Work, Energy & Power

Work : Work is said to be done by a force acting on a body when a body is displaced along the direction of force. The work done by a constant force acting on a body is equal to the product of the force and the component of displacement along the direction of the force.

If a constant force $\vec{F}$ acts on a body and the body moves a distance $\vec{S}$ in the direction of force.

Then work, $W = \vec{F} \cdot \vec{S}$ ——— (1)

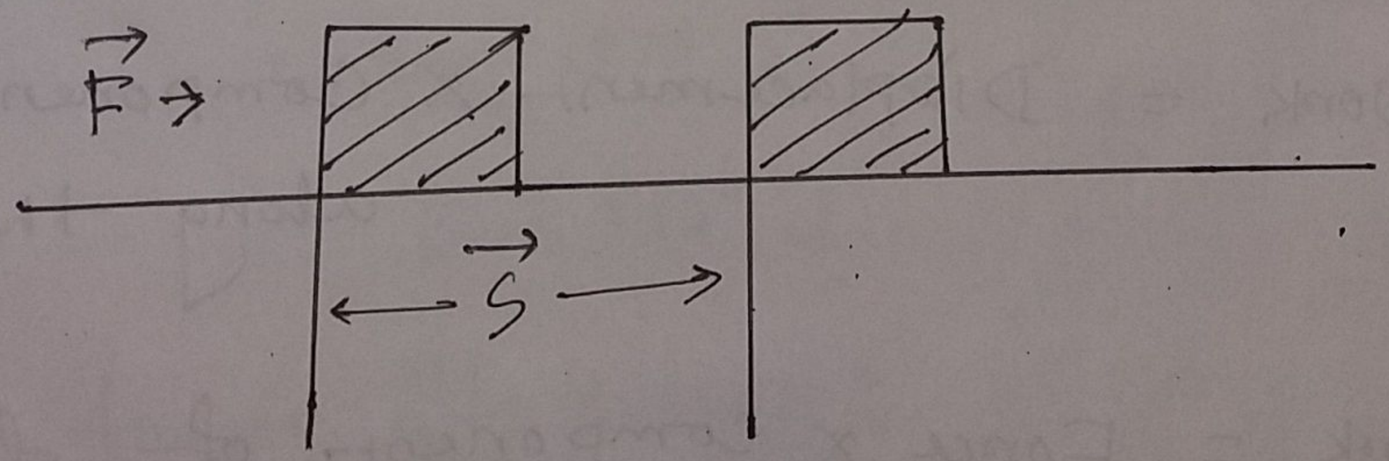

fig (a)

If the force $\vec{F}$ acts obliquely such that it makes an angle θ with the direction of motion. Fig (b), and $\vec{S}$, the distance moved by the body.

the two components of this force are:

1. $F\cos\theta$ in the direction of motion.
2. $F\sin\theta$ perpendicular to the direction of motion.

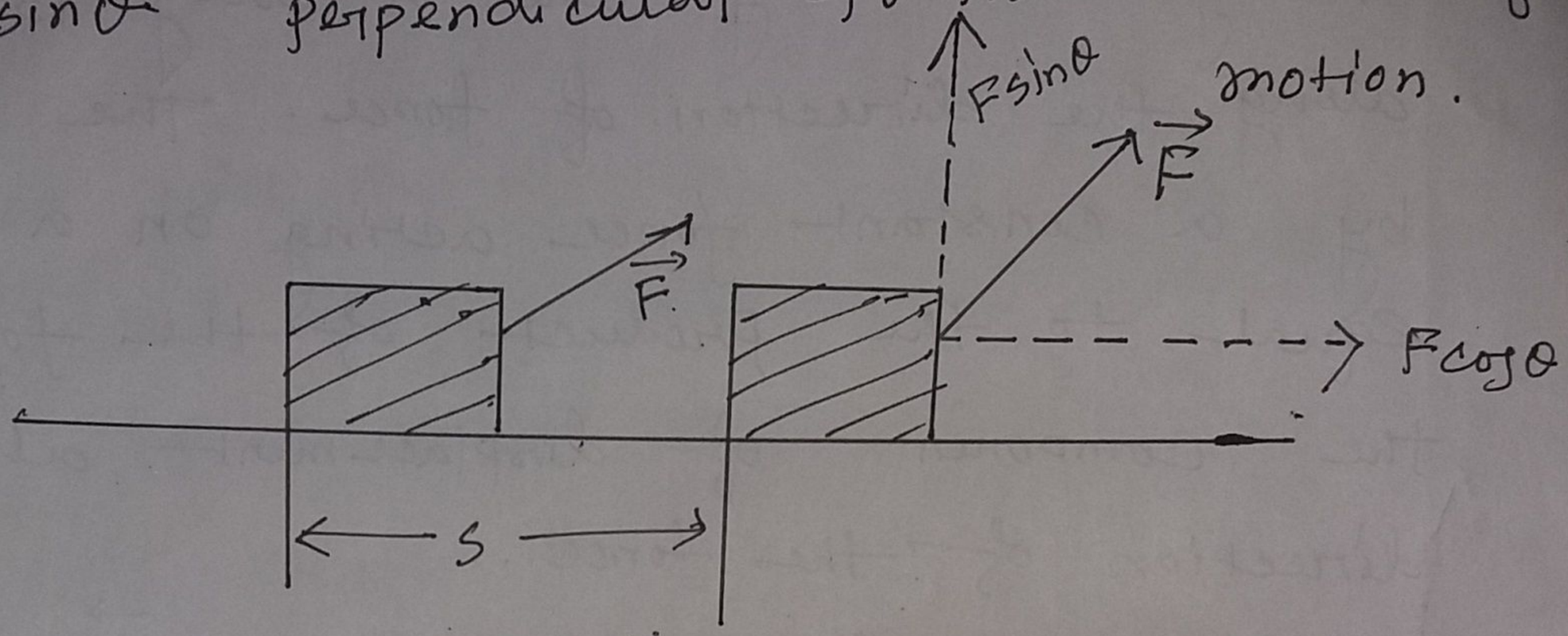

fig (b)

The distance moved along the direction $F\cos\theta$ is S, and along $F\sin\theta$ is zero. So, we have,

$$W = (F\cos\theta)\,s \quad \text{——— (1)}$$

$$W = F(s\cos\theta) \quad \text{——— (2)}$$

(i) Work = Displacement × Component of the force along the displacement

(ii) Work = Force × component of displacement along the direction of force.

Work is a scalar quantity. But force $\vec{F}$ and displacement $\vec{s}$ are vector quantities. So, W is a scalar or dot product of $\vec{F}$ & $\vec{s}$.

Unit: Joule

Energy:

work is the evidence to recognize the presence of energy and a body acquires energy when work is done on it.

Energy is the ability to do work and is equal to the work done on the body.

Energy, like work is a scalar quantity.

Unit: Joule

Another unit of energy which is used in industry is Kwh (kilowatt hour).

$1\ kwh = 1\ kW \times 1\ hr$

$= 1000\ W \times 3600\ S$

$= 3600,000\ J.$

$= 3.6 \times 10^6\ J.$

Various forms of energy:

Energy can be in different forms:

* Kinetic energy } mechanical energy
* Potential "

  * Gravitational potential
  * elastic potential

* Chemical Potential energy
* Electrical " "
* Nuclear " "
* Thermal energy
* Radiated energy.
*

Kinetic energy:

Object is the energy which it possesses due to its motion. It is defined as the work needed to accelerate a body of a given mass from rest to its stated velocity.

Having gained this energy during its acceleration, the body maintains this kinetic energy unless its speed changes. The same amount of work is done by the body is decelerating from its current speed to a state of rest.

In classical mechanics,

the kinetic energy of a non-rotating object of mass m travelling at a speed v is $\frac{1}{2}mv^2$.

In relativistic mechanics, this is only a good approximation when v is much less than the speed of light.