**WORK & ENERGY**

**LEARNING OBJECTIVE:**

**TO DEFINE WORK, ENERGY, POWER.**

**TO DERIVE THE EXPRESSION FOR WORK, ENERGY, POWER.**

**TO CALCULATE NUMERICAL USING WORK, ENERGY, POWER.**

**WORK**

**MATHEMATICAL EXPRESSION FOR WORK AGAINST ACCELERATION DUE TO GRAVITY**

Consider a body of mass m on the surface of earth , g is acceleration due to gravity. If the body is raised vertically upward through a height h, then : m

Force , F = mg

Work W=Force×displacement h

=mg ×h m

W = mgh surface of earth

**POSITIVE WORK :-** When the applied force cause displacement in its own direction, the work done is said to be positive work.

**EX:** when a coolie lifts a box from the ground to put it on his head, work done is said to be positive. In this case , coolie applies the force on the box in the upward direction and the box also is in upward direction.

**NEGATIVE WORK:-** When a force acting on a body is opposite to the direction of displacement of the body , the work done is said to be negative work.

**EX**: when an object is lifted upward to a certain height then work done is negative.

**ZERO WORK:-** No work is done, when a force acts right angles to the direction of displacement.

**EX:** when a person pushes the wall but fails to move the wall, then work done by the force on the wall is zero.

**ENERGY**

Energy is capacity of a body to do work is called energy. SI unit is Joule.

**MECHANICAL ENERGY**

The energy possessed by the body due to displacement caused in it by the application of force is called mechanical energy.

**POTENTIAL ENERGY:-** The energy possessed by the body by virtue of its position, is called P.E.

**EX:** A stretched catapult , A wound up spring of a watch etc

**KINETIC ENERGY:-** The energy possessed by the body by virtue of its motion, is called K.E

**EX**: A speeding train, Flowing water etc

**MATHEMATICAL EXPRESSION FOR P.E**

Consider a body of mass m on the surface of earth , g is acceleration due to gravity. If the body is raised vertically upward through a height h, then : m

Force , F = mg

Work W=Force×displacement h

=mg ×h m

W = mgh surface of earth

This work done is stored as P.E

P.E =mass×acceleration due to gravity×height

P.E=mgh

**MATHEMATICAL EXPRESSION FOR K.E**

Consider a body of mass m at A, such that initial velocity v . Let the body roll on the floor , such that it stops after covering distance s . As the body stops ,there must be a some retarding force acting on the body.

initial velocity=v final velocity=0

m

A s B

V2 – u2 = 2as

02 – v2 = 2as

a=- v2/2s

Retardation acting on the body = -a = -(-v2/2s) =v2/2s

Retarding force acting on the body = Mass × Retardation = m× v2/2s

Work = F×s =mv2/2s × s = mv2/2

This work done is stored as K.E.

K.E = ½ mv2

**LAW OF CONSERVATION OF ENERGY**

The energy can neither be created nor destroyed.it may be transformed from one form to another , but total energy of the system remains constant.

PROOF

Consider a body of mass m at height h held by a person . Let the body be released such that it falls freely under acceleration due to gravity g . Let us consider total energy possessed by the body at the height of h ; from the ground level . Let v be the final velocity of the on reaching the ground level

Case I : when a body is at a height of h from the ground level.

As the body is stationary, its velocity is zero.

K.E = ½ mv2 = ½ m(0)2 =0

P.E = mgh

Total energy of the body = P.E + K. E

= mgh + 0 =mgh

Case II: when a body just reaches ground level and its height is zero

Let us calculate the velocity of the freely falling body at ground level.

V2 = u2 + 2gh

As initially the body is at rest , therefore u2 =0

V2 =0 + 2gh = 2gh

K.E = ½ mv2 =1/2 m(2gh)

= mgh

P.E = mgh = m×g×0 = 0

Total energy of the body = P.E + K. E

= 0+mgh = mgh

As total energy remains same, the law proved.