1. INTRODUCTION

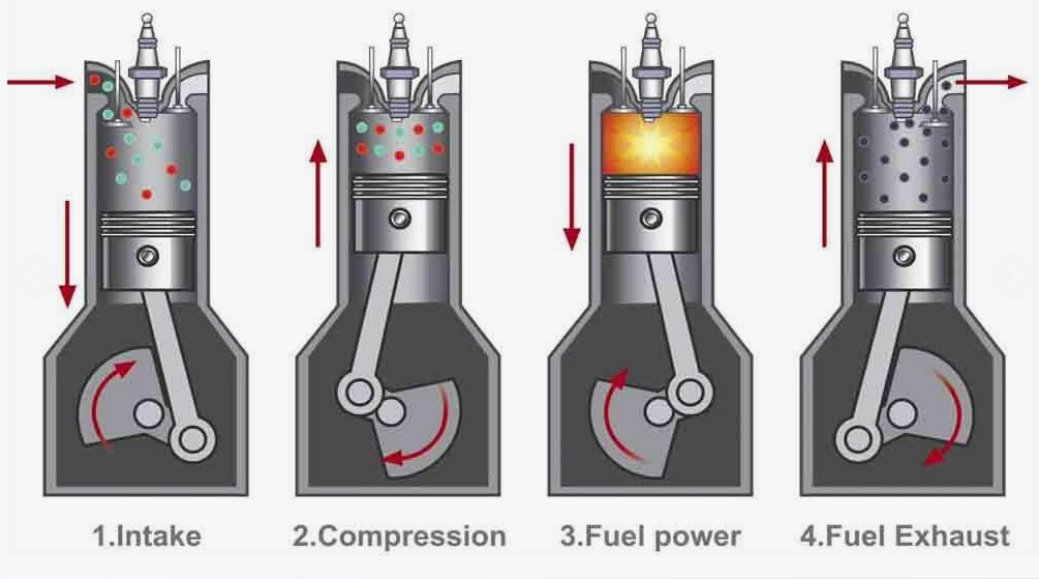
1.1 Concepts and Definitions

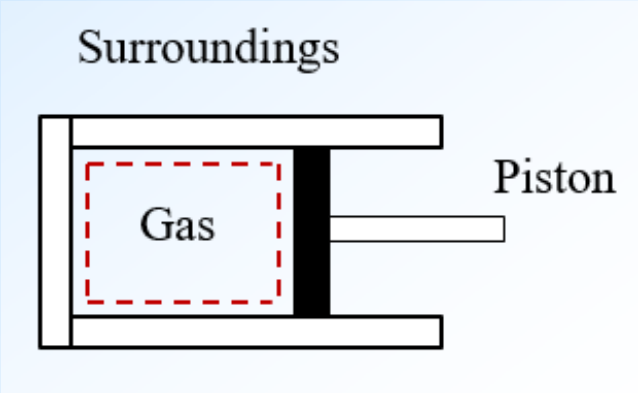
Thermodynamics: Thermal energy in action

Relations between heat and work

System: A quantity of matter of fixed mass and identity upor which attention is focused for study

Internal Combustion Engine





The gas only is the system

Surroundings: Anything external to the system

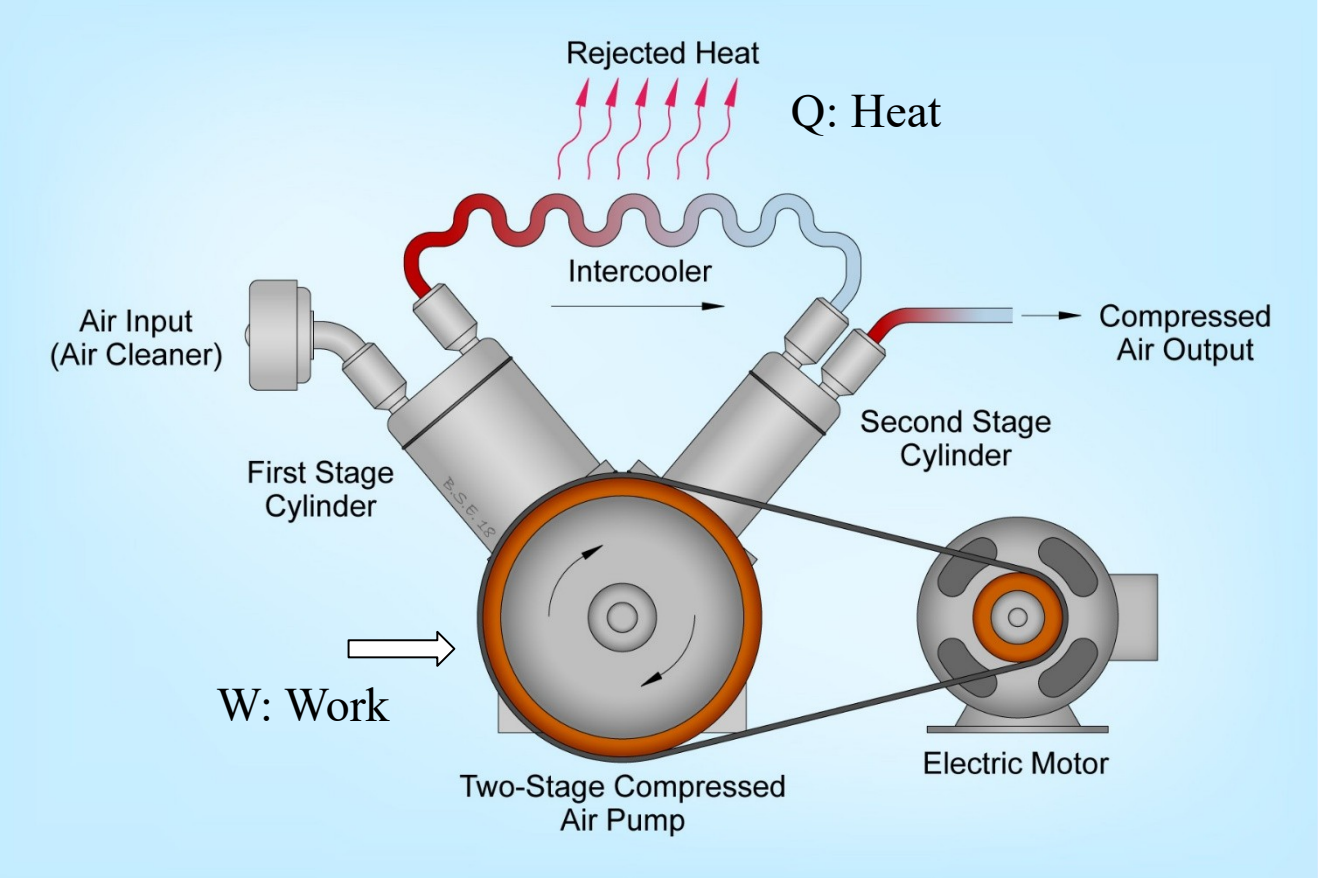
System Boundaries { Movable / Fixed

Heat and Work may cross the system boundaries.

Mass does not cross the movable boundaries of the piston-cylinder device. It is called closed system.

If mass crosses the boundaries, the system is called open system or control volume. The boundary is called control surface.

This is a typical open system where air (mass) comes in and out.



Classical Thermodynamics: Macroscopic view where time-averaged influence of many molecules is considered. System is a continuum.

Phase: A quantity of matter that is homogeneous throughout

Phases of a substance
- Solid
- Liquid
- Gas

State: is identified by certain observable macroscopic properties of a sustance

Thermodynamic Properties
- Intensive: independent of mass
- Extensive: varies directly with mass

Intensive Property: Temperature, Pressure, Density, Specific volume, ...

Extensive Property: Mass, Total volume, ...

Equilibrium
- Thermal: temperature of all substances in a system is the same
- Mechanical: pressure throughout the system does not change with time
- Chemical: concentrations of the ractants and the products do not change with time

A system is in thermodynamic equilibrium if the system is in equilibrium with all possible changes of state.

Change of state: one or more properties of a system change

Process: Succession of state changes, or the path of succession of state changes through which the system passes

Quasiequilibrium Process: Deviation from dynamic (thermodynamic) equilibrium is infinitesimal

Iso (prefix): constant
- Isothermal: constant temperature
- Isobaric: constant pressure
- Isochoric: contant volume

Cycle: A system undergoing a series of state changes and returning to the original state is said to undergo a cycle.

A mechanical cycle is not necessarily the same as a thermodynamic cycle.

1.2 Units

Time: seconds (s)

Length: meter (m)

Mass: kilogram (kg)

Mole: Amount of a substance containing as many elemental entities as the atoms in 12 g of C-12 (6.023 1023 atoms – Avagadro's number)

Gram-mole: Amount of a substance in grams numerically equal to its molecular weight

Force: Newton (N) 1 N = 1 kg.m/s

Density: kg/m^3

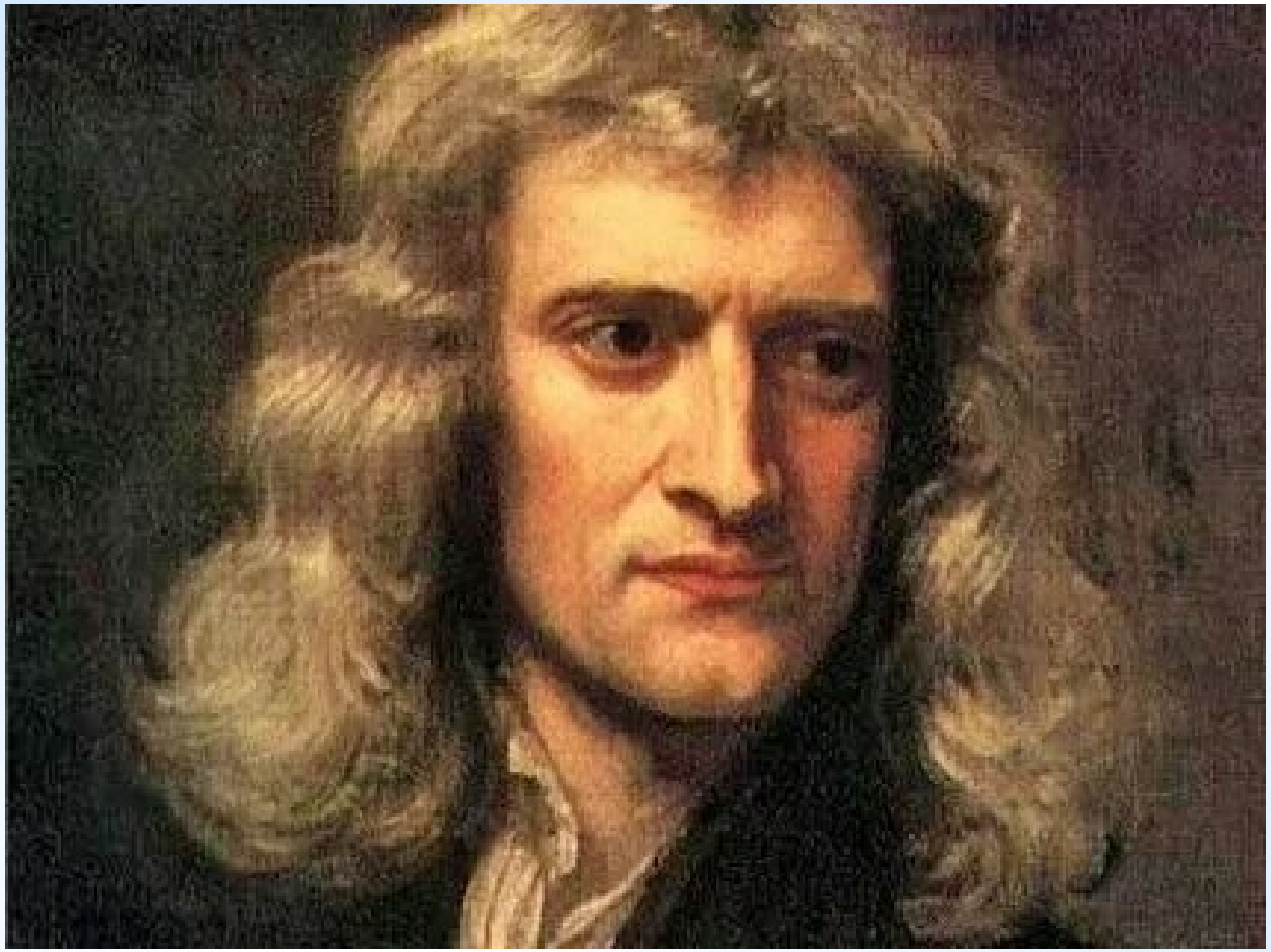
Specific volume: m^3/kg

Weight: (mass) x (local acceleration of gravity)

Amedeo Carlo Avogadro

Italian Scientist

1776 - 1856



Sir Isaac Newton

English Scientist

1643 - 1727

Pressure: Pascal (Pa)

1 Pa = 1 N/m

1 bar = 10^5 Pa = 0.1 Mpa

1 atm = 101.325 kPa

Absolute pressure , Gage pressure

Temperature: °C (Celcius) or K (Kelvin)

Energy (Heat or Work): Joule (J)

1 J = 1 N.m - (force) x (distance)

See «OdtuClass» for a review of unit systems

1.3 Zeroth Law of Thermodynamics

When two bodies have equality of temperature with a third body, they in turn have equality of temperature with each other.

Blaise Pascal

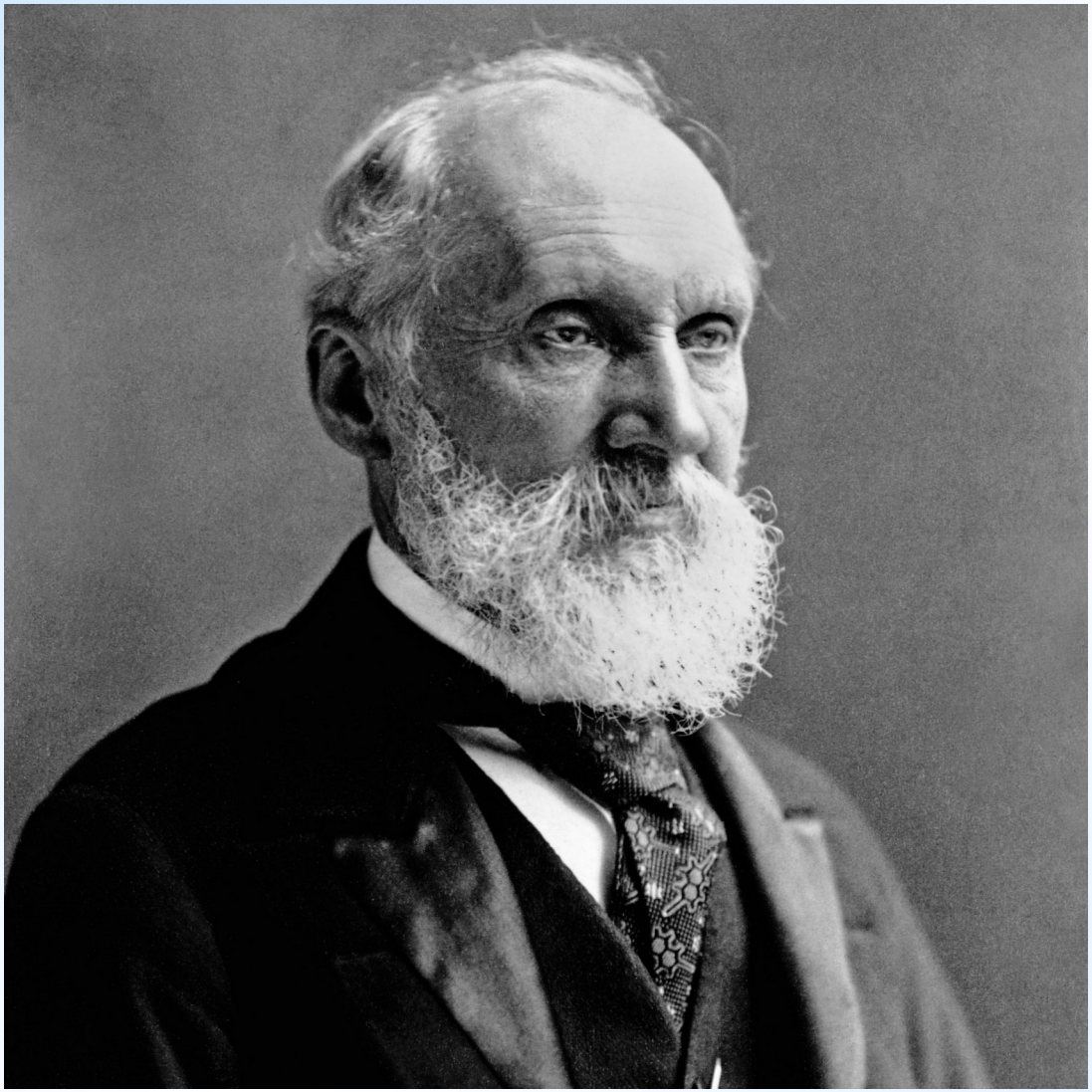
French Scientist

1623 - 1662

Anders Celsius

Swedish Physicist

1701 - 1744

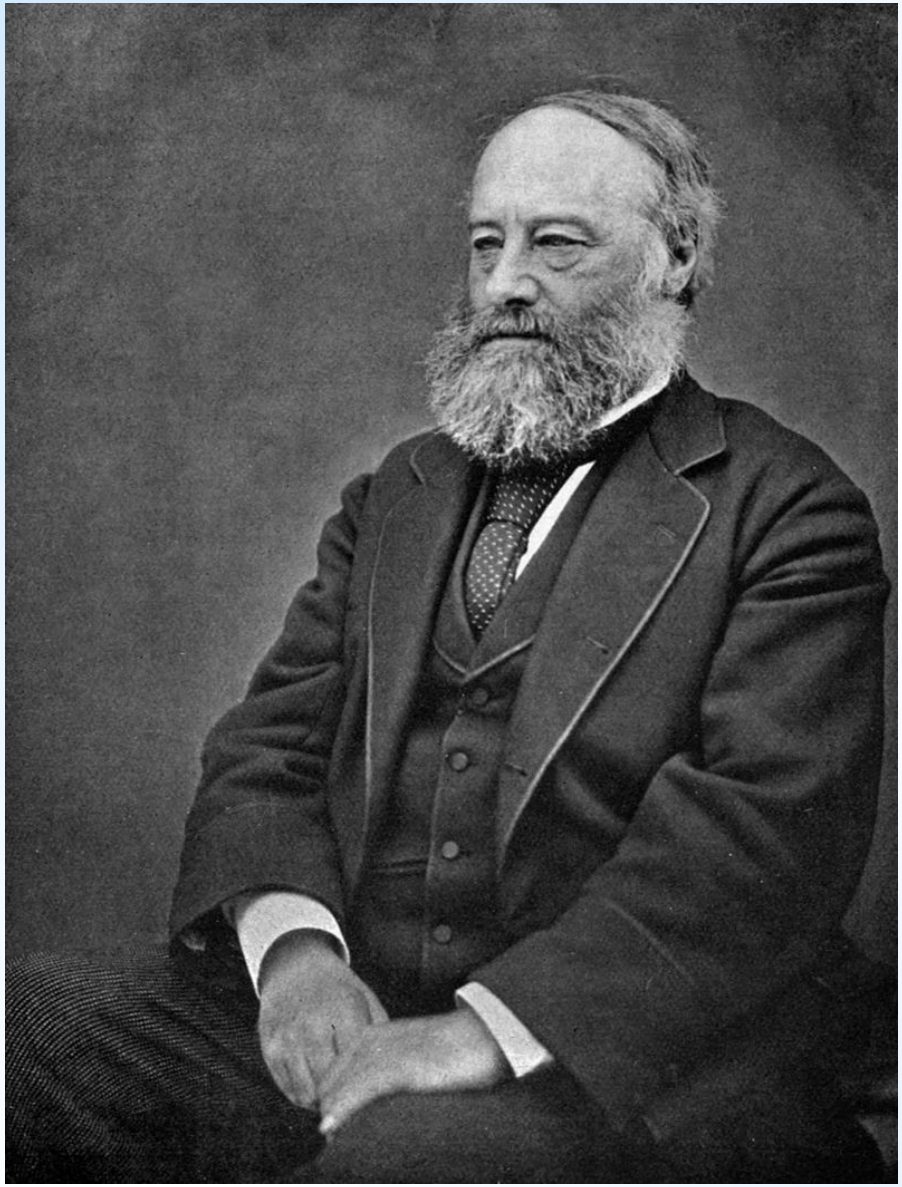


William Thomson

(Lord Kelvin)

British Mathematician

1824 - 1907



James Prescott Joule

English Physicist

1818 - 1889