osbincbse.com

Work and Energy

Q. How is work define.

Ans. Work is done when a force acting on a body Produces displacement in it.
work is a Scalar Quantity.
The S.I. Unit of work is Joule. The Unit Joule is denoted by 'J'

Q. What are the essential Conditions for Work to be done.

An. There are two Conditions.
a. A force should act on the body.
b. The body should move in the direction of the force, or opposite to it

Q. On what factors does the amount of work done depend.

An. The amount of work done depends upon the following two factors.
a. Magnitude of the force (F)
b. Displacement of the body (S) in the direction of the force.

Q. How is the amount of work measured.

Ans. The amount of work done depends upon.
a. The force applied.
b. The displacement of the body.
c. The angle between the direction of the force and that of the displacement of the body.

When the body moves in the direction of the force then the amount of work done is equal to the Product of force and displacement

work = Force × displacement.

and the S.I. Unit of work = N×m or 'J'

OSBINCBSE.COM

osbincbse.com

When the body moves in a direction opposite to the force then.

$$W = F \times (-S) = -FS$$

Thus, the work done by the force is Negative. The negative work means that the force opposes the motion of the body.

When the force is not along the direction of motion, then the work done is given by the relationship.

Work done = Force x Displacement of the body in the direction of the force.

= Force x Projection of the actual displacement on the line of action of the force.

= Force x Displacement of the body x $\cos\theta$.

When $\theta = 0^\circ$, when the displacement is in the direction of the force.

$W = F \times S \times \cos 0^\circ$ $\qquad \cos 0^\circ = 1$

$W = F \times S$.

When $\theta = 90^\circ$, when the displacement is at right angles to the force.

$W = F \times S \times \cos 90^\circ$ $\qquad \cos 90^\circ = 0$

$W = F \times S \times 0 = 0$

When a body moves along a circular path, the force acts along the radius of the circular path and the motion of the body is in the tangential direction, so the angle between the direction of motion and the force is 90°. As a result no work is done on a body when it moves along a circular path.

When $\theta = 180^\circ$, when the displacement of the body is in the opposite direction to that of the force

$W = F \times S \times \cos 180^\circ$ $\qquad \cos 180^\circ = -1$

$W = -F \times S$

The work done by the force is Negative.

OSBINCBSE.COM

osbincbse.com

Q. How much work is done in lifting a body against gravity

An. When a body of mass m is lifted to a height h above the ground, work equal to mgh is done on the body.

$$W = m \times g \times h.$$

The work done on the body in lifting it to a height h from the ground is stored in it as potential energy so, the potential energy of a body of mass m at a height h from the ground is equal to mgh.

Q What is the work done by the force of gravity on a satellite moving round the earth.

An. As a satellite revolves around the earth, it experiences a centripetal force directed towards the earth. The displacement produced in the satellite is tangential at any point of its motion. Here the force and the displacement are at right angle therefore no work is done by the force of gravity on the satellite.

Q. Can there be displacement of an object in the absence of any force acting on it.

An. In the absence of any force, the acceleration of any object will be zero, and the velocity of the object remains constant. That is, if the force acting on an object is zero, either the object will at rest or it will move with uniform velocity. If so the object can suffer displacement even in the absence of any force acting on it.

Q. Whether the work done or not.

a. An engine is pulling a train.

An. The engine applies a pulling force on the train. and the train moves in the direction of this force. So engine is doing work.

OSBINCBSE.COM

osbincbse.com

b. A sailboat is moving due to wind energy.
Ans. Work is done by the air. The sailboat moves in the direction of the force exerted by wind.

Q. Does the transfer of energy take place when you push a huge rock with all your might and fail to move it. Where is the energy you spend going.

An. No transfer of energy take place when we push a huge rock unsuccessfully.

Q. An object thrown at a certain angle to the ground moves in a curved path and falls back to the ground. The initial and the final points of the path of the object lie on the same horizontal line. What is the work done by the force of gravity on the object.
An. Since initial and the final positions are on the same horizontal line, no work is said to have been done.

Q. The acceleration in an object could be zero even when several forces are acting on it. Do you agree
An. Yes. It may be true only if all the forces form a system of balanced forces.

Q. What is meant by energy.
An. Energy :- The capacity of a body to do work is called energy. and energy is a scalar quantity. The S.I. Unit of energy is Joule
Mechanical energy = Potential energy + Kinetic energy.
Commercial unit of energy is (Kilowatt-hour) 1 KWh and it is equal to 3.6×10^6 Joules.
The sum of the potential energy and kinetic energy is called Mechanical energy.
2. Q. How is the kinetic energy of a body expressed.
An. The total amount of work which a moving body could do before coming to rest is equal to its kinetic energy.

OSBINCBSE.COM

osbincbse.com

Q. Derivation of the formula for kinetic energy.

An. Let a body of mass 'm' moving with a velocity v be at position at given time. if this body moves against an opposing force F, then its velocity gradually decreases. Let the body come to rest after covering a distance S then

Total work done by body = F×S

so.

kinetic energy of body = F×S.

For the body.

$v^2 - u^2 = -2 \times a \times S$.

v = Final velocity
u = Initial "
S = distance.
$-a$ = Acceler. (Retr.)

$0 - v^2 = -2aS$.

$a = \frac{v^2}{2S}$ —①

because

$F = m \times a$.

then $a = \frac{F}{m}$ —②

by eq. ① and ②

$\frac{v^2}{2S} = \frac{F}{m}$

$F \times S = \frac{1}{2} m v^2$

then kinetic energy $= \frac{1}{2} m v^2$.

When the velocity of the body is kept constant, the kinetic energy is directly proportional to the mass of the body.

$K.E \propto m$.

When the mass constant then $K.E. \propto v^2$

OSBINCBSE.COM

osbincbse.com

Q. How is the Kinetic energy of a body related to its momentum.

An.

momentum of the body P = mass × velocity
$= m \times v$.

$v = \frac{P}{m}$.

$K.E. = \frac{1}{2} m \times v^2 = \frac{1}{2} m \times \frac{P^2}{m^2} = \frac{1}{2} \frac{P^2}{m}$.

So

$P^2 = 2 \times K.E. \times m$.

$P = \sqrt{2 \times K.E. \times m}$.

Q. What is Potential energy.

An. Energy Possessed by a body by virtue of its Position or Configuration is Called Potential energy.

there are two types of Potential energy.

a. Gravitational Potential energy :- The Potential energy of a body by virtue of its height above ground level is Called gravitational Potential energy.

b. Elastic Potential energy :- The Potential energy of a body by virtue of its Configuration (or shape) is Called Potential energy.

Work done by the body W = Force × Displacement.

∴ Potential energy = Force × Displacement.
$= m \times g \times h$.

It is also Called gravitational Potential energy. $= m \times g \times h$.

and the S.I. Unit of Potential energy is newton-meter or joule.

Q.

Note :- Certain bodies may Possess both Kinetic and Potential energies at the Same time. Some are

a. A man climbing a hill
b. A flying aeroplane
c. A Bird flying in the sky
d. A body rolling down a hill.

OSBINCBSE.COM

osbincbse.com

Q. The Potential energy of a freely falling object decreases Progressively. Does this violate the law of Conservation of energy. why

An. It does not violate the law of Conservation of energy because the falling object gains kinetic energy at the cost of Potential energy. At any time during the fall the sum of Potential and kinetic energies remains Constant.

Q. A freely falling object eventually stops on reaching the ground. what happens to its kinetic energy on reaching the ground.

An. The Kinetic energy of a falling object on reaching the ground gets Converted into mechanical work and heat. The mechanical work involves Causing a depression in the soil.

Q. what is meant by transformation of energy.

An. The Change of one form of energy into another form of energy is called transformation of energy.

Q. What kind of energy transformation take Place when a body falls from a certain height.

An. When a body falls from a certain height its Potential energy changes into kinetic energy.

Some examples of transformation of energy.

a. The chemical energy of a firwork is Converted into thermal energy and light and Sound energies when it explodes.

b. The Potential energy of the stretched elastic of a Catapult gets Converted into the Kinetic energy of the Pellet released from the Catapult.

c. When a body is thrown up its kinetic energy gradually changes into Potential energy.

Q. What is meant by the law of Conservation of energy.

An. The law of Conservation of energy may be stated as any one of the following statement.

a. Energy Can be transformed from one form to another but the total amount of all the energies remains the same.

osbincbse.com

b. Energy can neither be created nor destroyed but can be transformed from one form to another.

c. Whenever one form of energy disappears, an equivalent amount of energy in another form appears.

Note:- A freely falling body has the same energy at every point during its motion. So the energy of a freely falling body is conserved.

Q. What is meant by Power.

An. The rate of doing work is called Power.

$$\text{Power} = \frac{\text{Total work done } (W)}{\text{Time taken. } (t)}$$

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

Power is a scalar quantity.

$$W = F \times S = m \times g \times S$$

$$P = \frac{m \times g \times h}{t}$$

the S.I. unit of Power is watt (W)

When a body works at the rate of 1 J per second then its Power is 1 watt and the bigger unit of Power is called kilowatt (kW). and the commercial unit of energy is kilowatt-hour.

→ way of solar energy gets transformed into other forms of energy.

Kinetic Energy of wind → used for generating electricity or doing mechanical work with the help of wind mill.

Heating of land and air.

Heat energy → Potential energy of clouds → Kinetic Energy of flowing water → Used for transportation

→ P.E. of water stored at altitude → generation of electricity.

Solar energy.

Light energy → chemical energy as a food of Plant. → Muscular energy in human and animals → Used for doing work.

chemical energy of Petroleum, coal, gas → heat energy for domestic and industrial work.

OSBINCBSE.COM

osbincbse.com

→ Heat transformation in Pendulum.

Extreme right Position. → Mean Position → Ex. left Pos. → Mean Posi. → Ex. Right Pos.
All. P.E. → All. K.E. → All. P.E. → All. K.E. → All. P.E.

The bob eventually comes to rest due to friction at support and air.

→ When water flowing down a dam runs a turbine to generate electricity.

P.E. of water in dam → K.E. of flowing water → K.E. of turbine → Electrical energy.

→ A running steam Engine.

Chemical energy of Coal → Heat energy of steam → K.E of moving Parts of Engine → K.E. of the engine and boggies.

→ Power generation in a thermal power station.

Chemical Energy of Fuel → Heat Energy of Steam → K.E. of turbine → Electrical Energy.

→ A battery lights a bulb.

Chemical energy of the Cell → Electrical energy of the Cell → Light energy of the bulb.

→ When riding a bicycle.

Mouscular energy of the leg → Mechanical energy of the Padal → Rotatory motion of the cycle wheel → K.E. of the cycle and the rider.

OSBINCBSE.COM