Electronic education
mustansiriyah university
college of pharmacy
clinical laboratory science dept.

Medical physics

- Name of lecturer:
- Abbas abed lateef

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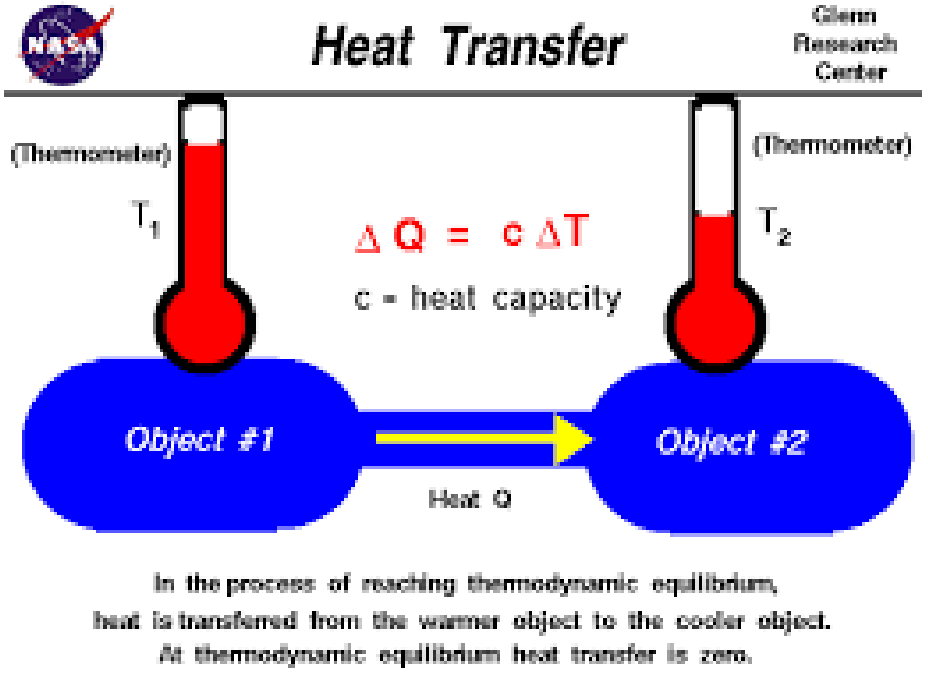
- Second course

- Lecture named:
- # Heat capacity

- Heat capacity or thermal capacity is equal to ratio of heat added to (or removed from) a given mass of material to produce a unit change in temperature. Its unit is Joul per Kelvin (J/K). It is an extensive property; this means that when material increases in size or mass, its heat capacity will increase.
- When dividing heat capacity on mole (the amount of mass), we shall obtain molar heat capacity.

Heat capacity mathematically

- Heat capacity (C) = ΔQ/ΔT --------- (1)
- ; that means, heat capacity C is equal to the change of heat (supplied or removed) that produce a change in temperature.
- $C = \frac{Q2 - Q1}{T2 - T1}$



In the process of reaching thermodynamic equilibrium, heat is transferred from the warmer object to the cooler object. At thermodynamic equilibrium heat transfer is zero.

examples

- A material of iron was attached to an ice until its temperature changed from 900 C˚ to 100 C˚. If the heat capacity of iron is 45 J/C˚, what is the initial energy of the iron (in joules) if the final energy became 500 joules?
- Answer:
- $C = \Delta Q/\Delta T$
- $\Delta Q = C * \Delta T = 45\ J/C^{\circ} * (100\ C^{\circ} - 900\ C^{\circ})$
- $= 45 (-800)\ J = -360\ J$
- $\Delta Q = Q_2 - Q_1 = -360\ J$
- $500\ J - Q_1 = -360\ J \longrightarrow -Q_1 = -360\ J - 500\ J$

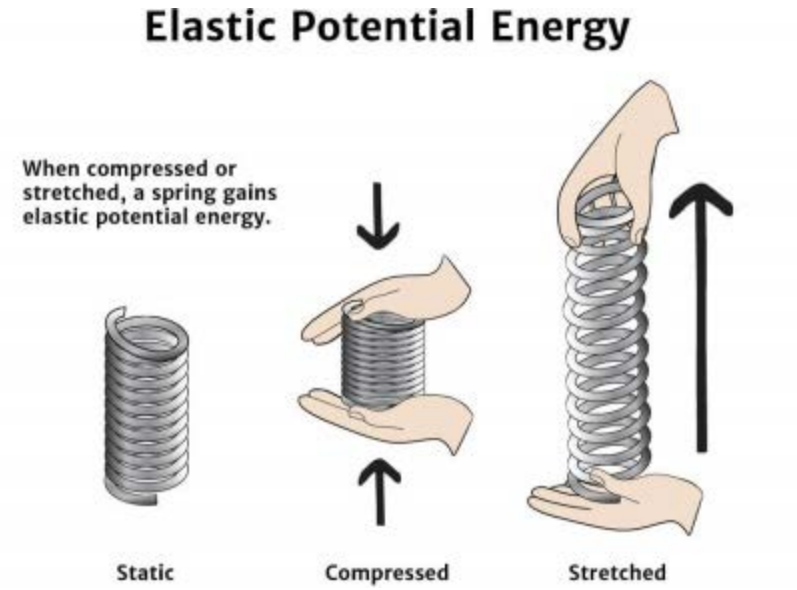
- Q_1 = 360J + 500J = 860 J
- i.e. the initial heat or energy was 860j and the final heat is 500 J
- Then the energy of the system was decreased from 860 J to 500J when it is attached to ice.

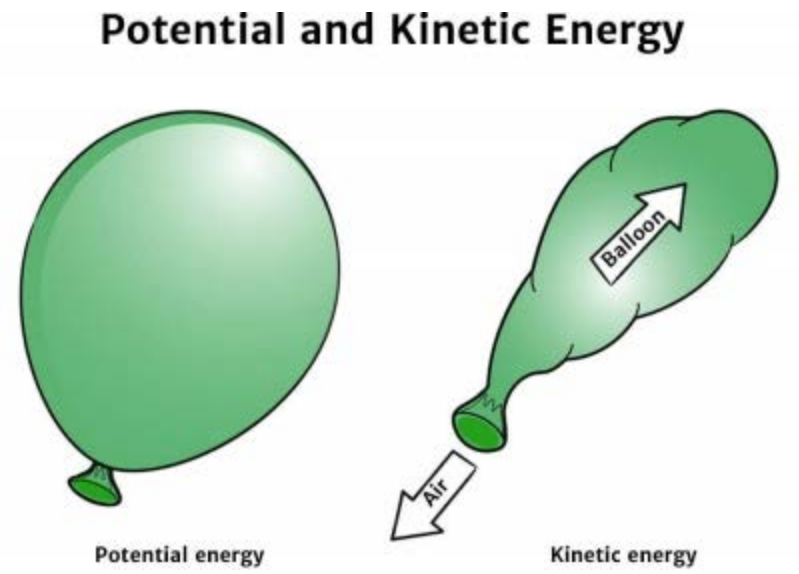
Specific heat capacity

- Specific heat capacity or specific heat is the heat required to raise one kilogram of mass one kelvin (J/Kg.K).

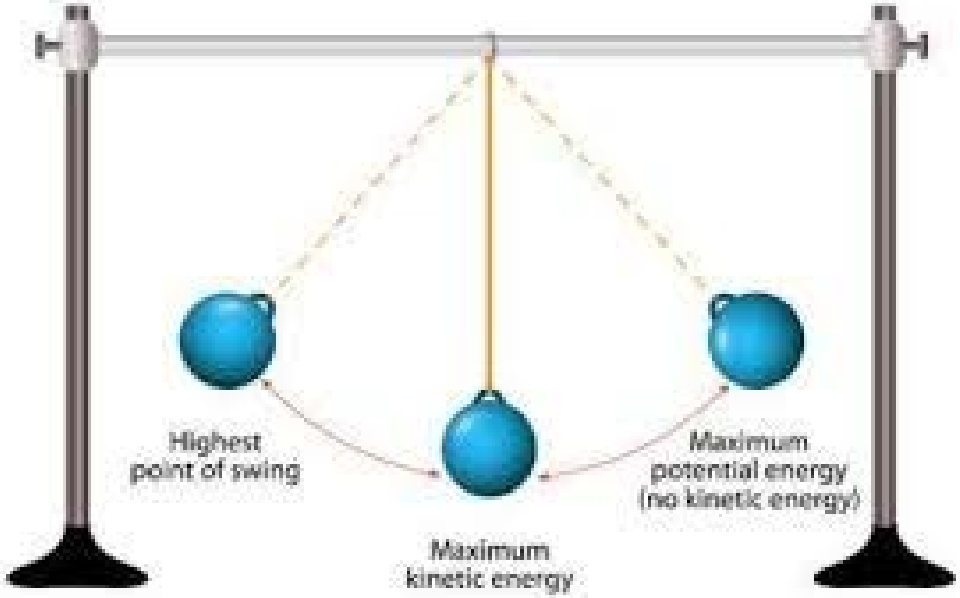
Internal energy

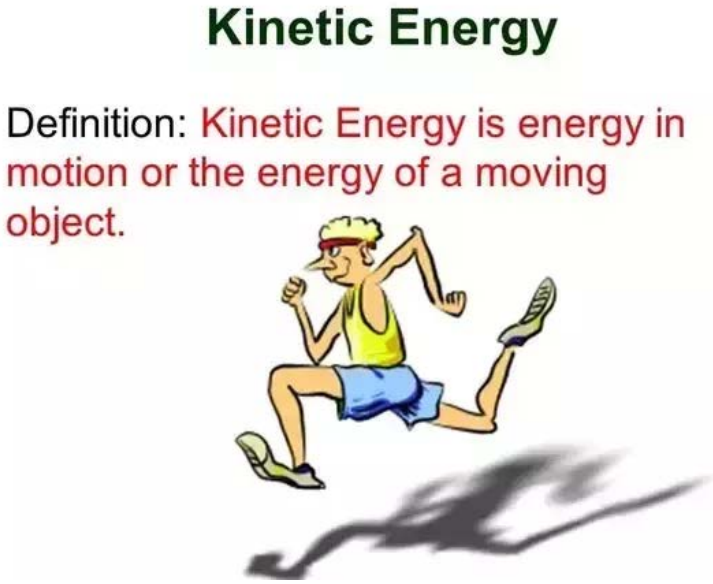
- Internal energy is the sum of potential energy and kinetic energy of a system.
- Potential energy is the energy stored in an object. If a work is done on the system its potential energy will increase.





- Kinetic energy is the motion of molecules inside the system or motion of atoms inside molecule.





Change in internal energy

- The change in internal energy is the magnitude of heat added to or loosed by system at constant pressure and volume.
- From equation (1) and from definition of heat capacity:
- $C = \Delta Q/\Delta T$ ------(1), for a given mass, equation (1) becomes
- $C = \Delta Q/n*\Delta T$ ----------(2)
  n is the number of moles.

- ΔQ is the heat difference or energy difference or change in internal energy. Eq. (2) becomes:
- $\Delta U = C * n * \Delta T$ ----------(3)
- C here is molar heat capacity. Equation (3) can be in the form :
- $\Delta U = C_m * m * \Delta T$ ——— (4)
- C_m is heat capacity per unit mass or it is called specific heat capacity.

Specific heat capacity

- Specific heat capacity is the amount of heat per unit mass required to raise material one degree of temperature (celecius).

meeting ID of the lecture in FCC is: abbaslateef26