NPTEL ONLINE CERTIFICATION COURSE

Course

On

Chemical Engineering Thermodynamics

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Week - 1

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Week outline:

- Introduction
- First law
- Second law
- Assignment – practice 0

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Thermodynamics:

- Thermo – Heat
- Dynamics – in motion
- This course will deals with the heat in motion and various parameters that affects the properties of the system.
- This course describe the processes in which properties of matter undergo changes and to relate these changes to energy transfer which accompany them.

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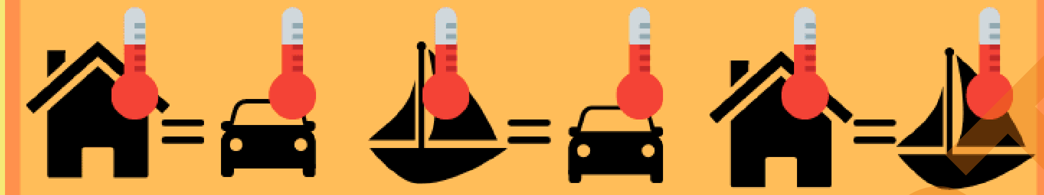
Laws of Thermodynamics

Zeroeth law

Temperature

Two systems in equilibrium with a third system are in thermal equilibrium with each other.



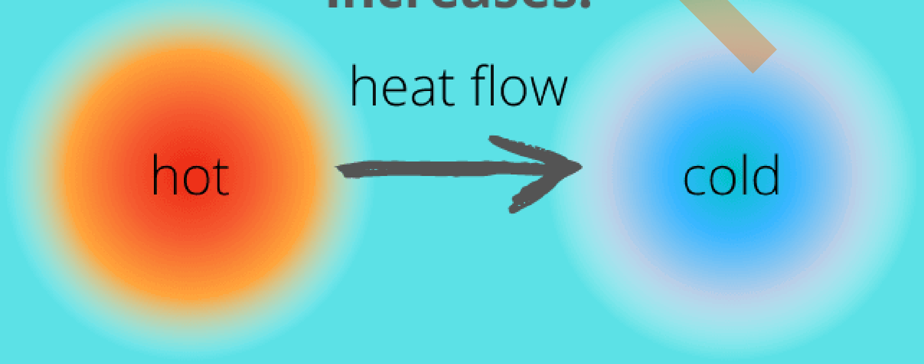
First law

Conservation of Energy

Energy can change forms, but is neither created nor destroyed.

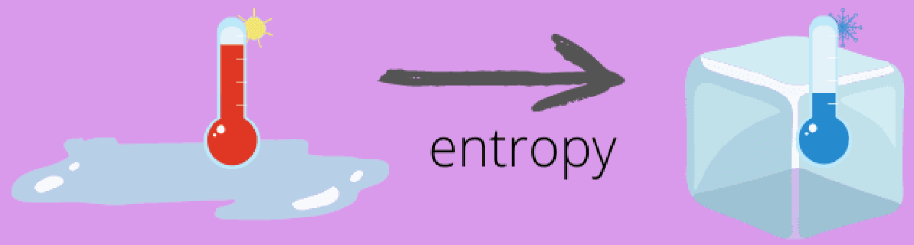
Second law

Entropy of an isolated system always increases.



Third law

Entropy of a system approaches a constant as temperature approaches absolute zero.



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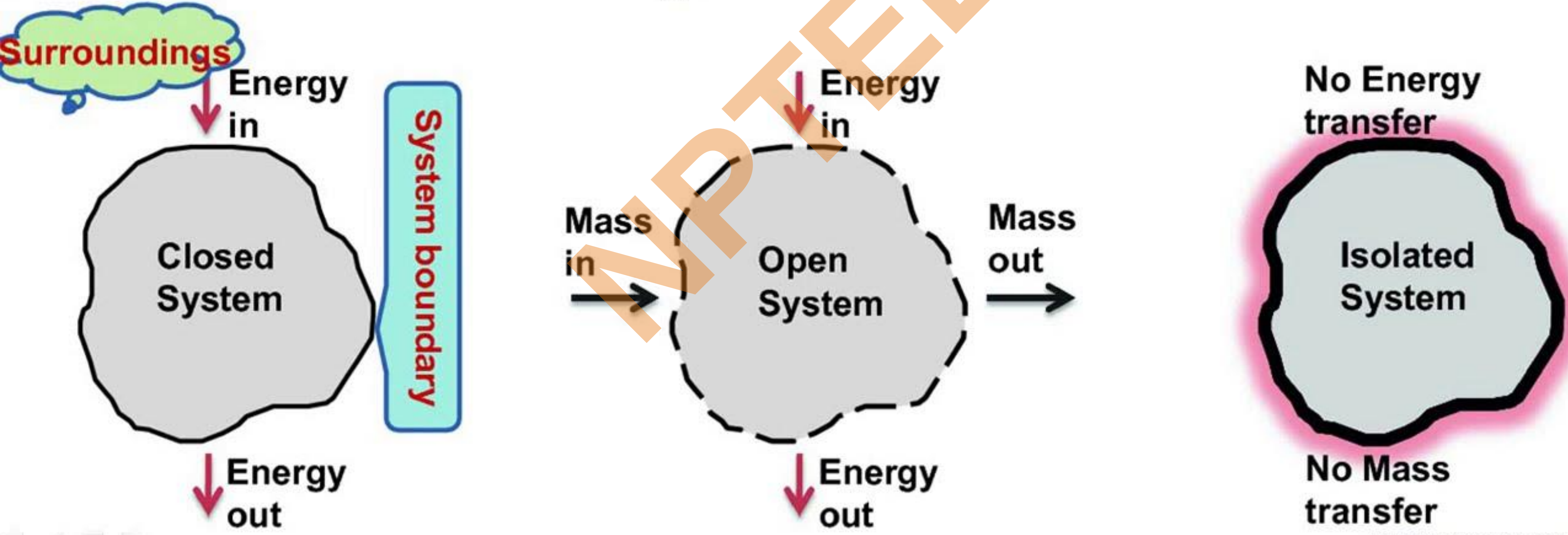
Types of Thermodynamic System



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Tutorials:

- STP (standard temperature and pressure) refers to:

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(a) 0 K and 101.325 kPa

(b) 273.15 K and 101.325 kPa

(c) 273.15 K and 1 kPa

(d) 0 K and 1 k Pa

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- STP (standard temperature and pressure) refers to:

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(b) 273.15 K and 101.325 kPa

(c) 273.15 K and 1 kPa

(d) 0 K and 1 k Pa

- Ans. - Standard temperature and pressure refers to 0◦C and 1 atm pressure or 273.15 K and 101.325 kPa

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- In equilibrium state, the net force acting on a system is

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- In equilibrium state, the net force acting on a system is

(a) zero

(b) infinity

(c) finite and constant

(d) finite and not constant

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Ans. - In equilibrium there is no net heat, mass or momentum flux. Hence the driving force is zero.

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- Under steady state, the net force acting on a system is

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- Under steady state, the net force acting on a system is

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- Ans. - Under Steady state, the system properties do not change with time. So, the driving force is always finite and remains constant over the entire time range, contrary to the equilibrium state where the driving force is zero.

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- Under isothermal conditions, the pressure of an ideal gas

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(a) increases linearly with decrease in molar volume

(b) increases non-linearly with decrease in molar volume

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(d) independent of molar volume

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- Ans. - Ideal gas law: $Pv=RT$

Where, P = pressure, v = molar volume, R = universal gas constant, T = absolute temperature.

For an isothermal process, T = constant. Thus, Pv = constant and $P \propto 1/v$.

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A copper ball of mass 1 kg and specific heat, c_p= 0.39 kJ/kg.K is initially at a temperature of 150K. 2 kJ of energy is supplied to the body. Estimate the final temperature attainted by the ball when it reaches equilibrium?

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(a) 144.872 K
(b) 155.128 K
(c) 180.34 K
(d) 210.12 K

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(b) 155.128 K
(c) 180.34 K
(d) 210.12 K

Ans. - Mass of the body (m) = 1kg.

Heat transferred (Q) = 2kJ.

c_p = 0.39 kJ/kg K

Initial temperature (T1) = 150 K.

Let, T2 be the final temperature attained at equilibrium.

We know that , Q = mcp(T2 − T1)

Hence, 2 = 1 × 0.39 × (T2 − 150) , T2 = 155.12K

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Match the process mentioned in column I with the condition mentioned in column II.

Column I	Column II
(A) Isobaric	(i) constant volume
(B) Adiabatic	(ii) constant pressure
(C) Isochoric	(iii) constant temperature
(D) Isothermal	(iv) zero heat transfer

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- Pressure remains constant in isobaric process, volume in isochoric process and temperature in isothermal process. For an adiabatic process there is no heat transfer between system and surroundings.

- Thank you!

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