accelerate a mass of 32.174 lbm (1 slug) at a rate of 1 ft/s^2 (Fig. 1–7). That isThe definition of the force units
- A force of 1 N is roughly equivalent to the weight of a small apple (m=102 g), whereas a force of 1 lbf is roughly equivalent to the weight of four medium apples (mtotal=454 g), as shown in Fig. 1–8.
- Another force unit in common use in many European countries is the kilogram-force(kgf), which is the weight of 1 kg mass at sea level (1kgf=9.807 N).

Weight

- The term weight is often incorrectly used to express mass, particularly by the "weight watchers." Unlike mass, **weight W is a force**.
- It is the gravitational force applied to a body, and its magnitude is determined from Newton's second law, W=mg (N) where m is the mass of the body, and g is the local gravitational acceleration (g is 9.807 m/s^2 or 32.174 ft/s^2 at sea level and 45° latitude).

Force, Weight, Mass



- The relative magnitudes of the force units newton (N), kilogram-force (kgf), and pound-force (lbf).
- An ordinary bathroom scale measures the gravitational force acting on a body. The weight of a unit volume of a substance is called the **specific weight** g and is determined from $\gamma=\rho g$, where ρ is density.

Thermodynamics & Engineering

- Thermodynamics is the one of the branches science which named Physics.
- Thermodynamics is the basis for engineering.
- Every engineer must know Thermodynamics, because it is important.
- Every thing has energy, and thermodynamics study everything with heat and energy.

Literature

- Thermodynamics An Engineering Approach 5th Edition - Gengel, Boles
- https://en.wikipedia.org/wiki/Thermodynamics
- A PowerPoint Presentation by Paul E. Tippens, Professor of Physics Southern Polytechnic State University