Grade 09
Science Chapter Notes
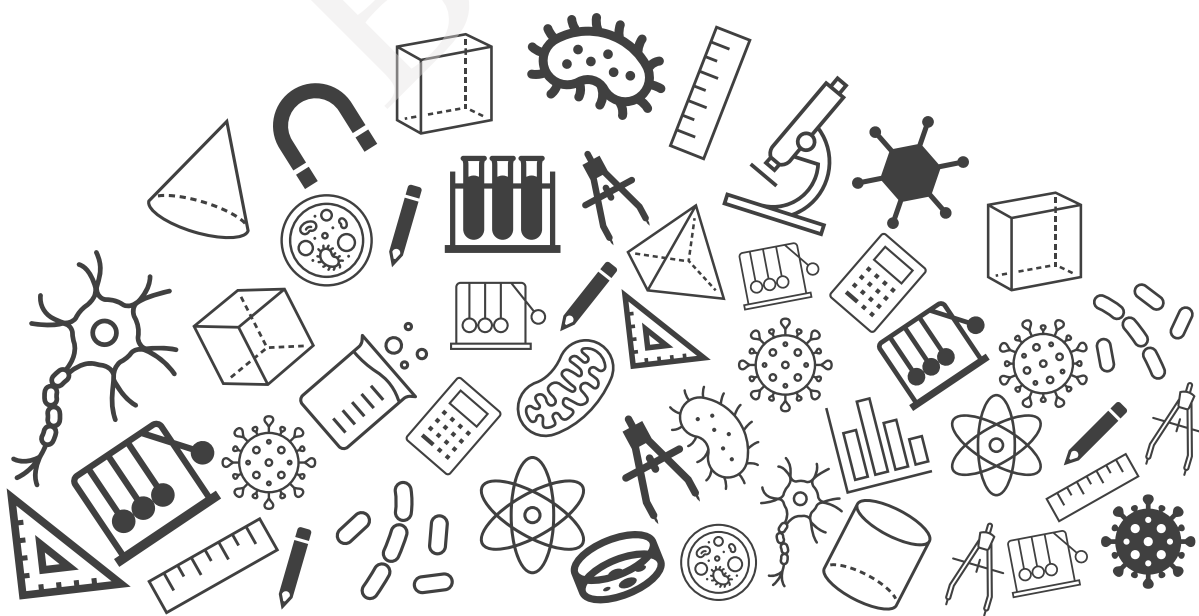
BYJU'S Classes

Chapter Notes

Work & Energy

Class 9

Contents

Scientific meaning of work

Work done = F × s

Positive Work

Zero Work

Negative Work

Work

Capacity to do work

Work-Energy Theorem

Work & Energy

Energy

Work done $= \frac{1}{2} m (v^2 - u^2)$

Power

Mechanical Energy

Kinetic Energy

$\frac{1}{2} mv^2$

Potential Energy

mgh

Conservation of energy

Without

friction

Conservation of mechanical energy

Rate of doing work

$P = \dfrac{W}{t}$

Commercial unit of electrical energy

kWh

1. Work done by Constant Force

1.1 Scientific Conception of Work

- Work done in moving a body is equal to the product of force exerted on the body and the displacement moved by the body in the direction of force

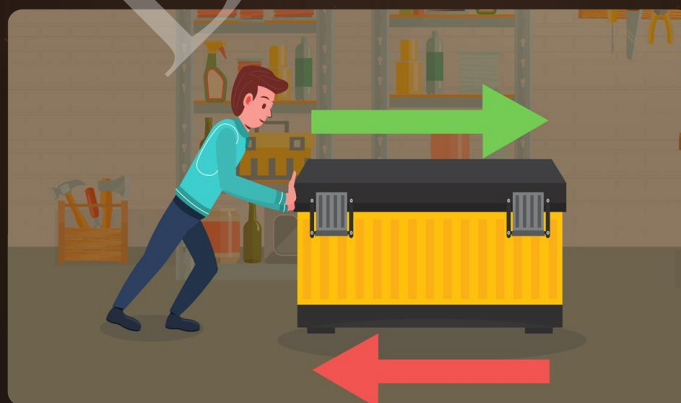$$\text{Work done} = F \times s$$

SI unit = 1 N × 1 m = 1 J

S

- F = Force applied
- s = Displacement in the direction of force

1.2 Positive, Negative Work

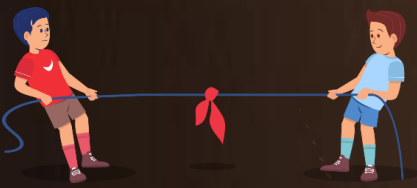Positive work (by Boy):
F and s act in the same direction.

W = F x s

Negative work (by Friction):
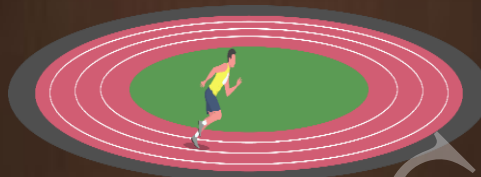F and s act in the opposite directions.

W = -F x s

1.3 Zero Work

- Work done is said to be zero when:

Net force (F) = 0	Displacement (s) = 0	F ⊥ s

1.4 Work done by Force of Gravity

- If an object of mass m is raised through a height h, the work done on the object is equal to mgh
- Work done by gravity can be positive or negative depending on the direction of displacement of the body

$$W = F\,s$$
$$= -mg(H)$$
$$= -mgH$$

$$W = F\,s$$
$$= -mg(\text{-H})$$
$$= mgH$$

2. Energy

- Energy is defined as the capacity to do work.
- Work done is the only way to transfer energy.
- SI unit of energy is joule (J).

2.1 Kinetic Energy

- Kinetic energy is defined as energy possessed by virtue of the motion of a body.

$$KE = \frac{1}{2}mv^2$$

v ● m

- The kinetic energy of a moving body is measured by the amount of work it can do before coming to rest

2.2 Work-Energy Theorem

- The total work done by the sum of all the forces acting on a particle is equal to the change in the kinetic energy of that particle.

u   v

Work done	=	$\frac{1}{2}m(v^2 - u^2)$ =	Change in kinetic energy

2.3 Potential Energy

- The energy of a body due to its position or change in shape is known as potential energy
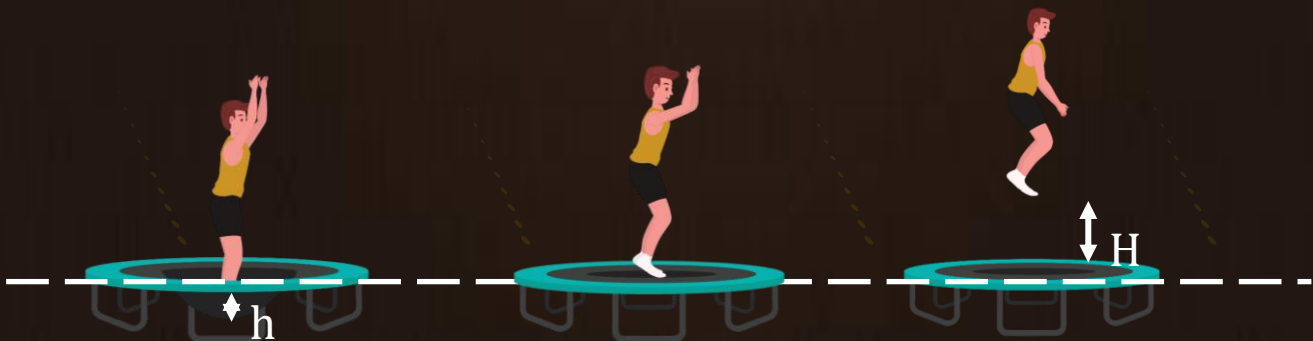
Elastic Potential Energy

Gravitational Potential Energy

- The energy stored by stretching or compressing an elastic object by an external force

- The energy stored due to the virtue of position (here, height above the ground)

$$\text{Work done}_{\text{gravity}} = -\Delta U_{\text{gravity}}$$
$$= -mg(h_2 - h_1)$$

- Any level can be considered as the reference (U = 0).
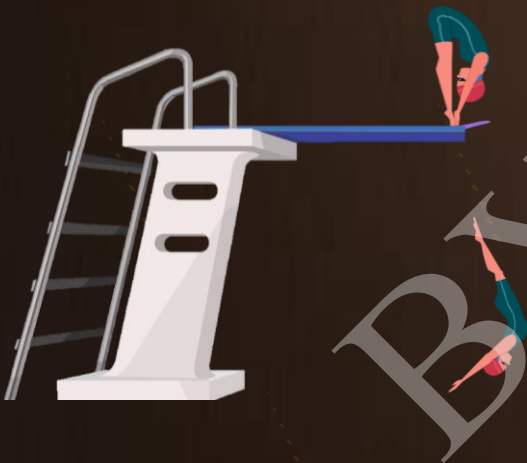
$U = -mgh$

$U = 0$

$U = mgH$

2.4 Mechanical Energy

- Total mechanical energy of a system is the sum of kinetic and potential energies possessed by the object.

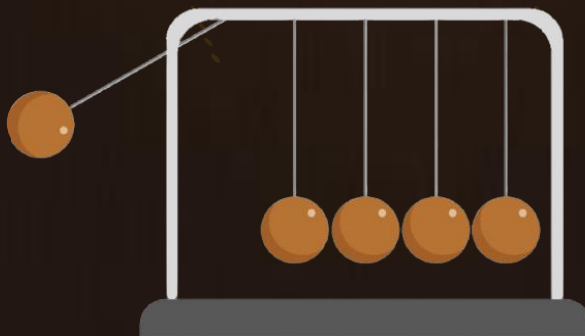$$E_{total} = KE + PE$$

Conservation of Mechanical Energy

- In a system with conservative forces, mechanical energy is always conserved

$$E_i = E_f$$
$$KE_i + PE_i = KE_f + PE_f$$

2.5 Conservation of Energy

- Energy can neither be created nor be destroyed, it changes from one form of energy into another form of energy.
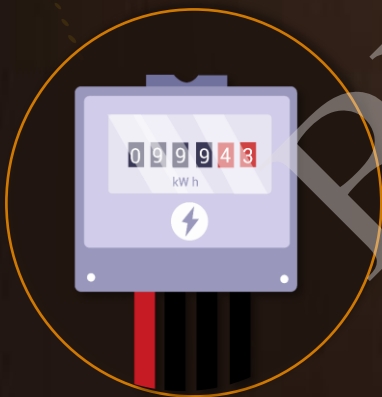
- Power is the rate of doing work or rate of transfer of energy.
- SI unit: watt (W) or joule/sec (J/s)

$$P = \frac{W}{t}$$

3.1 Commercial Unit of Electrical Energy

- The commercial unit of electrical energy is kilowatt-hour (kWh).

$$1kWh = 1000\,W \times 60 \times 60\,s$$
$$1kWh = 3.6 \times 106\,J$$

Special Note:

A force, like gravity, for which the potential energy is defined and can be restored as kinetic energy is termed as a **conservative force**.

1 Work Done $\quad W = Fs$

2 Kinetic Energy $\quad KE = \frac{1}{2}mv^2$

3 Work-Energy Theorem

$$W = \frac{1}{2}m(v^2 - u^2)$$

4 Potential Energy

$$U = mgH$$

5 Work done by gravity

$$W_{gravity} = -\Delta U$$

6 Power

$$P = \frac{W}{t} = Fv$$