Work, Energy, Power

* Work: $W = \int_a^b \vec{F} \cdot d\vec{s}$ [in serious definition, ds should be infinitesimally small].

When W is +ve, the work is done by the force. When W is -ve, the work is done against the force.

* No-work force: $W = F \cdot \delta S \cdot \cos 90^\circ = 0$
* Work done by a couple: $w = \int_{\theta_1}^{\theta_2} \vec{\tau} \cdot d\theta$. (algebraic product).
* $E_K = \frac{1}{2}mv^2$; $p = \sqrt{2mE_K}$
* Work-Energy Theorem: The change in kinetic energy of a body is equal to the work done on it by the net force acting on it.
* Power, $P = \frac{dW}{dt}$. $P = (\vec{F} \cdot d\vec{s})/dt = \vec{F} \cdot \vec{v}$
* Principle of Minimum Potential Energy: In all spontaneous motion, potential energy of a body always decreases.
* When force is applied on a body, which is, placed above another body the work done by the friction force on the lower body is positive.
* Work done, changes with frame of reference.
* $f(x) = -\frac{dU(x)}{dx}$

* 1 amu = 1.67×10^{-27} kg ≡ 931 MeV
  $1 kg \equiv 9 \times 10^{16}$ J $= 1.5 \times 10^{-10}$ J (by $E = mc^2$).

* Various forms of Energy: Mechanical, Chemical, Electrical, Magnetic, Nuclear, Sound Energy, Light Energy, Heat.

* In thermo-couple heat to electrical energy transformation occurs.

* Types of Equilibrium:

a) Stable: $f = -\frac{dU}{dx} = 0$ & $\frac{d^2U}{dx^2} = +ve.$

b) unstable: $f = -\frac{dU}{dx} = 0$ & $\frac{d^2U}{dx^2} = -ve.$

c) neutral: $f = -\frac{dU}{dx} = 0$ & $\frac{d^2U}{dx^2} = 0.$

* If a chain of length L & mass M is held on a frictionless table with $(1/n)^{th}$ of length hanging over the edge, work done or pulling the chain against gravity $= \frac{MgL}{2n^2}$.

• velocity of chain while leaving the table $= \sqrt{gL\left(1-\frac{1}{n^2}\right)}$

* 1 watt = 1 J/s = 10^7 erg/s.

1 hp = 746 watt. 1 kWh = 3.6×10^6 J

* Position & velocity of an automobile wrt time, while the engine supplies constant power P. $v = (2Pt/m)^{1/2}$ | $s = \left(\frac{8P}{9m}\right)^{1/2} t^{3/2}$