

Chapter 11

WORK AND ENERGY

Work is the term, which we often come across in our day-to-day life. Let us look at how work is defined in science?

Definition:

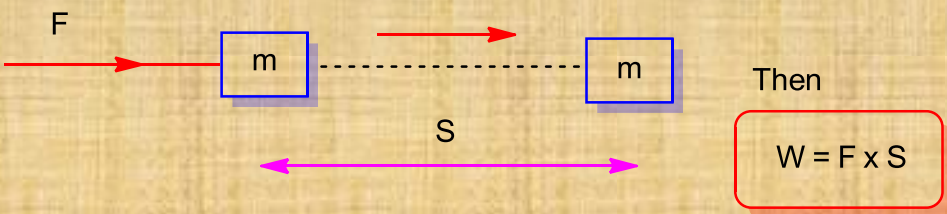
“ When a constant force ‘F’ act on an object and the object is displaced through a distance of ‘S’ in the direction of force then the product of force and displacement is defined as work”.

Mathematically,

Work = force x Displacement

$$W = F \times S$$

Let ‘F’ is the force acting on a body of mass ‘m’ and body is displaced by ‘S’.



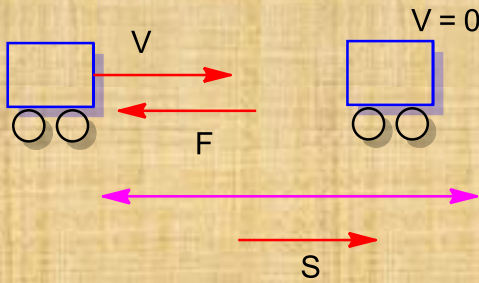
Here, it is to be noted that force and displacement are along same direction hence ‘W’ is positive.

If the force and displacement are in opposite direction then work is said to be negative.

Example:

When a car is moving with uniform velocity ‘V’ and a force ‘F’ is applied opposite its motion, then the car experiences the retardation and

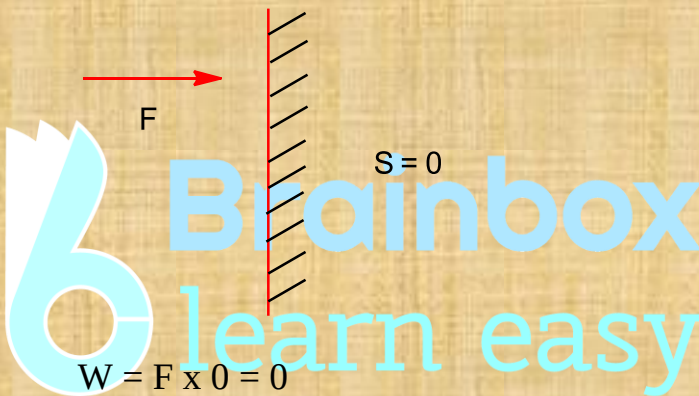
finally stops. In this case the work done is negative. Because force and displacement are in opposite directions.



$$\therefore W = - F \times S \Rightarrow \text{Negative work}$$

Similarly, when force applied but body is not displaced then work done is zero.

Ex: Pushing the wall



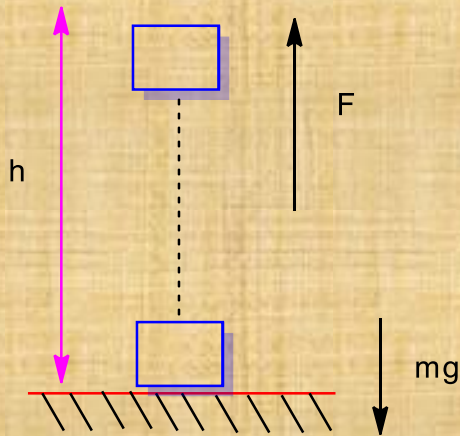
Few cases to think,

(1) What is work done by a gravitational force when an object is lifted up by an external force 'F' through a height 'h'?

Ans.

By gravitational force = $- mgh$ (-ve)

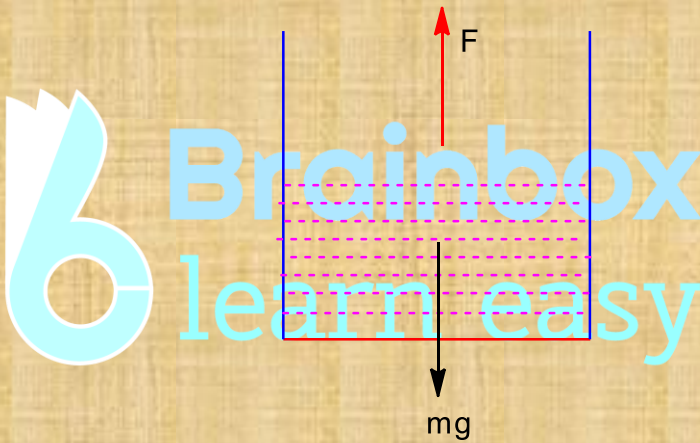
By external force = Fh (+ve)



(2) When a bucket containing water is pulled from a well, then work done by gravitational force is negative.

Work done by force 'F' is +ve.

Work done by force 'mg' is -ve.



Work is measured in joules.

joule - S.I unit

erg - C.G.S unit

$$1\text{J} = 10^7 \text{ erg}$$