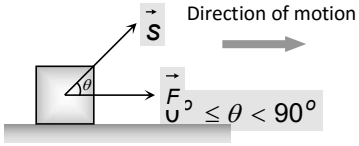
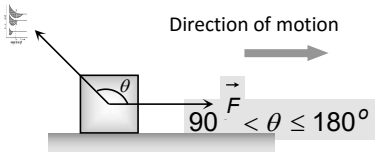
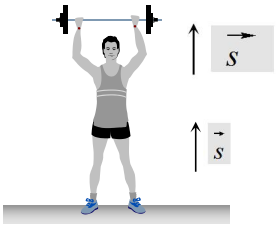
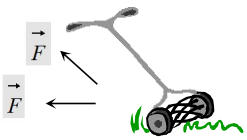
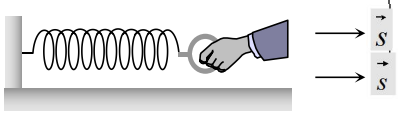
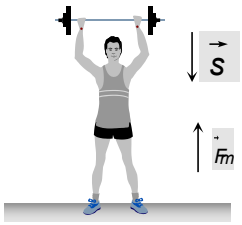
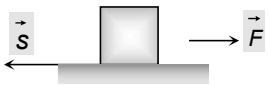
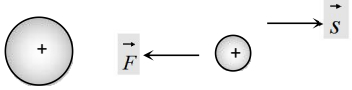
Nature of Work Done.

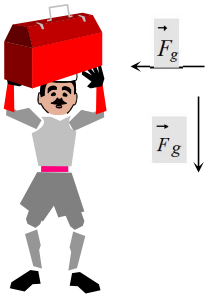
Positive work	**Negative work**
Positive work means that force (or its component) is parallel to displacement  The positive work signifies that the external force favors the motion of the body.	Negative work means that force (or its component) is opposite to displacement i.e.  The negative work signifies that the external force opposes the motion of the body.
Example: (i) When a person lifts a body from the ground, the work done by the (upward) lifting force is positive  (ii) When a lawn roller is pulled by applying a force along the handle at an acute angle, work done by the applied force is positive.  (iii) When a spring is stretched, work done by the external (stretching) force is positive. 	Example: (i) When a person lifts a body from the ground, the work done by the (downward) force of gravity is negative.  (ii) When a body is made to slide over a rough surface, the work done by the frictional force is negative.  (iii) When a positive charge is moved towards another positive charge. The work done by electrostatic force between them is negative. 

Maximum work : $W_{max} = F\,s$ When $\cos\theta = \text{maximum} = 1$ i.e. $\theta = 0^o$ It means force does maximum work when angle between force and displacement is zero.	Minimum work : $W_{min} = -F\,s$ When $\cos\theta = \text{minimum} = -1$ i.e $\theta = 180^o$ It means force does minimum [maximum negative] work when angle between force and displacement is 180°.

Zero work

Under three condition, work done becomes zero $W = Fs\cos\theta = 0$

(1) **If the force is perpendicular to the displacement** $[\vec{F} \perp \vec{s}]$

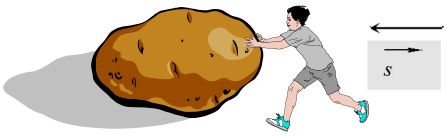


Example: (i) When a coolie travels on a horizontal platform with a load on his head, work done against gravity by the coolie is zero.

(ii) When a body moves in a circle the work done by the centripetal force is always zero.

(iii) In case of motion of a charged particle in a magnetic field as force $[\vec{F} = q(\vec{v} \times \vec{B})]$ is always perpendicular to motion, work done by this force is always zero.

(2) **If there is no displacement [s = 0]**



Example: (i) When a person tries to displace a wall or heavy stone by applying a force then it does not move, the work done is zero.

(ii) A weight lifter does work in lifting the weight off the ground but does not work in holding it up.

(3) **If there is no force acting on the body [F = 0]**

Example: Motion of an isolated body in free space.