

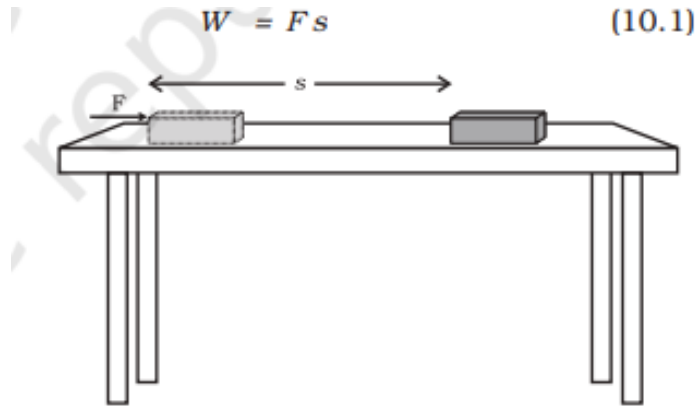
## ◆ What is Work?

### 📖 Scientific Definition:

Work is said to be done when a force is applied on an object and the object gets displaced in the direction of the force.

### 📐 Work = Force × Displacement

$$W = F \times s$$



📷 Fig. 10.1 – Force causing displacement

### 📖 Unit of Work = joule (J)

$$1 \text{ joule} = 1 \text{ newton} \times 1 \text{ metre}$$

## ! Important Conditions for Work:

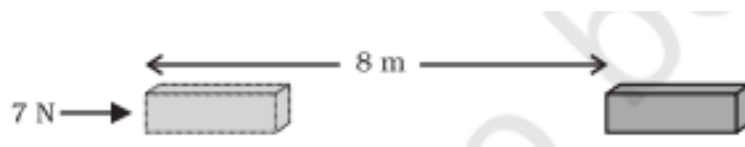
- Force must act on the object
- The object must get displaced
- The force and displacement must have a component in the same direction


### ✅ Positive Work:

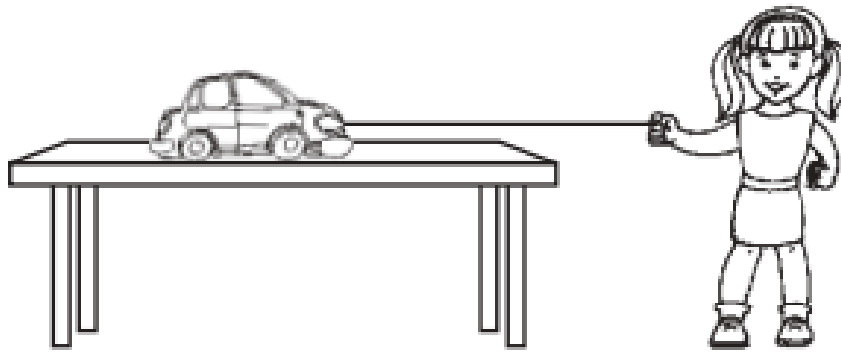
- When force and displacement are in same direction (e.g., lifting a book upward)


### ❌ Negative Work:

- When force and displacement are in opposite direction (e.g., friction while sliding)



 Fig. 10.3 – 7 N force applied, 8 m displacement → Work = 56 J



 Fig. 10.4 – Baby pulling toy → force and displacement same → positive work

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## Activity 10.1–10.4: Work Scenarios

- Pushing a wall – no displacement → no work
- Lifting object upward → displacement with force → work done
- Holding object still → no displacement → no work
- Cart pulled by bullock → force with movement → work done

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## ◆ Energy

### Definition:

Energy is the capacity to do work.

✓ Unit: Same as work → joule (J)

1 kilojoule (kJ) = 1000 J

### Sources of Energy:

Sun, fuels, food, tides, Earth's core, etc.

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## Activity 10.5: Identify energy sources from daily life


Discuss: Which sources are directly/indirectly from the Sun?

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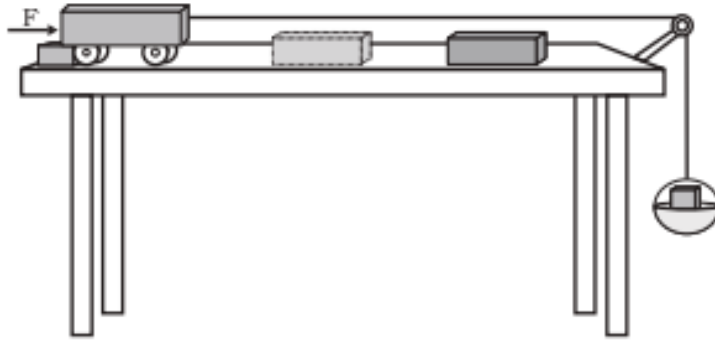
## ◆ Kinetic Energy


### Definition:

Energy possessed by an object due to its motion.

 Kinetic Energy ( $E_k$ ) =  $\frac{1}{2} mv^2$

Where  $m$  = mass,  $v$  = speed



 Fig. 10.5 – Trolley hits block → work done = energy transferred

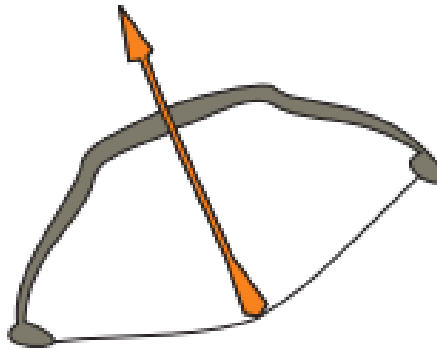



 Fig. 10.6 – Ball dropped from different heights → deeper dent = more energy

 **Activity 10.6–10.7: Drop heavy object or use trolley → faster object = more kinetic energy**

 Example:

Mass = 15 kg, Speed = 4 m/s


$E_k = \frac{1}{2} \times 15 \times 16 = 120 \text{ J}$

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## ◆ Potential Energy

 **Definition:**

Energy possessed by an object due to its position or configuration.

 Potential Energy ( $E_p$ ) =  $mgh$

Where  $h$  = height,  $g = 9.8 \text{ m/s}^2$

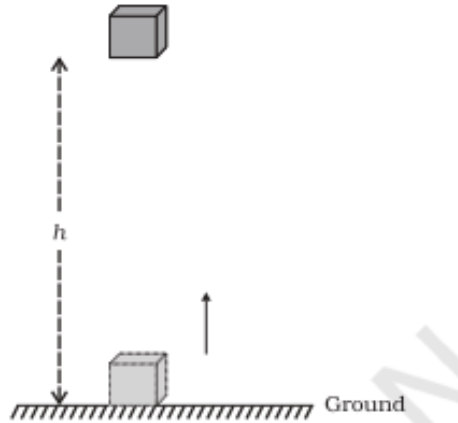


Fig. 10.7 – Object lifted up → gains energy

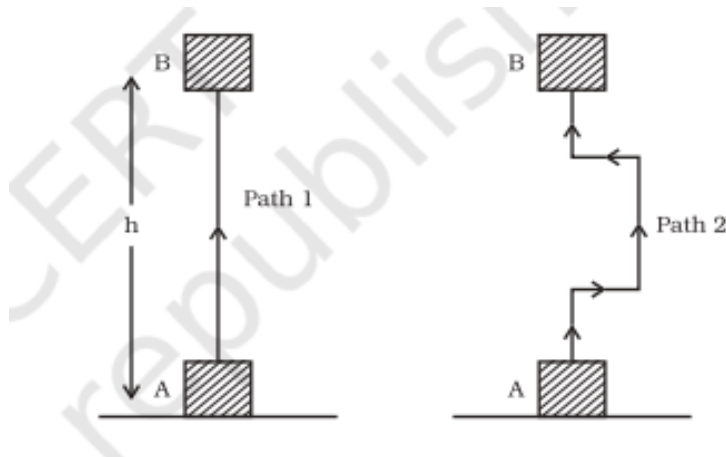


Fig. 10.8 – Path doesn't matter, only vertical height matters

**Activity 10.8–10.12:** Stretch rubber band, compress spring, pull bowstring → all store potential energy

Example:

$$m = 10 \text{ kg}, h = 6 \text{ m}$$

$$E_p = 10 \times 9.8 \times 6 = 588 \text{ J}$$

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## ◆ Energy Transformation

Energy can change from one form to another

e.g., Solar → Chemical in plants, Chemical → Mechanical in engines

Law of Conservation of Energy:

Energy can neither be created nor destroyed. It only transforms from one form to another. Total energy remains constant.

**Mechanical Energy = Kinetic + Potential**

$$E = E_k + E_p = \text{constant}$$

**Activity 10.13–10.14:** List gadgets and their energy conversions


## **Activity 10.15:**

Drop 20 kg object from 4 m → Fill table with  $E_p$  &  $E_k$  values at each height (use  $g = 10$ )

## ◆ **Power**

 Definition:

Rate at which work is done or energy is transferred.


 Power ( $P$ ) = Work / Time

Unit: watt (W)

1 W = 1 J/s

1 kW = 1000 W

 Average Power = Total work done / Total time

 Example:

Girl lifts 400 N weight through 8 m in 20 s →

Power =  $(400 \times 8) / 20 = 160$  W

 **Activity 10.16–10.17: Climb rope or observe home electricity meter readings**

## **Summary: What You Have Learnt**

- Work = Force × Displacement
- Energy = Capacity to do work
- Kinetic Energy =  $\frac{1}{2} mv^2$
- Potential Energy =  $mgh$
- Energy can be converted from one form to another
- Power = Work / Time
- SI Unit of Work & Energy = joule
- SI Unit of Power = watt