

Energy

Definition: The property of matter or an object which can be transferred to other objects or converted into different forms. The ability of a system to perform work.

Types of Energy:

Kinetic: motion of a body (velocity)

$$E_k = \frac{1}{2} m v^2$$

Gravitational: gravitational fields

$$E_p = m g h$$

Chemical: chemical bonds

Electric: electric fields

Nuclear: nuclear bonds

Thermal: temperature

Latent: phases of matter.

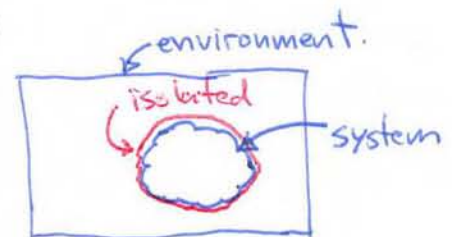
⋮

Units of Energy:

$$[N \cdot m] = [Joule] = [J]$$

Types of Systems

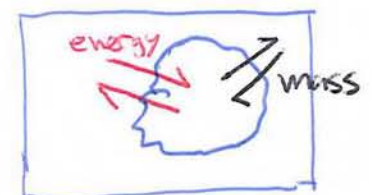
Isolated system



Closed system



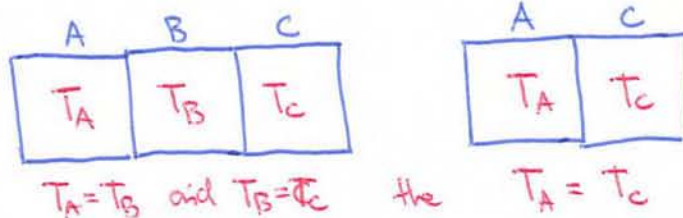
Open system



Laws of Thermodynamics

Zeroth Law: IF two system are each in thermal equilibrium with a third, they are also in thermal equilibrium with each other.

this is the
one we will
use in this
course.



First Law: The increase in internal energy of a closed system is equal to the difference of the heat (Q) added to the system and the work (W) done by the system.

$$\Delta E = Q - W$$

energy heat work.

Second Law: Heat cannot spontaneously flow from a colder location to a hotter location

$$\Delta S > 0$$

entropy.

Third Law: As a system approaches absolute zero the entropy of the system approaches a minimum value i.e. You can't reach 0K.

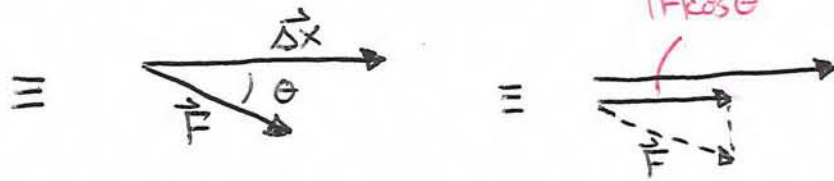
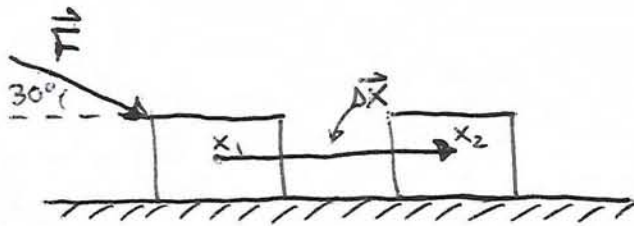
Work (energy)

Refers to energy that is transferred into or out of a system.

for linear motion

$$W = \vec{F} \cdot \vec{\Delta x} = |\vec{F}| |\vec{\Delta x}| \cos \theta$$

dot product. (only counts if the force & distance are aligned)



Power

Rate at which work is done. Units are $[J/s] = [watt] = [W]$

$$P = \frac{W}{\Delta t}$$

Summary

$$\Delta E = -W$$

1st law of thermodynamics

↙ "potential energy"

$$E_p = PE = mgh$$

↙ "kinetic energy"

$$E_k = KE = \frac{1}{2}mv^2$$

$$W = \vec{F} \cdot \Delta \vec{x}$$
$$= |\vec{F}| |\Delta \vec{x}| \cos \theta$$

Laws of Thermodynamics

0. You must play the game
1. You can't win
2. You can't break even
3. You can't quit.