What is work? Work is product of Force and Displacement caused by that force.
Work $= \text{Force} \times \text{Displacement}$
But as force and displacement both are vectors
Work $= \mathbf{F.s} = Fs \cos\theta$
But for any variable force
$W = \int F\, ds \cos\theta$
Unit of force is Joule = 1 Newton × Meter
Since the work done is F.s. The area under the curve in F vs s graph is work done.

Conservative Field is the field in which the work done is dependent ONLY on initial and final position. And NOT on path followed. Example of such field is Gravitational, Magnetic and Electrostatic field etc.
Non conservative field on the other hand is the field in which the work done does depend on path as well. Example of such fields are viscous forces, Frictional forces etc.

Energy is the capability of doing work. It is measured again in units of WORK i.e. Joules.
For atomic level we have one more unit of energy $1\ eV = 1.6 \times 10^{-19}\ J$
Here in this case we study mainly the MECHANICAL ENERGY
ENERGY is calculated by DOING WORK

Types of Mechanical Energy
POTENTIAL ENERGY : It is energy possessed by a body by virtue of its position, shape or configuration.
Gravitational potential energy = MgH
As the body having weight Mg is raised by height H, we require exactly Force = Mg
Thus work done $= F \times s = Mg \times H = MgH$

Spring Potential Energy : is possessed by spring when it is either elongated or compressed from natural length. Its value is $\frac{1}{2} kx^2$. Where k is defined as spring constant and 'x' is compression or elongation.
To find k we must remember that $F = -kx$; this –ve sign is JUST for direction and IS not used in calculating Energy.

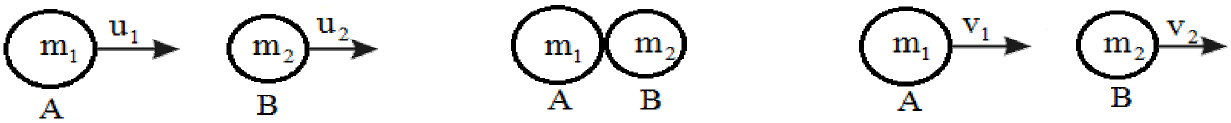
KINETIC ENERGY : is energy possessed by body by virtue of its MOTION.
Value is given as $KE = \frac{1}{2} mv^2$
In this chapter we take ONLY translational energy but as soon as rotational motion comes into picture we have Kinetic energy in two forms
Translational Energy $= \frac{1}{2} mv^2$ and Rotational Kinetic Energy as $\frac{1}{2} I\omega^2$
RELATION between KE and momentum $p^2 = 2m(KE)$

Now power is defined as rate of doing work
Unit of Power is WATT
Also instantaneous power $= \mathbf{F.v}$
So again the area under P t curve is work done

COLLISION : When ever two bodies are in contact for a short interval of time, it is stated as Collision
MOMENTUM is CONSERVED in all type of COLLISIONS
TYPES OF COLLISION :
ELASTIC COLLION : In this type of collision NO energy is LOST
INELASTIC COLLISION : In this type some energy is lost
PERFECTLY INELASTIC : In such collision the bodies stick after collision,
Wherever it is referred as ENERGY it means Kinetic Energy only as PE DOES NOT CHANGE IN COLLISION

COLLISION
It is the impact when two bodies are in contact for small time (Approaching zero)

Thus the momentum of system remains conserved.



Before collision During Collision After Collision

Momentum conservation $m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$ .....(1)

Energy conservation $\frac{1}{2}m_1u_1^2 + \frac{1}{2}m_2u_2^2 = \frac{1}{2}m_1v_1^2 + m_2v_2^2$ .....(2)

Equation (2) rearranged $m_1(u_1^2 - v_1^2) = m_2(v_2^2 - u_2^2)$ .....(3)

Equation (1) rearranged $m_1(u_1 - v_1) = m_2(v_2 - u_2)$ .....(4)

Dividing (3) by (4) $u_1 + v_1 = u_2 + v_2 \Rightarrow v_2 = u_1 - u_2 + v_1$ .....(5)

Substituting value of v_2 in (4) gives $v_2 = \frac{2m_1u_1 + u_2(m_2 - m_1)}{m_1 + m_2}$

Similarly solving for v_1 we get $v_1 = \frac{2m_2u_2 + u_1(m_1 - m_2)}{m_1 + m_2}$

COLLISION IN TWO DIMESNIONS

(a) Before the collision (b) After the collision

EQUATING The x axis component and y component

$$m_1u_1 = m_1v_1\cos\theta + m_2v_2\cos\phi$$
$$m_1v_1\sin\theta = m_2v_2\sin\phi$$

Coefficient of restitution $e = -\frac{v_2 - v_1}{u_2 - u_1}$